SAVITRIBAI PHULE PUNE UNIVERSITY

Board of Studies in Civil Engineering

Structure and Syllabus for B.E. Civil 2015 Course (w. e. f. June, 2018)

SAVITRIBAI PHULE PUNE UNIVERSITY

Board of Studies in Civil Engineering

Structure for B.E. Civil 2015 Course (w. e. f. June 2018)

	Semester-I										
Subject code	**Subject**	**Teaching Scheme Hrs/Week**			**In-Semester Assessment**	**TW**	**Pract /Or**	**End-Semester Exam**	**Total**	**Credit**	
		Lect	**Tu**	**Pr**						**Th**	**Lab**
401 001	Environmental Engineering II	3	--	2	30	--	50	70	150	3	1
401002	Transportation Engineering	3	--	2	30	50	--	70	150	3	1
401 003	Structural Design and Drawing III	4	--	2	30	--	50	70	150	4	1
401 004	Elective I	3	--	2	30	50	--	70	150	3	1
401 005	Elective II	3	--	--	30	--	--	70	100	3	--
401 006	Project (Phase-I)	--	2	--	--	50	-	--	50	--	2
Total :		16	2	8	150	150	100	350	750	16	6
										22 Credits	

	Semester-II										
Subject code	**Subject**	**Teaching Scheme Hrs/Week**			**In-Semester Assessment**	**TW**	**Or**	**End-Semester Exam**	**Total**	**Credit**	
		Lect	**Tu**	**Pr**						**Th**	**Pr**
401 007	Dams and Hydraulic Structures	3	--	2	30	--	50	70	150	3	1
401008	Quantity Surveying, Contracts and tenders	3	--	2	30	--	50	70	150	3	1
401 009	Elective III	3	--	2	30	50	--	70	150	3	1
401 010	Elective IV	3	--	2	30	50	--	70	150	3	1
401 006	Project	--	6	--	--	50	100	--	150	--	6
Total :		12	6	8	120	150	200	280	750	12	10
										22 Credits	

Following will be the list of electives.

Semester I

Elective-I 401 004	Elective-II 401 005
1. Structural Design of Bridges	1. Matrix Methods of Structural Analysis
2. Systems Approach in Civil Engineering	2. Integrated Water Resources Planning and Management
3. Advanced Concrete Technology	3. TQM & MIS in Civil Engineering
4. Architecture and Town Planning	4. Earthquake Engineering
5. Advanced Engineering Geology with Rock Mechanics	5. Advanced Geotechnical Engineering

Semester-II

Elective-III 401 009	Elective-IV 401 010
1. Advanced Structural Design	1. Construction Management
2.Statistical Analysis and Computational Methods in Civil Engineering	2. Advanced Transportation Engineering
	3. Advanced foundation Engineering.
3. Hydropower Engineering	4. Coastal Engineering
4. Air Pollution and control	**5. Open Elective**
5. Finite Element Method in Civil Engineering	a) Plumbing Engineering
6. Airport and Bridge Engineering	b) Green Building Technology
	c) Ferrocement Technology
	d) Sub sea Engineering
	e) Geoinformatics

Savitribai Phule Pune University, Pune

BE Civil 2015 Course

Syllabus

Semester-I

401 001 Environmental Engineering – II

Teaching Scheme:	Examination Scheme:
Lectures: 3 Hrs/week	Paper In-sem : 30 Marks (1Hr.)
Practical: 2 Hrs/week	Paper End-sem : 70 Marks (2.5 Hrs.)
	Oral : 50 Marks

Unit I **(6 Hrs.)**

Sewage quantity: Collection and conveyance of sewage, sources of sewage, variations in sewage flow, Flow quantity estimation (sewage and storm water quantification), design of storm water system, Design of circular sanitary sewers. Pumping of sewage, necessity, location. Effect of change of life style on sewage quality.

Characteristics of sewage: Methods of sampling, Physical, chemical and biological characteristics, Quality requirements for disposal and recycle/reuse of sewage as per CPCB norms.

Stream sanitation: Self-purification of natural streams, river classification as per MoEF & CC, Govt. of India; Oxygen Sag Curve, Streeter - Phelps equation and terminology (without derivation and numerical). National river cleaning plan.

Unit II **(6Hrs.)**

Sewage treatment: Pollution due to improper disposal of sewage, Introduction to sewage treatment, preliminary, primary, secondary and tertiary treatment, Unit operation and Process flow diagram for sewage treatment, Theory and design of screen chamber, Grit Chamber and Primary sedimentation tank as per the Manual of CPHEEO.

Unit III **(6 Hrs.)**

Theory & design of secondary treatment units: Introduction to unit operations and processes for secondary treatment. Principles of biological treatments, role of microorganism in wastewater treatment.

Activated sludge process: Theory and design of ASP, sludge volume index, sludge bulking & control, modifications in ASP. Operational problems and maintenance in ASP.
Concept of Sequential batch reactor (SBR) .

Trickling filter: Biological principle, different T.F media & their characteristics, design of standard rate and high rate filters using NRC formula, single stage & two stage filters, recirculation, ventilation, operational problems, control measures, theory of rotating biological contactors.

Unit IV **(6 Hrs.)**

Low cost treatment methods for rural areas

Oxidation pond: Bacteria – algae symbiosis, design of oxidation pond as per the manual of CPHEEO, advantages & disadvantages of oxidation ponds.

Aerated lagoons: Principle, aeration method, advantages & disadvantages of aerated Lagoons, design of aerated lagoon.

Introduction and theory of Phytoremediation technology for wastewater treatment. Introduction and theory of root zone cleaning system.

Unit V **(6 Hrs.)**

Onsite Sanitation Treatment systems: Septic tank**,** up-flow anaerobic filter. and Package Sewage Treatment Plant**-** Working principle, advantages and disadvantages. Introduction to MBR, MBBR and FMBR.

Anaerobic digester: Principle of anaerobic digestion, stages of digestion, bio – gas production its characteristics & application, factors governing anaerobic digestion,. Dewatering of sludge by gravity thickener, sludge drying bed, decanters. Methods of sludge treatment and disposal, advantages & disadvantages. Up-flow Anaerobic Sludge Blanket (UASB) Reactor– Principle, advantages & disadvantages.

Unit VI **(6 Hrs.)**

Industrial waste water treatment: Equalization and neutralization. Application of preliminary, primary and secondary treatment for industrial wastewater as per the CPCB norms.

Sources of waste water generation from manufacturing process, characteristics of effluent, different methods of treatment & disposal of effluent for the following industries: Sugar, dairy and distillery. Discharge standards as per CPCB norms.

Recycle & reuse of treated wastewater: Gardening, sewage farming, W.C. Flushing, reuse in industry.

Term Work:

A. Compulsory Assignment:

1. Brief report on Sewer materials, choice of materials, testing of sewer pipes, sewer appurtenances.
2. Design of septic tank.

B. Experiments:

The term work shall consist of a journal giving details of at least 8 out of 12 of the following experiments conducted in Environmental Engineering laboratory, of which, **Sr.No.12 is compulsory**.

Determination of

1. Solids -Total solids, suspended solids, volatile solids, settle able solids & non settle able solids.
2. Sludge Volume Index.
3. Dissolved oxygen.
4. Bio-Chemical Oxygen Demand.
5. Chemical Oxygen Demand.
6. Electrical Conductivity.
7. Determination of Phosphates by spectrophotometer.
8. Determination of Nitrates by spectrophotometer.
9. Determination of heavy metals like Cr6+ or Zn or Ni or Cd.
10. Determination of total nitrogen by Kjeldal method.
11. Visit to domestic / Industrial wastewater treatment plant & its detailed reports.

12. **Computer aided design of Sewage Treatment Plant (STP) OR Effluent Treatment** Plant (ETP) of Sugar or Dairy Industry using suitable software (C programming or any other suitable software).

Note: - Term Work should include a detailed analysis of practical interpretation, significance and application of test results.

Text Books:

1. Environmental studies by Rajgopalan- Oxford University Press.
2. Waste Water Treatment & Disposal – Metcalf & Eddy - TMH publication.
3. Environmental Engg. - Peavy, Rowe - McGraw Hill Publication.
4. Waste Water Treatment – Rao & Dutta.

Reference Books:

5. Waste Water Engg. – B.C. Punmia & Ashok Jain - Arihant Publications.
6. Water Supply & Waste Water Engg.- B.S.N. Raju – TMH publication.
7. Sewage Disposal & Air Pollution Engg. – S. K. Garg – Khanna Publication.
8. Environmental Engg. – Davis - McGraw Hill Publication.
9. Manual on sewerage and sewage treatment – Public Health Dept., Govt. of India.
10. Standard Methods by APHA.

I.S. Codes:

I.S. 3025 (all parts).

e – Resources:

i) http://nptel.iitm.ac.in/courses-contents/IIT Kanpur and IIT Madras.

ii) http://cpcb.nic .in

iii) http://moef.nic .in

401 002 Transportation Engineering

Teaching scheme
Lectures: 3 Hrs/week
Practical: 2 Hrs/week

Examination Scheme
In-Sem Exam: 30 Marks 1 Hr.
End-Sem Exam: 70 Marks 2.5 Hrs.
Term work: 50 Marks

Unit I **(6 Hrs.)**

Highway Development & Planning:

History, Development Plans, Classification of roads, Road Patterns, road development in India - Vision 2021 & Rural Road Development Vision 2025, Current road projects in India; highway alignment and highway project report preparation (Planning surveys & Master Plans based on saturation system).

Unit II: **(6 Hrs.)**

Geometric design of highways:

Introduction; highway cross section elements; sight distance, design of horizontal alignment; design of vertical alignment; design of intersections, problems, Highway drainage, Importance of highway drainage, subsurface and surface drainage systems.

Unit III **(6 Hrs.)**

Traffic engineering & control:

Traffic Characteristics, traffic engineering studies, traffic flow and capacity, traffic regulation and control devices (signs, signals, islands, road markings); Accident studies, types of road intersections; parking studies; highway lighting.

Unit IV **(6 Hrs.)**

Pavement materials:

Materials used in Highway Construction and related tests - Soil subgrade and CBR Test, Stone aggregates, bituminous binders, bituminous paving mixes, viscosity based gradation of bitumen, Modified Bitumen (Cutbacks, Emulsions, Crumbed Rubber Modified Bitumen – CRMB, Polymer Modified Bitumen-PMB, Foamed Bitumen), Marshall Stability Mix Design and Test (All 5 test parameters).

Unit V **(6 Hrs.)**

Pavement Design:

Introduction; flexible pavements – Computation of design traffic (Vehicle Damage Factor VDF, Lane distribution factor LDF, Traffic growth rate); stresses in flexible pavements; design guidelines for flexible pavements as per IRC 37-2012 (steps only); rigid pavements- components and functions; factors affecting design; stresses in rigid pavements (ESWL); design guidelines for concrete pavements as per IRC 58-2015 (steps only); joints in CC pavements, problems.

Unit VI **(6 Hrs.)**

A. Pavement Construction:

Construction process of GSB, WBM, WMM; Cemented base, Introduction to bituminous works such as prime coat, tack coat, seal coat, Built-up Spray Grout (BSG), Asphaltic Concrete (AC) or Bituminous Concrete (BC), Bituminous Macadam (BM), Dense Bituminous Macadam (DBM) and premix carpet, Dry lean Concrete (DLC), Pavement Quality Concrete (PQC).

B. Modern Trends in Highway Materials, Construction & Maintenance:

Mastic Asphalt, Cold Mix Asphalt Technology, Warm Mix Asphalt Technology, Recycled/Reclaimed Asphalt Pavement (RAP) (Manual Series - 2), Concept of Super pave Mix Design (Super pave Series 2), Non-Destructive Evaluation of Pavements (Falling Weight Deflectometer FWD).

Term work:

Term work shall consist of the following:

A. Practicals:

I. Tests on Aggregate (Any Five) :

1. Aggregate Impact Value Test
2. Aggregate Crushing Strength Test
3. Los Angeles Abrasion Test
4. Shape Test (Flakiness Index and Elongation Index)
5. Specific Gravity and Water Absorption Test by basket method
6. Stripping Value Test
7. Soundness Test

II. Tests on Bitumen (Any Five):

1. Penetration Test
2. Ductility Test
3. Viscosity Test (Tar Viscometer)
4. Softening Point Test
5. Flash Point & Fire Point Test
6. Specific Gravity Test
7. Bitumen Extraction Test

III. Tests on Aggregate Bitumen Combined:

1. Marshall Stability Test

IV. Tests on Soil Subgrade:

1. California Bearing Ratio Test (CBR Test)

B. Technical visits to:

1) Road Construction and/or RAP Site
2) Hot mix Plant with detailed report

Text Books:

1. Highway engineering – S.K. Khanna, C.E.G. Justo & A. Veeraragavan, Nem Chand and Brothers, Roorkee
2. Principles of Highway Engineering and Traffic Analysis (4^{th} edition) F. L. Mannering, Scott S. Washburn, Wiley India
3. Principles and practices of Highway engineering –Dr. L.R. Kadiyali, Khanna Publishers Delhi.

Reference Books:

1. A Course in Highway Engineering – S.P. Bindra, Dhanpat Rai and Sons, Delhi.
2. Principles of Transportation Engineering – G.V. Rao Tata MacGraw Hill Publication
3. Highway Engineering – Rangawala, Charotar publishing House, Anand 388001 (Gujrat)
4. Principles of Transportation Engineering – Partha Chakraborty, Animesh Das, Prentice Hall of India Pvt. Ltd., New Delhi.
5. Highway and Bridge Engineering – B.L. Gupta, Amit Gupta Standard publishers Distributors, Delhi.

Other References:

1. National Cooperative Highway Research Program (NCHRP)
2. Federal Highway Authority (FHWA)

Codes:

1. I.S. 1201 TO 1220-1978, IS 73, IS 2386 PART I toV
2. I.R.C. 58- 2015, IRC 37-2012
3. Specifications for Road and Bridge works (MORTH) 5th Revision, New Delhi.

e – Resources:

1. www.nptel.iitm.ac.in/courses/iitkanpur
2. www.cdeep.iitb.ac.in/nptel
3. www.fhwa.dot

401 003 Structural Design and Drawing III

Teaching Scheme:
Lectures: 4 Hrs / week
Practical: 2 Hrs/week

Examination Scheme:
In Sem: 30 and End Sem : 70 Marks
Oral: 50 Marks
Duration: In-Sem: 1.5 Hrs.
End-Sem: 3 Hrs.

Unit 1 **(8 Hrs.)**

Prestressed concrete – Analysis:

Introduction, Basic concepts, materials, various Pre-tensioning and Post-tensioning systems, concept of losses, Stress calculations, and concept of cable profile.

Unit 2 **(8 Hrs.)**

Prestressed concrete – Design:

Design of post tensioned prestressed concrete simply supported rectangular and flanged sections for flexure and shear including end block.

Design of one way and two way post tensioned slabs (Single panel only).

Unit 3 **(8 Hrs.)**

Design of Flat slab:

Introduction to flat slab, Design of prestressed two way flat slab by direct design method.

Unit 4 **(8 Hrs.)**

Earth retaining structures:

Introduction, Functions and types of retaining walls, Analysis and design of RCC cantilever type of retaining wall for various types of backfill conditions.

Unit 5 **(8 Hrs.)**

Liquid retaining structures:

Introduction, types, function, codal provisions, methods of analysis, Design of circular, square, and rectangular water tanks resting on ground by working stress method, Introduction to limit state design of water tanks.

Unit 6 **(8 Hrs.)**

Introduction to vibration and earthquake analysis:

Introduction to single and multi-degree of freedom systems: free, forced, un-damped and damped vibration, Estimation of earthquake forces by seismic coefficient method, Estimation of combined effect of lateral forces and vertical loading on G+2 storied frames.

Note: Design based on above unit shall conform to latest versions of IS 456, IS 875, IS 1343, IS 3370, IS 1893, IS 13920.

Term Work:

Term work shall be based on the above syllabus. It consists of

1) Assignment on calculation of losses in prestress.
2) Assignment on stress calculation in prestressed structures.
3) Design and detailing of design of prestressed girder.
4) Design and detailing of prestressed flat slab by direct design method.
5) Design and detailing of retaining wall for various loading conditions.
6) Design and detailing of ground resting water tank.
7) Report on analysis and design of any one of the structures listed in the syllabus using software or computer program.
8) Two site visit reports, one each on RCC and Prestressed concrete structure.

Note:

(a) There should be separate design problem statement for a group of students not exceeding *four* in numbers.

(b) Minimum four full imperial sheets based on two projects on design of RCC and two projects on design of prestressed concrete structural elements.

Text Books:

1. Limit state theory and design of reinforced - Dr. V. L. Shah and Dr S. R. Karve - Structures Publications, Pune.
2. Fundamentals of Reinforced Concrete- N.C. Sinha, S.K. Roy – S. Chand & Co. Ltd
3. Advanced design of structures- Krishnaraju - Mc Graw Hill.
4. Design of Prestressed concrete structures- T. Y. Lin.
5. Prestressed Concrete- N. Krishna Raju – Tata Mc Graw Hill Publication Co.
6. Earthquake resistant design of structures- Agarwal, Shrikhande, PHI learning.

Reference Books:

7. Comprehensive RCC Design - Punmia, Jain & Jain - Laxmi Publications.
8. Design of design of reinforced Concrete structures- M. L. Gambhir –PHI.
9. Reinforced Concrete, Vol I- Dr.H J. Shah Charotar Publishing House
10. Prestressed Concrete – A Fundamental Approach- Edward Nawy – PHI..
11. Reinforced concrete design- Pillai and Menon TMH.
12. Elementary Structural Dynamics-Selvam, Dhanpatrai Publications.

I.S. Codes

1. IS: 456: Indian Standard code of practice for plain and reinforced concrete, BIS, New Delhi.
2. IS: 1343: Indian Standard code of practice for Prestressed concrete, BIS, New Delhi.
3. IS: 1893: Indian Standard Code of practice for criteria for Earthquake resistant design of structures, BIS, New Delhi.
4. IS: 3370-Indian Standard code of practice for concrete structures for storage of liquids, BIS, New Delhi.

401 004 Elective I: (1) Structural Design of Bridges

Teaching Scheme:
Lecture: 3 Hrs/week.
Practical:- 2 Hrs/week

Examination Scheme:
In-sem. Exam.: 30 Marks (1 Hr.)
End Sem. Exam.: 70 Marks (2.5 Hrs.)
Term work: 50 Marks.

Unit 1 **(6 Hrs.)**

Introduction to RC highway bridges and steel railway bridges: Types of bridges, classification, IRC codal provisions for RC highway bridges, IRS codal provisions for railway steel bridges, loading standards.

Unit 2 **(6 Hrs.)**

RC highway bridges: Slab culvert and T-beam deck slab bridges – Design of slab culvert, Deck slab: Structural configuration, Piegaud's method, analysis and design of deck slab.

Unit 3 **(6 Hrs.)**

RC highway bridges: T-beam deck slab bridges – Post tensioned girders: Load distribution on longitudinal and cross girders, methods of analysis, analysis and design of longitudinal and cross girders.

Unit 4 **(6 Hrs.)**

Railway steel bridges – Truss bridges: Structural configurations, loads and load combinations, analysis and design of truss elements, longitudinal and cross-girders, bracing systems.

Unit 5 **(6 Hrs.)**

Bearings: Function of bearings, types of bearings, design of steel bearings and elastomeric bearings.

Unit 6 **(6 Hrs.)**

Sub-structure: Function, loads, analysis and design of RC abutments and piers, design of well foundation.

Note: The designs should conform to the latest codal provisions.

Term Work:

a) One project on RC highway bridges which shall include - the design of deck slab, longitudinal girder, cross-girder, bearings and abutment and pier.

The detailing shall be shown in at least three full imperial sheets.

b) One project on railway steel bridges which shall include – the design of truss elements, longitudinal girder, cross-girder, and bearings.

The detailing shall be shown in at least two full imperial sheets.

c) The term work can be prepared in a group of not more than four students in a group.

d) Report of at least two site visits covering the contents of the syllabus.

e) The projects can be done using any drafting software.

Reference Books:

1. Design of Bridges, N. Krishna Raju, Oxford and IBH Publishing Company Pvt. Ltd.
2. Design of Bridge Structures, M.A. Jayaram Prentice-Hall Of India Pvt. Limited. Prestressed Concrete, N. Krishna Raju, Tata-McGraw Hill.
3. Design of Steel Structures, Ramachandra, Standard Publications New-Delhi.

401 004 Elective I (2) - Systems Approach in Civil Engineering

Teaching scheme:
Lectures: 3 Hrs/week
Practical: 2 Hrs/week

Examination scheme:
In semester exam: 30 marks---1 Hr.
End semester exam: 70 marks—2.5 Hrs.
Term Work: 50 marks.

Unit 1: Introduction of systems approach (6 Hrs)

(A) Introduction to System approach, Operations Research and Optimization Techniques, Applications of systems approach in Civil Engineering.

(B) Introduction to Linear and Non linear programming methods (with reference to objective function, constraints), Graphical solutions to LP problems.

(C) Local & Global optima, unimodal function, convex and concave function.

Unit 2: Stochastic Programming (6 Hrs)

(A) Sequencing– n jobs through 2, 3 and M machines.

(B) Queuing Theory : elements of Queuing system and it's operating characteristics, waiting time and ideal time costs, Kendall's notation, classification of Queuing models, single channel Queuing theory : Model I (Single channel Poisson Arrival with exponential services times, Infinite population (M/M/1) : (FCFS/ /).

(C) Simulation : Monte Carlo Simulation.

Unit3: Linear programming (A) (6 Hrs)

(A) The Transportation Model and its variants.

(B) Assignment Model, and its variants.

Unit 4: Linear programming (B) (6 Hrs)

(A) Formulation of Linear optimization models for Civil engineering applications. The simplex method.

(B) Method of Big M, Two phase method, duality.

Unit 5: Nonlinear programming (6 Hrs)

(A) Single variable unconstrained optimization: Sequential Search Techniques-Dichotomous, Fibonacci, Golden section.

(B) Multivariable optimization without constraints-The gradient vector and Hessian Matrix, Gradient techniques, steepest ascent/decent technique, Newton's Method.

(C) Multivariable optimization with equality constraints - Lagrange Multiplier Technique.

Unit 6: Dynamic programming, Games Theory & Replacement Model (6 Hrs)

(A) Multi stage decision processes, Principle of optimality, recursive equation, Applications of D. P.

(B) Games Theory – 2 persons games theory, various definitions, application of games theory to construction Management.

(C) Replacement of items whose maintenance and repair cost increase with time, ignoring time value of money.

Term Work :

1. One exercise/assignment on each unit. Out of these any one exercise/assignment to be solved using Computer.
2. One exercise on formulation of a problem applicable to any field of Civil Engineering, requiring use of LP/ NLP/ DP. Formulation of objective function and constraints (No solution).

Text Books :

1. Operations Research by Premkumar Gupta and D.S.Hira, S. Chand Publications (2014).
2. Engineering Optimization: Methods and Application-- A. Ravindran, K. M. Ragsdell— Wiley India.
3. Engineering Optimization by S. S. Rao.
4. Operations Research by Hamdy A. Taha.
5. Quantitative Techniques in Management by N.D. Vohra (Mc Graw Hill) .
6. Operations Research by Pannerselvam, PHI publications.

Reference Books :

1. Topics in Management Science by Robert E. Markland(Wiley Publication).
2. An Approach to Teaching Civil Engineering System by Paul J. Ossenbruggen.
3. A System Approach to Civil Engineering Planning & Design by Thomas K. Jewell (Harper Row Publishers).

e - Resources

1. Mathematical Model for Optimization (MMO Software).
2. nptel.iitm.ac.in/courses/webcourse-contents/IISc-Bang/OPTIMISATION METHODS/New-index1.html.

401004 Elective I (3) - Advanced Concrete Technology

Teaching scheme	**Examination scheme**
Lectures: 3 Hrs/week	**In semester exam: 30 Marks-1 Hr.**
Practical: 2 Hrs/week	**End semester exam: 70 Marks—2.5 Hrs.**
	Term Work: 50 Marks

Unit I **(6 Hrs.)**

Cement and its types: general, hydration of cement, alkali aggregate reaction. Grading curves of aggregates, Manufactured sand as fine aggregate, copper slag as fine aggregate.

Concrete: properties of concrete, w/b ratio, gel space ratio, Problems on maturity concept, aggregate cement bond strength, Green concrete, Guidelines for Quality control & Quality assurance of concrete, Effect of admixtures.

Unit II **(6 Hrs.)**

Structural Light weight concrete, ultra light weight concrete, vacuum concrete, mass concrete, waste material based concrete, sulphur concrete and sulphur infiltrated concrete, Jet cement concrete (ultra rapid hardening), gap graded concrete, high strength concrete, high performance concrete ,Self curing concrete, Pervious concrete, Geo polymer concrete .

Unit III **(6 Hrs.)**

Design of high strength concrete mixes, design of light weight aggregate concrete mixes, design of fly ash cement concrete mixes, design of high density concrete mixes, Design of pump able concrete mixes, Design of self-compacting concrete.

Advanced non-destructive testing methods: ground penetration radar, probe penetration, break off maturity method, stress wave propagation method, electrical/magnetic methods, nuclear methods and infrared thermographs**.**

Unit IV **(6 Hrs.)**

Historical development of fibre reinforced concrete, properties of metallic fibre, polymeric fibres, carbon fibres, glass fibres, Basalt fibres and naturally occurring fibres. Interaction between fibres and matrix (uncracked and cracked matrix), basic concepts and mechanical properties: tension and bending.

Unit V **(6 Hrs.)**

Properties of hardened frc, behavior under compression, tension and flexure of steel fibres and polymeric fibres, GFRC, SFRC, SIFCON,SIMCON -development, constituent materials, casting, quality control tests and physical properties.

Unit VI **(6 Hrs.)**

Ferrocement: Properties & specifications of ferrocement materials ,analysis and design of prefabricated concrete structural elements,manufacturing process of industrial concrete elements, precast construction, erection and assembly techniques.

Termwork / Labwork :

The Termwork / Labwork will be based on completion of assignments / practicals / reports of site visits, confined to the course in that semester.

1. Write a review on any recent research article from standard peer-reviewed journal.
2. Report on at least one patent (national/international)– on any topic related to concrete technology.
3. Concrete mix design and production in lab of any one – Self compacting concrete, Fiber reinforced concrete, light-weight concrete, high strength or ultra-high strength concrete . Comparison with traditional concrete mix is to be clearly stated in the report. 4. Cost analysis (material, labour, equipment, others) of any type of concrete for lab, in-situ and RMC production.
4. Perform any two Fresh (workability tests – Slump Flow Test, T-50, J-Ring, Visual Stability Index, Column Segregation, L-Box, U-box) and Hardened (Compressive, tensile, flexural) properties tests on any high performance concrete.
5. Any one experiment on any one of the topics – NDTs; Microscopic examination of cement/concrete; Performance study of any one admixture (Mineral/Chemical) in concrete.
6. Visit reports on minimum two site visits - exploring the field and practical aspects of concrete technology.

Note:

Term Work should include a detailed analysis of practical interpretation, significance and application of test results including above contents and site visit report in form of journal.

Text books:

1. Concrete Technology --M.S. Shetty, S. Chand Publications.
2. Concrete Technology -- A R Santhakumar, Oxford University Press.
3. Concrete technology -- M. L. Gambhir, Tata Mcgraw Hill Publications.
4. Fiber Reinforced Cement Composite- P.N.Balguru & P.N.Shah.
5. Concrete: Microstructure, Properties and Materials-- P. Kumar Mehta and P. S. M. Monteiro-- Tata Mc-Graw Hill Education Pvt. Ltd.

Reference Books:

1. Handbook on Advanced concrete Technology Edited by N V Nayak,A .K.Jain, Narosa Publishing House .
2. Design of concrete mixes by Raju N Krishna, CBS Publisher.
3. Properties of concrete by A. M. Neville, Longman Publishers.
4. Concrete Technology by R.S. Varshney, Oxford and IBH.
5. Concrete technology by A M. Neville, J.J. Brooks, Pearson.
6. Ferrocement Construction Mannual-Dr. D.B.Divekar-1030, Shivaji Nagar,Model Colony, Pune.
7. Concrete Mix Design-A.P.Remideos--Himalaya Publishing House (ISBN-978-81-8318-996-5
8. Concrete, by P. Kumar Metha, Gujrat Ambuja.
9. Learning from failures----- R.N.Raikar.
10. Structural Diagnosis----- R. N. Raikar.
11. Concrete Mix Design --Prof. Gajanan Sabnis.

General Reading suggested:

1) Codes : i) IS 456 ii) IS 383 iii) IS 10262-2009 iv) IS 9103.
2) Ambuja cement booklets on concrete Vol .1 to 158.
3) ACC booklets on concrete.

401 004 Elective I (4)- Architecture and Town Planning

Teaching scheme:	**Examination scheme:**
Lectures: 3 Hours/week	**In semester exam: 30 marks-1 Hr.**
Practical: 2 Hrs/week	**End semester exam: 70 marks-2.5 Hrs.**
	Term Work: 50 marks

Unit I **(6 Hrs.)**

• Principles and elements of Architectural Composition.

• Qualities of Architecture: user friendly, contextual, ecofriendly, utility of spaces, future growth etc.

• Role of –Urban Planner and Architect‖ in planning and designing in relation with spatial organization, utility, demand of the area and supply.

Unit II: **(6 Hrs.)**

• Landscaping: importance , objectives, principles, elements, material (soft and hard).

• Urban renewal for quality of life and livability.

• Importance of sustainable architecture with case study.

Unit III: **(6 Hrs.)**

• Goals and Objectives of planning; components of planning; benefits of planning.

• Levels of planning: Regional plan, Development Plan, Town Planning Scheme.

• Neighborhood plan; Types of Development plans: Master Plan, City Development Plan, Structure Plan.

Unit IV: **(6 Hrs.)**

• Various types of civic surveys for DP: demographic, housing, land use, Water Supply & sanitation, etc.

• Planning agencies for various levels of planning. Their organization and purpose (CIDCO-MHADA-MIDC, MMRDA/ PMRDA etc).

• Traffic transportation systems: urban road, hierarchy, traffic management, Intelligent Transport Systems.

Unit V: **(6 Hrs.)**

• Legislative mechanism for preparation of DP: MRTP Act 1966.

• UDPFI guidelines (for land use, infrastructure etc.), SEZ, CRZ, Smart City Guidelines.

Unit VI : **(6 Hrs.)**

• Special townships, Land Acquisition Rehabilitation and Resettlement Act 2013.

• Application of GIS, GPS, remote sensing in planning.

Term Work: - 50 Marks

Sr. no. 1 and 2 are compulsory and any four from remaining.

1. Study and analysis of Development Plan with respect to land use, services, infrastructure, street furniture, housing etc. (group work).
2. Neighborhood- planning (group work).
3. Report on contribution of Engineers, Planners and Architects in post-independence India (individual work).
4. Report on any existing new towns and planned towns like new Mumbai, Gandhinagar, PCNTDA etc.(infrastructure, disaster management etc), (individual work).
5. Study of salient features of urban renewal schemes (group work).
6. Study of any existing town planning scheme (group work).
7. Smart City approaches (individual work).
8. Study of Special Townships: (site visit) (group work).
9. Study of urban housing and housing change (group work).

Text Books:

1. Town Planning By G K Hiraskar --Town Planning by S Rangwala.
2. Building Drawing and Built Environment- 5th Edition – Shah, Kale, Patki--Planning Legislation by Koperdekar and Diwan.
3. G. K. Bandopadhyaya, –Text Book of Town Planning‖.
4. Climate Responsive Architecture – Arvind Krishnan.
5. Introduction to Landscape Architecture by Michael Laurie.

Reference Books:

- MRTP Act 1966.
- Manual Of Tropical Housing And Building By Koenigsbeger.

- Sustainable Building Design Manual.
- UDPFI Guidelines.
- ‒The Urban Pattern: City planning and design‖ by Gallion and Eisner.
- Design of cities by Edmond bacon.
- LARR Act 2013.
- MoUD By GoI.
- Web sites of NRSA, CIDCO, MHADA, MIDC, MMRDA, PMRDA.

401004 Elective-I (5) Advanced Engineering Geology with Rock Mechanics

Teaching Scheme:
Lecture: 3 Hrs/week
Practical: 2 Hrs/week

Exam. Scheme:
In Sem: 30 Marks (1 Hr.)
End Sem: 70 Marks (2.5 Hrs.)
Termwork: 50 Marks

Unit I: **(6 Hrs.)**

Indian Geology, Seismic Zones and Geological Studies in Engineering Projects.

Geological Map of India with special reference to Maharashtra. Distribution and Geological characters of Major rock formations of India. Engineering characters of major rock formations of India. Engineering characters of major rock formations of India. Engineering characters of major rock formations of India. Engineering characters of major rock formations of India.

The study of Plate Tectonics and highlights of Seismic Zones of India. Importance of geological studies in engineering investigations.

Unit II **(6 Hrs.)**

Geohydrological characters of rock formations and Geological process of Soil formations

Geohydrological characters of major rock formations of India:

Geohydrological characters and factors controlling various characters of rocks. Introduction to morphometric analysis. Various water conservation techniques, effect of over exploitation of tube wells, bore wells and dug wells. Artificial recharge, rainwater harvesting, watershed development and necessity of geological studies. Relevant case studies highlighting success and failure of these techniques.

Geological Process of Soil formations:

Effect of climate on formation of soil. Soil profile of different states in India.

Rock weathering conditions favorable for decomposition, disintegration, residual and transported soils.

UNIT III **(5 Hrs.)**

Resource Engineering, Role of Geology in planning and development.

Resource Engineering:

Utility of various rock formations as construction material. Illustrative case studies.

Geological Hazards and mitigation.

Role of Geology in planning and development:

Influence of geological factors upon urban development & planning. Reclamation of abandoned grounds and mining regions, illustrative examples.

UNIT IV: (6 Hrs.)

Rock Mechanics and Geophysical techniques.

Rock Mechanics:

General principles of rock mechanics. Dependence of physical and mechanical properties of rocks on geological characters.

Analyzing and evaluating of core recovery, R.Q.D. and Joint Frequency Index.

Various Methods of Geomechanical classifications of rocks such as Terzahagi, U.S.B.M, R.M.R., R.S.R., Q- system, Deer and Miller, Bieniawaski‘s geomechanical classification etc.

Geophysical techniques :

Electrical Resistivity method and Seismic method of exploration. Evaluation and analyzing the data produced through electrical resistivity for the determination of thickness of overburden, locating ground water potential zones which leads for strengthening the major civil projects.

UNIT V (7 Hrs.)

Subsurface Geological Explorations for various projects; Foundation Treatments, Tail Channel Erosion.

Subsurface Explorations for Dams, Reservoir, Percolation Tanks:

The strength and water tightness of rocks found at the dam, reservoir and percolation tank site. Case studies illustrating the success and failure of major projects owing to negligence of geological studies. Earthquakes occurring in the areas of some dams and RIS theories.

Geological Foundation Treatments for various Civil Engineering Projects:

Foundation investigation during construction of projects for assessing various geological defects in rocks and suggesting appropriate remedial measures by various methods of grouting.

Erosion of Tail Channels:

Geological reasons for selection of site for spillway, causes of erosion of tail channel. Relevant Case studies.

Unit VI: **(6 Hrs.)**

Geological exploration for Tunnels and Bridges

Geological exploration for Tunnels:

Variations in methodology of investigation for different types of tunnels for different purposes, location, spacing, angles & depths of drill holes suitable for different types of tunnels.

Difficulties introduced in various geological formation and their unfavorable field characters. Standup time of rock masses and limitations of it.

Dependence of protective measures such as guniting, rock bolting, shotcreting, steel fiber shotcreting, permanent steel supports, lagging concreting & grouting above permanent steel supports on geological conditions. Illustrative case studies.

Bridges Investigation for bridge foundation, difference in objectives of investigation of bridge foundation. Bridge foundation based on nature & structure of rock. Foundation settlements. Case studies.

Practical Work / Term Work

- **i.** Study of Geological map and seismic zone map of India **(2 Practicals)**
- **ii.** Study of Morphometric Analysis of river, (topsheet will be made available by the college) **(1 Practical)**
- **iii.** Study of Soil Profile, weathering index and clay geology. **(1 Practical)**
- **iv.** Use of electrical resistivity method for determining depth of bedrock. **(1 Practical)**
- **v.** Engineering Classification of rocks and Computation of RQD & Joint Frequency Index **(1 Practical)**
- **vi.** Interpretation of drill hole data. Logging of drill cover, preparation of Litho logs & interpretation of drill data. Preparing geological cross sections from drill hole data & using them for designing of civil engineering structures representing following case studies.
  1. Dipping sedimentary formation.
  2. Faulted region.
  3. Folded region.
  4. Locating spillway.
  5. Tunnels in Tectonic areas.
  6. Tunnels and open cuts in non-tectonic areas. **(6 Practicals)**
- **vii.** A compulsory guided tour to study geological aspects of an engineering projects & writing a report based on studies carried out during visits to civil engineering projects.

Note:

Field visits will be made to different places around study area and one study tour to important geological places.

The practical journal will be examined as term work**.**

REFERENCE BOOKS AND TEXT BOOKS:

1. Jaeger J. C., Cook N. & Zimmerman R. – Fundamentals of Rock Mechanics, Blackwell Scientific Publications.
2. Goodman R. E. – Introduction to Rock Mechanics, John Wiley & Sons.
3. Bieniawski Z. T. - Engineering Classification of jointed Rock Masses.
4. M. B. Dobbrin - Introduction to Geophysical Prospecting, McGraw Hill Inc., USA.
5. B. P. Verma - Introduction to Rock Mechanics, Khanna Pub New Delhi.
6. Keller E A - Environmental Geology, Prentice – Hall Publication.
7. Subinoy Gangopadhyay - Engineering Geology, Oxford University Press.
8. Vasudev Kanithi – Engineering Geology, Universities Press.
9. Dr. J. B. Auden Commemorative Volume – Indian Soc. Of Engineering Geology, Culcutta.
10. Seminar on Engineering and Geological Problems in Tunneling (Part 1 & 2) – Indian Society of Engineering Geology, New Delhi.

Handbooks:

a. Gupte R. B. (1980) – P. W. D. Handbook Chapter –6, Part-II ‗Engineering Geology Government of Maharashtra.

b. Tunneling India '94, ‖Central Board of Irrigation and Power‖, New Delhi.

c. Manual on Rock Mechanics, Central Board of Irrigation and Power, New Delhi, 1988.

d. Handbook of Geology in Civil engineering, Robert Fergussion, Legget, Mc- Graw hill.

I. S. Codes

a. IRC code of practice for Road Tunnels. IRC-78-2000; IS-12070; IS-1336 Part I and II.

b. I. S. 4453-1967 Code of practice for Exploration, pits, trenches, drifts & shaft.

c. I. S. 6926-1973 Code of practice for diamond drilling for site investigation river valley project.

d. I. S. 4078-1967 Code of practice for Logging and Storage of Drilling Core.

e. I. S. 5313-1969 Guide for core drilling observation.

e- Resources:

1. www.ebd.co.in/undergraduate/eng
2. www.library.iisc.ernet.in
3. www.iitb.ac.in
4. www.nptel.iitm.ac.in
5. Free online course-swayam-https//swayam.gov.in
6. Open source course management – https//moodle.org

401 005 Elective-II (1) Matrix Methods of Structural Analysis

Teaching scheme:
Lectures: 3 Hrs/week

Examination scheme:
In semester exam: 30 marks (1 Hr.)
End semester exam: 70 marks (2.5 Hrs.)

Unit I: Computational Techniques (6 Hrs)

Review of matrix algebra, computer oriented numerical methods-Gauss elimination, Gauss Jordon and Gauss Seidel. Computer algorithm and flowcharts of above methods.

Unit II: Flexibility matrix method for beams and frame (6 Hrs)

Degree of static indeterminacy, flexibility, selection of redundant, flexibility matrix, analysis of indeterminate continuous beams and simple portal frames involving not more than three unknowns.

Unit III: Stiffness matrix method for bars and trusses (6 Hrs)

a) Degree of kinematic indeterminacy (degrees of freedom), local and global coordinate systems, stiffness matrices of a axially loaded bar members, global stiffness matrix, analysis of determinate/indeterminate bars involving not more than three unknowns using member approach.
b) Stiffness matrices of a truss member with four DOF, transformation matrix, global stiffness matrix, analysis of determinate/indeterminate trusses involving not more than three unknowns using member approach.

Unit IV: Stiffness matrix method for beams (6 Hrs)

a) Structure approach: Degree of kinematic indeterminacy, problems involving not more than three unknowns.
b) Member approach: Derivation of stiffness matrix for beam member, Global stiffness matrix, problems involving not more than three unknowns.

Unit V: Stiffness matrix method for frames (6 Hrs)

a) Structure approach: Degree of kinematic indeterminacy, problems involving not more than three unknowns.
b) Member approach: Derivation of stiffness matrix for plane and space frame member, transformation matrix, global stiffness matrix, problems involving not more than three unknowns.

Unit VI: Stiffness matrix method for grid structures **(6 Hrs)**

a) Structure approach: Degree of kinematic indeterminacy, problems involving not more than three unknowns.

b) Member approach: Derivation of stiffness matrix for grid member, transformation matrix, global stiffness matrix, problems involving not more than three unknowns.

Reference Books:

[1] Matrix Methods of Structural Analysis- Wang, C. K., International Textbook Co., 1970.

[2] Matrix Analysis of Framed Structures – Gere & Weaver- CBS Publications, Delhi.

[3] Matrix & Finite Element analysis of structures – A.H. Shaikh and Madhujit Mukhopadhyay.

[4] Numerical Methods for Engineering – S.C. Chapra& R.P. Canale Tata McGraw Hill Publication.

[5] Structural Analysis – A Matrix Approach – Pandit & Gupta - Tata McGraw Hill Publication.

[6] Matrix Methods of Structural Analysis – Meghre & Deshmukh- Charotar Publishing House, Anand.

401005 Elective-II (2) Integrated Water Resources Planning & Management

Teaching Scheme: Lectures: 3 Hrs / week

Examination Scheme:
Paper In-sem. 30 Marks (1 hr),
Paper End-sem : 70 Marks (2.5 hr)

Unit1: (6 Hrs)

a) Introduction :World water resources, water resources in India, water as finite resource, variability of water in time & space, history of water resources development, water infrastructure-problems and perspectives, present institutional framework for water management.

b) Water laws: Constitutional provisions, National Water Policy, riparian rights / ground water owner ship, prior appropriation, permit systems, acquisition and use of rights, scope for privatization. EPA 1986, MWRRA act.

Unit2: Economics & Paradigm shift in water management (6 Hrs)

a) Economics of water :Water as economic good, intrinsic value, principles of water pricing & water allocation, capital cost, opportunity cost, internal rate of return, benefit cost analysis, principles of planning and financing of water resources project : Discussion on any two case studies.

b) Paradigm shift in water management:

Global and national perspectives of water crisis, water scarcity, water availability and requirements for human and nature, concepts of _blue water‘, _Green water‘, and _virtual water‘, and their roles in water management. Sustainability principles for water management, framework for planning a sustainable water future.

Unit 3: Basin scale flogy (6 Hrs)

a) Estimation of surface water, estimation of ground water draft/recharge import/export of water (inter basin water transfer, interlinking of national river), recycling and reuse and storage, control of water logging, salinity, & siltation of storages.

b) Flood & Drought management: causes of floods, structural and non-structural measures, mitigation plan, flood damage assessment, use of geoinformatics for flood management. Types of droughts, severity index, drought forecasting, damage assessment, mitigation plan, use of geoinformatics for drought management.

Unit 4: Water demand and supply based management **(6 Hrs)**

a) Consumptive & non consumptive demands, irrigation demand estimation, water utilization, irrigation efficiency, water management in irrigation sector.

b) Demand estimation in hydro/thermal/nuclear power sector, estimation & forecasting of water demands of domestic & industrial sector, navigation and recreational water demands.

Unit 5: Environmental and social aspects **(6 Hrs)**

a) Environmental management: protection of vital ecosystem, water requirements for environmental management, aquaculture, minimum flows, environmental flow, water quality management for various uses.

b) Social impact of water resources development: direct/ indirect benefits, employment generation, industrial growth, agro-industry, enhanced living standards, education & health, co-operative movement, management of rehabilitation & resettlement, interstate dispute of water sharing and tribunals, sectorial conflicts.

Unit6: Basin planning &Watershed management **(6 Hrs)**

a) Perspective plan for basin development & management, Decision support system for Integrated Water Resources Management (IWRM), use of data driven techniques like Artificial Neural Networks, Genetic programming, Model Tree in water resources planning, development & management.

b) Watershed Management:

Watershed definition, classification of watersheds, integrated approach for watershed management, role of RS & GIS in watershed management, soil and water conservation-necessity- soil erosion-causes- effects-remedial measures, contour bunding-strip cropping-bench terracing-check dams, farm ponds, percolation tank.

Text Books:

1) Water Resources Systems Engg, D. P. Loucks, Prentice Hall
2) Water Resources Systems Planning and Management, Chaturvedi, M.C. Tata McGraw Hill
3) Economics of Water Resources Planning, James L.D and Lee R.R, McGraw Hill
4) Water resources hand book; Larry W. Mays, McGraw International Edition
5) Design of Water Resources Systems, Arthur Mass, MacMillan 1962
6) Water resource system, Pramod .R. Bhave - Narosa Publication

Reference Books:

1. Economics of Water Recourses Planning, L. D. James & R.R.Leo, McGraw Hills, NY 1971.
2. Water Resources Systems Engineering, W. A. Hill & J. A. Dracup.
3. Water shed Management – B.M. Tideman
4. Watershed management –J. V. S. MURTY, new Age International Publisher.
5. Integrated Watershed Management Perspectives and Problems - Beheim, E., Rajwar, G.S., Haigh, M., Krecek, J. (Eds.) , Springer Publication.
6. Managing Water in River Basins: Hydrology, Economics and Institutions -- M. Dinesh
7. Kumar, Publisher: Oxford Universit Press
8. Water Resources Design Planning Engg. and Economic; Edward Kuiper, Butterworth & Co.
9. ANN in Hydrology; Govinda Raju & Ramachandra Rao; PHI
10. Integrated Water Resources Management in Practice: Better Water Management for Development - R. L. Lenton, Mike Muller , Publisher Earthscan.
11. Sustainability of Integrated Water Resources Management - Editors**:** Setegn, Shimelis Gebriye, Donoso**,** Maria Concepcion (Eds.) Publisher Springer International Publishing .
12. Integrated Water Resources Management in the 21st Century: Revisiting the paradigm -Pedro Martinez-Santos, Maite M. Aldaya, M. Ramón Llamas, Publisher CRC Press, Taylor & Francis Group.
13. Key Concepts in Water Resource Management: A Review and Critical Evaluation - Jonathan Lautze, publisher Routledge.
14. Water Management – Jasapal Singh, M.S.Achrya, Arun Sharma – Himanshu Publication.

e – Resources:

1. nptel.iitm.ac.in/courses /webcourse-contents / IISc-Bang/water resource management.

401 005 Elective II (3) TQM and MIS in Civil Engineering

Teaching scheme:
Lectures: 3 Hrs/week

Examination scheme:
In semester exam: 30 marks---1 Hr.
End semester exam: 70 marks—2.5 Hrs.

Unit I: Quality in Construction (6 Hrs)

a) Quality – Various definitions and interpretation. Importance of quality on a project in the context of global challenges, Factors affecting quality of construction, Reasons for poor quality & measures to overcome, Contribution of various Quality Gurus(Juran, Deming, Crossby, Ishikawa).
b) Evolution of TQM- QC, TQC, QA, QMS, TQM.

Unit II: TQM & Six Sigma (6 Hrs)

a) TQM – Necessity, advantages , 7QC tools, Quality Function Deployment(QFD).
b) Six sigma – Importance, levels.
c) Defects & it‘s classification in construction. Measures to prevent and rectify defects.

Unit III: ISO & Quality Manual (6 Hrs)

a) Study of ISO 9001 principles.
b) Quality manual – Importance, contents, documentation. Importance of check-lists in achieving quality. Typical checklist for concreting activity, formwork activity, steel reinforcement activity.
c) Corrective and Preventive actions, Conformity and NC reports.

Unit IV: Management Control & Certifications (6 Hrs)

a) Benchmarking in TQM, Kaizen in TQM.
b) Quality Circle.
c) Categories of cost of Quality.
d) CONQAS, CIDC-CQRA certifications.

Unit V: Techniques in TQM Implementation and awards (6 Hrs)

a) 5 _S‘ techniques.
b) Kaizen.
c) Failure Mode Effect Analysis (FMEA).

d) Zero Defects.
e) National & International quality awards- Rajeev Gandhi Award, Jamuna lal Bajaj Award, Golden Peacock Award, Deming Prize, Malcolm Baldrize award.

Unit VI: MIS **(6 Hrs)**

a) Introduction to Management Information systems (MIS) Overview, Definition.
b) MIS and decision support systems, Information resources, Management subsystems of MIS, MIS based on management activity whether for operational control, management control, strategic control.
c) Study of an MIS for a construction organization associated with building works.

Text Books:

1. Total Quality Management-- Dr. Gunmala Suri and Dr. Puja Chhabra Sharma—Biztantra.
2. Quality Control and Total Quality Management by P.L.Jain- Tata McGraw Hill Publ. Company.
3. Total Quality Management - Dr. S.Rajaram and Dr. M. Sivakumar—Biztantra.
4. Total Engineering Quality Management – Sunil Sharma – Macmillan India Ltd.

Reference Books:

1. Juran's Quality Handbook – Juran Publication. Importance of quality on a project in the context of global challenges. Importance of quality on a project in the context of global challenges.
2. Management –Principal, process and practices by Bhat – Oxford University Press.
3. Financial management by Shrivastava- Oxford University Press.
4. Management Information Systems – Gordon B. Davis, Margrethe H. Olson – Tata McGraw Hill Publ. Co.
5. Total Project Management – The Indian Context - P.K.Joy Macmillan India Ltd.

E- Sources:

www.nptel.ac.in , www.mobile.enterpriseappstoday.com

401 005 Elective II (4) Earthquake Engineering

Teaching scheme:
Lectures: 3 Hrs/week

Examination scheme:
In semester exam: 30 marks---1 Hr.
End semester exam: 70 marks—2.5 Hrs.

Unit I

Introduction to earthquakes: **(6 Hrs.)**

Geology of earth, configuration of tectonic plates in a globe, influence of Geology on earthquake, behavior of plates, their motion and effects, causes of earthquake and their Characteristics, Earthquake parameters, magnitudes, intensity, scales, classification of earthquake seismic zoning of India, seismic coefficients for different zones, .Lessons from past earthquake: - Study of damages caused due to past, earthquakes in/ outside India and remedial measures.

Unit II **(6 Hrs.)**

Theory of vibrations:

Vibrations - definition, causes, classifications. Single Degree of Freedom systems (SDOF) - Free, forced, damped, un-damped vibrations with basic examples. Introduction to Multi-degrees of Freedom systems (MDOF) - derivations of related equations and solutions to two degree and three degree of freedom systems.

Unit III **(6 Hrs.)**

Static analysis of earthquake forces:

Introduction to IS1893 (Part-I): Seismic design Philosophy, provision, Seismic coefficient method.

Unit IV **(6 Hrs.)**

Dynamic analysis of earthquake forces:

Response Spectra, estimation of story shear, effect of unsymmetrical geometry and masses, mass center and stiffness center, estimation of story shear for symmetrical and torsion for unsymmetrical buildings. Effect of infill masonry and shear walls.

Unit V **(6 Hrs.)**

Earthquake force calculation and analysis and design of frames

Estimation of combined effect of lateral forces and vertical loading on multi storeyed frames. Design any intermediate continuous beam of the frames for combined effect of loadings, Concept of ductile detailing, IS 13920 provisions for RC frame.

Unit VI **(6 Hrs.)**

Introduction of different control systems: Passive control: base isolation and active control: bracing system. Strengthening and Retrofitting techniques, methodology of retrofitting for walls, slabs roofs columns, foundations etc. for buildings in stones, bricks, RCC. Introduction to Disaster Management: Types of Disaster, Phases of disaster management, Disaster rescue, psychology and plan of rescue operations.

Notes:

Every design should confirm to latest versions of IS 1893, 4326, 13920, 13827, 13828, 13935

Text Books:

1. Earthquake resistance design of structure by Duggal- Oxford University Press.
2. Earthquake – Resistant Design of Building Structures-Dr. Vinod Hosur-- Wiley India.
3. Earthquake Tips NICEE, IIT, Kanpur.
4. Elements of Earthquake Engineering by Jaikrishna and Chandarsekaran.
5. Earthquake resistant design of structures- Agarwal, Shrikhande, PHI learning.

Reference Books:

1. Dynamics of structure by Clough R.W. and Penzin J. McGraw Hill Civil Engineering Series.
2. Dynamics of structure by Anil Chopra, Prentice Hall India Publication.
3. Dynamics of structure by Mario Paz, CBSPD Publication.
4. Geo-technical Earthquake Engineering by Kramer S. L. Prentice Hall India Publication.
5. Introduction to Structural Dynamics by John M. Biggs.
6. Mechanical Vibrations by V. P. Singh.
7. Relevant Latest Revisions of IS codes.

401 005 Elective II (5)- Advanced Geotechnical Engineering

Teaching scheme:
Lectures: 3 hours/week

Examination scheme:
In semester exam: 30 marks---1 hour
End semester exam: 70 marks—2.5 hours

Unit I **(6 Hrs.)**

(a) Soil classification Identification and classification, criteria for classifying soil - classification on the basis of grain size, plasticity, symbolic & graphic presentation. Classified soils and engineering properties. (b) Soil structure & clay minerals Clay minerals, clay water relations, clay particle interaction, soil structure & fabric, granular soil fabric.

Unit II **(6 Hrs.)**

(a) Earth pressure theory Earth pressure theories for calculation of active and passive pressure, Rankines and coulombs earth pressure theories, analytical and graphical methods. (b) Design of earth retaining structures Design of gravity and cantilever retaining walls, design - cantilever sheet pile walls, anchored sheet pile walls, timbering and bracing for open cuts.

Unit III **(6 Hrs.)**

(a) Geosynthetics Geosynthetics- types, functions, properties and functional requirements. Application of geosynthetics in geoenviroment. (b) Reinforced soil Mechanism, reinforcement soil – interaction. Applications – reinforcement soil structures with vertical faces, reinforced soil embankments. Reinforcement soil beneath unpaved roads, reinforcement of soil beneath foundations. Open excavation and slope stabilization using soil nails.

Unit IV **(6 Hrs.)**

(a) Soil behavior under dynamic loads Soil behavior under static and dynamic loads. Acceptable levels of strain under static and dynamic loading. Soil properties relevant for dynamic loading and its determination.

(b) Machine foundations: Types of machine foundations, design criteria, methods of analysis – elastic half space method, linear elastic weightless spring method. Evaluation of soil parameters. Design procedure for a block foundation for cyclic loading and impact loading.

Unit V **(6 Hrs.)**

Ground Improvement In-situ ground improvement by compaction piles, dynamic loads, sand drains, grouting, deep mixing, inserting reinforcement elements, freezing soil, and vibroflotation.

Unit VI **(6 Hrs.)**

Rheology Rheological elements, basic and composite rheological models. Examples of compound models used to explain different soil phenomena; such as secondary consolidation, creep etc.

Reference Books:

1. Physical and Geotechnical properties of soils- Joseph E. Bowels, Tata Mac-Grawhill.
2. Advance Soil Mechanics – Braja Mohan Das- Tata Mc- Grawhill.
3. Geotechnical Engineering by Shashi K. Gulati & Manoj Datta – Tata Mc-Grawhill.
4. Basic and Applied Soil Mechanics- Gopal Ranjan & A.S. Rao- New Age Publication.

Codes:

1. I.S .Codes 1. IS: 1892-1979 – ‖Code of Practice for Subsurface Investigation for Foundation‖.
2. 2. IS: 2131-1981 (Reaffirmed 1997), ‖Method for Standard penetration Test for Soils‖.

Handbooks:

1. Bolt, Bruce A.(1999),‖Earthquakes‖, W. H. Freeman.
2. Baghi, A., (1994)‖ Design, Construction and Monitoring of Landfills.‖ John Wiley & Sons.
3. Day. R.W.(2002),‖Geotechnical Earthquake Engineering Handbook‖,McGraw Hill.

e -Resources:

1. Website www.nptel.iitm.ac.in

401006 Project Phase-I

Teaching Scheme: **Examination Scheme:**

Tutorial: 2 Hrs/week **TW: 50 Marks.**

Project phase I Term Work will be evaluated for an individual student based on the seminar presented on the work done in first semester and submission of the report. If the student fails to present the seminar and submit the report, he / she will be marked absent in project examination. The project work phase I shall be consist of any one of the following nature in Civil Engineering related subjects.

1. Experimental investigation.
2. Software development.
3. Benefits cost economic analysis.
4. Case study with own design.
5. Working model design and fabrication.
6. Case study with development of methodology using soft computing tools.

It is mandatory to present a seminar in presence of Internal and External Examiners and submit preliminary project report based on work done in first semester. The report shall contain finalization of topic, literature survey, planning schedule/ flow chart for completion of project. The report shall be typed or printed and hard/spiral bound. The project work to be taken up individually or in groups. The group shall not be of more than 4 students. References shall be mentioned at the end as per universal standards as mentioned in any international journal of professional body.

Format of project report: Sequence of pages:

i) Front Cover Page ii) Certificate iii) Acknowledgement iv) Synopsis v) Contents vi) Notations vii) List of Tables viii) List of Figures ix) List of Graphs.

Chapter 1 Introduction (This consists of: 1.1 Introduction of the Project Work; 1.2 Problem Statement, 1.3 Objectives and 1.4 Scope of the Project Works, 1.5 Research Methodology, 1.6 Limitations of study, 1.7 Expected outcome.

Chapter 2 Literature Review from minimum 10 articles (It shall include theoretical support, details regarding work done by various persons, methods established, any new approach. It should preferably highlight the development in the field of research chronologically as reflected from books, journals etc.).

Chapter 3 Planning Schedule/ Flow Chart For Completion of Project References and Bibliography (The references and bibliography shall include name of author/code/manual/book, title of paper/code/manual/book, name of the journal, month & year of publication, volume number/ISBN number, page number x-y. The references and bibliography shall be as per universal standards as mentioned in any international journal of professional body).

Report Printing details:

1. Report shall be typed on A4 size Executive Bond paper with single spacing preferably on Both sides of paper.
2. Margins: Left Margin: 37.5 mm, Right Margin: 25 mm, Top Margin: 25 mm, Bottom Margin: 25 mm.
3. Give page number at bottom margin at center.
4. Size of Letters: Chapter Number: 16 font size, Times New Roman in Capital Bold Letters, Chapter Name: 12 Font size in Capital Bold Letters, Main Titles (1.1, 2.5 etc): 16 Font size in Bold Letters Sentence case, Sub Titles (1.1.5, 4.5.1 etc): 14 Font size in Bold Letters- Sentence case. All other matter: 12 Font size sentence case.
5. No blank sheet be left in the report.
6. Figure name: 12 Font size in sentence case Bold- Below the figure.
7. Table title -12 font size in sentence case- Bold-Above the table.

Semester-II

Savitribai Phule Pune University Board of Studies in Civil Engineering B.E. Civil 2015 Course (w. e. f. June 2018)

401007 Dams and Hydraulic Structures

Teaching Scheme:
Lectures: 3 hours/week
Practical: 2 hours/week

Examination Scheme:
In-sem: 30 marks (1 Hour)
End-sem :70 marks (2.5 Hours)
Oral : 50 marks

Unit I **(4 Hrs.)**

a) Introduction to dams

Introduction, Historical development of dams, Different terms related to dams, Selection of site for dam, Factors governing selection of type of dam, Classification of dams, Classification based on purpose, Classification based on materials, Classification based on size of project, Classification based on hydraulic action, Classification based on structural action, Dams and earthquakes, Dams and social issues, Large dams verses small dams, Displacement and rehabilitation, Dams and climate change.

b) Dam Safety and Instrumentation

Introduction, Objectives of dam safety and instrumentation, Types of measurements, Instrumentation data system, Working principles and functions of instruments, Selection of Equipment‘s, Different Instruments, Piezometers, Porous tube piezometer, Pneumatic piezometer, Vibrating wire piezometer ,Settlement measurement system Vibrating wire settlement cell, Magnetic settlement system, Inclinometer, Joint meter, Pendulums, Inverted Pendulum, Hanging Pendulum, Automatic pendulum coordinator ,Vibrating wire pressure cell, Extensometer, Embedment strain gauge, Temperature gauge, distributed fiber optics temperature tool, seismograph.

UNIT 2 **(7 Hrs.)**

a) Gravity Dams

Introduction, Components of gravity dam, Conditions favoring gravity dams, Forces acting on gravity dam, Combinations of loading for design, Seismic analysis of dam, Terms related to seismic analysis, Determination of Seismic forces (Zangar‘s method) , Effect of horizontal earthquake acceleration, Effect of vertical earthquake acceleration, Stress analysis in gravity dam (Only concept, no derivations), Vertical or normal stress , Principal stresses, Shear stress, Middle third rule, Modes of failure of gravity dam, Elementary profile of gravity dam, Concept of low and high gravity dams, Various Design methods of gravity dam (Introduction only)— Details of Gravity method or 2 D method, ,Construction of gravity dams, Colgrout masonry, Roller Compacted Concrete (R.C.C.),Temperature control in mass concreting, Crack formation in gravity dam, Control of crack formation in dams, Construction joints, Keys, Water seal, Retrofitting.

b) Arch Dam and Other Dams (Introduction only)

Introduction, Concept of Arch Dam, Conditions favoring an arch dam, Classification of an arch dam, Constant angle arch dam, Constant radius arch dam, Variable radius arch dam, Arch gravity dam, Double curvature arch dam, Buttress dams, Advantages of Buttress dams, Limitations of Buttress dams, Types of buttress dams.

Unit III **(7 Hrs.)**

a) Spillway and Gates [6 Lectures]

Introduction, Location of Spillway, Different key levels and heads in spillway, Spillway Capacity, Components of spillway, Approach channel, Control structure, Discharge channel, Energy dissipation device, Tail channel, Classification of spillway, Classification based on operation, Main or service spillway, Auxiliary spillway, Emergency spillway, Classification based on gates, Gated spillway, Ungated spillway, Classification based on features, Straight drop spillway(Free overflow spillway),Saddle spillway, Side channel spillway, Overflow or ogee spillway, Chute or open channel or trough spillway, Shaft or morning glory spillway, Siphon spillway, Conduit or tunnel spillway, Stepped spillway,

Design of Ogee spillway or overflow spillway, Shape of crest, Equations for spillway profile on upstream and downstream, Energy dissipation below spillway, Classification of energy dissipation devices, Energy dissipation in stilling basin, Stilling basin, Components of stilling basin, Types of stilling basins, Indian standard stilling basins, Energy dissipation through buckets, Solid roller bucket, Slotted roller bucket, Ski jump bucket, Correlation between jump height and tail water depth.

b) Spillway Gates

Introduction of Spillway gates , Classification of spillway crest gates, Classification based on function, Classification based on movement of gates, Classification based on special features, Introduction to automatic gates, Maintenance of gates, Inspection of gates.

Unit IV **(7 Hrs.)**

a) Earth Dam

Introduction, Conditions favoring an earth dam, Limitations of earth dam, Classification of earth dam, Classification based on---materials, method of construction, height; Selection of type of earth dam, Components of an earth dam, Requirements for safe design of earth dam, Hydraulic (Seepage) Analysis, Plotting of seepage line, Case 1: Homogeneous earth dam with horizontal drainage blanket, Determination of seepage discharge using phreatic line.

Case II: Composite earth dam with casing and hearting, Properties of phreatic line, Determination of seepage discharge through earth dam using flownet, Structural stability analysis of homogeneous and zoned earth dam, Forces acting on earth dam, Method of stability analysis of an earth dam, Procedure of analysis by Swedish slip circle method, Fellenius Method of Locating Centre of Critical Slip circle, Stability analysis for foundation, Failure of earth dam, Classification of failure of earth dams, Hydraulic Failure, Seepage failure, Structural failure, Seepage control in earth dams, causes of seepage, Seepage control measures, Construction of earth dam,

b) Diversion head works

Introduction, Function of diversion headworks, Selection of site for diversion headworks, Layout of diversion headworks, Components of diversion headworks, Design of weir on permeable foundation, Criteria for safe design of weir floor, Brief introduction to Bligh and Lane‘s theory, Khosla's theory based on potential theory approach, Khosla's theory of independent variables, Design criteria of weirs on permeable foundations, Checks for stability and safety of weirs.

Unit V **(6 Hrs.)**

a) Canals

Introduction, Classification of canals, Classification based on alignment, Classification based on soil, Classification based on source of supply, Classification based on discharge, Classification based on lining, Classification based on excavation, Components of canal , Data required for canal design, Selection of canal alignment, Design of stable canal in alluvial beds, Kennedy‘s theory, Design of canal by Kennedy‘s theory, Limitations of Kennedy‘s theory, Lacey‘s regime theory, Design of canal by Lacey‘s theory, Canal lining, Need of canal lining, Requirements of lining material, Classification of canal lining, Hard surface lining including Ferrocement lining, Soft surface lining, Burried lining, Advantages of canal lining, Design of lined canal, Benefit – cost analysis for canal lining.

b) Canal Structures

Canal falls Introduction, Necessity of canal fall, Selection of site for canal fall, Classification of canal fall, Types of falls, Free fall or open fall, Notch fall, Ogee Fall, Rapid Stepped fall, Straight glacis fall, Sarda fall, Semi pressure fall, Baffle or Englis Fall, Montague fall Siphon well or cylinder fall, Pressure or closed conduit fall, Shaft or Pipe fall, Selection of type of fall, **Canal outlets-** Introduction of Canal outlet or module, **Canal escapes-** Introduction of Escapes, Significance of canal escape, **Canal regulators--**Canal regulators.

Unit VI **(5 Hrs.)**

a) C. D. Works

Introduction, Necessity of cross drainage works, Selection of site for Cross Drainage work, Data required for design of Cross Drainage work, Classification of Cross Drainage works, Drain over canal-Siphon, Super passage, Canal over drain—Aqueduct, Siphon aqueduct, Canal and drain water mixed in each other--Level crossing, Inlet and Outlet, Selection of suitable type of C. D. works, Design considerations for cross drainage works.

b) River Training Structures

Introduction, Classification of rivers, Classification based on topography, regime, alignment, source, Behaviour of rivers, River training, Objectives of river training, Classification of river training, purpose, orientation, River training structures, Embankment or Levee, Guide banks, Groynes or spurs, Artificial cut off, Pitched island, Submerged sill or dykes, Closing dykes.

Term Work (A+B+C)

A) Analysis /Design Assignments. (Compulsory)

1) Stability analysis of gravity dam
2) Design of profile of spillway and energy dissipation device below the spillway
3) Stability analysis of zoned earthen dam
4) Analysis of weirs on permeable foundations.
5) Design of unlined and lined canal.

B) Site visits and reports with photographs (compulsory)

1. Gravity dam.
2. Earth dam.
3. D. work/ Canal structure(s)/Weirs/Barrage.

C) Review of any one case study of failure of hydraulic structure from the published literature or patent related to Hydraulic structures (in a group of five students).

Note:-

Visit report should consist of Name of project, date of visit , need and practical significance of project, salient features of project, technical details of project, detailed description and figures of different components of project, special features of project, the technical, social, financial and environmental impact of project on downstream and upstream, photographs of technical details of visit, if allowed . If not allowed for technical details, the photograph near board of project or site as a proof of visit.

Reference Books :-

1. Design of Small Dams- United States Department of the Interior, Bureau of Reclamation revised reprint 1974, Oxford and IBH Publishing Co.
2. Irrigation and Water Resources Engineering- Asawa G.L- New Age International (P) Ltd. Publishers, first ed, 2005.
3. Irrigation Engineering and Hydraulic Structures- Garg S.K- Khanna Publishers N.D. 13th ed, 1998.
4. Design Textbook in Civil Engineering: Volume Six: Dams- Leliavsky, Serge – Oxford and IBH Publishing Co. Pvt. Ltd., 1981.
5. Roller Compacted Concrete Dams- MehrotraV.K- Standard Publishers Distributors, Delhi, 1st ed, 2004.
6. Irrigation, Water Resources and Water Power Engineering- Modi, P.N. - Standard Book House, New Delhi, 2nd ed, 1990.
7. Irrigation and Water Power Engineering - Punmia B.C. - Laxmi Publication.

I.S. Codes:

1. I.S. 8605 – 1977 (Reaffirmed 1998), Code of practice for construction of masonry in dams, third reprint, July 1999, B.I.S. New Delhi.
2. I.S. 6512-1984 (Reaffirmed 1998), Criteria for design of solid gravity dams, first revision, first reprint, September, 1998, B.I.S. New Delhi.
3. I.S. 457 – 1957 (Reaffirmed, 2005), Code of practice for general construction of plain and reinforced concrete for dam and other massive structures, sixth reprint, January 1987, B.I.S. New Delhi.

4. I.S. 10135 – 1985, Code of practice for drainage system for gravity dams, their foundations and abutments, first revision, B.I.S. New Delhi.
5. I.S. 14591 – 1999, Temperature control mass concrete for dams – guidelines, B.I.S.
6. I.S. 11223 – 1985 (Reaffirmed 2004), Guidelines for fixing spillway capacity, edition 1.2 (1991-09), B.I.S. New Delhi.
7. I.S. 6934 – 1998 (Reaffirmed 2003), Hydraulic design of high ogee overflow spillways – recommendations, first revision, B.I.S. New Delhi.
8. I.S. 11155- 1994, Construction of spillways and similar overflow structures – Code of practice, B.I.S. New Delhi.
9. I.S. 5186 – 1994, Design of chute and side channel spillway – criteria, first revision, B.I.S. New Delhi.
10. I.S. 10137- 1982 (Reaffirmed 2004), Guidelines for selection of spillways and energy dissipaters, B.I.S. New Delhi.
11. I.S. 4997 – 1968 (Reaffirmed 1995) Criteria for design of hydraulic jump type stilling basins with horizontal and sloping apron, sixth reprint, January, 1998, B.I.S. New Delhi.
12. I.S. 7365-1985, Criteria for hydraulic design of bucket type energy dissipaters, first revision, B.I.S. New Delhi.

01 008 Quantity Surveying, Contracts & Tenders

Teaching scheme:
Lectures: 3 Hrs/week
Practical: 2 Hrs/week

Examination scheme:
In semester exam: 30 Marks---1 Hr.
End semester exam: 70 Marks—2.5 Hrs.
Oral: 50 Marks

Unit I **(6 Hrs.)**

Introduction and Approximate Estimates:

a) **Introduction to estimates and related terms:** Definition of estimation and valuation. Significance (application) of the Course. Purpose of estimation. Type of estimates, data required for estimation as a pre requisite. Meaning of an item of work, and enlisting the items of work for different Civil Engineering projects. Units of measurement. Mode of measurement of building items/ works. Introduction to components of estimates: face sheet, abstract sheet (BOQ), measurement sheet, Rate Analysis, lead statement. Provisional sum& prime cost items, contingencies, work charge establishment, centage charges. Introduction to D. S. R.

b) **Approximate Estimates**: Meaning, purpose, methods of approximate estimation of building & other civil engineering projects like roads, irrigation/ water supply, sanitary engineering, electrical works.(Theory & Numericals).

Unit-II **(6 Hrs.)**

Taking out quantities &Detailed estimate:

a) **Detailed estimates**: Factors to be considered while Preparing Detailed Estimate, Detailed estimate of R.C.C framed structures using IS 1200, Concept of Estimation of Load Bearing Structure (PWD & Centre Line Method).

b) **Bar Bending Schedule:** Preparing Bar Bending Schedule for all RCC members of building.

Unit-III **(6 Hrs.)**

Specifications and Rate Analysis:

a) **Specifications**: Meaning & purpose, types. Drafting detailed specifications for materials, quality, workmanship, method of execution, mode of measurement and payment for major items like, excavation, stone/ brick masonry, plastering, ceramic tile flooring, R.C.C. work.

b) Rate Analysis: Meaning and factors affecting rate of an item of work, materials, sundries, labour, tools & plant, overheads & profit. Task work or out turn, factors effecting task work. Working out Rate Analysis for the items mentioned in specifications above.

Unit IV **(6 Hrs.)**

Valuation:

a) **Valuation:** Purpose of valuation. Meaning of price, cost and value. Factors affecting

‗Value‘. Types of value: only Fair Market Value, Book Value, Salvage/ Scrap Value, Distressed Value and Sentimental Value. Concept of free hold and lease hold property. Estimation versus valuation. Methods of depreciation & obsolescence, Sinking Fund, Years Purchase.

b) **Methods of Valuation of Building:** Rental Basis, Land & Building basis, Direct Comparison Method, Profit based method, Belting of Land, Development method.

Unit V **(6 Hrs.)**

Tendering and Execution of Works:

a) Tenders: Definition. Methods of inviting tenders, tender notice, tendering procedure,
Pre and post qualification of contractors, tender documents. 3 bid/ 2 bid or single bid system. Qualitative and quantitative evaluation of tenders. Comparative statement, Pre-bid conference, acceptance/ rejection of tenders. Various forms of BOT &Global Tendering, E-tendering.

b) Methods of Executing Works: PWD procedure of work execution, administrative approval, budget provision, technical sanction. Methods of execution of minor works in PWD: Piecework, Rate List, Daily Labour. Introduction to registration as a contractor in PWD.

Unit VI **(6 Hrs.)**

Contracts and Arbitration:

a) **Contracts**: Definition, objectives & essentials of a valid contract as per Indian Contract

Act (1872), termination of contract. Types of contracts: only lump sum, item rate, cost plus. **Conditions of contract**: General and Specific conditions. Conditions regarding EM, SD, and time as an essence of contract, conditions for addition, alteration, extra items, testing of materials, defective work, subletting, etc. Defect liability period, liquidated damages, retention money, interim payment or running account bills, advance payment, secured advance, final bill.

b) Arbitration: Introduction to Arbitrations as per Indian Arbitration & Conciliation Act (1996) Meaning and need of arbitration, qualities and powers of an Arbitrator.

Term Work:

The following exercises should be prepared and submitted:

1. Report on contents, use of current DSR & Drafting detailed specification for major items of works.
2. Working out quantities using C-L and PWD method for a small single storied load bearing structure up to plinth and Preparing Abstract Sheet using DSR(Regional)
3. Detailed Estimate of a single storied R.C.C framed building using D.S.R.
4. Working out quantities of steel reinforcement for a column footing, a column, a beam and a slab by preparing bar bending schedule.
5. Working out rate analysis for the items as in the specifications of Assignment No. 1.
6. Preparing Valuation of a Residential building and writing report using O-1 form.
7. Estimating quantities for any one of the following using appropriate software.
   a) A Factory Shed of Steel Frame
   b) Underground Water Tank
   c) Pipe Culvert
   d) Road / Railway Track/ Runway
8. Drafting of tender notice, Preparation of Schedule A & B and Conditions of Contract regarding time, labour payment, damages for RCC Framed Structure (Assignment No. 3) and collecting minimum of 3 tender notices of Civil Engineering Works.

Oral Examination: Based on the Term Work.

Reference Books:

1. Estimating and Costing in Civil Engineering: Theory and Practice: B.N Dutta - S. Dutta & Company, Lucknow.
2. Estimating, Costing Specifications & valuation in Civil Engineering: M. Chakraborty.
3. Estimating and Costing: R. C. Rangwala - Charotar Publ. House, Anand.
4. Theory and Practice of Valuation: Dr. RoshanNamavati, Lakhani Publications.
5. Valuation Principles and Procedures: Ashok Nain, Dewpoint Publ.
6. Laws for Engineers : Dr. Vandana Bhat and Priyanka Vyas –Published by PRO-

CARE,5/B,/Sagarika Society,Juhu Tara Road,Juhu,Santacruz(W),Mumbai-400049 procure@technolegal.org).

Handbooks:

1. Standard Contract Clauses for Domestic Bidding Contracts: Ministry of Statistics and Program Implementation, Government of India.
2. FIDIC Document: Federation International Des Ingenieurs Conseils i.e. International Federation of Consulting Civil Engineers, Geneva, Switzerland.
3. Indian Practical Civil Engineers‘ Handbook: P. N. Khanna, UBS Publi. Distri. Pvt. Ltd. (UBSDP).

Codes:

1. IS 1200 (Part 1 to 25): Methods of Measurement of Building & Civil Engg.Works.
2. IS 3861-1966: Method of Measurement of Areas and Cubical Contents of buildings.
3. D. S. R. (District Schedule of Rates) for current year.
4. PWD Redbooks, Vol 1 & 2.

e – Resources: nptel.iitm.ac.in

401 009 Elective III (1) Advanced Structural Design

Teaching Scheme
Lectures: 3 hours/week
Practical: 2 hours/week

Examination Scheme
Theory Examination:
In-sem : 30 marks (1 Hour)
End-sem:70 marks (2.5.Hours)
Term work: 50 Mark

Unit 1 **(6 Hrs.)**

Cold-formed light gauge steel structural members: Design of axially loaded compression members, tension members and beams (not more than two spans).

Unit 2 **(6 Hrs.)**

Frames: Uniqueness theorem, lower bound and upper bound theorems, mechanisms, analysis and design of frames (single story), design of connections.

Unit 3 **(6 Hrs.)**

Composite deck slab: Design of composite deck slab with cold form light gauge profile and shear connectors.

Unit 4 **(6 Hrs.)**

Yield line analysis and design of slabs: Yield line theory, yield lines, ultimate moment along a yield line, principle of virtual work, analysis and design of slabs of different geometry, support conditions and loading conditions.

Unit 5 **(6 Hrs.)**

Elevated water tanks: Analysis and design for gravity and earthquake loads (static analysis) for square, rectangular and circular water tanks (excluding Intze tank) supported on staging, design of staging and foundation system.

Unit 6 **(6 Hrs.)**

Shear walls: Function, types, analysis and design of cantilever type shear walls.

Note: The designs should conform to the latest codal provisions.

Term Work:

a) At least three plates showing the details of cold-formed light gauge steel sections used in compression, tension and flexural members

b) At least three plates showing the details based on yield line analysis and design of slabs

c) Sheet 1: Detailing of any one design problem from Unit 2 or Unit 3

d) Sheet 2: Detailing of any one design problem from Unit 5 or Unit 6

e) Report of two site visits covering the contents of the syllabus mentioned above.

References:

1). Design of Steel Structures, Ramachandra, Standard Publications New-Delhi

2). Structural and Stress Analysis, T.H.G. Megson, Butterworth-Heinemann

3). Design of Concrete Structures, J. N. Bandyopadhyay, PHI

4). Punmia, Reinforced Concrete Structures Vol. 1 and 2, Standard Book House NewDelhi.

5). Sinha and Roy., RCC Analysis and Design . S. Chand and Co. New-Delhi

6). Ramachandra, Design of Steel Structures Vol.-II Standard Publications New-Delhi.

7). Punmia,B. C. and Jain and Jain, Comprehensive Design of Steel Structures, Standard Book House

8) INSDAG publications

401009 Elective=III (2) Statistical Analysis and Computational Methods in Civil Engineering

Teaching Scheme	**Examination Scheme**
Lectures : 3 hours/week	**In-sem : 30 marks (1 Hour)**
Practical: 2 hours/week	**End-sem:70 marks (2.5.Hours)**
	Term work: 50 Mark

Unit I: (6 Hrs.)

Numerical methods: Bisection method, False Position method, Newton Raphson, Secant method.

Unit II: (6 Hrs.)

Numerical Integration Need and scope, trapezoidal rule, Simpsons 1/3rd rule, Simpsons 3/8th rule, Gauss Quadrature method.

Unit III: (6 Hrs.)

Optimization techniques: Introduction to optimization techniques-concepts and applications, direct solution of linear equations-Gauss elimination and Gauss Jordon method. Iterative solution of linear equations- Gauss Seidel method.

Unit IV: (6 Hrs.)

Statistical methods: Introduction, collection, classification and representation of data, measures of central value (mean, median, mode), measures of dispersion, sampling.

Unit V: (6 Hrs.)

Probability and Probability distributions including Binomial, Poisson, Normal, test of hypothesis, chi-square test.

Unit VI: (6 Hrs.)

Correlation analysis, regression analysis. Coefficient of correlation, probable error, single and multiple regression, curve fitting, Interpolation and extrapolation.

Term Work:

1. One exercise on each unit.
2. Any two problems to be solved using c, c++, excel or using softwares like SPSS, minitab, etc.
3. One exercise on formulation and solution of an optimization problem applicable to any field of Civil Engineering.

Reference Books:

1. Statistical methods – S.P.Gupta.
2. Probability and Statistics for Engineers – Richard A Johnson 3. Probability and Statistics for Science and Engineering – G Shankar Rao.
4. Numerical Methods – E Balagurusamy.
5. Numerical methods for Engineers – S. Chapra, R.P.Canale.
6. Higher Engg. Mathematics – B.S. Grewa.

401009 Elective III (3): Hydro Power Engineering

Teaching Scheme
Lectures: 3 hours/week
Practical: 2 hours/week

Examination Scheme
Theory Examination
In-sem: 30 marks (1 Hour)
End-sem:70 marks (2.5.Hours)
Term work: 50 Marks

Unit I **(6 Hrs.)**

Energy Resources – Planning and Potential:

Power resources – Conventional and Nonconventional, Need and advantages, Overview of World Energy Scenario, energy and development linkage, Environmental Impacts of energy use, Green House Effect, Trends in energy use patterns in India, Hydropower development in India, Hydropower potential basin wise and region wise, investigation in hydropower plants.

Unit II **(6 Hrs.)**

Hydropower Plants:

Hydrological Analysis, Classification of hydropower plants based on hydraulic characteristics - Run of river plants, Storage or Valley dam plants, Pumped storage plants, Classification based on head, Classification based on operating function, Classification based on plant capacity, Classification based on nature of topography, Introduction to micro hydro, advantages and disadvantages, Principle Components of hydropower plants.

Unit III **(6 Hrs.)**

Load Assessment:

Estimation of electrical load on turbines. Load factor, Plant factor, peak demand and utilization factor, installed capacity, diversity factor, firm power, secondary power, load curve, load duration curve, Prediction of load and significance, Tariffs, Hydro-Thermal Mix, Combined Efficiency of Hydro-Thermal-Nuclear Power Plants.

Unit IV **(6 Hrs.)**

Water Conductor System and Powerhouse:

Water Conductor System – Alignment, Intake Structures- Location and Types, Trash Rack. Headrace tunnel/ Canal, Penstock and pressure shaft, Types of Powerhouses, Typical layout of powerhouse, Components, Power plant equipments, Instrumentation and control.

Unit V **(6 Hrs.)**

Turbines:

Classification, Principles and design of impulse and reaction turbines, Selection of Turbine, Specific Speed, Governing of turbines, Water hammer, Hydraulic Transients and Surge tanks, Draft tubes, Cavitation.

Unit VI **(6 Hrs.)**

Economics of Hydroelectric Power:

Hydropower - Economic Value and Cost and Total Annual Cost. Economic considerations – pricing of electricity, laws and regulatory aspects, Policies, Electricity act – 2003, Investment in the power sector, Carbon credits, Participation of private sector.

Term Work:

Minimum eight assignments as per the list given below. **Assignments 1 and 10 are compulsory.**

1. Calculating the electricity bill of upper middle class family that uses various electrical appliances.
2. Determination of power output for a run of river plant with and without pondage.
3. Justification of economics of Pumped storage plants.
4. Design of Kaplan / Francis / Pelton turbine.
5. Determination of diameter of penstock using different methods.
6. Design of surge tank.
7. Design of straight conical draft tube.
8. Use of any software to calculate water hammer pressure.
9. Case study of any hydropower project.
10. Report based on visit to any micro/small/mega hydropower project

Reference Books:

1. Water Power Engineering – M. M. Dandekar and K. N. Sharma, Vikas Publishing House.
2. Water Power Engineering – R. K. Sharma and T. K. Sharma, S. Chand and Co. Ltd.
3. Handbook of Hydroelectric Engineering – P.S. Nigam
4. Modern Power System Planning – Wang.
5. Hydropower Resources in India – CBIP.

6. Hydro Power Structures – R. S. Varshney.
7. Water Power Development – E. Mosonvi, Vol. I & II.
8. Hydro-electric Engineering Practice – G. Brown, Vol. I, II & III.
9. Hydro – Electric Hand Book – Creager and Justin.
10. Water Power Engineering – P. K. Bhattacharya, Khanna Pub., Delhi.
11. Water Power Engineering – M. M. Deshmukh, Dhanpat Rai Pub.
12. Manual of –Energy Group‖ of ‗PRAYAS‘, an NGO.

401009 Elective-III: (4) Air Pollution and Control

Teaching Scheme:	**Examination Scheme:**
Lectures: 3 Hrs/week	**Paper In-sem. 30 Marks (1 hr),**
Practical: 2 Hrs/week	**Paper End-sem : 70 Marks (2.5 hrs)**
	TW : 50 Marks

Unit I **(6 hrs)**

Meteorological aspects: Zones of atmosphere, Scales of meteorology, Meteorological parameters, Temperature lapse rate, Plume behaviour. Gaussion diffusion model for finding ground level concentration, Plume rise, Types & quality of fuels, Formulae for effective stack height and determination of minimum stack height as per CPCB norms.

Unit II **(6 hrs)**

Ambient Air sampling and analysis: Air pollution survey, basis and statistical considerations of sampling sites, devices and methods used for sampling of gases and particulates. Stack emission monitoring for particulate and gaseous matter, isokinetic sampling. Analysis of air samples chemical and instrumental methods. Emission inventory and source apportionment studies. Ambient air quality monitoring as per the procedure laid down by CPCB. National Ambient Air Quality Standards (NAAQS) 2009.

Unit III **(6 hrs)**

Indoor air pollution: Causes of air pollution, sources and effects of indoor air pollutants, factors affecting exposure to indoor air pollution, sick building syndrome. Investigation of indoor air quality problems, changes in indoor air quality, control of indoor air pollutants and air cleaning systems. Use of various plants to control indoor air pollution. Radon and its decay products in indoor air.

Odour pollution: Theory, sources, measurement and methods of control of odour pollution.

Unit IV **(6 hrs)**

Control of air pollution: By process modification, change of raw materials, fuels, process equipment and process operation. Control of particulate matters. Working principle and design of control equipment as Settling chamber, Cyclone, Fabric filter and Electro Static Precipitator. Control of gaseous pollutants. Combustion chemistry & control of air pollution from automobiles.

Unit V **(6 hrs)**

Land use planning: As a method of control. Economics of air pollution control: Cost/benefit ratio and optimization. Legislation and regulation: Air (Prevention and Control) Pollution Act, 1981. The Environment (Protection) Act 1986. Emission standards for stationary and mobile sources.

Unit VI **(6 hrs)**

Environmental impact assessment and management: Methodology for preparing environmental impact assessment (Identifying the sources of air pollution, calculating the incremental values, prediction of impacts and mitigation measures). Role of regulatory agencies and control boards in obtaining environmental clearance for project. Public hearing. Environmental impacts of thermal power plants, sugar and cement industry. Environmental management plan. The environmental rules 1999 (sitting of industries).

Term Work:

Term work shall consist of

A. One assignment on each unit.
B. Detailed industrial visit report on Sugar/Cement/Steel//Thermal/Rubber/Dairy industry with reference to air pollution Control device(s).

Reference Books:

1. Air Pollution – H. V. N. Rao and M. N. Rao, TMH, Pub.
2. Air pollution – KVSG Murali krishna.
3. Air Pollution – Perkins.
4. Environmental Engineering – Davis, McGraw Hill- Pub.
5. Environmental Engineering – Peavy H.S and Rowe D.R, McGraw Hill- Pub.
6. Air Pollution – Stern.
7. Air Pollution Control – Martin Crawford.
8. Air Pollution Control: its origin and control, K. Wark, C.F. Warner & W.T.Davis .
9. Fundamentals of Air Pollution-Richard W. and Donald L. Academic Press.

I.S. Codes:

1. I.S. 5182 (all parts), and
2. I.S. 15442 (2004)

e – Resources:

1. http://nptel.iitm.ac.in/courses-contents/IIT Kanpur and IIT Madras.
2. http://cpcb.nic .in
3. http://moef.nic .in

401009 Elective III (5): Finite Element Method in Civil Engineering

Teaching Scheme:
Lectures: 3 hours/week
Practical: 2 hours/week

Examination Scheme:
Theory Examination:
In-sem: 30 marks (1 Hour)
End-sem:70 marks (2.5.Hours)
Term work: 50 Mark

Unit I **(6 Hrs.)**

Theory of elasticity: Strain-displacement relations, compatibility conditions in terms of strain, plane stress, plane strain and axisymmetric problems, differential equations of equilibrium, compatibility condition in terms of stresses, stress-strain relations in 2D and 3D problems.

Unit II **(6 Hrs.)**

General steps of the finite element method, Applications and advantages of FEM, concept of finite element for continuum problems, discretisation of continuum, use of polynomial displacement function, Pascal's triangle, convergence criteria.

Principle of minimum potential energy, formulation of stiffness matrix for truss element using variational principles.

Unit III **(6 Hrs.)**

Displacement function for 2D triangular (CST and LST) and rectangular elements, Use of shape functions, Area co-ordinates for CST element, Shape functions in cartesian and natural coordinate systems, shape functions for one dimensional element such as truss and beam, shape functions of 2D Lagrange and serendipity elements.

Unit IV **(6 Hrs.)**

Introduction to 3D elements such as tetrahedron and hexahedron. Iso-parametric elements in 1D, 2D and 3D analysis, Jacobian matrix, Formulation of stiffness matrix for 1D and 2D Iso-parametric elements in plane elasticity problem.

Unit V **(6 Hrs.)**

Formulation of stiffness matrix, analysis of spring assemblage, member approach for truss and beam element, node numbering, assembly of element equations, formation of overall banded matrix equation, boundary conditions and solution for primary unknowns, applications to truss and beam not involving unknowns more than three.

Unit VI **(6 Hrs.)**

Formulation of stiffness matrix using member approach for portal frame and grid elements, transformation matrix, applications to frame and grid not involving unknowns more than three.

Termwork:

The Termwork shall be based on completion of assignments as given below.

1. At least one assignment on each unit.
2. One assignment based on FEM by using coding tools for
   a) Formulation of stiffness matrix for any 1-D element
   b) Formulation of stiffness matrix for any 2-D element
3. Finite Element Method -Software applications of any one of following cases using any standard available software.
   a) Truss/ grid problem
   b) Plane stress / plane strain problem

Reference Books

1. A first course in the finite element method-Daryl L. Logon, Thomson Publication.
2. Nonlinear finite element analysis by Reddy- Oxford University Press.
3. Introduction to the Finite Element Method – Desai & Abel, CBS Publishers & Distributors, Delhi
4. Introduction to Finite Elements in Engineering – T.R. Chandrupatla & A.D. Belegundu Prentice Hall of India Pvt. Ltd.
5. Matrix, Finite Element, Computer & Structural Analysis – M. Mukhopadhyay, Oxford IBH Publishing Co. Pvt. Ltd.
6. Finite Element Analysis – Theory & Programming – C.S. Krishnmoorthy, TATA McGraw Hill Publishing Co. Ltd.
7. An Introduction to the Finite Element Method – J.N. Reddy, TATA Mc Graw Hil Publishing Co. Ltd.
8. Theory & Problems – Finite Element Analysis – Gorge R. Buchanan, Schaum‘s Outline series. TATA Mc Graw Hill Publishing Co. Ltd.
9. The Finite Element Method – O.C. Zien kiewicz, TATA Mc Graw Hill Publishing Co. Ltd.
10. Finite Element Analysis – S.S. Bhavikatti, New Age International (P) Ltd.

401 0010 Elective III (6): Airport & Bridge Engineering

Teaching scheme
Lectures: 3 hours/week
Practical: 2 hrs

Examination Scheme
In-Sem Exam: 30 marks 1 hour
End-Sem Exam: 70 marks 2.5 hrs
Termwork: 50 marks

Unit 1: (6 hrs)

Introduction:

Advantages and limitations of air transportation. Aeroplane component parts and important technical terms, Organizations related to Air Transportation (ICAO, FAA, AAI) Roles and Responsibilities.

Airport planning:

Aircraft characteristics, which influence judicious and scientific planning of airports, Selection of sites, survey and drawings to be prepared for airport planning, Air Travel Demand forecasting, Airport classification by ICAO.

Unit 2: (6 hrs.)

Airport layout:

Characteristics of good layout, runway configuration, airport obstruction, location of terminal buildings, aprons and hangers. Zoning requirements regarding permissible heights of constructions and landing within the airport boundary, Airport landslide planning, Navigation and landing aids – ILS, Air Traffic Control (ATC).

Design of Runways and taxiways:

Runway orientation, wind coverage, use of wind rose diagram, basic runway length, corrections for elevation, temperature and gradient as per ICAO and FAA recommendation, Taxiways – Concept, types, design criteria.

Unit 3: (6 hrs.)

Structural Design of Runways and taxiways:

Runway pavement design criteria, aircraft loading, Design methods for flexible and rigid runways, Airport drainage.

Unit 4: **(6 hrs.)**

Heliports

Helicoptor characteristics, planning of heliports - site selection, size of landing area, orientation of landing area, Heliport marking and lighting, Vertical Takeoff and Landing (VTOL).

Unit 5: **(6 hrs.)**

Bridge engineering:

Introduction:

Classification of bridges, components of bridges, preliminary data to be collected during investigation of site for bridges, determination of discharge – empirical formula, direct methods, economical span, afflux, HFL, scour depth and clearance, locations of piers and abutments, factors influencing the choice of bridge super structure, approach roads.

Loads on bridges:

Brief specifications of different loads, forces, stresses coming on bridges, IRC load specification, requirements of traffic in the design of highway bridges.

Substructure:

Abutment, Piers, and wing walls with their types based on requirement and suitability.

Unit 6: **(6 hrs)**

Types of bridges

Various types of bridges:

Culvert: Definition, waterway of culvert and types.

Temporary bridges: Definition, materials used brief general ideas about timber, floating and pantoon bridges.

Movable Bridges: Bascule, cut boat, flying, swing, lift, transporter and transverse bridges, their requirement and suitability.

Fixed span bridges: Simple, continuous, cantilever, arch, suspension, bowstring girder type and rigid frame and cable stayed bridges, materials for super structure.

Bearing: Definition, purpose and importance. Types of bearings with their suitability.

Erection of bridge super structure and maintenance:

Introduction to different techniques of erection of bridge super structure and maintenance of bridges.

Term work:

Term work shall consist of: (Any eight)

1. Recent Trends in Airport planning and design (report expected)
2. Assignment on study and use of Windrose Type 1 and 2 diagram
3. Assignment on Runway Design for length and related corrections
4. Structural Design of Flexible or Rigid Runway
5. Selection of Bridge site, alignment and collection of design data
6. Assignment on conditional assessment of existing Bridges
7. Seminar on one topic each in Airport Engineering or Bridge Engineering
8. Report on Guest lecture in Airport Engineering or Bridge Engineering
9. Site visit to Bridge site or Airport site

Text Books:

1. Bridge engineering – S. Ponnuswamy, Tata Mc Graw – Hill publishing co. Ltd. New Delhi.
2. Airport planning and design – S.K. Khanna , M.G. Arora , S.S. Jain, Nem Chand and Brothers, Roorkee.
3. Airport Engineering - Rangawala, Charotar publishing House, Anand 388001 (Gujrat)
4. Essentials of Bridge Engineering – D. Johnson and Victor, Oxford and IBH publishing Co. Pvt. Ltd. , New Delhi.
5. Bridge engineering – Rangawala, Charotar Publishing House, Anand –388 001.
6. Principles and practice of Bridge Engineering – S.P. Bindra, Dhanpatrai and Sons, Delhi.

401 010 Elective IV (1): Construction Management

Teaching Scheme:
Lectures: 3 hours/week
Practical: 2 hours/week

Examination Scheme:
Theory Examination:
In-sem : 30 marks (1 Hour)
End-sem:70 marks (2.5.Hours)
Term work: 50 Mark

Unit – I **(6 Hrs.)**

Overview of construction sector:

Role of construction industry in infrastructure development, components of infrastructure sector, construction industry nature, characteristics, size, structure, role in economic development, construction management – necessity, applications, project management consultants – role, types, selection and appointment process, project overruns and means to combat them, project monitoring and reporting systems, managerial correspondence and communications, generation and identification of project investment opportunities. (*At least 2 expert lectures by experts from field are to be conducted on above topics).

Unit – II **(6 Hrs.)**

Construction scheduling, work study and work measurement Construction scheduling. Construction project scheduling – purpose, factors affecting scheduling, time as a control tool, work breakdown structure, project work breakdown levels, line of balance technique, repetitive project management Work study and work measurement .

Definition, objectives, basic procedure of work study, symbols, activity charts, string diagrams, time and motion studies.

Unit – III **(6 Hrs.)**

Labour laws and financial aspects of construction projects Labour laws. Need and importance of labour laws, study of some important labour laws associated with construction sector- workmans compensation act 1923, Building and other construction workers act 1996, child labour act, interstate migrant workers act Financial aspects of construction projects. Capital investments: importance and difficulties, means of finance, working capital requirements, project cash flow projections and statements, project balance sheet, profit loss account statements.

Unit – IV **(6 Hrs.)**

Elements of risk management and value engineering. Risk management. Introduction, principles, types, origin, risk control, use of mathematical models: sensitivity analysis, break even analysis, simulation analysis, decision tree analysis, risk identification, analysis and mitigation of project risks, role of insurance in risk management. Value engineering Meaning of value, value analysis, value engineering and value management, energy resources, consumption patterns, energy cost escalation and its impact.

Unit – V **(6 Hrs.)**

Materials management and human resource management . Materials management Materials flow system, role of materials management in construction management and its linkage with other functional areas, vendor networking, buyer-seller relationships, eoq model and its variations, material codification and classification, concept of logistics and supply chain management, role of ERP in materials management – material resource information systems Human resource management. Human Resource in Construction Sector, Staffing policy and patterns, Human Resource Management Process, Human Resource Development Process, Performance Appraisal and Job Evaluation, Training and Career planning, Role of ERP in Human Resource Management – Human Resource Information System (HRIS).

Unit – VI **(6 Hrs.)**

Introduction to artificial intelligence technique. Basic terminologies and applications in civil engineering (a) Artificial neural network (b) Fuzzi logic (c) Genetic algorithm.

Term Work:

1. Site Visit to a Construction project to study following documents and preparing a report –

a. Project Cash Flow Analysis.

b. Project Balance Sheet.

c. Work Break Down Structure.

d. Materials Flow System in the Project.

2. Scheduling of a Construction Project using Line of Balance Technique.

3. Assignment on Work Study on any two Construction Trades.

4. Assignment on EOQ Model and its variation.

5. Assignment on application of AI techniques in Civil Engineering.

6. Seminar on any one topic from above syllabus.

Reference Books:

1. Projects – Planning, Analysis, Selection, Implementation and Review, Prasanna Chandra, Tata McGraw Hill Publications.
2. Construction Management and Planning – B. Sengupta and H. Guha, Tata McGraw Hill Publications.
3. Civil Engineering Project Management – C. Alan Twort and J. Gordon Rees, Elsevier Publications.
4. Total Project Management – The Indian Context – P. K. Joy, MacMillian Publications.
5. Materials Management–Gopalkrishnan & Sunderasan,Prentice Hall Publications.
6. Human Resource Management – Biswajeet Pattanayak, Prentice Hall Publishers.
7. Laws for Engineers : Dr. Vandana Bhat and PriyankaVyas –Published by PROCARE,5/B,/Sagarika Society,Juhu Tara Road,Juhu,Santacruz(W),Mumbai-400049 (procure@technolegal.org).
8. Labour and Industrial Laws – S. N. Mishra, Central Law Publications.
9. Artificial Neural Network – Veganarayanan – Prentice Hall.
10. Genetic Algorithm – David & Goldberg.
11. Fuzzi Logic & Engg Applications – Ross.
12. Principles of Construction Management by Roy Pilcher (McGraw Hill)

e-Resourses:

1. ERP Software-Builders Management Software.
2. Project mates Construction Software.

401 0010 Elective IV (2): Advanced Transportation Engineering

Teaching scheme	Examination Scheme
Lectures: 3 hours/week	In-Sem Exam: 30 marks 1 hour
Practical: 2 hrs	End-Sem Exam: 70 marks 2.5 hrs
	Termwork: 50 marks

Unit I **(6 hrs.)**

Transport System Planning: Transportation planning process and types of surveys. Travel demand forecasting - trip generation, modal spilt analysis, trip distribution and route assignment analysis, Transportation System Management (TSM), application in Comprehensive Mobility Plan (CMP) and DPR.

Unit II **(6 hrs.)**

Urban Transport Technology: Classification- light, medium, mass and rapid transit system, Introduction to Intelligent Transportation System (ITS) and its components, Public Transport Policy. Introduction to BRT, Mono rail, Metro rail, Bullet train and Hyperloop. Concept of Integrated Inter Model Transit System and freight transportation.

Unit III **(6 hrs.)**

A. Transport Economics & Financing: Road user cost **-** Vehicle operations cost, running cost, value of travel time, road damage cost, accident cost. Economic evaluation – Benefit cost method, Net present value method, First year rate of return method, Internal rate of return method & comparison of various methods.

B. Environmental Impact Assessment: EIA requirement of highway projects, procedure and guidelines, pollution cost and concept of congestion pricing.

Unit IV **(6 hrs.)**

Traffic Engineering: Traffic studies, basic traffic theory, traffic analysis process, level of service, intersection studies- turning movements, grade separated intersection, signal design- IRC method and Webster‘s method, parking study and analysis, bicycle and pedestrian facility design, instrumentation of traffic monitoring.

Unit V **(6 hrs.)**

Study of flexible pavement: Philosophy of design and design criteria, design of flexible pavement using IRC 37-2012, Distresses in flexible pavement, evaluation of pavement – Benkelmen beam, Falling Weight Deflectometer (FWD), Pavement Management Systems (PMS).

Unit VI **(6 hrs.)**

a) **Study of rigid pavement:** Philosophy of rigid pavement, comparison of rigid pavement over flexible pavement, types of rigid pavements, design of rigid pavement using IRC 58-2015 including design of joints, distresses in rigid pavement.

b) **Overlay types and their design as per IRC:** Types of overlays, design of overlay using IRC 81-1997.

Term work:

1. Traffic counts using Manual Methods.
2. Design of a flexible pavement using IRC: 37-2012 using IITPAVE.
3. Design of rigid pavement using IRC: 58-2015.
4. Road deflections measurement using Benkelmen Beam method.
5. Design of an overlay using IRC: 81-1997.
6. Conduct of distress surveys on a flexible pavement or a rigid pavement and determining its condition index (PCI).
7. Study of any two softwares related to transportation engineering.
8. Study of format of household survey and recording sample measurements.
9. Parking survey and analysis.

Reference Books:

1. Highway Engineering - Laurence I Hewes & Clarkson H Oglesby
2. Traffic Engineering and Transport Planning - L R Kadiyali, Khanna Publishers.
3. The Design and Performance of Road Pavements - David Croney, Paul Croney.
4. Understanding Traffic System -Michel A Taylor, William Young, PeterW Bonsall.
5. Principles of Urban Transport Systems Planning - B. G.Hutchinson.
6. Introduction to transport planning - M. J. Bruton.

7. Transportation Engineering An Introduction – C. Jotin Khisty, B. Kent Lall, Pearson Publication.
8. Transportation Engineering & Planning – C. S. Papacostas, P. D. Prevedouros, Pearson Publication.
9. Principles of Pavement Design - E.F. Yoder (John Wiley & Sons, lnc USA).
10. Fundamentals of Transportation Engineering - C. S. Papacostas.
11. Pavement analysis and Design – Huang Y H, Prentice Hall, Englewood Cliff, New Jersey.
12. Introduction to Transportation Engg. and Planning – Morlok E K, McGraw-Hill company.
13. Fundamentals of Traffic flow Theory – Drew, McGraw-Hill book Co.
14. A course in Traffic Planning and design-Saxena Subhash,Dhanpat Rai & sons,Delhi
15. Traffic analysis (New technologies new solutions)-Taylor M P ,Hargreen Pub.Co. New Delhi.

Codes:

1. IRC 37-2012
2. IRC 58-2015
3. IRC 81-1997
4. IRC 82-2015
5. IRC 115-2014

Hand Books:

Handbook of Road Technology _Lay M. G.Gorden Breach Science Pub.Newyork.

e-Resources:

1) www.nptel.iitm.ac.in/courses/iitkanpur
2) www.cdeep.iitb.ac.in/nptel

401 010 Elective IV (3): Advanced Foundation Engineering

Teaching Scheme	**Examination Scheme**
Lectures: 3 Hours/week	**Theory Examination:**
Practical: 2 Hours/week	**In-sem : 30 marks (1 Hr.)**
	End-sem:70 marks (2.5Hrs.)
	Term work: 50 Mark

Unit I **(6 Hrs.)**

IS code provision in respect of subsoil exploration for dams, canals, tunnels, off shore structure, air ports and bridges. IRC, provisions for exploration in respect of roads. Case studies of failures of foundation.

Unit II **(6 Hrs.)**

Design of pile based on cyclic load test. Study of provision made in different IS codes related to deep foundation, various types of pile. Design of Racer piles & piles subjected to lateral load. Testing and Design of piles subjected to tensile loads.

Unit III **(6 Hrs.)**

Design of under reamed pile foundation subjected to tensile loads. Design of sand drains and stone columns.

Unit IV **(6 Hrs.)**

Design of shallow foundations subjected to inclined loads. Design of Raft foundation on different types of soil. Design of combined and isolated footing based on field test including calculation of settlement. Introduction to software available for geotechnical foundation design.

Unit V **(6 Hrs.)**

Study of various provisions made as per IRC and as per IS in respect of design of well foundation. Case studies of failure of well foundation. Design of Rock fill coffer Dams.

Unit VI **(6 Hrs.)**

Stress distribution in the shaft, tunnels, underground conduits, classification, load on ditch conduits, positive and negative projecting conduits, and Imperfect ditch conduits.

Term Work:

Term work will consist of

A) Any Four of following 6 assignments.

1) Comparative study of provisions made for the extent of exploration in IS, IRC codes adapted by Indian railways, and PWD.
2) Detailed study of any two Geophysical methods of exploration.
3) Computations of Bearing capacity and Settlement of a Shallow Foundation involving inclined loads.
4) Design of Pile foundations subjected to inclined load and tensile load.
5) Design of Sand Drains.
6) Comparative study of provisions for well Foundation as per IS, IRC and code adapted by Indian railways.

B) Computer Modeling:

Design of any one type of Deep foundation using computer software.

C) Site visit and Case study:

1) One site visit to any important deep foundation and submission of report on the same giving details of design and construction.
2) Any one case study of failure of foundation from the published literature.

Reference Books:

1. Foundation Analysis and Design- Joseph E. Bowels, TATA Mc-Graw hill.
2. Design Aids in Soil Mechanics and Foundation Engineerimg-Shenbage R Kaniraj, TATA Mc-Grawhill.
3. Foundation Design & Construction (4th Ed.)- M.J.Tamlinson, ELBS publication.
4. G. A. Leonards, Foundation Engineering, McGraw-Hill, 1962.
5. R.B. Peck, W.E. Hanson and T.H. Thornburn, Foundation Engineering, 2nd Edition, John Wiley and Sons, 1974.
6. ―Principles of Foundation Engineering‖ by B.M. Das.
7. Theory and Practice of Pile Foundations Wei Dong Guo CRC Press.

I.S .Codes:

IS: 1892-1979 – ―Code of Practice for Subsurface Investigation for Foundation‖.

IS: 2131-1981 (Reaffiemed 1997), ―Method for Standard penetration Test for Soils‖.

IS: 6403-1981 – –Code of Practice for Determination of B.C. of Shallow Foundation‖. IS: 8009 (Part-1) 1976, –Code of Practice for Calculation of settlements of foundations‖.

IS: 1904-1986, –Code of Practice for Design and Construction of Foundations in Soils, general Requirements‖.

IS: 2911-1979, –Code of Practice for Design and Construction of Pile Foundation‖.

Handbooks:

1. Fang , H.Y.,(1991),‖ Foundation Engineering Handbook‖, Chapman & Hall, NY.
2. Teng .W.C.(1962), Foundation Design , Prentice Hall International.
3. Foundation Design Manual by Narayan V. Nayak, Dhanpat Rai & Sons.

401 0010 Elective IV (4): Coastal Engineering

Teaching Scheme
Lectures: 3 Hours/week
Practical: 2 Hours/week

Examination Scheme
Theory Examination:
In-sem: 30 marks (1 Hour)
End-sem: 70 marks (2.5.Hours)
Termwork : 50 marks

Unit I **(6 Hrs.)**

Basics of Ocean Waves:

Generation ,classification, Basic understanding of wave mechanics including wave propagation,wave theories,, wave diffraction , wave refection, wave breaking. Waves of unusal character-currents, giant waves , tsunami etc.

Unit II **(6 Hrs.)**

Tides:

Tide producing forces- earth moon and earth sun system , dynamic theory of tides-; types of tides-tides and tidal current in shallow sea, storm surges, tides in rivers and estuaries ,tidal power.

Unit III **(6 Hrs.)**

Coastal Processes:

Coastal process- Erosion/accretion due to waves, bed forms, long shore transport (Littoral drift) estimate of wave induced sediment, budget. Tides, effect of Tides, stability of inlets. Effect of construction of coastal structures on stability of shoreline / beaches.

Unit IV **(6 Hrs.)**

Design of Marine Structures:

Design of Marine Structures: Seawalls, Revetments, Breakwater rubble mound, composite, floating and pneumatic types, and jetties. Offshore structures, Oil Production platform, sub marine pipelines. Model studies.

Unit V **(6 Hrs.)**

Design Technology:

Dredging Technology: Types of dredgers, design of disposal methods of dredged materials Environmental aspect of dredging , studies for feasibility of dumping ground for dredged material.

Unit-VI **(6 Hrs.)**

Coastal Management:

Pollution in Coastal zone, disposal of waste/dredged spoils, design criteria of coastal outfall inlets and system. Oil spills and contaminants, coastal zone management: activities in coastal zone, CRZ, Issues related to Integrated coastal zone management. Coastal regulation zone.

Reference Books:

1. Brunn Per ,B. U. Naik, ―Shore Protection Manual‖, NIO Goa.
2. Quinn A. D., ―Port Planning‖, Mc Grow Hill Book Co. New York.
3. Richard Silvester, ―Coastal Engineering‖, Vol-I-II, University of Western Australia.
4. Shore Protection Manual-U.S.Waterways Experiment Station Corps of Engineer.
5. Costal Engineering Research Center, Vickburg andU.S.A.1984.Coastal Protection Manual 2002.
6. Harbour and Coastal Engineering‖, Vol. I&II, Ocean and Coastal Engineering Publication, NIOT, Chennai.

Term work-

One assignment on each unit.

401 010 Elective IV: Open Elective : 5 (a): Plumbing Engineering

Teaching Scheme:
Lectures: 3 hours/week
Practical: 2 hours/week

Theory Examination Scheme:
In-sem : 30 marks (1 Hour)
End-sem :70 marks (2.5 Hours)
Term work: 50 Marks

Unit I **(6Hrs.)**

Introduction to plumbing engineering Definition- plumbing engineering/public health engineering, Indian plumbing industry, Roles of plumbing contractor, plumber, plumbing consultant, plumbing terminology, Principles of plumbing,

a) **Introduction to codes and standards:**
Introduction to UPC-I and ITM, Green plumbing code supplement-India (GPCS-I) and other codes applicable in plumbing, Approvals of authority having jurisdiction, General regulations, Testing and labeling, Alternative materials, workmanship and minimum standards, Prohibited fittings and practices, Local laws related to plumbing.

b) **Architectural and structural coordination**, plumbing shafts, Sunken toilet floors, Ledge walls.

Unit II **(6 Hrs)**

Water Supply, fixtures and fittings.

a) Water Supply**:** Types of water supply pipes Fittings and joints, Galvanized iron, Copper, Stainless steel, HDPE, MDPE, Rigid PVC, CPVC, PPR, Composite pipes, (PE-AL-PE), PEX, Joints, Jointing methods and materials, Tools etc. Water hammering, Pipe protection, Velocity, pressure, temperature limitations, Water Supply Fixture Unit (WSFU), Sizing, testing, Valves and regulators, Backflow prevention, Commissioning, Water tanks.
b) Plumbing fixtures, Water conserving fixtures, Rating system for water efficient products, (WEP-I), Water closets, Bidets, Urinals, Flushing devices, Lavatory and bath units, Kitchen sinks, Water coolers, Purifiers, Drinking water fountain, Cloth washers, Mop sinks, Dish washers, Receptors Overflows, Strainers, Standard heights. Prohibited fixtures, Floor slopes, Minimum spacing.

Unit III **(6Hrs.)**

Sanitary system and Storm water Drainage:

a) Sanitary system: Fixtures, Appliances and appurtenance, Classification of fixtures, Soil and waste and grey water, Soil fixtures, Bathroom fixtures, Accessories, Indirect waste connections, Food handling establishments, Fixtures below invert level.

b) Building Drains:

Introduction, Four systems of plumbing, One pipe and two pipe system, Air admittance valves and solvents, Comparison of systems, Vent pipe, Symphonic action, Antisyphon and vent pipes, Loop, Circuits, Types of building drainage pipes, Fittings and jointing methods, Clean outs, Drainage fixture units (DFU), Sizing, Testing, Case study

Unit IV Traps and Interceptors **(6Hrs.)**

Traps-Purpose, Fixture traps and floor traps, Prohibited traps, Trap arm, Developed length, Trap seal, Trap seal protection, Venting of traps, Trap primers, Building traps, Clarifiers, Grease interceptors, Sizing, oil and sand interceptors.

b) Vents:

Vent requirement, Parts of vent system. Parts of vent system, Materials, Sizing, Vent connections, Flood rim level, Island sink venting, Venting of interceptors, Water curtain and hydraulic jump, Termination of vent stacks, Stack venting, Yoke vent, Wet venting.

Unit V **(6Hrs.)**

a) Building Sewers:

DFU, Change in direction of flow, Hydraulic jump,Sudsing stack, Cleanouts, Pipe grading, pipes and fittings suitable for building sewers, RCC, PVC, Nu-Drain, Stoneware., Sizing, testing, Types of traps, Gully, Chambers and manholes, Materials, Venting, Sizing, Testing, Sumps, Pumps, Sewage disposal, Septic tanks.

b) Plumbing in high rise buildings:

Definition of high rise building, Multiple storage tanks, Plumbing shafts, Break pressure tanks, Water supply, Hydro pneumatic system, Pressure reducing valves, Building drainage system, Rain water system, Sizing, Testing, Case study, Introduction to centralized hot water supply, Principles of design.

Unit VI **(6 Hrs)**

Design Parameters & Case Study

Introduction, Plumbing Drawings & Layouts, Water Supply Design Consideration, Sewer Network design consideration, Storm water design consideration as per CPHEEO manuals, Case study on each.

Term work

Term work will consist of 8 assignments with necessary plans /sketches.

1. Introduction of available codes in plumbing
2. Introduction of associations in plumbing in India and outside India
3. Detailed hydraulic design for High rise structure OR G+1 Bungalow by using software.
4. Compilation of rules and regulations of local governing bodies.
5. Roles of plumbing contractor and plumbing consultants.
6. Report on Plumbing fixtures and fittings and explain any ten.
7. Report on materials for water supply and drainage.
8. Report on necessity of traps, intercepts and vents

Books:

1. ―Plumbing Engineering‖ by Deolalikar.
2. ―Plumbing, Sanitation and Domestic Engineering‖ Volume – 1to 4 by G. S. Williams, Mc Graw Hill.
3. ―Plumbing, Sanitation and Domestic Engineering, Data Sheets & Wall Charts‖ by G. S. Williams, Mc Graw Hill
4. ―Plumbing Engineering, Theory and Practice‖ by Subhsh Patil. SEEMA Publishers Mumbai
5. ―National Plumbing Codes Handbook‖, by R. Dodge Woodson.
6. ―Central Public Health and Environmental Engineering Organisation Manual (CPHEEO)‖.

Codes:

1. Uniform Plumbing Code- India (UPC-I), 2008
2. Illustrated Training Manual (ITM), 2008.

401 010 Elective IV: Open Elective: 5 (b): Green Building Technology

Teaching Scheme:
Lectures: 3 Hours/week
Practical: 2 Hours/week

Examination Scheme:
Theory Examination:
In-sem : 30 Marks (1 Hour)
End-sem:70 Marks (2.5 Hours)
Term work: 50 Marks

Unit I: **(6 Hrs.)**

Materials and Its Applicability, Indoor Environmental Quality, Reuse and Recycle of Construction Waste.

A) Eco Friendly/ Green Building Materials: To understand Environmental impact of building materials. Eco Friendly building materials, their composition, availability, production, physical properties etc. Application of the Eco Friendly/ Green Building materials for different components of the buildings at different level, both internally and externally.
B) Indoor environmental quality, Low VOC materials: Adhesives - Sealants, Paints- Coatings etc.
C) Construction Waste as a Resource- Resource Economics, Disposable Materials, Recovery, Recycling, Collection, Processing, Governmental Role in Waste Management, Potential for Reuse.

Unit II **(6 Hrs.)**

Site / Building Planning

A) Sustainable Site planning: wind / sun path, water management , material use, landscape, topography.
B) Climate Responsive Architecture: orientation, solar- wind, Building envelope.
C) Thermal comfort indices. Heat flow through building materials. Thermal properties of common building materials available in India. Thermal performance of building envelope. Air movement and buildings. Ventilation and buildings. Wind an Stack effect. Mechanical ventilation. HVAC System, Day lighting. Passive and sustainable architecture. Passive and active systems.

Unit III **(6 Hrs.)**

Embodied Energy, Life Cycle Assessment, Environmental Impact Assessment, Energy Audit and Energy Management.

A) Embodied energy of various construction materials. Introduction to the Concept: –Life Cycle assessment of materials‖.

B) EIA : Introduction to EIA., Process of EIA and its application through a case study., EIA as a strategic tool for sustainable development.

C) Energy Management.

Unit IV **(6 Hrs.)**

Appropriate Technologies / Approaches for:

A) Water conservation / efficiency.

B) Sanitation (Grey water, black water management, SWM)

C) Treatments.

D) Biogas.

E) Composting.

F) Solar energy and its applicability through panels, photovoltaic cells etc.

G) Use of –LED, CFL, Fresnel Lens‖ etc.

H) Wind energy and its use.

I) Orientation aspects in site planning to achieve maximum daylight and natural ventilation.

UNIT V: **(6 Hrs.)**

A) Clean Development Mechanism.

B) Kyoto Protocol.

C) Energy Conservation Building Code.

UNIT VI **(6 Hrs.)**

Rating Systems: - Leadership in Energy and Environmental Design (LEED), Green Globes, National Association for Home Builders (NAHB) – For Homes, Building Research Establishment Environmental Assessment Method (BREEAM), Green Star by Green Building Council Australia (GBCA), LEED India, Comprehensive Assessment System for Built Environment Efficiency (CASBEE), Estimada -Abu Dhabi Urban Planning Council (UPC) etc.

Term Work:

Any Eight of the following:

A) To study: Innovative Materials Developed by CBRI, SERC.

B) To study: Environmental Audit of any existing building and prepare a report.

C) To study, analyze present scenario of organic waste collection and management of any of the premise; preferably hotels.

D) To compare the benefits under different rating systems.

E) To prepare detailed plan for a hypothetical site indicating utility of solar path, wind direction, rainfall intensity etc. to make it sustainable.

F) To prepare a report on carbon credit.

G) To prepare a report on energy efficient buildings in India.

H) To study sustainable planning aspects for urban housing.

I) Study of Design of On Site Sanitation Systems for Indian conditions developed by Appasaheb Patwardhan Safai V Paryavaran Tantraniketan, Dehugaon .

J) To study the benefits given by Municipal Corporations to Green Buildings.

Reference Books and Additional Reading material:

1. Manual of Tropical housing and climate by Koenisberger.
2. Climate responsive architecture by Arvind Krishnan.
3. Manual of solar passive architecture - by Nayak J.K. R. Hazra J. Prajapati.
4. Energy Efficient Buildings in India by Milli Mujumdar.
5. Green Building Materials by Ross Spiegel and Dru Meadows.
6. Publications from - CBRI – Roorkee, - IDC – Mumbai, NID – Ahmedabad.
7. Solar Energy in Architecture and Urban Planning by Herzog Thomas.
8. Solar Heating, Design Process by Kreider Jan F.
9. Energy - Manual for college teachers (CEE publications).
10. Renewable Energy & Environment - A policy analysis for India (CEE publications).
11. Sustainable Building Design Manual-Volume I and II –TERI Publication.
12. Mechanical and Electrical Systems in Construction and Architecture-by Frank R Dagostino.

Principles of Air conditioning-By V. Paul Lang:

1. Heating, Cooling and lighting design methods for architecture. By Lechor Worbert.
2. LEED Manual.
3. Green Globes Manual.
4. Florida Green Building Coalition Manual.
5. The green building process.
6. Green building codes and standards.
7. International Green Construction Code.
8. ASHRAE 189P.
9. ANSI/GG 01, TERI, BREEAM etc.

401 010 Elective IV: Open Elective: 5 (c): Ferrocement Technology

Teaching Scheme:
Lectures: 3 hours/week
Practical: 2 hours/week

Examination Scheme:
Theory Examination:
In-sem : 30 marks (1 Hour)
End-sem:70 marks (2.5 Hours)
Term work: 50 Mark

Unit 1 **(6 Hrs.)**

What is Ferrocement?

a) Definition, Basic concept like bond increase. Comparison with concretes like RCC, Prestressed, Asbestos cement, Fiber reinforced, Polymer concretes. Composition of ferrocement. Special types of ferrocement. Ferrocement as substitute for conventional building materials. Typical characteristics and their applications.

b) Raw materials, skills, tools and plants. Ferrocement as material of construction. Forming a ferrocement structure. Properties and specifications of raw materials. Proportioning of cement mortar. Job requirements of required skills. Tools and plants.

Unit 2 **(6 Hrs.)**

Mechanical properties and construction methods:

a) Mechanical properties and typical features affecting design. Properties under static and dynamic loading. Shrinkage and creep. Testing of ferrocement.

b) Methods of constructing ferrocement structures. Standardizing method of construction. Planning the work. Fabricating skeleton, tying meshes and mortaring. Curing. Maintenance. Protective surface treatments. Damage to ferrocement structures.

Unit 3 **(6 Hrs.)**

Strength through shape and design:

a) Strength through shape. Design of structure based on form and shape. Forms in nature, various structural forma and their behavior. Typical strengths of different materials. Comparative study of various forms.

b) Design of ferrocement structures. Design, analysis and optimization. Special design considerations for ferrocement. Typical features of ferrocement affecting design. Conventional design methods like working stress, load factor, applied to ferrocement. Design based on equivalent area method for compression, tension and flexural members. Specific surface method and crack control method, Design of structures subjected to membrane stresses. Design of shaped structures in ferrocement like stiffened plates, arch faced walls, stiffened cavity walls and hollow floors and beams, Design of forms like _T‘ _U‘ _T‘ _+‘ _L‘

Unit 4 **(6 Hrs.)**

Cost analysis and ferrocement in Building construction.

a) Cost analysis : Factors governing cost analysis. Special considerations for ferrocement structures. Cost comparison with conventional construction. Specifications for ferrocement structures. Quantity analysis of material and labour for ferrocement items. Cost and value of ferrocement construction.

b) Ferrocement in building construction. Ferrocement in foundations, walls, floors roofs. Ferrocement single wall construction. Design and construction of houses with cavity walls, hollow floors and hollow beams. Staircases and other building accessories. Earthquake resisting structures. Special characteristics of ferrocement to resist shock loading design and construction of quake proof structures.

Unit 5 **(6 Hrs.)**

Hydraulic and soil retaining structures in ferrocement :

a) Hydraulic structures. Why ferrocement? Water retaining structures, Storage tanks of various types. Structures across streams. Ferrocement in layered form used for lining, water proofing and surface coating.

b) Soil retaining structures. Types of retaining walls and their comparison with ferrocement arch faced wall. Design and method of fabrication and casting. Ferrocement counterfort retaining wall. Ferrocement containers for storing granular materials.

Unit 6 **(6 Hrs.)**

Space structures and precast products:

a) Ferrocement large size special purpose structures. Space structures like shells, pyramids, domes corrugated catenaries.

b) Precast ferrocement products : Why ferrocement for precasting? Methods of precasting. Design of precast elements. Ferrocement precast walling and flooring panels. Joints in precast ferrocement elements.

Term Work :

Minimum 02 site visits with detailed reports and one assignment based on each unit (Journal consisting of total 6 assignments + 2 visit reports).

Books Recommended:

1) Ferrocrete Technology- A Construction Manual. -- Dr. B. N. Divekar Published by the Author.
2) Ferrocement --- : B. R. Paul and R. P. Pama.Published by International Ferrocement Information Centre. A.I.T. Bangkok, Thailand.
3) Ferrocement and laminated cementitious composites --: A.E. Naaman. Publisher : Techno-press, Ann Arbor, Michigan, USA.
4) Ferrocement - Materials and applications; Publication SP 61, A C I Detroit. USA
5) State of the art report and guide for design, Construction and repairs of Ferrocement; ACI Committee Report. No. ACI 549R-88 and ACI 549.1R.88. Published by American Concrete Institute, Detroit, USA.
6) Chapter 1 titled ‗Ferrocement' by S. P. Shah and P. N. Balaguru in book ‗Concrete Technology and Design Vol. II, Editor; R. N. Swamy.
7) Proceedings of International Symposiums on ‗Ferrocement and thin reinforced composites – Ferro 1 to Ferro 10. Available with International Ferrocement Information Centre, A I T Bangkok, Thailand.
8) Ferrocement Conference Proceedings of Ferrocement Society, India--FS 2011, F.S.2013, F. S. 2015.

401 010 Elective IV: Open Elective: 5 (d): Sub Sea Engineering

Teaching Scheme	**Examination Scheme**
Lectures: 3 hours/week	**Theory Examination**
Practical 2 hours/week	**In-sem: 30 marks (1 Hour)**
	End-sem: 70 marks (2.5.Hours)
	Termwork: 50 Marks.

Unit1 **(6 Hrs.)**

Introduction to oil and gas industry: general view of oil and gas industry, technological challenges and future developments. Overview of deep water developments: introduction, deep water areas and potential, challenges, route for development Metaocean and environmental conditions: Overview of the determination of Metaocean conditions (meteorological and oceanographic) and the influence of wave, wind, tide and current on marine operations. Introduction to marine ecology and its impact on marine operations.

Unit 2 **(6 Hrs.)**

Introduction to subsea infrastructure development: Summarize the current state of the art and highlights the design challenges. Outlines the way in which water depth influences the architecture and technology of Oil and Gas infrastructure.

Flow assurance: overview of flow assurance and the fundamentals of flow management for subsea production systems, Introduction to flow assurance issues like paraffin deposition; hydrate formation and blockage; Asphaltene precipitation; emulsions; experimental methods, flow assurance assessment methods; prevention, mitigation and remediation tools for flow assurance issues; thermal management and insulation materials.

Unit 3 **(6 Hrs.)**

Subsea installation and intervention: Overview of the installation of subsea plant, risers and pipelines and the main intervention methods including AUVs, ROVs and divers.

Subsea operations and control: An overview of the principle methods of subsea control including electrical, acoustic and hydraulic systems.

Subsea processing and artificial lift: introduction the analytical and numerical models used to design subsea processing systems for sustained recovery of hydrocarbons.

Unit 4 **(6 Hrs.)**

Reliability and integrity management: Introduction to Risk Assessment, FMECA and HAZOPS, Monitoring, Intervention and Inspection Methods, Data Management Construction management of oil field, future challenges.

Unit 5 **(6 Hrs.)**

Subsea field equipment, structures and architectures: scale of operations, environmental factors, A description of each of the pieces of the subsea infrastructure, their use and interconnection including subsea trees, flow lines, umbilicals, risers, moorings and pipelines Materials and corrosion. Types of corrosion found in the oilfield with emphasis on the effects of acid gases (CO_2 and H_2S).

Unit 6 **(6 Hrs.)**

Pipelines and design: Introduction to pipeline engineering, the main pipeline design challenge in deep water. Analysis and design methods of pipelines that address stress analysis, buckling and collapse of deep water pipelines. Limit state based strength design methods. Geotechnical aspects of pipeline design and its installation.

Deepwater risers: different design options available for deep water risers, and defines the key design drivers for each. General principles of stress analysis: An introduction to the principles of stress analysis and the principles of reliability based design, finite element analysis.

Termwork:--Shall consist of one assignment per unit.

References:

1. A Primer of Offshore Operations by Petex
2. Subsea Engineering Handbook Hardcover by Yong Bai (Editor), Qiang Bai (Editor)
C. Norsok standard Common requirements Subsea structures and piping system U-cr-001 Rev. 1, January 1995.
D. Norsok codes, DNV codes : Design specifications for subsea system.

401 010 Elective IV : Open Elective : 5 (e): (Geoinformatics)

Teaching Scheme:
Lectures: 3 Hrs/week

Examination Scheme:
Paper In-sem. 30 Marks (1 Hrs),
Paper End-sem : 70 Marks (2.5 Hrs.)

Unit I **(6 Hrs.)**

Introduction to Remote Sensing GIS and SBPS:

Electro-magnetic radiations (EMR) - atmospheric scattering, Raleigh scattering, Mie scattering, non-selective scattering -atmospheric absorption - atmospheric windows, refraction - interaction of EMR earth_s surface - reflection - transmission - spectral signature - Reflectance characteristics of Earth_s cover type: Vegetation, water, soil

Introduction to GIS - Basic spatial concepts - Coordinate Systems - GIS and Information Systems – Definitions – History of GIS - Components of a GIS – Hardware, Software, Data, People, Methods – Proprietary and open source Software - Types of data – Spatial, Attribute data- types of attributes – scales/ levels of measurements. Introduction to SBPS, Segments and errors in GPS.

Unit II **(6 Hrs.)**

THERMAL REMOTE SENSING: Thermal radiation principles – Thermal interaction sensors and characters – thermal image characters – image degradation sources & correction – interpretation of thermal images – Application and Case studies.

MICROWAVE REMOTE SENSING: Introduction-Plane waves-Interference, Radar remote sensing - Radar basics- Antenna Systems -Real aperture radar - Radar frequency bands - SLAR Imaging Geometry, Resolution Concepts - Geometric Distortions, SAR – Concepts - Doppler principle & Processing. RADAR Interaction with earth surface- RADAR equation.

Unit III Unit II **(6 Hrs.)**

DIGITAL IMAGE PROCESSING :

Fundamentals of Image Processing, sensors model and pre processing, image enhancement, image classification, object recognition.

Unit IV **(6 Hrs.)**

OPEN SOURCE GIS:

DESKTOP GIS WITH OPEN SOURCE GIS : View Graphics – Data exchanges- portability and interoperability – Raster handling and Image analysis – vector data management –Rater and vector analysis - 2D/3D vectors with topology, 3D Voxel, 2D Raster.

OPEN SOFTWARE AND WEB MAPPING : Open Source Software : GRASS, QGIS, OSSIM, PostopesSQL and (R) Environment – WEB Mapping Architecture and components – WEB mapping servers- Thin clients in WEB mapping - WMS,WFS, WCS,WPS and other web services- Open Server standards.

Unit V **(6 Hrs.)**

MAP PROJECTION:

Concepts of sphere, ellipsoid and geoid - latitudes, longitudes and graticules –map projections– shape, distance, area and direction properties - role of aspect, development surface, secant and light source / view points – perspective and mathematical projections – Indian maps and projections – Map co-ordinate systems – UTM and UPS references – common projections and selections– projections for hemispheres and the world maps , Map projection for cadastral maps.

Unit VI **(6 Hrs.)**

FUNDAMENTALS and GEOMETRIC GEODESY:

Definitions- Classifications, Problem of Geodesy and purpose of Geodesy Historical development and Organization of Geodesy. Reference Surfaces and their relationship. Applications, Engineering, Lunar, Planetary and interferometric Synthetic aperture radar Geodesy – Local and International Spheroid.

Geomentry of ellipsoid, fundamental mathematical relationship of ellipsoid, Geodetic, Geocentric and Reduced latitudes and their relationship. Ellipsoidal Co-ordinates in terms of Reduced, Geodetic and geocentric latitude. Radius of curvature in the meridian & prime vertical and their relationship. Mean Radius of curvature in any azimuth, Length of the meridian arcs and arcs of parallel and Area of trapezium on the ellipsoid. Curves on the ellipsoid, properties of Geodesic.

Reference Books:

1. Wolfgang Torge, Geodesy, Walter De Gruyter Inc., Berlin, 2001
2. Lillesand, T.M. and Kiefer R.W. Remote Sensing and Image interpretation, John Wiley and Sons, Inc, New York, 2002.
3. Neteler M, Helena M (2008) _Open source GIS: A GRASS GIS approach_, 3rd edn, Springer, New York
4. Kang-Tsung Chang, Introduction to Geographic Information Systems, Mc-Graw Hill Publishing, 2nd Edition, 2011.
5. John, R. Jensen, Introductory Digital Image Processing, Prentice Hall, New Jersey,2005 3rd edition
6. R.W. Anson and F.J. Ormeling, Basic Cartography for students and Technicians. Vol.I, II and III, Elsevier Applied Science Publishers, 3rd Edition, 2004.

401006 Project work

Teaching Scheme:
Tutorial: 6 Hrs/week

Examination Scheme:
TW : 50 Marks.
Oral : 100 Marks.

Project Work will be evaluated for an individual student based on the presentation of the work done in a year(I Sem + II Sem) and submission of the report .The student may work in a group during project work, if any.

The project work shall consist of any one of the following nature in Civil Engineering related subjects.

1. Experimental investigation.
2. Software development.
3. Benefit : Cost economic analysis.
4. Case study with own design.
5. Working model design and fabrication.
6. Case study with development of methodology using soft computing tools.

The details of report writing and preparation of report will be similar to that of as mentioned in syllabus of Project Phase I in first semester.

Evaluation of Project work in final exam. Will be done by the pair of internal guide having minimum 3 years approved experience as teacher and external guide.

It is recommended to promote the students to present a paper based on project work in appropriate conference / journal.

Savitribai Phule Pune University

Syllabus for SE (Civil Engineering) 2019 course

(To be implemented from June 2020)

Board of Studies in Civil Engineering

Faculty of Science and Technology

SPPU June 2020

SE Civil

Savitribai Phule Pune University, Pune SE(Civil Engineering) 2019 Course (With effect from Academic Year 2020-21)														
Semester-III														
Course Code	**Course Name**	**Teaching Scheme (Hours/Week)**			**Examination Scheme and Marks**						**Credit**			
		Theory	**Practical**	**Tutorial**	**IN-Sem**	**End-Sem**	**TW**	**PR**	**OR**	**Total**	**TH**	**PR**	**TUT**	**Total**
201001	Building Technology and Architectural Planning	03	-	-	30	70	--	-	-	100	03	--	--	03
201002	Mechanics of structure	03	-		30	70		-	-	100	03	-	-	03
201003	Fluid Mechanics	03	-	-	30	70	-	-	-	100	03	-	-	03
207001	Engineering Mathematics III	03	--	--	30	70	--	--	--	100	03		--	03
207003	Engineering Geology	03	-	-	30	70	-	-	-	100	03	-	-	03
201004	Building Technology and Architectural Planning **Lab**	-	04	-	-	-	50		-	50	-	02	-	02
201005	Mechanics of structure **Lab**	-	04	-	-	-	-	-	50	50	-	02	-	02
201006	Fluid Mechanics **Lab**	-	02	-	-	-	-		50	50		01		01
207002	Engineering Mathematics III **Tutorial**	--	--	01	--	--	25	--	--	25	--		01	01
207004	Engineering Geology **Lab**	-	02	-	-	-	25		-	25	-	01	-	01
201007	**Audit Course 1 Awareness to civil Engineering Practices / Road Safety Management / Foreign Language**	--	01	-	-	Grade	-	-	-	Grade	--	--	-	--
Total		15	13	01	150	350	100	--	100	700	**15**	**06**	**01**	**22**

Abbreviations:
H : Theory TW: Term Work PR : Practical OR: Oral TUT : Tutorial

Note: Interested students of S.E. (Civil) can opt any one of the audit course from the list of audit courses prescribed by BoS (Civil Engineering)

<u>Note: The Underlined portion of the syllabus will be covered by video lectures/ on-line lectures/ flip classroom, self study, NPTEL course lecture and/or using relevant ICT technique</u>

Savitribai Phule Pune University, Pune
SE(Civil Engineering) 2019 Course
(With effect from Academic Year 2020-21)

Semester-IV

Course Code	Course Name	Teaching Scheme (Hours/Week)			Examination Scheme and Marks						Credit			
		Theory	Practical	Tutorial	IN-Sem	End-Sem	TW	PR	OR	Total	TH	PR	TUT	Total
201008	Geotechnical Engineering	03	-	-	30	70	--	-	-	100	03	--	--	03
201009	Survey	03	-		30	70		-	-	100	03	-	-	03
201010	Concrete Technology	03	-	-	30	70	-	-	-	100	03	-	-	03
201011	Structural Analysis	03	-	--	30	70	-	-	-	100	03	-	--	03
201012	Project management	03	--	-	30	70	--	--	--	100	03		-	03
201013	Geotechnical Engineering **Lab**	-	02	-	-	-	-	-	50	50	-	01	-	01
201014	Survey Lab	-	04	-	-	-	-	50	-	50		02		02
201015	Concrete Technology **Lab**	-	02	-	-	-	25		-	25	-	01	-	01
201016	Structural Analysis **Tutorial**	--	-	01	--	--	25	-	-	25	--	-	01	01
201017	Project Based Learning	-	04	-	-	-	50		-	50	-	02	-	02
Total		15	12	01	150	350	100	50	50	700	**15**	**06**	**01**	**22**

Abbreviations:
TH : Theory TW: Term Work PR : Practical OR: Oral TUT : Tutorial

Note: The Underlined portion of the syllabus will be covered by video lectures/ on-line lectures/ flip classroom, self study, NPTEL course lectures and/or using relevant ICT technique

SEMESTER I

Savitribai Phule Pune University, Pune
Second Year Civil Engineering (2019 Course)
201001 Building Technology and Architectural Planning

Credits: 3

Teaching Scheme:		**Examination Scheme:**	
Theory	: 03hrs/week	In-semester	: 30 Marks
Practical	: 04 hrs/week	End- semester	: 70 Marks

Prerequisites:

Fundamentals of Engineering Graphics

Course Objectives:

1. To enumerate different types of structure and their requirement.
2. To describe all basic activities of construction.
3. To study different types of materials, byelaws and Architectural aspects used in construction for civil engineering projects.
4. To plan different building units, Town planning parameters and safety of buildings.

Course Outcomes:

On completion of the course, learner will be able to:

1. Identify types of building and basic requirements of building components.
2. Make use of Architectural Principles and Building byelaws for building construction.
3. Plan effectively various types of Residential Building forms according to their utility, functions with reference to National Building Code.
4. Plan effectively various types of Public Buildings according to their utility functions with reference to National Building Code.
5. Make use of Principles of Planning in Town Planning, Different Villages and Safety aspects.
6. Understand different services and safety aspects

Course Contents

Unit I: Introduction to Building Construction and Masonry. (06 Hours)

a) Introduction to building construction– <u>definition, types of building as per National Building Code. Building components and their basic requirements i.e substructure and superstructure requirements. Introduction to automation in construction</u>

b) Masonry– Introduction of stone masonry and brick masonry, characteristics of good building bricks, IS specification and tests, classification of bricks, types of bonds: English, Flemish, Header, Stretcher, construction procedure, supervision. Recent trends in light weight construction

Form work and casting procedure for reinforced concrete columns, R.C.C. beams, R.C.C. slabs, Slip form work, introduction of underpinning and Scaffolding.

Unit 2: Building bye laws and introduction to Architectural drawing (06Hours)

a) Building Byelaws

<u>Necessity of bye-laws, plot sizes, road width, open spaces, floor area ratio (F.A.R.), concept of</u>

V.P.R. Marginal distances, building line, control line, height regulations, room sizes, Area calculations (built-up area, carpet area etc.), Rules for ventilation, lighting, Vertical circulation, Sanitation and Parking of vehicles.Minimum Standard Dimensions

b) Introduction to Architectural drawing : Principles of Building Planning and Principles of Architectural design relation between form and function, utility, aesthetics, Concept of Line plan, Developed Plan, Elevation, Section, Selection of scales for various drawings, dimensioning, abbreviations and symbols as per IS 962, Elements of perspective drawings, parallel and angular perspective of small building elements.

Unit 3: Building Components: (06 Hours)

a) Doors and Windows: Definition of technical terms, installation of doors and window frames and their size specifications, fixtures and fastenings. Different types of doorsand windows: Ventilators: purpose and types.

b) Arches and Lintels – Introduction of arch construction, **Lintels:** necessity and types, chajja or weather shade necessity and types.

Functional requirement of flooring, types of floor finishes and their suitability, Types of flooring.

Roofing Materials – galvanized iron pre-coated aluminium sheets, fiber sheets. Roof construction types and their suitability, method of construction, Protective Coatings with plastering and finishing.

Unit 4: Residential Buildings and green buildings (06Hours)

a) **Residential Buildings-** Functional requirements and dimensions of Residential Buildings like Bungalows, Twin bungalows, Row houses, Apartment. Prepare Developed Plan, Elevation and Sectional Elevation of above mentioned categories. Design of staircase : Dog legged /Quarter turn

b) **Green Building -**Salient features, benefits, planning concepts of Green Building (site selection, orientation, sun path and wind diagram etc.), introduction to Leadership in Energy and Environmental Design (LEED)

Unit 5: Planning of Public Buildings (06Hours)

Functional requirements and dimensions and planning of Public Buildings like industrial buildings, commercial buildings, School, Colleges , Hostel, Auditorium, Restaurant/ Hotel building, Primary Health Center/ Hospital, Shopping complex, Sports complex, Vegetable market, Post office, and Bank buildings.

Unit 6 (ONLINE): Town Planning and Legal Aspects: (06 Hours)

a) Town Planning and legal aspects: Necessity of town planning. Development plan and its importance, Land use zoning, N.A. Sanction procedure, Introduction to different zones of land in town planning, Aspects of zoning.7/12 abstract, meaning of different terms of 7/12 abstract, Form 6 and its types, Concept of TDR, List of documents to be submitted to local authority. , Introduction to RERA act. Introduction to Maharashtra Regional and Town Planning (MRTP) Act

b) Safety aspects and services –Fire load, grading of occupancies by fire loads, Evacuation Time, fire escape elements, Need for earthquake resistant structures.

Noise and Acoustics – Sound insulation, Acoustical defects, Reverberation time, Sabine's formula, sound absorbents, planning for good acoustics.

Ventilation – Necessity and types of Ventilation.

Lighting -Principles of day lighting,Solar energy systems for lighting (BIPV). **Plumbing** –Types of plumbing system.
Books
Text books: 1. Building Construction by B.C. Punmia, Laxmi Publications. 2. Building Materials by S.V.Deodhar, Khanna Publication. 3. Building Construction by Bindra and Arora, DhanpatRai Publications. 4. Building Drawings with an integrated Approach to Built-Environment by M. G. Shah, C. M. Kale and S. Y. Patki, New Delhi, Tata McGraw Hill. (5th edition.) **Reference books:** 1. Building Materials by S. K. Duggal, New Age International Publishers. 2. Building Construction by S.C. Rangwala, Charotdar Publications. 3. The construction of buildings; seventh edition, Vol.1 & Vol.2 by R. Barry, Oxford: Blackwell Science. 4. Building Materials Technology by Ruth T. Brantley & L. Reed Brantley, Tata McGraw Hill. 5. National Building Code (latest). 6. Building Design and construction by Frederick Merrit, Tata McGraw Hill. 7. I.S. 962 – 1989 Code for Practice for Architectural and Building Drawings. 8. Development plan and DCP Rules of urban local body, New Delhi, Volume 12.

Savitribai Phule University of Pune
Second Year Civil Engineering (2019 Course)
201002 Mechanics of Structures
Credit : 3

Teaching Scheme:	**Examination Scheme:**
Theory : 03hrs/ week	In-semester : 30 Marks
Practical : 04 hrs/week	End-semester : 70 Marks

Prerequisites:

Fundamentals of Physics, Mathematics and Engineering Mechanics.

Course Objectives:

1. To study various types of stresses for determinate structural members.
2. To learn concept of Shear Force and Bending Moment Diagram for determinate beams.
3. To learn the concept of slope and deflection for determinate structural members.

Course Outcomes:

On completion of the course, learner will be able to:

1. Understand concept of stress-strain and determine different types of stress, strain in determinate, indeterminate homogeneous and composite structures.
2. Calculate shear force and bending moment in determinate beams for different loading conditions and illustrate shear force and bending moment diagram.
3. Explain the concept of shear and bending stresses in beams and demonstrate shear and bending stress distribution diagram.
4. Use theory of torsion to determine the stresses in circular shaft and understand concept of Principal stresses and strains.
5. Analyze axially loaded and eccentrically loaded column.
6. Determine the slopes and deflection of determinate beams and trusses.

Course Contents:

Unit I: Simple Stresses and Strains **(06 Hours)**

a) Materials used in construction and their nature, Hook's Law, Stress-Strain Diagram for elastic, plastic materials and brittle material, Idealized stress-strain diagram , Concept of axial stresses (compression, tension), strains(linear, lateral, shear and volumetric), Elastic constants and their relations. Stresses and strains due to change in temperature.

b) Stresses, strains and deformations in determinate and indeterminate structures for homogeneous and composite structures under concentrated loads and temperature changes.

Unit II: Shear Force and Bending Moment Diagram **(06Hours)**

Concept of shear force and bending moment. Relation between shear force, bending moment and intensity of loading. Shear force and bending moment diagrams for determinate beams due to concentrated, uniformly distributed, uniformly varying loads and couples. Bending moment and loading diagram from given shear force diagram.

Unit III: Shear and Bending Stresses **(06Hours)** a) Shear stresses in beams: concept of shear, complimentary shear, derivation of shear stress formula, shear stress distribution for various cross sections, maximum and average shear stress for circular and rectangular sections. b) Bending stresses in beams: theory of simple or pure bending, assumptions, derivation of flexure formula, bending stress distribution diagrams, Moment of Resistance of cross-section.
Unit IV: Torsion of Circular Shaftsand Principal Stresses and Strains **(06Hours)** a) Torsion of circular shafts: theory of torsion, assumptions, derivation of torsion formula. Stresses, strains and deformations in determinate and indeterminate shafts of hollow, solid, homogeneous cross-sections subjected to twisting moments. Power transmitted by shafts. b) Principal stresses and strains: concept of principal planes and principal stresses, normal and shear stresses on an oblique plane, magnitude and orientation of principal stresses andmaximum shear stress.
Unit V: Axially and Eccentrically Loaded Columns. **(06 Hours)** a) Axially loaded columns: concept of critical load and buckling, Euler's formula for buckling load with hinged ends, concept of equivalent length for various end conditions, Rankine's formula, safe load on column and limitations of Euler's formula. b) Direct and bending stresses for eccentrically loaded short column and other structural components such as retaining walls, dams, chimneys, etc. Effect of lateral force and self-weight. Resultant stress diagrams due to axial loads, uni-axial, and bi-axial bending. Concept of core of section for solid and hollow rectangular and circular sections.
Unit VI: Slope and Deflection of Beams and Trusses **(06Hours)** a) Slope and deflection of determinate beams by Macaulay's method and Strain energy method, Castigliano's first theorem. Joint displacement of determinate trusses by Unit load method. **Note: Only the concept explanation can be taught through Online teaching mode, however, the problem solving is to be done in offline mode.**
Books:
Text books: 1. Mechanics of Structures Vol. I &II by S. B. Junnarkar and Dr. H. J. Shah, Twenty second edition, Charotar Publishing House Pvt Ltd. 2. Strength of Materials by R. Subramanian, Oxford University Press. 3. Strength of Materials by S. S. Ratan, Tata McGraw Hill. **Reference books:** 1. Elements of Strength of Materials by Timoshenko and Young, East-West Press Ltd. 2. Strength of Materials by F.L. Singer and Andrew Pytel, Harper and Row Publication. 3. Mechanics of Materials by Beer and Johnston, McGraw Hill Publication. 4. Introduction to Mechanics of Solids by E.P. Popov, Prantice Hall Publication. 5. Mechanics of Materials by Gere & Timoshenko, CBC publisher. 6. Elementary Structural Analysis by Norris, Wilbur and Utku, Tata McGraw Hill Publisher. 7. Intermediate Structural Analysis by R. C. Hibbler, Pearson Education Publishers.

Savitribai Phule Pune University, Pune
Second Year Civil Engineering (2019 Pattern)
201003 : Fluid Mechanics

Credits : 03

Teaching Scheme:		**Examination Scheme:**	
Theory	: 03 hrs/week	In-semester	: 30 Marks
Practical	: 02hrs/week	End-Semester	: 70 Marks

Prerequisites:

Engineering Physics, Engineering Mathematics and Engineering Mechanics

Course Objectives:

1. To understand conceptually the properties of fluid, fluid statics, fluid kinematics and fluid dynamics, dimensional analysis, boundary layer theory, open channel flow and fluid flow around submerged objects.
2. Apply principles of continuity, mass, momentum and energy as applied to fluid at rest as well as for fluid flow in open channel.
3. To apply fundamental principles of fluid mechanics for the solution of practical Civil Engineering problems.

Course Outcomes:

At the end of the course, the learners will be able to

1. Understand the use of Fluid Properties, concept of Fluid statics, basic equation of Hydrostatics, measurement of fluid pressure, buoyancy & floatation and its application for solving practical problems.
2. Understand the concept of fluid kinematics with reference to Continuity equation and fluid dynamics with reference to Modified Bernoulli's equation and its application to practical problems of fluid flow
3. Understand the concept of Dimensional analysis using Buckingham's π theorem, Similarity & Model Laws and boundary layer theory and apply it for solving practical problems of fluid flow.
4. Understand the concept of laminar and turbulent flow and flow through pipes and its application to determine major and minor losses and analyze pipe network using Hardy Cross method.
5. Understand the concept of open channel flow, uniform flow and depth-Energy relationships in open channel flow and make the use of Chezy's and Manning's formulae for uniform flow computation and design of most economical channel section.
6. Understand the concept of gradually varied flow in open channel and fluid flow around submerged objects, compute GVF profile and calculate drag and lift force on fully submerged body.

Course Contents:

Unit I: **(07 hours)**

a) <u>Properties of Fluids:</u> <u>Definition of fluid and fluid mechanics: examples and practical</u>

applications, classification of fluids: Real and Ideal, , physical properties of fluids: mass density, specific weight, specific volume, relative density, viscosity, Newton's law of viscosity Dynamic and kinematic viscosity, compressibility, cohesion, adhesion, surface tension, capillarity, vapour pressure. **b) Fluid Statics**: Basic equation of hydrostatics, concept of pressure, pressure head, Pascal's Law, measurement of pressure (absolute, gauge), principle of manometers: Balancing liquid column, dead weight, pressure transducers and their types, total pressure and centre of pressure: on plane horizontal, vertical, inclined and curved surfaces: practical applications, **Buoyancy and Floatation:** Principle of floatation and buoyancy, stability of floating and submerged bodies
Unit II: **(07 Hours)** **a) Fluid Kinematics** Eulerian and Lagrangian approach, velocity and acceleration, and theircomponents in Cartesian co-ordinates, Classification of flows, stream line, stream tube, path line, streak line, control volume. Equation of continuity for 3-D flow in Cartesian co-ordinates, components of rotation, velocity potential, stream function and flow net. **b) Fluid Dynamics:** Forces acting on fluid mass in motion, Euler's equation of motion along a streamline and its integration to get Bernoulli's equation and its limitations, Modified Bernoulli's equation, concept of HGL and TEL, Application of Bernoulli's equation to measure discharge and velocity of flow: Venturimeter, Orifice meter, Rotameter and Pitot tube.
Unit III: **(07 Hours)** **a) Dimensional Analysis and Model Studies** Dimensional homogeneity, dimensional analysis using Buckingham's π theorem method, geometric, kinematic and dynamic similarity, important dimensionless Numbers (Reynolds No., Froude No., Euler No., Mach no. and Weber No) and their significance, Model Laws (Reynold's law and Froude's Law) **b) Boundary layer Theory** Concept, development of boundary layer on flat plate and factors affecting growth, Boundary layer thickness, displacement thickness, momentum and energy thickness, Laminar sub layer, Local and mean drag coefficients, Hydrodynamically smooth and rough boundary, boundary layer separation and methods to control separation
Unit IV **(07Hours)** **a) Laminar & Turbulent Flow through Pipe:** Characteristics of laminar flow**,** laminar flow through a circular pipe: Hagen Poiseuille equation**,**Characteristics of turbulent flow, instantaneous velocity, temporal mean velocity, scale of turbulence and intensity of turbulence, Prandtl's mixing length theory, velocity distribution equation, variation of friction factor for laminar flow and for turbulent flow, resistance to flow in smooth and rough pipes, friction factor for commercial pipes, Moody's diagram. **b)Flow through pipes:** Energy losses in pipe flow, Equation for major loss and minor losses in pipe, flow through pipes in simple and compound pipe, pipes in series, parallel, Dupit's equation, pipe network analysis by Hardy Cross method, Introduction to siphon.
Unit V **(07 Hours)** **a) Introduction to Open channel flow:** Classification of channels, channel flows and geometric

elements of channel, Basic governing equations of Channel flow viz. continuity equation, energy equation and momentum equation, One dimensional approach, Velocity distribution in open channel flow.

b) Uniform flow in open channels: Uniform flow formulae: Chezy's and Manning's formulae; Factors affecting Manning's roughness coefficient; Important terms pertaining to uniform flow, viz. normal depth, conveyance, section factor, concept of second hydraulic exponent, Uniform flow computations. Most efficient channel sections: rectangular, triangular and trapezoidal. **Depth-Energy Relationships in Open Channel Flow:** Specific energy and Specific force diagram, Depth discharge Diagram, Critical depth, Conditions for occurrence of critical flow; Froude's number, flow classification based on it, Important terms pertaining to critical flow viz. section factor, concept of first hydraulic exponent

Unit VI (07 Hours)

a) Gradually Varied Flow (GVF) in Open Channel Flow: Theory and Computation

Basic Assumptions of GVF; Dynamic equation of GVF - Alternative forms; Classification of channel bed slopes,Various GVF profiles, Methods of GVF computations: Direct Step method. (mention of other method)

b) Fluid Flow around Submerged Objects:

Practical problems involving fluid flow around submerged objects, Definitions and expressions for drag, lift, drag coefficient, lift coefficient, types of drag. Introduction to Drag on sphere, cylinder, flat plate and Aerofoil, Karman's vortex street, Development of lift~~,~~ Introduction to Magnus effect**,** Lift on cylinder and Aerofoil, Polar diagram.

Books:

Text books:

1 Hydraulics and Fluid Mechanics including Hydraulic Machine by Dr P. N. Modi & S. M. Seth Pub: Standard book house, Delhi-6
2. Flow in Open Channels by K Subramanya, Pub: Tata McGraw Hill, New Delhi
3. A Text Book on Fluid Mechanics and Hydraulic Machines by Sukumar Pati Pub: McGraw Hill, New Delhi

Reference books:

1. Engineering Fluid Mechanics by R. J. Garde and A.J Mirajgaonkar, Pub: SCITECH Publications(India)Pvt.Ltd, Chennai
2. Fluid Mechanics and its Applications, Vijay Gupta, Santosh K Gupta, New Age international pvt. Ltd, New Delhi,
3. Fluid Mechanics, Fundamentals and applications by Yunus. A Cengel and John.M Cimbala, Mc Graw Hill International, New Delhi.
4. Fluid Mechanics by Streeter, Wylie and Bedford – Pub: McGraw Hill International, New Delhi.
5. Open Channel Hydraulics by Ven Tee Chow, Pub: Mcgraw- Hill Book Company- Koga.
6. A Text Book of Fluid Mechanics and Hydraulic Machines- by Dr. R K Rajput Pub: S Chand and Co Ltd. New Delhi

Savitribai Phule Pune University, Pune

Second Year of Civil Engineering– Sem I (2019 Course)

207001 Engineering Mathematics III

Credits: 03

Teaching Scheme:		**Examination Scheme:**	
Theory	: 03hrs/ week	In-semester	: 30 Marks
Tutorial	: 01hrs/week	End-semester	: 70 Marks

Prerequisites:

Differential and Integral Calculus, Differential equations of first order and first degree, Fourier series, Collection, classification & representation of data, Permutations & combinations and Vector algebra.

Course Objectives:

To make the students familiarize with concepts and techniques in Ordinary & Partial differential equations, Numerical methods, Statistical methods, Probability theory and Vector calculus. The aim is to equip them with the techniques to understand advanced level mathematics and its applications that would enhance analytical thinking power, useful in their disciplines.

Course Outcomes:

At the end of this course, students will be able to

1. Solve Higher order linear differential equations and its applications to modelling and analysing Civil engineering problems such as bending of beams, whirling of shafts and mass spring systems.
2. Solve System of linear equations using direct & iterative numerical techniques and develop solutions for ordinary differential equations using single step & multistep methods applied to hydraulics, geotechnics and structural systems.
3. Apply Statistical methods like correlation, regression and probability theory in data analysis and predictions in civil engineering.
4. Perform Vector differentiation &integration, analyze the vector fields and apply to fluid flow problems.
5. Solve Partial differential equations such as wave equation, one and two dimensional heat flow equations.

Course Contents:

Unit I: Linear Differential Equations (LDE) and Applications (08 Hours)

LDE of n^{th} order with constant coefficients, Complementary Function, Particular Integral, General method, Short methods, Method of variation of parameters, Cauchy's and Legendre's DE, Simultaneous and Symmetric simultaneous DE.

Modelling of problems on bending of beams, whirling of shafts andmass spring systems.

Unit II: Numerical Methods (08 Hours)

Numerical solutions of system of linear equations: Gauss elimination method, Cholesky, Jacobi and Gauss-Seidel methods.

Numerical solutions of ordinary differential equations: Euler's, Modified Euler's, Runge-Kutta 4^{th} order and Predictor-Corrector methods.

Unit III: Statistics and Probability **(07 Hours)**

Measures of central tendency, Standard deviation, Coefficient of variation, Moments, Skewness and Kurtosis, Correlation and Regression, Reliability of Regression estimates.

Probability, Probability density function, Probability distributions: Binomial, Poisson, Normal, Test of hypothesis: Chi-square test, t-test.

Unit IV: Vector Differential Calculus **(08 Hours)**

Physical interpretation of Vector differentiation, Vector differential operator, Gradient, Divergence and Curl, Directional derivative, Solenoidal, Irrotational and Conservative fields, Scalar potential, Vector identities.

Unit V: Vector Integral Calculus and Applications **(08 Hours)**

Line, Surface and Volume integrals, Work-done, Green's Lemma, Gauss's Divergence theorem, Stoke's theorem. Applications to problems in Fluid Mechanics, Continuity equations, Streamlines, Equations of motion, Bernoulli's equation.

Unit VI: Applications of Partial Differential Equations (PDE) **(07 Hours)**

Basic concepts, modeling of Vibrating String, Wave equation, One and two dimensional Heat flow equations, method of Separation of variables, use of Fourier series, Applications of PDE to problems of Civil and allied Engineering.

Books:

Text Books:

1. Higher Engineering Mathematics by B.V. Ramana (Tata McGraw-Hill).
2. Higher Engineering Mathematics by B. S. Grewal (Khanna Publication, Delhi).

Reference Books:

1. Advanced Engineering Mathematics, 10e, by Erwin Kreyszig (Wiley India).
2. Advanced Engineering Mathematics, 2e, by M. D. Greenberg (Pearson Education).
3. Advanced Engineering Mathematics, 7e, by Peter V. O'Neil (Cengage Learning).
4. Numerical Methods for Engineers,7e by S. C. Chapra and R. P. Canale (McGraw-Hill Education)
5. Introduction to Probability and Statistics for Engineers and Scientists, 5e, by Sheldon M. Ross (Elsevier Academic Press)
6. Partial Differential Equations for Scientists and Engineers by S. J. Farlow (Dover Publications, 1993)

Savitribai Phule Pune University, Pune

Second Year of Civil Engineering– Sem I (2019 Course)

207003 Engineering Geology

Credits: 03

Teaching Scheme:		**Examination Scheme:**	
Theory	: 03 hrs/week	In-semester	:30 Marks
Practical	: 02 hrs/week	End-semester	: 70 Marks

Prerequisites:

Course Objectives:

1. To get the knowledge of the physical properties of mineral and differentiate between the rocks types, their inherent characteristics with Civil Engineering applications.
2. To learn geomorphic features formed by fluvial, marine processes and their role, Indian stratigraphy and historical geology in civil engineering projects.
3. To comprehend Structural geology applied to civil engineering projects and to get idea about plate tectonics.
4. To acquire and apply knowledge of PGE essential for civil engineering projects.
5. To identify and to enable the Students to examine favorable & unfavorable conditions for the proposed construction of dams, reservoir and tunnels. Precautions and treatments required to improve the site conditions of dams, reservoir and tunnels.
6. To learn the role played by the effect of Ground water, Geological hazards and the requirement and utility of good building stone.

Course Outcomes:

After successful completion of course, students will be able to :

1. Explain about the basic concepts of engineering geology, various rocks, and minerals both in lab and on the fields and their inherent characteristics and their uses in civil engineering constructions.
2. Exploring the importance of mass wasting processes and various tectonic processes that hampers the design of civil engineering projects and its implications on environment and sustainability.
3. Recognize effect of plate tectonics, structural geology and their significance and utility in civil engineering activities.
4. Incorporate the various methods of survey, to evaluate and interpret geological nature of the rocks present at the foundations of the dams, percolation tanks, tunnels and to infer site / alignment/ level free from geological defects.
5. Assess the Importance of geological nature of the site, precautions and treatments to improve the site conditions for dams, reservoirs, and tunnels.
6. Explain geological hazards and importance of ground water and uses of common building stones.

Course Contents:

Unit I: General Geology, Mineralogy and Petrology **(07 Hours)**

a) Introduction to the subject, scope and sub divisions. **General Geology:**The Earth as a planet, Interior & General composition of the Earth, The rock cycle

b) Introduction to mineralogy: Physical Properties of Minerals, Classification of Minerals, silicate and non-silicate minerals, Rock forming minerals.

c) Introduction to petrology and Broad classification of rocks.

Igneous Petrology: Plutonic, Hypabyssal and Volcanic rocks, Structures, Textures and Classification of Igneous rocks. Study of common rock types prescribed in practical work and their engineering applications.

Secondary Petrology: Rock weathering, Sedimentary Structures, lithification and digenesis Process, Genetic classification of secondary rocks and grain size classification and Textures, Study of common rock types prescribed in practical work and their civil engineering applications.

Metamorphic Petrology: Agents, Types of metamorphism, Texture and structures. Study of common rock types prescribed in practical work and their civil engineering applications.

Unit II: Geomorphology and Historical Geology. **(07 Hours)**

a) Geomorphology: Endogenic and Exogenic processes, Geological action by fluvial process i.e. river and Landforms formed it, Aeolian and glacial process, Coastal geomorphology.

b) Historical Geology: General principles of Stratigraphy, Geological time scale w.r.t. Indian geological time scale, Physiographic divisions of India, Archean's&Dharwar formation, Cudappah formations, Vindhyan formations, Gondwana formations, Deccan Trap formations, significance of their structural characters in major civil engineering activities.

Unit III: Structural Geology, Plate Tectonics **(07 Hours)**

a) Introduction to plate tectonics and Mountain building activity.

b) Structural Geology: Out crop, dip and strike, conformable series, unconformity, its types and overlap, faults and their types, folds and their types, inliers and outlier. Civil engineering importance of faults and folds with examples.

c) Structures of rocks: Igneous intrusions and their types, joints and their types, stratification and lamination.

Unit IV: Remote Sensing and G.I.S., Preliminary Geological Studies **(07 Hours.)**

a) Remote sensing (RS): Definition, Stages of Remote sensing, Remote sensing platforms, Active & Passive Remote sensing, Electromagnetic spectrum, visible band, scattering & absorption of EMR in atmosphere and its effect on Satellite Imagery; resolution of satellite images, Elements of remote sensing for Visual interpretation viz.Tone, shape, size, pattern, texture, shadow and Association.

b) Geographical Information System (GIS): Introduction, Definition, tools, applications of remote sensing and geographical information system in Civil Engineering.

c) Preliminary Geological Exploration: reconnaissance survey, Desk Study, surface and subsurface Geological Investigations: Direct methods likeTest& trial pits, pilot trenches, Drilling, Core inspection significance and limitations of it. Indirect methods like Resistivity, seismic survey and its significance and limitations.

Unit V: Role of Engineering Geology in Dams, Reservoirs and Tunneling. (07 Hours.)

a) Geology of Dams & Reservoir*:* Strength, stability and water tightness of foundation rocks, influence of geological conditions on the choice and type of dam, preliminary geological work on dam and reservoir sites, precautions to be taken to counteract unsuitable conditions and their relevant treatments with case studies.

b) Tunneling: Preliminary geological investigations, important geological considerations while choosing alignment, difficulties during tunneling as encountered due to various geological conditions, Role of groundwater and suitability of common rock types for excavation and tunneling and important case studies in Kasara and BorGhat sections of central railway in Maharashtra and in India, particularly in Himalayas etc.

Unit VI: Geological Hazards, Ground Water and Building Stones. (07 Hours)

a) Geological Hazards: Volcanism, Earthquakes & Seismic zones of India, Landslides and stability of hill slopes and preventive measures.

b) Groundwater: Types of ground water, water table and depth zones, influence of hydro geological properties of rocks, types of aquifers, artesian wells and its geological conditions, artificial recharge of groundwater. Geological work of groundwater, levels, effects of dams and canals, effect of pumping, cone of depression, circle of influence, fluctuations in water table Methods of conservation of groundwater and its management; introduction of watershed management.

c) Building stones: Requirements of good building stone: strength, durability, ease of dressing, appearance, mineral composition, textures and field structures, suitability of common rocks as building stone.

Books:

Text Books:

1. Text Book of Engineering Geology by R.B. Gupte , 2001, P.V.G. Publications, Pune.
2. A Text Book of Engineering Geology by N. ChennaKesavulu. 2010, McMillan India Ltd.
3. Principles of Engineering Geology by D. Venkat Reddy. 2010, Vikas Publishers.

Reference Books:

1. Geology P. K. Mukerjee, World Press
2. Engineering Geology by F. G. H Blyth and De Frietus, Reed Elsevier India
3. Geology for geotechnical engineers, J. C. Harvey, Cambridge University Press
4. Principals of Engineering Geology,S.K. Garg, VikasPublishe
5. Engineering Geology, Parbin Singh
6. Geology and Engineering, K. V. G. K. Gokhale, D. M. Rao ,Tata McGraw Hill.
7. Structural Geology, M. P. Billings, Pearson India Pvt. Ltd.

Any Other book of prominent publisher that is recommended by Geology faculty.

Savitribai Phule Pune University, Pune

Second Year of Civil Engineering– Sem I (2019 Course)

201004 Building Technology and Architectural Planning –Lab

Credits: 01

Teaching Scheme:	**Examination Scheme:**
Practical : 04 hrs/week	Term Work : 50 Marks

List of Laboratory Assignments

1. Students shall prepare drawings of types of masonry and Brick bonds (Quarter plate)
2. Prepare sheet showing details of at least two Doors, windows and Arches.(Quarter plate)
3. Draw the line plans of any one residential building and any two Public Buildings (Graph Paper)
4. Perspective drawing of a small building element (Total 2 problems - 1 based on one point and two point each)
5. Floor Plan/ Typical floor plan with construction notes, schedule of openings, of any type of building, Plan, Elevation and Section on separate sheet **(Full Imperial sheet)**
6. Developing typical floor plan drawing exercise completed in assignment number 5, using CAD and Printout of the same.
7. Layout/ Site plan indicating water supply and drainage line (with area statement, make max. four students in one group).
8. **Site Visit** : Any on-going Construction Site (visit report should contain: details of the project, stage of construction, sketches of components with cross section & dimensions, materials used and site plan, etc.)

OR

8. Site Visit : **Green Building**, Salient features like materials used/technology etc, benefits, planning concepts of Green Building (site selection, orientation, sun pathand wind diagram etc.),
9. Document collection: Different sanction forms and at least six brochures of building materials

Report file:

1. It shall consist of data given for the project, Planning considerations and line plans, Design calculations.
2. Terminology of Perspective drawing
3. Dimension standards of Residential building and Public building
4. Visit Report

Savitribai Phule Pune University, Pune

Second Year of Civil Engineering– Sem I (2019 Course)

201005 Mechanics of Structures-Lab

Credits: 02

Teaching Scheme:	**Examination Scheme:**
Practical : 04 hrs/week	Oral : 50 Marks

List of Laboratory Experiments

Sr. No.	Group A
1	**Metals** 1. Tension test on mild and TMT steel. 2. Shear (Single & Double)test on mild steel. 3. Torsion test on mild steel. 4. Impact (Izod&Charpy) test on mild steel, aluminum, brass.
	Group B
2	**Timber & Ply wood** 1. Compression test on timber (Parallel & Perpendicular) 2. Bending test on timber and plywood.
	Group C
3	**Bricks &Tiles** 1. Field tests on bricks 2. Water absorption test on bricks. 3. Efflorescence test on bricks. 4. Compressive strength test on bricks 5. Flexural strength of flooring tiles. 6. Abrasion test of flooring tiles.
5	One Assignment on each unit of this subject.
6	Assignment on Influence Line Diagram (ILD) of Reactions, Shear Force and Bending moment of determinate beams.
7	Market survey of structural materials including its costing.
Oral : Based on above syllabus	

*** The concept explanation part can be taught through Online teaching mode, however, the problem solving needs offline mode.**

Savitribai Phule Pune University, Pune
Second Year Civil Engineering (2019 Pattern)
201006 : Fluid Mechanics - Lab
Credits : 01

Teaching Scheme:	**Examination Scheme:**
Practical : 02hrs/week	Oral : 50 Marks

The Term work shall consists of Experiments (09), Assignments(02) and Visit Report (01)

Term work:

A) Any nine experiments of below mentioned experiments, out of which **first seven are compulsory:**

1. Measurement of viscosity of fluid by Redwood/Saybolt viscometer.
2. Experimental verification of Bernoulli's theorem with reference to loss of energy.
3. Calibration of Venturimeter / Orifice meter.
4. Determination of Darcy-Weisbach friction factor (*f*) for a given pipe and study of variation of *f* with Reynolds Number (*Re*).
5. Flow around a Circular Cylinder/Aerofoil.
6. Study of Uniform Flow Formulae for Open channel.
7. Velocity Distribution in Open Channel Flow.
8. Calibration of Rectangular and Triangular Notch.
9. Determination of Stability of Floating Bodies using Ship Model
10. Drawing Flow net by Electrical Analogy for flow below Weir (with & without sheet pile)
11. Measurement of Pressure using different Pressure Measuring Devices (including Transducers /state of arts Digital Instruments also).
12. Measurement of Surface Tension.
13. Determination of Minor Losses inPpipes

B) Assignments: Any two assignments of below mentioned**. First assignment is compulsory.**

1. Analysis of pipe network using Hardy Cross Method (minimum two loops) – both by hand calculations and using computer any language/software solution.
2. Developing a Demo Model related to any fluid flow phenomenon (physical model/soft model).
3. Demonstration of any Software related to Fluid Mechanics/Hydraulics.
4. GVF computation using any computer Language/Software.

C) Site visit : Report on Site visit to any one of the Research Institute like **CWPRS, WALMI, MERI etc.**

Savitribai Phule Pune University, Pune

Second Year of Civil Engineering– Sem I (2019 Course)

207002 Engineering Mathematics III - Tutorial

Credits: 01

Teaching Scheme:	**Examination Scheme:**
Tutorial : 01 hrs/week	Term Work : 25 Marks

Guidelines for Tutorial and Term Work:

1. Tutorial shall be engaged in four batches (batch size of 20 students maximum) per division.
2. Term work shall be based on continuous assessment of six assignments (one per each unit) and performance in internal tests.

Savitribai Phule Pune University, Pune

Second Year of Civil Engineering– Sem I (2019 Course)

207004 Engineering Geology - Lab

Credits: 01

Teaching Scheme:		**Examination Scheme:**	
Practical	: 02 hrs/week	Term Work	: 25 Marks

List of Laboratory Assignments:

Following experiments are to be compulsorily performed. Term work shall consist of journal giving details of the experiments performed.

1. Megascopic identification of following mineral specimens (around 50).

Rock Forming Minerals, Economic Minerals and Ore Minerals such as:

Silica group: Rock Crystal, Rosy Quartz, Transparent Quartz, Milky Quartz, Smoky Quartz, Amethyst, Chalcedony, different varieties of Agate, Jasper Banded Hematite Jasper

Feldspar group: Orthoclase, Microcline, Plagioclase **Mica group**: Muscovite, Biotite

Olivine group: Olivine **Pyroxene group:** Augite, Diopside, Hypersthene, **Amphibole group**: Hornblende, Asbestos, **Zeolite and other group:** Apophyllite, Stilbite, different varieties of Calcite, Gypsum Tourmaline, Chromite, Limonite, Laterite, Kyanite, Graphite, Hematite, Micaceous Haematite, Pyrite, Garnet etc.

2. Megascopic identification of following different rock specimens.(Around 50).

a) Igneous Petrology: Plutonic, Hypabyssal, Volcanic Rocks and their varieties like Granites , Syenite, Pegmatite, Graphic Granite, Dolerite,Andesite,Diorite, Gabbro, Rhyolite, Pumice, Trachyte, All varieties of Basalt like Compact, Giant Phenocryst Basalt (GPB),Amygdaloidal, Pipe A.B, Volcanic Breccia, Tachylytes,Tuff breccia.

b) Sedimentary Rocks: Rudaceous, Areanceous, Argillaceous, Chemical and Organic Deposits: Laterite, Bauxite, Conglomerates, Secondary Breccia, varieties of Sandstones (Red), Grit,Arkose sandstone, Sandstone with Ripple marks, Sandstone (Current Bedding), Shahabad Limestone, Black Limestone (Cudappah), Stalactite Limestone, Oolitic limestone, Shelly Limestone, Mudstone, Shale (White), Shale (Yellow), Shale (Black).

c) Metamorphic Petrology: Contact Metamorphic rocks, Dynamothermal Metamorphic rocks: Quartzite's, Marbles, Phyllite, Slate, varieties of Schists (Mica Schist, Biotite Schist with Garnet, Muscovite Schist, Chlorite Schist, Hornblende Schist, Chlorite Schist, Talc Schist, Quartz Sericite Schist), varieties of Gniesses (Augen Gneiss, Hornblende Biotite Gneiss, Hornblende Gneiss), Khondalite, Charnockite, Amphibolite.

3. **Interpretation and construction of geological sections from contoured geological maps (A. G. Series—IV Total 8 maps and 2 maps to be constructed by the faculty members.)**

4. Solution of engineering geological problems such as alignment of dams, tunnels, roads, canals, bridges, etc. based on geological maps.

5. Logging of drill core and interpretation of drilling data with graphical representation of core log.

6. Two Site visits are desirable to study various geological features.

7. GRAM++ software and open source software like QGIS, ARCGIS software may be optional to perform.

Savitribai Phule Pune University, Pune
Second Year Civil Engineering (2019 Pattern)
Awareness to Civil Engineering Practices
Audit Course I

Teaching Scheme:
Practical: 01 hrs/week

(Certificate to be issued by institute based on performance assessment)

Civil Engineering is the oldest engineering profession comprising of a variety of sub-disciplines such as Structural Engineering, Geotechnical, Water resources, Environmental Engineering, Construction technology, Transportation Engineering etc. Undergraduate programs are designed with different theoretical approaches on the application of basic sciences to solve different societal problems by engineering knowledge. However, there is a need to make the students aware about how the Civil Engineering industry operates and how theories taught in different courses are applied in practice. The students can learn from the experience gained from different workplaces such Civil Engineering consultancies, contracting companies, construction sites etc. The course aims to provide insight of the different practices followed by the industry such as use of different documents & contracts in Civil Engineering practice, drawings required, engineering ethics, duties and responsibilities of the engineers, site records and diaries, health and safety practices on site.

Course Objectives:

1. To provide basic overview of functioning of different Civil Engineering related industries / firms.
2. To create awareness about application of different drawings, contract documents in Civil Engineering.
3. To provide insight of code of ethics, duties and responsibilities, health and safety as a Civil Engineer.

Course Outcomes:

On completion of the course, learner will be able to…

CO1: Describe functioning/working of different types of industries/sectors in Civil Engineering.
CO2: Describe drawings and documents required and used in different Civil Engineering works.
CO3: Understand the importance of Code of Ethics to be practiced by a Civil Engineer and also understand the duties and responsibilities as a Civil Engineer.
CO4: Understand different health and safety practices on the site.

Course Contents (During 1hr. Practical Session per week)

Unit I: Sectors in Civil Engineering **(03 Hours.)**

Details of different Sectors/sub-disciplines in Civil Engineering along with the following details: description, eminent institutes in India & abroad, related research institutes, noteworthy projects, higher education, latest & ongoing research in the domain, jobs opportunities in government as well as private sector.

Suggestion for effective content delivery:

Lecture cum interaction by alumni of your college working in different sectors of Civil Engineering

Unit II: Drawings and Documents **(03 Hours.)**

Types of drawings in different construction projects. Contract agreement & other documents in different construction projects.

Suggestion for effective content delivery:

i.] Visit to various construction sites/ architectural firms/ structural engineering firms etc. to understand drawings, documents & working culture.

ii.] Lecture by professional practitioner

Unit III: Engineering Ethics **(03 Hours.)**

Introduction, moral issues and moral dilemmas. Code of ethics in Civil Engineering followed by Construction Industry Development Council (CIDC) of India, national & international associations and institutes. Effective case studies (Minimum 2 case studies).

Suggestion for effective content delivery:

Case study based content delivery menthod, Lecture by professional practitioner

Unit IV: Construction Site Safety **(03 Hours.)**

Importance of site safety. Different health and safety parameters during actual execution of Civil Engineering constructions. Safety measures: conventional and modern.

Suggestion for effective content delivery:

On site visit & lecture by professional practicing Safety Engineer.

Guidelines for Assessment (Any one or more of following but not limited to)

1. Group discussion
2. Presentation
3. Mini Project / Activity
4. Site visit report
5. Guest lecture report

Savitribai Phule Pune University, Pune
Second Year Civil Engineering (2019 Pattern)
Road Safety Management
Audit Course I

Teaching Scheme:
Practical: 01 hrs/week

(Certificate to be issued by institute based on performance assessment)

Road transport remains the least safe mode of transport, with road accidents representing the main cause of death of people. The boom in the vehicle population without adequate road infrastructure, poor attention to driver training and unsatisfactory implementation of regulations have been responsible for increase in the number of accidents. India's vehicle population is negligible as compared to the world statistics; but the comparable proportion for accidents is substantially large. The need for strict enforcement of law to ensure greater safety on roads and an environment-friendly road transport operation is of paramount importance. Safety and security are growing concerns for businesses, governments and the traveling public around the world, as also in India. It is, therefore, essential to take new initiatives in raising awareness, skill and knowledge of students as one of the important stake holders who are expected to follow the rules and policies of the government in order to facilitate safety of individual and safe mobility of others.

Course Objectives:

1. To provide basic overview on road safety & traffic management issues in view of the alarming increase in vehicular population of the country.
2. To explain the engineering & legislative measures for road safety.
3. To discuss measures for improving road safety education levels among the public.

Course Outcomes:

On completion of the course, learners will be able to…

CO1: Summarize the existing road transport scenario of our country

CO2: Explain the method of road accident investigation

CO3: Describe the regulatory provisions needed for road safety

CO4: Identify the safety issues for a road and make use of IRC's road safety manual for conducting road safety audit.

Course Contents (During 1hr Practical Session per week)

Unit I: Existing Road Transport Scenario **(02 Hours.)**

Introduction, national & international statistics related to road transport. Factors responsible for increase in vehicle growth. Share of public transport: importance and current scenario (national & international)

<u>Suggestion for effective content delivery:</u> Displaying updated and authentic statistics & real time scenario images during the session.

Unit II: Road Accidents & its Investigation **(03 Hours.)**

Definition of road accident. National & international statistics related to road accidents. Causes of road accident. Remedies / Measures for control road accidents. Methods for accident investigation. Condition diagram & collision diagram. Black spots & its identification based on accident data.

Suggestion for effective content delivery:

i.] Activity related to drawing condition & collision diagram based on actual accident data.

ii.] Activity related to identification of black spots based on actual accident data

Unit III: Motor Vehicle Act & Central Motor Vehicle Rules (03 Hours.)

The Motor Vehicle Act of 1988. Central Motor Vehicle Rules (CMVR) of 1989. Amendments to CMVR – 2017 & 2019.

Suggestion for effective content delivery:

i.] Guest lecture by RTO Officer / Traffic Police Officer.

ii.] Public awareness campaign

Unit IV: Road Safety Audit (RSA) (04 Hours.)

Introduction & importance of RSA. Methodology, phases and checklists for Road Safety Audit as per IRC SP: 88 – 2010 (Manual on Road Safety Audit)

Suggestion for effective content delivery:

Mini project – Conducting Road Safety Audit on minimum 2 km (both directions included) road stretch in the nearby vicinity.

Guidelines for Conduction(Any one or more of following but not limited to)

1. Guest Lectures.
2. Visits and reports.
3. Assist government authorities like Municipal corporations, RTO in Road Safety Audits
4. Mini Project

Guidelines for Assessment(Any one or more of following but not limited to)

1. Written Test
2. Practical Test
3. Presentation
4. Report

Savitribai Phule Pune University, Pune

Second Year Civil Engineering (2019 Pattern)

Foreign Language

Audit Course I

Teaching Scheme:

Practical: 01 hrs/week

(Certificate to be issued by institute based on performance assessment)

The institute can offer any foreign language as audit course as per the teaching scheme depending upon the demand of the students and availability of the faculty

SEMESTER II

Savitribai Phule Pune University, Pune
Second Year Civil Engineering (2019 Course)
201008 Geotechnical Engineering

Credits: 03

Teaching Scheme:		**Examination Scheme:**	
Theory	: 03 hrs/week	In-semester	: 30 Marks
Practical	: 02hrs/week	End-Semester	: 70 Marks

Prerequisites :

Fundamentals of Physics, Mathematics, Engineering Mechanics

Course Objectives:

1. To describe soil properties, classification and its behavior under stress.
2. To learn methods for measurements and determination of index & engineering properties of soil.
3. To study the interaction between water and soil and the effects of static vs flowing water on soil strength

Course Outcomes:

On completion of the course, learner will be able to,

1. Identify and classify the soil based on the index properties and its formation process
2. Explain permeability and seepage analysis of soil by construction of flow net.
3. Illustrate the effect of compaction on soil and understand the basics of stress distribution.
4. Express shear strength of soil and its measurement under various drainage conditions.
5. Evaluate the earth pressure due to backfill on retaining structures by using different theories.
6. Analysis of stability of slopes for different types of soils.

Course Contents

Unit I: Introduction and Index Properties **(06 Hours)**

a) Introduction to Geotechnical Engineering and its applications to Civil Engineering.(Types of soil structure, major soil deposits of India), Field identification of soils. {Introduction to soil exploration: objective and purpose.}

b) Three phase soil systemweight **–** volume relationships, Index properties of soil: Methods of determination and their significance. [IS and Unified Soil classification systems.]

Unit II: Permeability and Seepage. **(06 Hours)**

a)Soil water, permeability definition and necessity of its study, Darcy's law, factors affecting permeability. (Laboratory measurement of permeability: Constant head method and Falling head method as per IS 2720.) {Field test for determination of permeability- Pumping in test and Pumping out test as per IS 5529 Part-I.}Permeability of stratified soil deposits.

b) Seepage and Seepage Pressure, quick sand phenomenon, critical hydraulic gradient, General flow equation for 2-D flow (Laplace equation).[Flow Net, properties and application]Flow Net construction for flow under sheet pile and earthen dam.

Unit III: Compaction and Stress Distribution.	**(06 Hours)**

a) Compaction – Introduction, Comparison between compaction and consolidation.[Compaction tests- Standard Proctor test, Modified Proctor test]. Zero air void line. Factors affecting compaction. Effect of compaction on soil properties. (Field compaction methods and compaction equipment for different types of soil), Placement water content, Field compaction control- use of compaction test result. {Proctor needle in field compaction control.}

b) Stress Distribution in Soils – Geostatic stress, Boussinesq's theory with assumptions for point load and circular load (with numerical), Pressure Distribution diagram on a horizontal and vertical plane, Pressure bulb and its significance. Westergaard's theory, equivalent point load method.Approximate stress distribution method.

Unit IV: Shear Strength of Soil. **(06 Hours)**

a) Introduction – Shear strength an Engineering Property. Mohr's stress circle, Mohr- Coulomb failure theory. The effective stress principle- Total stress, effective stress and neutral stress / pore water pressure. [Peak and Residual shear strength], {factors affecting shear strength.} (Stress-strain behaviour of sands and clays.)

b) Measurement of Shear Strength – Direct Shear test, Triaxial Compression test, Unconfined Compression test, Vane Shear test. Their suitability for different types of soils, advantages and disadvantages. Different drainage conditions for shear tests. (Sensitivity and thixotropi of cohesive soils.)

Unit V: Earth Pressure. **(06 Hours)**

a) Earth Pressure – Introduction, Rankine's state of Plastic Equilibrium in soils- Active and Passive states due to wall movement, Earth Pressure at rest. [Rankine's Theory: Earth pressure on Retaining wall due to submerged backfill.]

b) Backfill with uniform surcharge, backfill with sloping surface, layered backfill.

(Coulomb's Wedge theory. Rebhann's and Culmann's graphical method of determination of earth pressure.)

Unit VI: Stability of Slopes. **(06 Hours)**

a) Stability of Slopes – Classification of slopes and their modes of failure, Stability of slope: i) Taylor's stability number, ii) Swedish slip circle method, iii) Friction circle method, iv) Bishop's method. (Infinite Slopes in cohesive and cohesion less soil,) {Landslides- Causes and remedial measures.}

Books:

Text Books:

1. Soil Mechanics and Foundation Engineering by Dr. B. C. Punmia, Laxmi Publications.
2. GeotechnicalEngineeringbyShashiK.Gulati&ManojDatta,TataMcGrawHill.
3. Geotechnical Engineering by T N Ramamurthy & T G Sitharam, S Chand Publications.

Reference Books:

1. GeotechnicalEngineeringbyC.Venkatramaiah,NewAgeInternationalPublishers.
2. Principles of Geotechnical Engineering by Braj M. Das, Cengage Learning.
3. Geotechnical Engineering by P.Purushothma Raj, Tata Mc GrawHill.
4. Geotechnical Engineering by Principles & Practices by Donald. P. Coduto, Pearson Education.
5. Basic and Applied Soil Mechanics by GopalRanjan and A. S. R. Rao, Newage International.
6. Physical and Geotechnical Properties of Soils by Joseph E. Bowles, International StudentsEdition.

e-Resources:

1. http://ascelibrary.org/page/books/s-gsp.
2. http://accessengineeringlibrary.com/browse/geotechnical-engineersportable-handbook-second edition.
3. http://nptel.ac.in/courses/105101084/
4. http://nptel.ac.in/courses/105106142/

Savitribai Phule Pune University, Pune
Second Year Civil Engineering (2019 Course)
201009 Surveying
Credit : 3

Teaching Scheme:	**Examination Scheme:**
Theory: 03hrs/ week	In-semester : 30 Marks
Practical: 04 hrs/week	End-semester : 70 Marks

Pre- requisites:

Basic Introduction to Civil Engineering field,Engineering Mathematics

Course Objectives:

With the successful completion of the course, the student should have the capability to:

1 Describe the function of surveying in civil engineering construction,
2 Identify the sources of measurement errors and mistakes; understand the difference between accuracy and precision as it relates to distance, differential leveling, and angular measurements,
3 Identify and calculate the errors in measurements and to develop corrected values for differential level circuits, horizontal distances and angles for open or closed-loop traverses,
4 Effectively communicate with team members during field activities; identify appropriate safety procedures for personal protection; properly handle and use measurement instruments.
5 Be able to identify hazardous environments and take measures to insure one's personal and team safety
6 Perform traverse calculations; determine latitudes, departures, and coordinates of control points and balancing errors in a traverse. Use appropriate software for calculations and plotting.
7 Operate a total station to measure distance, angles, and to calculate differences in elevation. Reduce data for application in a geographic information system,
8 Work as a team member on a surveying party to achieve a common goal of accurate and timely project completion,
9 Calculate, design and establish curves, Understand, interpret, and prepare plan, profile, and cross-section drawings, Work with cross-sections and topographic maps to calculate areas, volumes, and earthwork quantities.

Course Outcomes:

On successful completion of this course, Student will be able to:

1. Define and Explain basics of plane surveying and differentiate the instruments used for it.
2. Express proficiency in handling surveying equipment and analyse the surveying data from these equipment.
3. Describe different methods of surveying and find relative positions of points on the surface of earth.
4. Execute curve setting for civil engineering projects such as roads, railways etc.
5. Articulate advancements in surveying such as space based positioning systems

6. Differentiate map and aerial photographs, also interpret aerial photographs.

Course Contents

Unit I: Compass and Levelling. **(08 Hours)**

a) Definition and Importance of Surveying; Principles of Surveying,

b) Definition, objective and fundamental classification of surveying (Plane and Geodetic), concept of Scale, Ranging, Chaining, Offsetting and Traversing. Construction and use of prismatic compass, Concept of bearing &, types of bearings such as Whole Circle Bearing, Quadrental Bearing, meridian and their types, local attraction and correction for local attraction, dip, declination and calculation of true bearings, including numericals of all types.

c) Equipment required for plane table surveying, uses, advantages and disadvantages and errors in plane table surveying. Methods of plane table Survey Radiation, intersection, traversing and resection –

d) Introduction to leveling, Types of leveling, Types of benchmarks, Study and use of dumpy level, auto level, digital level and laser level in construction industry, principal axes of dumpy level, testing and permanent adjustments reciprocal leveling, curvature and refraction corrections, distance to the visible horizon. Collimation Plane Method, Rise & Fall Method

Unit II: Theodolite Surveying **(08 Hours)**

a) Study of vernier transit 20” theodolite, uses of theodolite for measurement of horizontal angles by repetition and reiteration, vertical angles, measurement of deflection angles using transit theodolite and magnetic bearing, prolonging a line, lining in and setting out an angle with a theodolite. Fundamental axes of theodolite: testing and permanent adjustments of a transit theodolite.

b) Theodolite traversing – computation of consecutive and independent co-ordinates, adjustment of closed traverse by transit rule and Bowditch’s rule, Gales traverse table. Checks, omitted measurements, area calculation by independent co-ordinates.

Unit III: Tacheometry and Contouring. **(06 Hours)**

a) **Tacheometry –** applications and limitations, principle of stadia tacheometry, fixed hair method with vertical staff to determine horizontal distances and elevations of points, finding tacheometric constants. Tacheometric contouring. Numericals

b) **Contouring** – Definition of Contours, Characteristics of Contours, Contour Patterns for various natural features, direct and indirect methods of contouring, <u>uses of contour maps, study and use of topo-sheets, profile leveling and cross-sectioning and their applications</u>

Unit IV: Curves. **(07 Hours)**

<u>Introduction to horizontal and vertical curves</u> (including numericals but derivation not expected), <u>different types of curves and their applications, simple and compound circular curves</u>, elements and setting out by linear methods such as radial and perpendicular offsets, offsets from long chord, successive bisection of chord and offsets from chords produced. Angular methods: Rankine’s method of deflection angles (one and two theodolite methods). (Numerical on simple circular curves and compound curves to be asked), <u>Transition curves: necessity.</u>

Unit V: Construction Survey & Modern Techniques such as Space Based Positioning System (SBPS) (06 Hours)

a. Introduction to construction survey, establishing of horizontal and vertical controls, setting out of buildings, maintaining verticality of tall buildings, survey for open traverse (roadway, railways, drainage lines, water lines, canals)., Setting out of a bridge, Determination of the length of the central line and the location of piers. Setting out of a tunnel – Surface setting out and transferring the alignment underground.

b. Introduction to SBPS, SBPS systems - GPS, GLONASS, Galileo, GAGAN, BeiDou and their features, Segments of SBPS (Space, Control and User), applications of SBPS in surveying.

Unit VI: Introduction to Geodetic Survey, Hydrograph Survey & Aerial Photogrammetry (07 Hours)

Introduction to Geodetic Survey, Objects, Methods of Geodetic Surveying, Introduction to triangulation and trilateration, Objective of triangulations surveys, Classification of triangulation systems, Triangulation figures, Strength of figure, Study and use of one second theodolite and Electronic Total Station,

Introduction to Hydrographic Survey Objects, Applications, Shore line survey, Sounding, Sounding equipment, Methods of Sounding & Sounding Equipment, Stream gauging,

Three point problem

Aerial Photogrammetry Objects, Classification- qualitative & quantitative photogrammetry, Applications, comparison of Map and aerial photographs, Flight Planning , Calculation of no of Photographs.

Books:

Text Books:

1. Surveying and Levelling Vol. I and Vol. II by T. P. Kanetkar and S. V. Kulkarni, Pune Vidyarthi Griha Prakashan.
2. Surveying, Vol. I & II by Dr. B. C. Punmia, Ashok K. Jain, Arun K. Jain, Laxmi Publications.
3. Plane Surveying & Higher Surveying by Dr A. M. Chandra, New age international publishers New Delhi.

Reference Books:

1. GPS Satellite Surveying—Alfred Leick—Wiley
2. Principles of Geographical Information System—Burrough-- Oxford University Press
3. Surveying—M. D. Saikia—PHI Learning Pvt .Ltd. Delhi
4. Advanced Surveying -Total Station, GIS and Remote Sensing by Satheesh Gopi, R. Sathikumar and N. Madhu , Pearson publication
5. Surveying & levelling by R. Subramanian, Oxford Publication.

Savitribai Phule Pune University, Pune
Second Year Civil Engineering
201010 Concrete Technology
Credits: 03

Teaching Scheme:	**Examination Scheme:**	
Theory : 03 hrs/week	In-semester	: 30 Marks
Practical : 02 hrs/week	End-semester	: 70 Marks

Course Objectives:

1. To know properties of various ingredients of concrete and concept of mix design.
2. To learn the behavior and propertiesof concrete infresh and hardened state.
3. To understand special concrete and their applications.
4. To understand the durability aspects and preventive measures to enhance the fife of concrete.

Course Outcomes:

1. Able to select the various ingredients of concrete and its suitable proportion to achieved desired strength.
2. Able to check the properties of concrete in fresh and hardened state.
3. Get acquainted to concreting equipments, techniques and different types of special concrete.
4. Able to predict deteriorations in concrete and get acquainted to various repairing methods and techniques.

Course Contents

Unit I: Introduction to Concrete and Ingredients of Concrete. (06 Hours)

a) Cementand Aggregate– Manufacture, chemical composition, hydration, physical and mechanical properties, classification, types and application of cement, tests on cement, Classification of aggregate, physical and mechanical properties of aggregate, deleterious materials in aggregate, alkali-aggregate reaction, Fineness and gradation of aggregates using sieve analysis, tests on aggregates.

b) Water and Admixtures –Quality of water for use in concrete, role of admixture, classification and types of admixtures like accelerators, retarders, plasticizers, super plasticizers, mineral admixtures-fly ash, silica fume, ground granulated blast furnace slag.

Unit II: Production, Properties and Testing of Fresh Concrete (06 Hours)

a) Production and Properties of Fresh Concrete: Nominal mixes, Water-cement ratio, Process of manufacturing fresh concrete-batching, mixing, transportation, compaction, curing of concrete, curing methods, influence of temperature, maturity rule, workability and factors affecting workability, cohesion and segregation.

b) Tests on fresh concrete – Workability by slump cone, compaction factor, Vee-Bee consistometer and flow table apparatus, Effect of admixture on workability of concreteand optimum dosage of admixture by Marsh cone test.

Unit III: Properties and Testing of Hardened Concrete (06 Hours)

a) Hardened concrete – Strength of concrete, factors affecting strength, micro-cracking and stress-strain relationship, relation between tensile and compression strength, impact strength, abrasion resistance, creep and shrinkage.

b) Testing of hardened concrete –Destructive tests -compression strength, flexural strength, indirect tensile strength, core test. Nondestructive tests: rebound hammer, ultrasonic pulse velocity, pullout test and impact echo test.

Unit IV: Concrete Mix Design and Methods of Mix Design (06 Hours)

a)Concrete Mix Design– Concept and objectives of concrete mix design, factors affecting the mix design, quality control, variability of laboratory test result, acceptance criteria, Grade designation and IS requirements as per IS 456 (Exposure conditions, minimum & maximum cement content and maximum W/C ratio

b) Methods of Mix Design: IS code method and DOE method (with and without mineral admixture), Use of spreadsheet/programming/ software for concrete mix design.

Unit V: Concreting Equipments, Techniques and Special concretes (06 Hours)

a) Concreting Equipments and Techniques–Batching plants, concrete mixers, hauling, pumps, concrete vibrators and compaction equipments. Special concreting techniques- ready mix concrete, under water concreting, roller compacted concrete, cold and hot weather concreting.

b) Special concretes – Light weight concrete and its types, foam concrete, no fines concrete, self compacting concrete, high density concrete, fiber reinforced concrete,geo-polymer concrete and Ferrocement technique.

Unit VI: Deterioration and Repairs in Concrete (06 Hours)

a) Deterioration –Durability, factors affecting the durability of concrete, Permeability, sulphate attack, acid attack, chloride attack, corrosion of reinforcement, carbonation of concrete

b) Repairs – Symptoms and diagnosis of distress, evaluation of cracks, selection of repair procedure, repair of defects using various types and techniques – shotcrete and grouting. Introduction to retrofitting of concrete structures by fiber reinforced polymer (FRP), polymer impregnated concrete. Corrosion monitoring and preventive measures.

Books:

Text Books:

1. Concrete Technology by M. S. Shetty, S Chand,New Delhi-110055.
2. Concrete Technology by M. L. Gambhir, Tata McGraw-Hill.
3. Concrete technology by A. M. Neville, J.J. Brooks, Pearson.

Reference Books:

1. Concrete Technology by A. R. Shantakumar, Oxford University Press, 2018.
2. Properties of Concrete by A. M. Neville, Longman Publishers.
3. Concrete Technology by R.S. Varshney, Oxford and IBH.
4. Microstructure and Properties of Concrete by P. Kumar Mehta, Prentice Hall.
5. Concrete Mix Design by A. P. Remideos, Himalaya Publishing House.
6. Concrete Structures, Repair, Rehabilitation and Retrofitting by J. Bhattacharjee, CBS Publishers & Distributors Pvt. Ltd.
7. Durability Design of Concrete Structures, by A. Sarja and E. Vesiari, E & FN Spon Publication, 1996.

IS Codes : Latest revised editions of IS codes: IS 456, IS 269, IS 1489, IS 4031, IS 383, IS 2386, IS 9103, IS 516, IS 1199, IS 10262, SP 23.IS 13311.

Savitribai Phule Pune University, Pune

Second Year Civil Engineering (2019 Course)

201011: Structural Analysis

Credits : 03

Teaching Scheme:		**Examination Scheme :**	
Theory	: 03 hrs/week	In-semester	: 30 Marks
Tutorial	: 01 hrs/week	End-semester	: 70 Marks

Prerequisites:

Fundamentals of Physics, Mathematics, Engineering Mechanics andMechanics of Structures

Course Objectives:

1. This subject will build on the concepts from Engineering Mechanics and Mechanics of Structures.
2. This will create a foundation for analyzing real life structures by imparting knowledge about various methods involved in the analysis of indeterminate structures.

Course Outcomes:

On completion of the course, learner will be able to:

1. Understand the basic concept of static and kinematic indeterminacy and analysis of indeterminate beams.
2. Analyze redundant trusses and able to perform approximate analysis of multi-story multi-bay frames.
3. Implement application of the slope deflection method to beams and portal frames.
4. Analyze beams and portal frames using moment distribution method.
5. Determine response of beams and portal frames using structure approach of stiffness matrix method.
6. Apply the concepts of plastic analysis in the analysis of steel structures.

Course Contents

Unit I: Fundamentals of structure and analysis of redundant beams. (07 Hours)

a)<u>Types and classification of structures based on structural forms, concept of indeterminacy, static and kinematics degree of indeterminacy.</u>

b) Analysis of propped cantilever, fixed beam and continuous beams with indeterminacy up to second degree by strain energy method.

Unit II: Analysis of redundant pin jointed frames and multi-storied multi-bay 2-D rigid jointed frames. (07Hours)

a) <u>Analysis of redundant trusses by unit load method for external loading</u>, lack of fit, sinking of support and temperature changes (indeterminacy up to second degree).

b) Approximate methods of analysis of multi-storied multi-bay 2-D rigid jointed frames by Cantilever method and Portal method.

Unit III: Slope-Deflection Method. **(07 Hours)**

a) Slope-deflection equations, equilibrium equation of Slope-deflection method, application of Slope deflection method to beams with and without joint translation and rotation, yielding of support, application to non-sway rigid jointed rectangular portal frames, shear force and bending moment diagram.

b) Sway analysis of rigid joint rectangular single bay single storey portal frames using Slope-deflection method. (Involving not more than three unknowns)

Unit IV: Moment Distribution Method. **(07 Hours)**

a) Stiffness factor, carry over factor, distribution factor, application of Moment distribution method of analysis to beams with and without joint translation and yielding of support, application to non-sway rigid jointed rectangular portal frames, shear force and bending moment diagram.

b) Sway analysis of rigid jointed rectangular single bay single storey portal frames using Moment distribution method (Involving not more than three unknowns).

Unit V: Stiffness method. **(07Hours)**

a) Fundamental concepts of flexibility and stiffness, relation between them. Stiffness method of analysis- Structure approach only. Application to beams (Involving not more than three unknowns).

b) Application of Stiffness structure approach to rigid jointed rectangular portal frames (Involving not more than three unknowns).

Unit VI: Plastic Analysis of Structure. **(07Hours)**

True and idealized stress-strain curve for mild steel in tension, stress distribution in elastic, elasto-plastic and plastic stage, concept of plastic hinge and collapse mechanism, static and kinematic methods of analysis, upper bound, lower bound and uniqueness theorem. Plastic modulus of section, Plastic moment, shape factor. Plastic analysis of determinate and indeterminate beams, single bay single storied portal frame.

Books:

Text Books:

1. Theory of Structures by S. Ramamrutham and R. Narayan, Dhanpat Rai Publishing Company (P) Ltd.
2. Structural Analysis-I & II by S. S. Bhavikatti, Vikas Publishing House Pvt. Ltd.
3. Structural Analysis: A Matrix Approach by G.S.Pandit and S. P. Gupta, Tata McGraw Hill Education Pvt. Limited.

Reference Books:

1. Intermediate Structural Analysis by C. K. Wang, Tata McGraw Hill Education Pvt. Ltd.
2. Mechanics of Structures Vol. II (Theory and Analysis of Structures) by Dr. H. J. Shah and S. B. Junnarkar, Charotar Publishing House Pvt. Ltd.
3. Basic Structural Analysis by C. S. Reddy, Tata McGraw Hill Education Pvt. Ltd.
4. Structural Analysis by R. C. Hibbler, Pearson Education.
5. The Plastic Methods of Structural Analysis by B. G. Neal, Champman& Hall.
6. Structural Analysis by AslamKassimali, Cengage Learning India Private Limited
7. Matrix Analysis of Framed Structures by William Weaver Jr. and James M. Gere, Springer US.

Savitribai Phule Pune University, Pune

Second Year Civil Engineering (2019 Course)

201012 Project Management

Credit : 3

Teaching Scheme:	**Examination Scheme:**
Theory:3hrs / week	In-semester : 30 Marks
	End-semester : 70 Marks

Prerequisites:

Fundamentals of Management, Indian Construction Industry, Economics.

Course Objectives:

Students will be able to:

1. **Describe** the various concepts involved in Project Management.
2. **Explain** scientific methods of planning and management
3. **Segregate** the materials as per their annual usage and **explain** process to find production rate of construction equipment
4. **Demonstrates** methods of manpower planning and **Use** various project monitoring methods.
5. **Discuss** engineering economics and different laws associated with project management.
6. **Differentiate** the methods of project selection and **recommend** the best economical project.

Course Outcomes:

On completion of the course, student will:

1. **Describe** project life cycle and the domains of Project Management.
2. **Explain** networking methods and their applications in planning and management
3. **Categorize** the materials as per their annual usage and also **Calculate** production rate of construction equipment
4. **Demonstrates** resource allocation techniques and **apply** it for manpower planning.
5. **Understand** economical terms and different laws associated with project management
6. **Apply** the methods of project selection and **recommend** the best economical project.

Course Contents:

UNIT I Introduction to Project Management (06 Hours)

Importance, Objectives & Functions of Management, Principles of Management, Categories of Project, Project Failure, Project--- Life Cycle Concept and Cost Components, Project Management Book of Knowledge {PMBOK} – Different Domain Areas, Project management Institute and Certified Project Management Professionals (PMP). Importance of Organizational Structure in Management- Authority / Responsibility Relation, Management By Objectives (MBO)

UNIT II Project Planning and Scheduling (06 Hours)

WBS – Work Breakdown Structure, Gantt / Bar chart & its Limitations, Network Planning, Network analysis, C. P. M.- . Activity on Arrow (A.O.A.), Critical Path and Type of Floats, Precedence Network Analysis (A.O.N.), Types of Precedence Relationship, P. E. R.T. Analysis

UNIT III Project Resources and Site Planning (06 Hours)

Objectives of Materials Management – Primary and Secondary Material Procurement Procedures -

Material Requirement - Raising of Indents, Receipts, Inspection, Storage, Delivery, Record Keeping – Use of Excel Sheets, ERP Software, Inventory Control - ABC Analysis, EOQ, Introduction to Equipment Management – Fleet Management, Productivity Studies, Site Layout and Planning, Safety Norms – Measures and Precautions on Site, Implementation of Safety Programs

UNIT IV Project Monitoring and Control (06 Hours)

Resource Allocation – Resource Smoothening and Leveling, Network Crashing – Time- Cost – Resource Optimization, Project Monitoring - Methods, Updating and Earned Value Analysis, Introduction to Use of Project Management Software's – MS Project / Primavera, Case study on Housing Project Scheduling for a Small Project with Minimum 25 Activities.

UNIT V Project Economics (06 Hours)

Introduction to Project Economics - Definition, Principles, Importance in Construction Industry, Difference between Cost, Value, Price, Rent, Simple and Compound Interest, Profit, Cash flow Diagram, Annuities and its Types, Demand, Demand Schedule, Law of Demand, Demand Curve, Elasticity of Demand and Supply, Supply Schedule, Supply Curve, Elasticity of Supply Equilibrium, Equilibrium Price, Equilibrium Amount, Factors Affecting Price Determination, Law of Diminishing Marginal Utility, Law of Substitution, Concept of Cost of Capital, Time Value of Money, Sources of Project Finance.

UNIT VI Project Appraisal (06 Hours)

Types of Appraisals such as Political, Social, Environmental, Techno-Legal, Financial and Economical, Criteria for Project Selection - Benefit - Cost Analysis, NPV, IRR, Pay-Back Period, Break Even Analysis [Fundamental and Application Component], Study of Project Feasibility Report and Detailed Project Report (DPR), Role of Project Management Consultants in Pre-Tender and Post-Tender.

Books:

Text Books:

1. Project planning and Control with PERT and CPM by DR. B.C. Punmia and K.K.Khadelwal Publisher: Firewall Media, Laxmi publication New Delhi.
2. Project management Principles and Techniques by B.B. Goel Publisher: Deep and Deep publisher

Reference Books:

1. Project Management—Khatua—Oxford University
2. Construction Project Management-Planning, Scheduling and Controlling by K. K. Chitkara, Tata McGraw Hill Publishing Company, New Delhi.
3. Construction Management and Planning by B. Sengupta and H. Guha, Tata McGraw Hill Publishing Company, New Delhi.
4. The Essentials of Project Management by Dennis Lock, Gower Publishing Ltd. UK.
5. Essentials for Decision Makers by Asok Mukherjee, Scitech Publication, New Delhi.
6. Total Quality Management - Dr. S.Rajaram and Dr. M. Sivakumar-- Biztantra
7. Total Engineering Quality Management – Sunil Sharma – Macmillan India Ltd.
8. Engineering Economics by R.Panneerselvam Publisher-PHI Learning; 2nd edition (2014)

Savitribai Phule Pune University, Pune
Second Year Civil Engineering (2019 Course)
201013 Geotechnical Engineering-Lab

Credit : 01

Teaching Scheme:	**Examination Scheme:**
Practical: 2 hrs / week	Oral : 50 Marks

List of Laboratory Experiments / Assignments

The term work shall consist of a journal giving details of at least 11 out of 13 of the following experiments.

1. Water content determination by any two methods a) Oven drying method, b) Infrared moisture method, c) calcium carbide method
2. Specific gravity determination by Pycnometer /density bottle.
3. Sieve analysis, particle size determination and IS classification as per I.S. Codes.
4. Determination of Consistency limits and their use in soil classification as per I.S. Codes.
5. Field density test by a) Core cutter b) Sand Replacement and c) Clod method
6. Determination of coefficient of permeability by a) Constant head and b) Variable head method.
7. Direct shear test.
8. Unconfined compression test.
9. Vane Shear test.
10. Triaxial test
11. Standard Proctor test / Modified Proctor test.
12. Differential free swell test.
13. Swelling Pressure test
14. **Assignments on the following topics** (Any 2):
    a) Rebhann's and Cullman's graphical method for determination of earth pressure.
    b) Solution of problems on shear strength parameters using graph.
    c) Collection of sample soil investigation report for any construction project.

Savitribai Phule Pune University, Pune
Second Year Civil Engineering (2019 Course)
201014 : Surveying - Lab
Credit : 01

Teaching Scheme:	**Examination Scheme:**
Practical: 4 hrs / week	Practical : 50 Marks

List of Laboratory Experiments

a) Perform any Eight Experiments out of 1 to 10 and Any 02 assignments & projects are mandatory:

1. Measurement of magnetic bearings of sides of a triangle or quadrilateral, correction for local attraction and calculations of true bearings using prismatic compass.
2. Plane table survey consisting of both Radiation and Intersection method. Actual mapping of small structure like an area map from central commanding area / small building using combination of both methods.
3. Finding horizontal distance and vertical elevation using a Tacheometer.
4. Simple and differential levelling with at least three change points using digital level.
5. Measurement of horizontal angles (by repetition method) and vertical angles using 1” and 20” Vernier Transit Theodolite. Setting the required horizontal and vertical angles
6. Setting out a circular curve by Rankine’s method of deflection angles.
7. Setting out a building from a given foundation plan (minimum six co-ordinates)
8. Study and use of nautical sextant and measurement of horizontal angles
9. Study of the instruments used in hydrographic surveying.
10. Practical based on various special functions available in a total station such as remote elevation measurements, remote distance measurements and co-ordinate stakeout.

Mandatory Assignments: (Minimum 02)

1. Spatial database creation by using GIS software like Google earth or any other.
2. Brief Introduction to City Survey.
3. Study of aerial photograph and finding out the scale of the photograph.
4. Determination of air base distance using mirror stereoscope.

b) Projects:(Minimum Two)

1. Road project using Auto level for a minimum length of 100 m including fixing of alignment, profile levelling, cross-sectioning, plotting of L section and Cross Section. (One full imperial sheet including plan, L-section and any three typical Cross-section.

2. Tachometric contouring project on hilly area with at least two instrument stations about 60 m to 100 m apart and generating contours using both methods, manual as well as using any suitable software such as Autodesk land desktop, Auto-civil, Foresight etc. (minimum contour interval 1 meter).

3. Total Station Traversing

Savitribai Phule Pune University, Pune

Second Year Civil Engineering (2019 Course)

201015 Concrete Technology - Lab

Credit : 01

Teaching Scheme:	**Examination Scheme:**
Practical: 2 hrs / week	Term work : 25 Marks

List of Laboratory Assignments

The term work shall consist of a journal giving details of all the following experiments.

A] Cementitious materials:

1. Fineness of cement and fly ash (by sieve method)
2. Standard consistency Initial and final setting time and Soundness of cement.
3. Compressive strength of cement
4. Tensile strength of cement (**Optional**)

* Fineness of cement by Blains Air permeability method (**<u>Video demo</u>**)

* Soundness of cement by Autoclave method (**<u>Video demo</u>**)

B] Filler Materials (Fine & coarse aggregate)

1. Fineness modulus, Moisture content, silt content, bulk density and specific gravity of fine aggregate.
2. Fineness modulus, Moisture content, water absorption, bulk density and specific gravity of coarse aggregate.

C] Concrete

1. Concrete mix design by IS code method and DOE **<u>using spread sheet/excel sheet</u>**.
2. Workability of concrete with and without admixture by slump cone, compaction factor, and or Vee-BeeConsistometer apparatus.
3. Compressive strength test of concrete on cubes by destructive and non-destructive method rebound Hammer and Quality of concrete by ultra-sonic pulse velocity (**<u>demo Video</u>**).
4. Compressive strength test of concrete on cylinder (Stress –strain behavior- **<u>demo Video</u>**).
5. Indirect tensile strength and flexural strength of hardened concrete.
6. Site visit to RMC plant.

Savitribai Phule Pune University, Pune

Second Year Civil Engineering (2019 Course)

201011: Structural Analysis -Tutorial

Credit : 01

Teaching Scheme:	**Examination Scheme:**
Tutorial: 1 hrs / week	Term work : 25 Marks

Tutorial: Every student should solve at least five problems on each unit covering all the topics listed in syllabus.

Savitribai Phule Pune University, Pune
Second Year Civil Engineering (2019 Course)
201017 Project Based Learning
Credits: 02

Teaching Scheme:
Practical : 04hrs/week

Examination Scheme:
Term Work: 50 Marks

Preamble:
Project Based Learning (PBL) was introduced in curriculum of First Year Engineering in Semester II (Course code- 110013) in 2019 course. In that course, students in group might have planned, managed and completed a task/ project/ activity which addressed the stated problem. In a continuation with this, PBL is introduced in core course of Civil Engineering. PBL demonstrates the power of student projects to develop college, community connections, applied research skills and higher levels of student thinking. PBL is a dynamic approach to teaching in which students explore real-world problems and challenges simultaneously developing 21st century Civil Engineering skills while working in collaborative groups. The aim of this course is to demonstrate the important attributes like communication, presentation, organization, time management, research, inquiry, self-assessment, group participation, leadership and critical thinking. Performance assessed on an individual basis and takes into account the quality of task/project/activity completed, the depth of content understanding demonstrated and the contributions made to the ongoing process of project realization. PBL allows students to reflect upon their own ideas and opinions and make decisions that affect project outcomes and the learning process in general.

Course Objectives:
1. To engage students in constructive learning environment and develop self-learning abilities.
2. To develop critical thinking and solving civil engineering problems by exploring and proposing sustainable solutions.
3. To integrate knowledge and skills from civil and other engineering areas.
4. To develop professional skills and project management.

Course Outcomes:
After completion of course the students will be able to
1. Identify the community/ practical/ societal needs and convert the idea into a product/ process/ service.
2. Analyse and design the physical/ mathematical/ ICT model in order to solve identified problem/project.
3. Create, work in team and applying the solution in practical way to specific problem.

Course Content
- Introduction to Project Based Learning, Traditional vs. Cognitive Learning, Why PBL? , Principles of Problem Design Seven Steps of Problem Design, Online PBL, Applications and Research Trends Case Studies in Civil Engineering.

Group Structure:

- Working in mentor – monitored groups. The students identify, plan, manage and complete a task/ project/ activity which address the stated problem related to civil engineering.
- There should be team/group of maximum four students.
- A supervisor / mentor faculty teacher assigned to individual groups.

Selection of Project/Problem:

At start of course revision of PBL, significance, guidelines and evaluation parameters should be discussed commonly at start of semester. In this session basics PBL, in brief research methodology points relevant to PBL, sample case studies related to civil engineering and brief information about patent, copy right and publications should be given.

Selection of project/problem related to any technical aspect of civil engineering is recommended or if any project/problem selected in first year engineering related to civil engineering can be continued if enough potential is there. Give preference to select project/problem related to solving any problem/ issue for which suitable model can be developed or software can be used. The project/problem selected could have different alternative solutions which could be theoretical, practical, working model, demonstration or software analysis. The project/problem selected may have multi-disciplinary approach to get the solution. Problem needs to refer back to a particular practical, scientific, or technical domain. It is recommended to include hands-on activities, organizational and field visits, expert consultation to make students aware with current use of technologies. Proper representation of project/problem, course work and report on the results and conclusion is important for assessment of course.

Assessment:

The institution/head/mentor is committed to assessing and evaluating both students' performance and program effectiveness. Progress and review of PBL is monitored regularly on weekly basis. It is recommended to appoint one teaching faculty as a mentor per group/ batch and it will be duty of mentor to perform monitoring and continuous assessment of individual students as well as entire group for their performance. College/ Department is required to provide necessary assistance. It is the responsibility of students to follow guidelines of their group mentor, maintain self-discipline, authentic collaboration, peer learning and personal responsibility, motivation and adopt interactive learning environment. The institution/department should support students in this regard through guidance/orientation programs and the provision of appropriate resources and services. Supervisor/mentor and Students must actively participate in assessment and evaluation processes. Intermittent review and assessment of each group should be done after six weeks from the start of the semester. Each group has to submit their work at end of semester during the end review. Group may demonstrate their knowledge and skills through presentation by developing a model/product/poster and report. Individual assessment for each student (Understanding individual capacity, role and involvement in the project). Group assessment (roles defined, distribution of work, intra-team communication and togetherness).

Evaluation and Continuous Assessment:

Prepare "**PBL Log Book**" which includes record of activities performed and evaluation carried out with appropriate remarks. Maintain regular record on weekly basis. Records and documents must also be maintained at student level. Continuous assessment sheet must be prepared by each faculty which consists assessment made on weekly basis also performance made during mid-review and end-review. PBL log book must be maintained as a record even after completion of semester. It will serve as document which will reflect the punctuality, accountability, technical writing ability and project workflow.

Recommended parameters for assessment, evaluation and weightage:

Evaluation criteria and respective percentage weightage for marks.

1. Idea Inception = 5%
2. Solution provided/ final product at end of course = 50% (Individual assessment and team assessment).
3. Documentation in the form of PBL report (typed, hard copy) = 15%
4. Presentation/ Demonstration of model/ PPT/ poster = 10%
5. Participation/ involvement in group activity =10%
6. Publication/ participation on technical platform = 10%

Course assessment rubrics can be prepared based on the given evaluation parameters for excellent, moderate, acceptable and not acceptable.

References:

1. M. Savin-Baden and C. Howell Major, Foundations of Problem-based Learning. McGraw-Hill Education, 2004
2. T. J. Newby, D. A. Stepich, J. D. Lehman and J. D. Russell, Instructional technology for teaching and learning: Designing instruction, integrating computers, and using media. Englewood Cliffs, NJ: Merrill/Prentice-Hall, 1996
3. S. N. Alessi and S. R. Trollip, Multimedia for learning: methods and development. Needham Heights, MA: Allyn& Bacon, 2001
4. Guerra, Aida, Ulseth, Ronald, Kolmos, Anette, PBL in Engineering Education: International Perspectives on Curriculum Change, Springer, 2017
5. MahnazMoallemWoei Hung Nada Dabbagh, The Wiley Handbook of Problem-Based Learning, Wiley, 2019
6. Jane I. Krauss, Suzanne K. Boss, Thinking Through Project-Based Learning: Guiding Deeper Inquiry.
7. John Larmer, David Ross, John R. Mergendollar, Project Based Learning (PBL) Starter Kit.
8. William N. Bender, Project-Based Learning: Differentiating Instruction for the 21st Century.
9. Bob Lenz, Justin Wells, Sally Kingston, Transforming Schools Using Project-Based Learning, Performance Assessment, and Common Core Standards.
10. Suzie Boss with John Larmer (ASCD/Buck Institute for Education), Implementing Project-Based Learning Solutions by Suzie Boss

Website for references

1. www.pblwork.org
2. www.my.pblworks.org
3. www.swayam.gov.in/nd2_ntr20_ed12/preview
4. www.schoology.com

Format of PBL report: Sequence of pages:

i) Front Cover Page ii) Certificate iii) Acknowledgement iv) Synopsis v) Contents vi) List of

Figures vii) List of Tables vii) Notations

Chapter 1 Introduction (This consists of: 1.1 Introduction of the Project Work; 1.2 Problem Statement, 1.3 Objectives and 1.4 Scope of the Project Works, 1.5 Research Methodology, 1.6 Limitations of study, 1.7 Expected outcome.

Chapter 2 Literature Review (It shall include theoretical support, details regarding work done by various persons, methods established, any new approach.

Chapter 3 Planning Schedule/ Flow Chart for Completion of Project

Chapter 4 Conclusion

References and Bibliography (The references and bibliography shall include name of author/code/manual/book, title of paper/code/manual/book, name of the journal, month & year of publication, volume number/ISBN number, page number x-y. The references and bibliography shall be as per universal standards as mentioned in any international journal of professional body).

Report Printing details:

1. Report shall be typed on A4 size Executive Bond paper with single spacing preferably on **Both** sides of paper.
2. Margins: Left Margin: 37.5 mm, Right Margin: 25 mm, Top Margin: 25 mm, Bottom Margin: 25 mm.
3. Give page number at bottom margin at center.
4. Size of Letters: Chapter Number: 16 font size, Times New Roman in Capital Bold Letters, Chapter Name: 12 Font size in Capital Bold Letters, Main Titles (1.1, 2.5 etc): 16 Font size in Bold Letters Sentence case, Sub Titles (1.1.5, 4.5.1 etc): 14 Font size in Bold Letters Sentence case. All other matter: 12 Font size sentence case.
5. No blank sheet be left in the report.
6. Figure name: 12 Font size in sentence case Bold- Below the figure.
7. Table title -12 font size in sentence case- Bold-Above the table.

Faculty of Engineering
Savitribai Phule Pune University, Pune

Maharashtra, India

Syllabus

for

Fourth Year of Computer Engineering
(2015 Course)

(with effect from 2018-19)

Prologue

It is with great pleasure and honor that I share the syllabi for Fourth Year of Computer Engineering (2015 Course) on behalf of Board of Studies (BoS), Computer Engineering. We, members of BoS are giving our best to streamline the processes and curricula design at both UG and PG programs.

It is always the strenuous task to balance the syllabus with the blend of core subjects, current developments and exotic subjects. By considering all the aspects with adequate prudence the contents are designed to make the graduate competent enough as far as employability is concerned. It is absolutely necessary and justified to add sufficient flexibility in the given constraints leading the curriculum design near to perfection.

It may be highly subjective to include or exclude the courses, but benefit of the learner is always the nucleus the process. Many thoughts, suggestions, recommendations and directions help us to come up with the final contents. For the final year finishing touch is absolutely necessary which is provided with project based learning at the most.

I sincerely thank all the minds and hands who work adroitly to materialize these tasks. I really appreciate everyone's contribution and suggestions in finalizing the contents.

Dr. Varsha H. Patil
Coordinator, Board of Studies (Computer Engineering), SPPU, Pune

[This document contents Program Educational Objectives - Program Outcomes - Program Specific Outcomes(page 3),Courses (teaching scheme, examination, marks and credit)(page 4-5), Courses syllabi(page 7-85) and FE to BE courses at a glance(Page 86-87)].

Other related Syllabus Links:
Syllabus for First Year Engineering (2015 Course)
Syllabus for Second Year Computer Engineering (2015 Course)
Syllabus for Third Year Computer Engineering (2015 Course)

Savitribai Phule Pune University, Pune
Bachelor of Computer Engineering

Program Educational Objectives

1. To prepare globally competent graduates having strong fundamentals, domain knowledge, updated with modern technology to provide the effective solutions for engineering problems.
2. To prepare the graduates to work as a committed professional with strong professional ethics and values, sense of responsibilities, understanding of legal, safety, health, societal, cultural and environmental issues.
3. To prepare committed and motivated graduates with research attitude, lifelong learning, investigative approach, and multidisciplinary thinking.
4. To prepare the graduates with strong managerial and communication skills to work effectively as individual as well as in teams.

Program Outcomes

Students are expected to know and be able –

1. To apply knowledge of mathematics, science, engineering fundamentals, problem solving skills, algorithmic analysis and mathematical modeling to the solution of complex engineering problems.
2. To analyze the problem by finding its domain and applying domain specific skills
3. To understand the design issues of the product/software and develop effective solutions with appropriate consideration for public health and safety, cultural, societal, and environmental considerations.
4. To find solutions of complex problems by conducting investigations applying suitable techniques.
5. To adapt the usage of modern tools and recent software.
6. To contribute towards the society by understanding the impact of Engineering on global aspect.
7. To understand environment issues and design a sustainable system.
8. To understand and follow professional ethics.
9. To function effectively as an individual and as member or leader in diverse teams and interdisciplinary settings.
10. To demonstrate effective communication at various levels.
11. To apply the knowledge of Computer Engineering for development of projects, and its finance and management.
12. To keep in touch with current technologies and inculcate the practice of lifelong learning.

Program Specific Outcomes (PSO)

A graduate of the Computer Engineering Program will demonstrate-

PSO1: Professional Skills-The ability to understand, analyze and develop computer programs in the areas related to algorithms, system software, multimedia, web design, big data analytics, and networking for efficient design of computer-based systems of varying.

PSO2: Problem-Solving Skills- The ability to apply standard practices and strategies in software project development using open-ended programming environments to deliver a quality product for business success.

PSO3: Successful Career and Entrepreneurship- The ability to employ modern computer languages, environments, and platforms in creating innovative career paths to be an entrepreneur, and a zest for higher studies.

Savitribai Phule Pune University
Fourth Year of Computer Engineering (2015 Course)
(with effect from 2018-19)

Semester I

Course Code	Course	Teaching Scheme Hours / Week		Examination Scheme and Marks						Credit	
		Theory	Practical	In-Sem	End-Sem	TW	PR	OR/ *PRE	Total	TH/ TUT	PR
410241	High Performance Computing	04	--	30	70	--	--	--	100	04	--
410242	Artificial Intelligence and Robotics	03	--	30	70	--	--	--	100	03	--
410243	Data Analytics	03	--	30	70	--	--	--	100	03	--
410244	Elective I	03	--	30	70	--	--	--	100	03	--
410245	Elective II	03	--	30	70	--	--	--	100	03	--
410246	Laboratory Practice I	--	04	--	--	50	50	--	100	--	02
410247	Laboratory Practice II	--	04	--	--	50	--	*50	100	--	02
410248	Project Work Stage I	--	02	--	--	--	--	*50	50	--	02
									Total Credit	**16**	**06**
Total		**16**	**10**	**150**	**350**	**100**	**50**	**100**	**750**	**22**	
410249	Audit Course 5									**Grade**	

Elective I	Elective II
410244 (A) Digital Signal Processing	**410245 (A)** Distributed Systems
410244 (B) Software Architecture and Design	**410245 (B)** Software Testing and Quality Assurance
410244 (C) Pervasive and Ubiquitous Computing	**410245 (C)** Operations Research
410244 (D) Data Mining and Warehousing	**410245 (D)** Mobile Communication

410249-Audit Course 5 (AC5) Options:

AC5-I Entrepreneurship Development
AC5-II: Botnet of Things
AC5-III: 3D Printing
AC5-IV: Industrial Safety and Environment Consciousness
AC5-V: Emotional Intelligence
AC5-VI: MOOC- Learn New Skills

Abbreviations:

TW: Term Work **TH:** Theory **OR:** Oral **PR:** Practical

Sem: Semester *__PRE__: Project/ Mini-Project Presentation

Savitribai Phule Pune University
Fourth Year of Computer Engineering (2015 Course)
(with effect from 2018-19)

Semester II

Course Code	Course	Teaching Scheme Hours / Week		Examination Scheme and Marks						Credit	
		Theory	Practical	In-Sem	End-Sem	TW	PR	OR/ *PRE	Total	TH/ TUT	PR
410250	Machine Learning	03	--	30	70	--	--	--	100	03	--
410251	Information and Cyber Security	03	--	30	70	--	--	--	100	03	--
410252	Elective III	03	--	30	70	--	--	--	100	03	--
410253	Elective IV	03	--	30	70	--	--	--	100	03	--
410254	Laboratory Practice III	--	04	--	--	50	50	--	100	--	02
410255	Laboratory Practice IV	--	04	--	--	50	--	*50	100	--	02
410256	Project Work Stage II	--	06	--	--	100	--	*50	150	--	06
									Total Credit	**12**	**10**
Total		**12**	**14**	**120**	**280**	**200**	**50**	**100**	**750**	**22**	
410257	Audit Course 6									**Grade**	

Elective III	**Elective IV**
410252 (A) Advanced Digital Signal Processing	**410253 (A)** Software Defined Networks
410252 (B) Compilers	**410253 (B)** Human Computer Interface
410252 (C) Embedded and Real Time Operating Systems	**410253 (C)** Cloud Computing
410252 (D) Soft Computing and Optimization Algorithms	**410253 (D)** Open Elective

410259-Audit Course 6 (AC6) Options:

AC6-I: Business Intelligence
AC6-II: Gamification
AC6-III: Quantum Computing
AC6-IV: Usability Engineering
AC6-V: Conversational Interfaces
AC6-VI: MOOC- Learn New Skills

Abbreviations:

TW: Term Work **TH:** Theory **OR:** Oral **PR:** Practical

Sem: Semester *__PRE__: Project/ Mini-Project Presentation

SEMESTER

I

Home

Savitribai Phule Pune University
Fourth Year of Computer Engineering (2015 Course)
410241: High Performance Computing

Teaching Scheme: TH: 04 Hours/Week	Credit 04	Examination Scheme: In-Sem (Paper): 30 Marks End-Sem (Paper): 70 Marks

Prerequisite Courses: 210253-Microprocessor, 210244- Computer Organization and Architecture, 210254-Principles of Programming Languages, 310251- Systems Programming and Operating System

Companion Course: 410246-Laboratory Practice I

Course Objectives:

- To study parallel computing hardware and programming models
- To be conversant with performance analysis and modeling of parallel programs
- To understand the options available to parallelize the programs
- To know the operating system requirements to qualify in handling the parallelization

Course Outcomes:

On completion of the course, student will be able to–

- Describe different parallel architectures, inter-connect networks, programming models
- Develop an efficient parallel algorithm to solve given problem
- Analyze and measure performance of modern parallel computing systems
- Build the logic to parallelize the programming task

Course Contents

Unit I	Introduction	09 Hours

Motivating Parallelism, Scope of Parallel Computing, Parallel Programming Platforms: Implicit Parallelism, Trends in Microprocessor and Architectures, Limitations of Memory, System Performance, Dichotomy of Parallel Computing Platforms, Physical Organization of Parallel Platforms, Communication Costs in Parallel Machines, Scalable design principles, Architectures: N-wide superscalar architectures, Multi-core architecture.

Unit II	Parallel Programming	09 Hours

Principles of Parallel Algorithm Design: Preliminaries, Decomposition Techniques, Characteristics of Tasks and Interactions, Mapping Techniques for Load Balancing, Methods for Containing Interaction Overheads, Parallel Algorithm Models, The Age of Parallel Processing, the Rise of GPU Computing, A Brief History of GPUs, Early GPU.

Unit III	Basic Communication	09 Hours

Home

Operations- One-to-All Broadcast and All-to-One Reduction, All-to-All Broadcast and Reduction, All-Reduce and Prefix-Sum Operations, Scatter and Gather, All-to-All Personalized Communication, Circular Shift, Improving the Speed of Some Communication Operations.

Unit IV	Analytical Models of Parallel Programs	09 Hours

Analytical Models: Sources of overhead in Parallel Programs, Performance Metrics for Parallel Systems, and The effect of Granularity on Performance, Scalability of Parallel Systems, Minimum execution time and minimum cost, optimal execution time. Dense Matrix Algorithms: Matrix-Vector Multiplication, Matrix-Matrix Multiplication.

Unit V	Parallel Algorithms- Sorting and Graph	09 Hours

Issues in Sorting on Parallel Computers, Bubble Sort and its Variants, Parallelizing Quick sort, All-Pairs Shortest Paths, Algorithm for sparse graph, Parallel Depth-First Search, Parallel Best-First Search.

Unit VI	CUDA Architecture	09 Hours

CUDA Architecture, Using the CUDA Architecture, Applications of CUDA Introduction to CUDA C-Write and launch CUDA C kernels, Manage GPU memory, Manage communication and synchronization, Parallel programming in CUDA- C.

Books:

Text:

1. Ananth Grama, Anshul Gupta, George Karypis, and Vipin Kumar, "Introduction to Parallel Computing", 2nd edition, Addison-Wesley, 2003, ISBN: 0-201-64865-2
2. Jason sanders, Edward Kandrot, “CUDA by Example”, Addison-Wesley, ISBN-13: 978-0-13-138768-3

References:

1. Kai Hwang, ”Scalable Parallel Computing”, McGraw Hill 1998, ISBN:0070317984
2. Shane Cook, “CUDA Programming: A Developer's Guide to Parallel Computing with GPUs”, Morgan Kaufmann Publishers Inc. San Francisco, CA, USA 2013 ISBN: 9780124159884
3. David Culler Jaswinder Pal Singh, ”Parallel Computer Architecture: A Hardware/Software Approach”, Morgan Kaufmann,1999, ISBN 978-1-55860-343-1
4. Rod Stephens, “ Essential Algorithms”, Wiley, ISBN: 978-1-118-61210-1

Home

Savitribai Phule Pune University
Fourth Year of Computer Engineering (2015 Course)
410242: Artificial Intelligence and Robotics

Teaching Scheme: TH: 03 Hours/Week	Credit 03	Examination Scheme: In-Sem (Paper): 30 Marks End-Sem (Paper): 70 Marks

Prerequisite Courses: 210254-Principles of Programming Languages

Companion Course: 410246-Laboratory Practice I

Course Objectives:

- To understand the concept of Artificial Intelligence (AI)
- To learn various peculiar search strategies for AI
- To acquaint with the fundamentals of mobile robotics
- To develop a mind to solve real world problems unconventionally with optimality

Course Outcomes:

On completion of the course, student will be able to–

- Identify and apply suitable Intelligent agents for various AI applications
- Design smart system using different informed search / uninformed search or heuristic approaches.
- Identify knowledge associated and represent it by ontological engineering to plan a strategy to solve given problem.
- Apply the suitable algorithms to solve AI problems

Course Contents

Unit I	Introduction	08 Hours

Artificial Intelligence: Introduction, Typical Applications. State Space Search: Depth Bounded DFS, Depth First Iterative Deepening. Heuristic Search: Heuristic Functions, Best First Search, Hill Climbing, Variable Neighborhood Descent, Beam Search, Tabu Search. Optimal Search: A^* algorithm, Iterative Deepening A^*, Recursive Best First Search, Pruning the CLOSED and OPEN Lists.

Unit II	Problem Decomposition and Planning	08 Hours

Problem Decomposition: Goal Trees, Rule Based Systems, Rule Based Expert Systems. Planning: STRIPS, Forward and Backward State Space Planning, Goal Stack Planning, Plan Space Planning, A Unified Framework For Planning. Constraint Satisfaction : N-Queens, Constraint Propagation, Scene Labeling, Higher order and Directional Consistencies, Backtracking and Look ahead Strategies.

Unit III	Logic and Reasoning	08 Hours

Home

Knowledge Based Reasoning: Agents, Facets of Knowledge. Logic and Inferences: Formal Logic, Propositional and First Order Logic, Resolution in Propositional and First Order Logic, Deductive Retrieval, Backward Chaining, Second order Logic. Knowledge Representation: Conceptual Dependency, Frames, Semantic nets.

Unit IV	Natural Language Processing and ANN	08 Hours

Natural Language Processing: Introduction, Stages in natural language Processing, Application of NLP in Machine Translation, Information Retrieval and Big Data Information Retrieval. Learning: Supervised, Unsupervised and Reinforcement learning. **Artificial Neural Networks** (ANNs): Concept, Feed forward and Feedback ANNs, Error Back Propagation, Boltzmann Machine.

Unit V	Robotics	08 Hours

Robotics: Fundamentals, path Planning for Point Robot, Sensing and mapping for Point Robot, Mobile Robot Hardware, Non Visual Sensors like: Contact Sensors, Inertial Sensors, Infrared Sensors, Sonar, Radar, laser Rangefinders, Biological Sensing. Robot System Control: Horizontal and Vertical Decomposition, Hybrid Control Architectures, Middleware, High-Level Control, Human-Robot Interface.

Unit VI	Robots in Practice	08 Hours

Robot Pose Maintenance and Localization: Simple Landmark Measurement, Servo Control, Recursive Filtering, Global Localization. Mapping: Sensorial Maps, Topological Maps, Geometric Maps, Exploration. Robots in Practice: Delivery Robots, Intelligent Vehicles, Mining Automation, Space Robotics, Autonomous Aircrafts, Agriculture, Forestry, Domestic Robots.

Books:

Text:

1. Deepak Khemani, “A First Course in Artificial Intelligence”, McGraw Hill Education(India), 2013, ISBN : 978-1-25-902998-1
2. Elaine Rich, Kevin Knight and Nair, “Artificial Intelligence”, TMH, ISBN-978-0-07-008770-5
3. Stuart Russell and Peter Norvig, “Artificial Intelligence: A Modern Approach”, Third edition, Pearson, 2003, ISBN :10: 0136042597
4. Michael Jenkin, Gregory, “ Computational Principals of Mobile Robotics”, Cambridge University Press, 2010, ISBN : 978-0-52-187157-0

References:

1. Nilsson Nils J , “Artificial Intelligence: A new Synthesis, Morgan Kaufmann Publishers Inc. San Francisco, CA, ISBN: 978-1-55-860467-4
2. Patrick Henry Winston, “Artificial Intelligence”, Addison-Wesley Publishing Company, ISBN: 0-201-53377-4
3. Andries P. Engelbrecht-Computational Intelligence: An Introduction, 2nd Edition-Wiley India- ISBN: 978-0-470-51250-0

Home

Savitribai Phule Pune University
Fourth Year of Computer Engineering (2015 Course)
410243: Data Analytics

Teaching Scheme:	Credit	Examination Scheme:
TH: 03 Hours/Week	03	In-Sem (Paper): 30 Marks End-Sem (Paper): 70 Marks

Prerequisite Courses: 310242-Database Management Systems

Companion Course: 410246-Laboratory Practice I

Course Objectives:

- To develop problem solving abilities using Mathematics
- To apply algorithmic strategies while solving problems
- To develop time and space efficient algorithms
- To study algorithmic examples in distributed, concurrent and parallel environments

Course Outcomes:

On completion of the course, student will be able to–

- Write case studies in Business Analytic and Intelligence using mathematical models
- Present a survey on applications for Business Analytic and Intelligence
- Provide problem solutions for multi-core or distributed, concurrent/Parallel environments

Course Contents

Unit I	Introduction and Life Cycle	08 Hours

Introduction: Big data overview, state of the practice in Analytics- BI Vs Data Science, Current Analytical Architecture, drivers of Big Data, Emerging Big Data Ecosystem and new approach. Data Analytic Life Cycle: Overview, phase 1- Discovery, Phase 2- Data preparation, Phase 3- Model Planning, Phase 4- Model Building, Phase 5- Communicate Results, Phase 6- Opearationalize. Case Study: GINA

Unit II	Basic Data Analytic Methods	08 Hours

Statistical Methods for Evaluation- Hypothesis testing, difference of means, wilcoxon rank–sum test, type 1 type 2 errors, power and sample size, ANNOVA. Advanced Analytical Theory and Methods: Clustering- Overview, K means- Use cases, Overview of methods, determining number of clusters, diagnostics, reasons to choose and cautions.

Unit III	Association Rules and Regression	08 Hours

Home

Advanced Analytical Theory and Methods: Association Rules- Overview, a-priori algorithm, evaluation of candidate rules, case study-transactions in grocery store, validation and testing, diagnostics. Regression- linear, logistics, reasons to choose and cautions, additional regression models.

Unit IV	Classification	08 Hours

Decision trees- Overview, general algorithm, decision tree algorithm, evaluating a decision tree. Naïve Bayes – Bayes' Algorithm, Naïve Bayes' Classifier, smoothing, diagnostics. Diagnostics of classifiers, additional classification methods.

Unit V	Big Data Visualization	08 Hours

Introduction to Data visualization, Challenges to Big data visualization, Conventional data visualization tools, Techniques for visual data representations, Types of data visualization, Visualizing Big Data, Tools used in data visualization, Analytical techniques used in Big data visualization.

Unit VI	Advanced Analytics-Technology and Tools	08 Hours

Analytics for unstructured data- Use cases, Map Reduce, Apache Hadoop. The Hadoop Ecosystem- Pig, HIVE, HBase, Mahout, NoSQL. An Analytics Project-Communicating, operationalizing, creating final deliverables.

Books:

Text:

1. David Dietrich, Barry Hiller, "Data Science and Big Data Analytics", EMC education services, Wiley publications, 2012, ISBN0-07-120413-X
2. Ashutosh Nandeshwar , "Tableau Data Visualization Codebook", Packt Publishing, ISBN 978-1-84968-978-6

References:

1. Maheshwari Anil, Rakshit, Acharya, "Data Analytics", McGraw Hill, ISBN: 789353160258.
2. Mark Gardner, "Beginning R: The Statistical Programming Language", Wrox Publication, ISBN: 978-1-118-16430-3
3. Luís Torgo, "Data Mining with R, Learning with Case Studies", CRC Press, Talay and Francis Group, ISBN9781482234893
4. Carlo Vercellis, "Business Intelligence - Data Mining and Optimization for Decision Making", Wiley Publications, ISBN: 9780470753866.

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Savitribai Phule Pune University
Fourth Year of Computer Engineering (2015 Course)
Elective I
410244(A): Digital Signal Processing

Teaching Scheme: TH: 03 Hours/Week	Credit 03	Examination Scheme: In-Sem (Paper): 30 Marks End-Sem (Paper): 70 Marks

Prerequisite Courses: 207003- Engineering Mathematics III

Companion Course: 410247-Laboratory Practice II

Course Objectives:

- To Study and understand representation and properties of signals and systems.
- To learn methodology to analyze signals and systems
- To study transformed domain representation of signals and systems
- To explore Design and analysis of Discrete Time (DT) signals and systems
- To Understand Design of filters as DT systems
- To get acquainted with the DSP Processors and DSP applications

Course Outcomes:

On completion of the course, student will be able to–

- Understand the mathematical models and representations of DT Signals and Systems
- Apply different transforms like Fourier and Z-Transform from applications point of view.
- Understand the design and implementation of DT systems as DT filters with filter structures and different transforms.
- Demonstrate the knowledge of signals and systems for design and analysis of systems
- Apply knowledge and use the signal transforms for digital processing applications

Course Contents

Unit I	Signals and Systems	08 Hours

Continuous time (CT), Discrete-time (DT) and Digital signals, Basic DT signals and Operations. Discrete-time Systems, Properties of DT Systems and Classification, Linear Time Invariant (LTI) Systems, Impulse response, Linear convolution, Linear constant coefficient difference equations, FIR and IIR systems, Periodic Sampling, Relationship between Analog and DT frequencies, Aliasing, Sampling Theorem, A to D conversion Process: Sampling, quantization and encoding.

Unit II	Frequency Domain Representation of Signal	08 Hours

Introduction to Fourier Series, Representation of DT signal by Fourier Transform (FT), Properties of FT: Linearity, periodicity, time shifting, frequency shifting, time reversal, differentiation, convolution theorem, windowing theorem Discrete Fourier Transform (DFT), DFT and FT, IDFT, Twiddle factor, DFT as linear transformation matrix, Properties of DFT, circular shifting, Circular Convolution, DFT as Linear filtering, overlap save and add, DFT spectral leakage.

Unit III	Fast Fourier Transform (FFT) and Z-Transform (ZT)	08 Hours

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Effective computation of DFT, Radix-2 FFT algorithms: DIT FFT, DIF FFT, Inverse DFT using FFT, Z-transform (ZT), ZT and FT, ZT and DFT, ROC and its properties, ZT Properties, convolution, initial value theorem, Rational ZT, Pole Zero Plot, Behavior of causal DT signals, Inverse Z Transform (IZT): power series method, partial fraction expansion (PFE) , Residue method.

Unit IV	Analysis of DT - LTI Systems	08 Hours

System function H(z), H(z) in terms of Nth order general difference equation, all poll and all zero systems, Analysis of LTI system using H(Z), Unilateral Z-transform: solution of difference equation, Impulse and Step response from difference equation, Pole zero plot of H(Z) and difference equation, Frequency response of system, Frequency response from pole-zero plot using simple geometric construction.

Unit V	Digital Filter Design	08 Hours

Concept of filtering, Ideal filters and approximations, specifications, FIR and IIR filters, Linear phase response, FIR filter Design: Fourier Series method, Windowing method, Gibbs Phenomenon, desirable features of windows, Different window sequences and its analysis, Design examples IIR filter design: Introduction, Mapping of S-plane to Z-plane, Impulse Invariance method, Bilinear Z transformation (BLT) method, Frequency Warping, Pre-warping, Design examples, Comparison of IIR and FIR Filters.

Unit VI	Filter Structures and DSP Processors	08 Hours

Filter Structures for FIR Systems: direct form, cascade form, structures for linear phase FIR Systems, Examples, Filter structures for IIR Systems: direct form, cascade form, parallel form, Examples DSP Processors: ADSP 21XX Features, comparison with conventional processor, Basic Functional Block diagram, SHARC DSP Processor Introduction to OMAP (Open Multimedia Application Platform).

Books:

Text:

1. Proakis J, Manolakis D, "Digital Signal Processing", 4th Edition, Pearson Education, ISBN 9788131710005
2. Oppenheium A, Schafer R, Buck J, "Discrete time Signal Processing", 2nd Edition, Pearson Education, ISBN 9788131704929

Reference:

1. Mitra S., "Digital Signal Processing: A Computer Based Approach", Tata McGraw-Hill, 1998, ISBN 0-07-044705-5
2. Ifleachor E. C., Jervis B. W., “Digital Signal Processing: A Practical Approach “, Pearson-Education, 2002, , ISBN-13: 978-0201596199,ISBN-10: 0201596199
3. S. Salivahanan, A. Vallavaraj, C. Gnanapriya, "Digital Signal Processing", McGraw-Hill, ISBN 0-07-463996-X
4. S. Poornachandra, B. Sasikala, “Digital Signal Processing”,3rd Edition, McGraw-Hill, ISBN-13:978-07- 067279-6

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Savitribai Phule Pune University

Fourth Year of Computer Engineering (2015 Course)

Elective I

410244(B): Software Architecture and Design

Teaching Scheme:	Credit	Examination Scheme:
TH: 03 Hours/Week	03	In-Sem (Paper): 30 Marks End-Sem (Paper): 70 Marks

Prerequisite Courses: 310243- Software Engineering and Project Management

Companion Course: 410247-Laboratory Practice II

Course Objectives:

- To introduce basic concepts and principles about software design and software architecture
- To learn practical approaches and methods for creating and analyzing software architecture
- To acquaint with the interaction between quality attributes and software architecture
- To experience with examples in design pattern application and case studies in software architecture

Course Outcomes:

On completion of the course, student will be able to–

- Express the analysis and design of an application
- Specify functional semantics of an application
- Evaluate software architectures
- Select and use appropriate architectural styles and software design patterns

Course Contents

Unit I	Introduction	08 Hours

Introduction to Software Architecture, Architecture Business Cycle- Where do architecture come from, Software processes and the Architecture Business cycle, What makes Good Architecture. What is software architecture- What Software Architecture is and what it is not, Other points of View, Architectural Patterns, Reference Models, Reference Architectures, Why is Software Architecture important, Architectural structure and Views. Case Study-A-7E Avionics System.

Unit II	Quality Attributes	08 Hours

Introduction to Quality Attributes, Understanding quality attributes- Functionality and Architecture, architecture and quality attributes, System Quality Attributes, Quality Attribute Scenario in Practice, Other System Quality Attributes, Business Qualities, and Architecture Qualities. Achieving quality attributes- Introducing Tactics, Availability tactics, Modifiability tactics, Performance tactics, Security tactics, Testability tactics, Usability tactics, Relationship of tactics to Architectural patterns, Architectural Patterns and Styles. Case study- Air Traffic Control.

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Unit III	Designing the Architectures and Introduction to Design Patterns	08 Hours

Architecture in Life Cycle, Designing the Architecture, Forming the team structure, Creating a skeletal system, Case Study- Flight Simulation. Design Patterns: What is Design Pattern?, Describing Design Patterns, The Catalog of Design Patterns, Organizing the Catalog, How Design patterns solves design problems, How to select Design Patterns, How to use Design Patterns.

Unit IV	Design Pattern Catalog	08 Hours

Creational Patterns- Abstract Factory, Singleton. Structural Patterns- Adaptor, Facade, Proxy. Behavioral Patterns- Chain of Responsibility, Iterator, Mediator, Observer. What to expect from Design Patterns.

Unit V	Client Side Technologies	08 Hours

Introduction to three tier and n-Tier Web Architectures, Need of Client side technology in multi-tier architectures, XML, Client side technologies- HTML, DHTML, Java Applets, Active X controls, DOM, AJAX. Case study-Mobile or portable client side technologies.

Unit VI	Middleware and Server Side Technologies	08 Hours

Introduction to Middleware, Types of Middleware, Application servers, Introduction to Java EE, Introduction to Java EE technologies like JMS, JDBC, RPC, RMI, SOCKET. EJB 3.0 Architecture, Entity, Session, Message beans, XML, XSLT. Specifications and characteristics of Middleware technologies. Server Side Technologies- Need of server side technology in multi-tier architectures, Java Web Services, Server side technologies: JSP, JSF, SOA, MVC. Java Servlets, struts.

Books:

Text:

1. Len Bass, Paul Clements, Rick Kazman, "Software Architecture in Practice", Second Edition, Pearson ,ISBN 978-81-775-8996-2
2. Erich Gamma, “Design Patterns”, Pearson, ISBN 0-201-63361-2.
3. Kogent, “Java Server Programming Black Book”, Dream Tech Press, PHI Publications, ISBN: 978-81-7722-835-9.

References:

1. James L. Weaver, Kevin Mukhar, "Beginning J2EE 1 .4: From Novice to Professional”, ISBN-10: 1590593413, ISBN-13: 978-1590593417
2. Richard N.Taylor , Nenad M., “Software Architecture Foundation Theory and practice”, Wiley ISBN: 978-81-265-2802-8.
3. Java6 Programming, Black Book DreamTech Press, ISBN:978-81-7722-736-9

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Savitribai Phule Pune University
Fourth Year of Computer Engineering (2015 Course)
Elective I
410244(C): Pervasive and Ubiquitous Computing

Teaching Scheme:	Credit	Examination Scheme:
TH: 03 Hours/Week	03	In-Sem (Paper): 30 Marks End-Sem (Paper): 70 Marks

Prerequisite Courses: 310245- Computer Networks

Companion Course: 410247-Laboratory Practice II

Course Objectives:

- To understand the characteristics and principles of Pervasive computing
- To introduce to the enabling technologies of pervasive computing
- To understand the basic issues and performance requirements of pervasive computing applications
- To learn the trends of pervasive computing

Course Outcomes:

On completion of the course, student will be able to–

- Design and implement primitive pervasive applications
- Analyze and estimate the impact of pervasive computing on future computing applications and society
- Develop skill sets to propose solutions for problems related to pervasive computing system
- Design a preliminary system to meet desired needs within the constraints of a particular problem space

Course Contents

Unit I	Pervasive Computing	08 Hours

Pervasive Computing, Applications, Pervasive Computing devices and Interfaces, Device technology trends, Connecting issues and protocols. Pervasive Computing- Principles, Characteristics, interaction transparency, context aware, automated experience capture. Architecture for pervasive computing.

Unit II	Open Protocols	08 Hours

Open protocols, Service discovery technologies- SDP, Jini, SLP, UpnP protocols, data Synchronization, SyncML framework, Context aware mobile services, Context aware sensor networks, addressing and communications- Context aware security. Pervasive Computing and web based Applications - XML and its role in Pervasive Computing, Wireless Application Protocol (WAP) Architecture and Security, Wireless Mark-Up language (WML) – Introduction. Moving on from Weiser's Vision of Calm Computing: Engaging UbiComp Experiences.

Unit III	Voice Enabled Pervasive Computing	08 Hours

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Voice Enabled Pervasive Computing, Voice Standards, Speech Applications in Pervasive Computing and security. Device Connectivity, Web application Concepts, WAP and Beyond. Voice Technology – Basis of speech Recognition, Voice Standards, Speech Applications, Speech and Pervasive Computing, Security, The Hitchhiker's Guide to UbiComp: Using techniques from Literary and Critical Theory to Reframe Scientific Agendas.

Unit IV	Personal Digital Assistant	08 Hours

Personal Digital Assistant – History, Device Categories, Device Characteristics, Software Components, Standards. Server side programming in Java, Pervasive Web application Architecture, Example Application, Access via PCs, Access via WAP, Access via PDA, and Access via Voice, Pinch Watch: A Wearable Device for One-Handed Micro interactions., Interfaces - Enabling mobile micro-interactions with physiological computing.

Unit V	User Interface	08 Hours

User Interface Issues in Pervasive Computing, Architecture, and Smart Card based Authentication Mechanisms, Wearable computing Architecture. Touche: Enhancing Touch Interaction on Humans, Screens, Liquids, and Everyday Objects

Unit VI	Context Awareness and Application Development	08 Hours

Location as context, Location Tracking, Co-ordinate models, Location Data Sources, sorting and search in location data. Sensing Activity based on various wearable sensors, smart phone sensors. Wearable Computing applications in Healthcare and Assistive Technologies. Developing, Deploying and Evaluating Pervasive computing applications. Application in Augmented Reality.

Books:

Text:

1. Jochen Burkhardt, Horst Henn, Stefan Hepper, Thomas Schaec and Klaus Rindtorff, “Pervasive Computing Technology and Architecture of Mobile Internet Applications”, Addision Wesley, 2002. ISBN:13: 978-0-201-72215-4
2. Uwe Hansman, Lothat Merk, Martin S Nicklous and Thomas Stober: “Principles of Mobile Computing”, Second Edition, Springer- Verlag, New Delhi, 2003, ISBN: 9783662043189

References:

1. Mohammads, Obaidait, Denko, Woungang, “Pervasive Computing and Networking”, Wiley, ISBN:978-0-470-74772-8
2. Seng Loke, “Context-Aware Computing Pervasive Systems”, Auerbach Pub., New York, 2007, ISBN: 978-1-4471-5006-0
3. Uwe Hansmann etl, “Pervasive Computing”, Springer, New York,2001., ISBN: 10: 3540002189
4. John Krumm, "Ubiquitous Computing Fundamentals", Shroff Publishers, ISBN: 9781420093605
5. Adelstein, “Fundamental of Mobile and Pervasive Computing”, McGrawHill, ISBN: 0-07-141237-9

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Savitribai Phule Pune University
Fourth Year of Computer Engineering (2015 Course)
Elective I
410244(D): Data Mining and Warehousing

Teaching Scheme: TH: 03 Hours/Week	Credit 03	Examination Scheme: In-Sem (Paper): 30 Marks End-Sem (Paper): 70 Marks

Prerequisite Courses: 310242-Database Management Systems, 310244- Information Systems and Engineering Economics

Companion Course: 410247-Laboratory Practice II

Course Objectives:

- To understand the fundamentals of Data Mining
- To identify the appropriateness and need of mining the data
- To learn the preprocessing, mining and post processing of the data
- To understand various methods, techniques and algorithms in data mining

Course Outcomes:

On completion of the course the student should be able to-

- Apply basic, intermediate and advanced techniques to mine the data
- Analyze the output generated by the process of data mining
- Explore the hidden patterns in the data
- Optimize the mining process by choosing best data mining technique

Course Contents

Unit I	Introduction	08 Hours

Data Mining, Data Mining Task Primitives, Data: Data, Information and Knowledge; Attribute Types: Nominal, Binary, Ordinal and Numeric attributes, Discrete versus Continuous Attributes; Introduction to Data Preprocessing, Data Cleaning: Missing values, Noisy data; Data integration: Correlation analysis; transformation: Min-max normalization, z-score normalization and decimal scaling; data reduction: Data Cube Aggregation, Attribute Subset Selection, sampling; and Data Discretization: Binning, Histogram Analysis

Unit II	Data Warehouse	08 Hours

Data Warehouse, Operational Database Systems and Data Warehouses(OLTP Vs OLAP), A Multidimensional Data Model: Data Cubes, Stars, Snowflakes, and Fact Constellations Schemas; OLAP Operations in the Multidimensional Data Model, Concept Hierarchies, Data Warehouse Architecture, The Process of Data Warehouse Design, A three-tier data warehousing architecture, Types of OLAP Servers: ROLAP versus MOLAP versus HOLAP.

Unit III	Measuring Data Similarity and Dissimilarity	08 Hours

Measuring Data Similarity and Dissimilarity, Proximity Measures for Nominal Attributes and Binary Attributes, interval scaled; Dissimilarity of Numeric Data: Minskowski Distance, Euclidean distance and Manhattan distance; Proximity Measures for Categorical, Ordinal Attributes, Ratio scaled variables; Dissimilarity for Attributes of Mixed Types, Cosine Similarity.

Unit IV	Association Rules Mining	08 Hours

Market basket Analysis, Frequent item set, Closed item set, Association Rules, a-priori Algorithm, Generating Association Rules from Frequent Item sets, Improving the Efficiency of a-priori, Mining Frequent Item sets without Candidate Generation: FP Growth Algorithm; Mining Various Kinds of Association Rules: Mining multilevel association rules, constraint based association rule mining, Meta rule-Guided Mining of Association Rules.

Unit V	Classification	08 Hours

Introduction to: Classification and Regression for Predictive Analysis, Decision Tree Induction, Rule-Based Classification: using IF-THEN Rules for Classification, Rule Induction Using a Sequential Covering Algorithm. Bayesian Belief Networks, Training Bayesian Belief Networks, Classification Using Frequent Patterns, Associative Classification, Lazy Learners-k-Nearest-Neighbor Classifiers, Case-Based Reasoning.

Unit VI	Multiclass Classification	08 Hours

Multiclass Classification, Semi-Supervised Classification, Reinforcement learning, Systematic Learning, Wholistic learning and multi-perspective learning. Metrics for Evaluating Classifier Performance: Accuracy, Error Rate, precision, Recall, Sensitivity, Specificity; Evaluating the Accuracy of a Classifier: Holdout Method, Random Sub sampling and Cross-Validation.

Books:

Text:

1. Han, Jiawei Kamber, Micheline Pei and Jian, "Data Mining: Concepts and Techniques", Elsevier Publishers, ISBN:9780123814791, 9780123814807.
2. Parag Kulkarni, "Reinforcement and Systemic Machine Learning for Decision Making" by Wiley-IEEE Press, ISBN: 978-0-470-91999-6

References:

1. Matthew A. Russell, "Mining the Social Web: Data Mining Facebook, Twitter, LinkedIn, Google+, GitHub, and More" , Shroff Publishers, 2nd Edition, ISBN: 9780596006068
2. Maksim Tsvetovat, Alexander Kouznetsov, "Social Network Analysis for Startups:Finding connections on the social web", Shroff Publishers , ISBN: 10: 1449306462

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Savitribai Phule Pune University
Fourth Year of Computer Engineering (2015 Course)
Elective II
410245(A): Distributed Systems

Teaching Scheme: TH: 03 Hours/Week	Credit 03	Examination Scheme: In-Sem (Paper): 30 Marks End-Sem (Paper): 70 Marks

Prerequisite Courses: 310245-Computer Networks, 310254-Web Technology, 210254-Principles of Programming Languages

Companion Course: 410247-Laboratory Practice II

Course Objectives:

- To understand the concept of Distributed system, remote method invocation and Remote Procedure Calls.
- To learn communication methodology in distributed systems.
- To acquaint with the Distributed File Systems.
- To know the concepts of shared memory and security aspects in distributed system.

Course Outcomes:

On completion of the course, student will be able to–

- Able to learn and apply the concept of remote method invocation and Remote Procedure Calls
- Able to analyze the mechanism of peer to peer systems and Distributed File Systems
- Demonstrate an understanding of the challenges faced by current and future distributed systems

Course Contents

Unit I	Introduction	08 Hours

Characteristics of Distributed Systems(DS): Introduction, Examples of DS, Trends in DS, Sharing Resources, Challenges in DS. System Models: Physical, Architectural and Fundamental Models Remote Invocation : Request Reply protocols, RPC, RMI, Case Study- JAVA RMI.

Unit II	Distributed Algorithms	08 Hours

Representing Distributed Algorithms: Representation Guarded Actions, Non-determinism, Atomic actions, Fairness, Central vs Distributed Scheduler. Time in Distributed Systems: Logical clocks, Vector clocks, Physical Clock Synchronization, Algorithms for Internal and External Clock Synchronization. Mutual Exclusion: Solution to Message passing systems, Token-Passing algorithms, Solutions on shared memory models, Mutual exclusion using special instructions, Group mutual exclusion.

Unit III	Distributed Snapshot	08 Hours

Distributed Snapshot: Properties of Consistent snapshot, Chandy-Lamport algorithm, Lai-Yang algorithm, Distributed debugging. Global state collection : Elementary algorithm for All-to- All broadcasting, Termination Detection algorithm, Wave algorithm, Distributed deadlock detection Coordination Algorithms: Leader Elections, Algorithms like Bully, Maxima finding on the ring, election in arbitrary networks, Election in anonymous networks. Synchronizers: ABD synchronizer, Awerbuch’s synchronizers.

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Unit IV	Distributed Consensus	08 Hours

Distributed consensus: Consensus in asynchronous systems, Consensus in synchronous systems, Paxo's algorithm, Failure detectors. Distributed Transactions: Classification of transactions, Implementing Transactions, Concurrency control and serializability, Atomic Commit protocols, Recovery from Failures.

Unit V	Group Communication	08 Hours

Group Communication: Atomic multicast, IP Multicast, Application layer multicast, Ordered multicast, Reliable multicast, Open groups. Replicated Data Management: Architecture of replicated Data Management, Data-Centric Consistency models, Client centric consistency protocols, Implementation of Data-Centric Consistency models, Quorum based protocols, Replica Placement, Brewer's CAP algorithm.

Unit VI	Distributed Discrete-Event Simulation	08 Hours

Distributed Discrete-Event Simulation: Distributed simulation, Conservative Simulation, Optimistic simulation and Time warp. Security in DS: Security Mechanisms to thwart various attacks in DS. Social and Peer-to-Peer network: Metrics of Social networks, Modeling Social Networks, Centrality measure in Social network, Community detection, Koorde and De Brujin Graphs, Skip graph, Replication management, Bit-torrent and free riding, Censorship resistance and anonymity.

Books:

Text:

1. George Coulouris, Jean Dollimore and Tim Kindberg, "Distributed Systems, Concepts and Design", Fifth Edition, Addison Wesley, ISBN 0-13-214301-1.
2. Sukumar Ghosh, "Distribute Systems : An Algorithmic Approach", Chapman and Hall, CRC Press, Second Edition, 2015, ISBN 10: 1584885645 ISBN 13: 9781584885641
3. Andrew S. Tanenbaum and Maarten van Steen, "Distributed Systems –Principles and Paradigms" , PHI Publication, ISBN 0-13-239227-5

References:

1. Shvartsman, A.A., Weatherspoon, H.; Zhao, "Future Directions in Distributed Computing Research and Position Papers Series: Lecture Notes in Computer Science" , Vol. 2584 Schiper, (Eds.) 2003, X, 219 p., ISBN: 978-3-540- 00912-2
2. Sape Mullender, "Distributed Systems", (Editor),Addison-Wesley Publication, I*SBN* 10: 0201624273 - ISBN13: 9780201624274
3. Kenneth, P. Birman, "Reliable Distributed Systems: Technologies, Web Services, and Applications", Springer; 1 edition, ISBN-10: 0387215093; ISBN-13: 978-0387215099
4. Galli D.L., "Distributed Operating Systems: Concepts and Practice", Prentice-Hall 2000, ISBN0-13-079843-6

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Savitribai Phule Pune University
Fourth Year of Computer Engineering (2015 Course)
Elective II
410245(B): Software Testing and Quality Assurance

Teaching Scheme: TH: 03 Hours/Week	Credit 03	Examination Scheme: In-Sem (Paper): 30 Marks End-Sem (Paper): 70 Marks

Prerequisite Courses: 310243- Software Engineering and Project Management,310263- Software Modeling and Design

Companion Course: 410247-Laboratory Practice II

Course Objectives:

- Introduce basic concepts of software testing
- Understand white box, block box, object oriented, web based and cloud testing
- Know in details automation testing and tools used for automation testing
- Understand the importance of software quality and assurance software systems development.

Course Outcomes:

On completion of the course, student will be able to–

- Describe fundamental concepts in software testing such as manual testing, automation testing and software quality assurance.
- Design and develop project test plan, design test cases, test data, and conduct test operations
- Apply recent automation tool for various software testing for testing software
- Apply different approaches of quality management, assurance, and quality standard to software system
- Apply and analyze effectiveness Software Quality Tools

Course Contents

Unit I	Introduction	08 Hours

Introduction, historical perspective, Definition, Core Components, Quality View, Financial Aspect, Customers suppliers and process, Total Quality Management(TQM), Quality practices of TQM, Quality Management through- Statistical process Control, Cultural Changes, Continual Improvement cycle, quality in different areas, Benchmarking and metrics, Problem Solving Techniques, Problem Solving Software Tools.

Software Quality- Introduction, Constraints of Software product Quality assessment, Customer is a King, Quality and Productivity Relationship, Requirements of Product, Organization Culture, Characteristics of Software, Software Development Process, Types of Product, Criticality Definitions, Problematic areas of SDLC, Software Quality Management, Why Software has defects, Processes related to Software Quality, Quality Management System's Structure, Pillars of Quality Management System, Important aspects of quality management.

Unit II	Test Planning and Management	08 Hours

Home

Review of Fundamentals of Software Testing, Testing during development life cycle, Requirement Traceability matrix, essentials, Work bench, Important Features of Testing Process, Misconceptions, Principles, salient and policy of Software testing, Test Strategy, Test Planning, Testing Process and number of defects found, Test teem efficiency, Mutation testing, challenges, test team approach, Process problem faced, Cost aspect, establishing testing policy, methods, structured approach, categories of defect, Defect/ error/ mistake in software, Developing Test Strategy and Plan, Testing process, Attitude towards testing, approaches, challenges, Raising management awareness for testing, skills required by tester.

Unit III	**Software Test Automation**	**08 Hours**

What is Test Automation, Terms used in automation, Skills needed for automation, What to automate, scope of automation, Design and Architecture of automation, Generic requirement for Test Tool, Process Model for Automation, Selecting Test Tool, Automation for XP/Agile model, Challenges in Automation, Data-driven Testing. Automation Tools like JUnit, Jmeter

Unit IV	**Selenium Tool**	**08 Hours**

Introducing Selenium, Brief History of The Selenium Project, Selenium's Tool Suite, Selenium-IDE, Selenium RC, Selenium Webdriver, Selenium Grid, Test Design Considerations

Unit V	**Quality Management**	**08 Hours**

Software Quality, Software Quality Dilemma, Achieving Software Quality, Software Quality Assurance. Elements of SQA, SQA Tasks, Goals, and Metrics, Formal Approaches to SQA, Statistical Software Quality Assurance, Six Sigma for Software Engineering, ISO 9000 Quality Standards, SQA Plan.

Unit VI	**Software Quality Tools**	**08 Hours**

Total Quality Management, Product Quality Metrics, In process Quality Metrics, Software maintenance, Ishikawa's 7 basic tools, Checklists, Pareto diagrams, Histogram, Run Charts, Scatter diagrams, Control chart, Cause Effect diagram. Defect Removal Effectiveness and Process Maturity Level.

Books:

Text:

1. M G Limaye, "Software Testing Principles, Techniques and Tools", Tata McGraw Hill, ISBN: 9780070139909 0070139903
2. Srinivasan Desikan, Gopalswamy Ramesh, "Software Testing Principles and Practices", Pearson, ISBN-10: 817758121X

References:

1. Naresh Chauhan, "Software Testing Principles and Practices ", OXFORD, ISBN-10: 0198061846. ISBN-13: 9780198061847
2. Stephen Kan, "Metrics and Models in Software Quality Engineering", Pearson, ISBN-10: 0133988082; ISBN-13: 978-0133988086

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Savitribai Phule Pune University
Fourth Year of Computer Engineering (2015 Course)
Elective II
410245(C): Operations Research

Teaching Scheme: TH: 03 Hours/Week	Credit 03	Examination Scheme: In-Sem (Paper): 30 Marks End-Sem (Paper): 70 Marks

Prerequisite Courses: 210241- Discrete Mathematics, 310243- Software Engineering and Project Management

Companion Course: 410247-Laboratory Practice II

Course Objectives:

- To introduce the learners the quantitative methods and techniques for effective analysis of decisions making
- To understand the model formulation and applications that is used in solving business decision problems.
- To introduce the optimization approaches and fundamental solution.
- To learn a variety of ways in which deterministic and stochastic models in Operations Research can be used

Course Outcomes:

On completion of the course, student will be able to–

- Identify the characteristics of different types of decision-making environments
- Use appropriate decision making approaches and tools
- Build various dynamic and adaptive models
- Develop critical thinking and objective analysis of decision problems
- Apply the OR techniques for efficacy

Course Contents

Unit I	Linear Programming	08 Hours

Introduction, Modeling with Liner Programming, Two variable LP model, Graphical LP solutions for both maximization and minimization models with various application examples, LP model in equation form, simplex method, special case in simplex method, artificial starting solution, Degeneracy in LPP, Unbounded and Infeasible solutions.

Unit II	Duality in Linear Programming and Revised Simplex Method	08 Hours

Duality theory: a fundamental insight. The essence of duality theory, Economic interpretation of duality, Primal dual relationship; Adapting to other primal forms, The revised simplex method-development of optimality and feasibility conditions, Revised Simplex Algorithms.

Unit III	The Transportation Problem and Assignment Problem	08 Hours

Home

Finding an initial feasible solution - North West-corner method, Least cost method, Vogel's Approximation method, Finding the optimal solution, optimal solution by stepping stone and MODI methods, Special cases in Transportation problems - Unbalanced Transportation problem. Assignment Problem: Hungarian method of Assignment problem, Maximization in Assignment problem, unbalanced problem, problems with restrictions, travelling salesman problems.

Unit IV	Game Theory and Dynamic Programming	08 Hours

Introduction, 2 person zero sum games, Minimax, Maximin principle, Principle of Dominance, Solution for mixed strategy problems, Graphical method for 2 x n and m x 2 games. Recursive nature of computations in Dynamic Programming, Forward and backward recursion, Dynamic Programming Applications – Knapsack, Equipment replacement, Investment models

Unit V	Integer Programming Problem and Project Management	08 Hours

Integer Programming Algorithms – BandB Algorithms, cutting plane algorithm, Gomory's All-IPP Method, Project Management: Rules for drawing the network diagram, Application of CPM and PERT techniques in project planning and control; Crashing and resource leveling of operations Simulation and its uses in Queuing theory and Materials Management

Unit VI	Decision Theory and Sensitivity Analysis	08 Hours

Decision making under certainty, uncertainty and risk, sensitivity analysis, Goal programming formulation and algorithms – The weights method, The preemptive method

Books:

Text:

1. Hamdy A. Taha, "Operations Research" , Pearson Education, 8th Edition, ISBN: 978-81-317-1104-0
2. Gillett, "Introduction to Operations Research", TMH, ISBN: 0070232458

References:

1. S.D. Sharma, Kedarnath, Ramnath and Co, "Operations Research", 2009, ISBN:978-81-224-2288-7
2. Hrvey M. Wagner, "Principles of Operations Research", Second Edition, Prentice Hall of India Ltd., 1980, ISBN: 10: 0137095767, 13: 9780137095766..
3. V.K. Kapoor, "Operations Research", S. Chand Publishers, New Delhi, 2004, ISBN: 9788180548543, 8180548546.
4. R. Paneer Selvam, "Operations Research", Second Edition, PHI Learning Pvt. Ltd., New Delhi, 2008, ISBN: 10: 8120329287,: 9788120329287.

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Savitribai Phule Pune University
Fourth Year of Computer Engineering (2015 Course)
Elective II
410245(D): Mobile Communication

Teaching Scheme:	Credit	Examination Scheme:
TH: 03 Hours/Week	03	In-Sem (Paper): 30 Marks End-Sem (Paper): 70 Marks

Prerequisite Courses: 310245-Computer Networks

Companion Course: 410247-Laboratory Practice II

Course Objectives:

- To understand the Personal Communication Services
- To learn the design parameters for setting up mobile network
- To know GSM architecture and support services
- To learn current technologies being used on field

Course Outcomes:

On completion of the course, student will be able to–

- Justify the Mobile Network performance parameters and design decisions.
- Choose the modulation technique for setting up mobile network.
- Formulate GSM/CDMA mobile network layout considering futuristic requirements which conforms to the technology.
- Use the 3G/4G technology based network with bandwidth capacity planning.
- Percept to the requirements of next generation mobile network and mobile applications.

Course Contents

Unit I	Introduction to Cellular Networks	08 Hours

Cell phone generation-1G to 5G, Personal Communication System (PCS), PCS Architecture, Mobile Station,, SIM, Base Station, Base Station Controller, Mobile Switching Center, MSC Gateways, HLR and VLR, AuC/EIR/OSS, Radio Spectrum, Free Space Path Loss, S/N Ratio, Line of sight transmission, Length of Antenna, Fading in Mobile Environment.

Unit II	Cellular Network Design	08 Hours

Performance Criterion, Handoff/Hanover, Frequency Reuse, Co-channel Interference and System Capacity, Channel Planning, Cell Splitting, Mobility Management in GSM and CDMA.

Unit III	Medium Access Control	08 Hours

Specialized MAC, SDMA, FDMA, TDMA, CDMA, Frequency Hopping Spread Spectrum (FHSS), Direct Sequence Spread Spectrum (DSSS), GMSK Modulation, 8PSK, 64 QAM, 128 QAM and OFDM

Unit IV	GSM	08 Hours

GSM – Architecture, GSM Identifiers, Spectrum allocation, Physical and Logical Traffic and Control channels, GSM Bursts, GSM Frame, GSM Speech Encoding and decoding, Location Update, Incoming and Outgoing Call setup, GPRS.

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Unit V	**Current 3G and 4G Technologies for GSM and CDMA**	**08 Hours**
EDGE, W-CDMA: Wideband CDMA, CDMA2000, UMTS, HSPA (High Speed Packet Access), HSDPA, HSUPA, HSPA+, LTE (E-UTRA) 3GPP2 family CDMA2000 1x, 1xRTT, EV-DO (Evolution-Data Optimized), Long Term Evolution (LTE) in 4G.		
Unit VI	**Advances in Mobile Technologies**	**08 Hours**
5GAA (Autonomous Automation), Millimetre Wave, URLLC, LTEA (Advanced), LTE based MULTIFIRE, Virtual Reality, Augmented Reality.		

Books:

Text:

1. Jochen Schiller, "Mobile Communications", Pearson Education, Second Edition, 2004, ISBN: 13: 978-8131724262
2. Jason Yi-Bing Lin, Yi-Bing Lin, Imrich Chlamtac, "Wireless and Mobile network Architecture", 2005, Wiley Publication, ISBN: 978812651560
3. Martin Sauter, "3G, 4G and Beyond: Bringing Networks, Devices and the Web Together", 2012, ISBN-13: 978-1118341483

References:

1. Theodore S Rappaport, "Wireless Communications – Principles and Practice" , Pearson Education India, Second Edition, 2010, ISBN: 978-81-317-3186-4
2. Lee and Kappal, "Mobile Communication Engineering", Mc Graw Hill, ISBN:
3. William Stallings, "Wireless Communication and Networks", Prentice Hall, Second Edition, 2014, ISBN: 978-0131918351

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Savitribai Phule Pune University
Fourth Year of Computer Engineering (2015 Course)
410246:Laboratory Practice I

Teaching Scheme:	Credit	Examination Scheme:
Practical : 04 Hours/Week	02	Term Work: 50 Marks Practical: 50 Marks

Companion Courses: 410241, 410242 and 410243

Course Objectives and Outcomes: Practical hands on is the absolute necessity as far as employability of the learner is concerned. The presented course is solely intended to enhance the competency by undertaking the laboratory assignments of the core courses.

About

Laboratory Practice I is for practical hands on for core courses High Performance Computing, AI & Robotics, and Data Analytics.

Guidelines for Laboratory Conduction

- **List of recommended programming assignments and sample mini-projects is provided for reference.**
- Referring these, Course Teacher or Lab Instructor may frame the assignments/mini-project by understanding the prerequisites, technological aspects, utility and recent trends related to the respective courses.
- Preferably there should be multiple sets of assignments/mini-project and distribute among batches of students.
- Real world problems/application based assignments/mini-projects create interest among learners serving as foundation for future research or startup of business projects.
- Mini-project can be completed in group of 2 to 3 students.
- Software Engineering approach with proper documentation is to be strictly followed.
- Use of open source software is to be encouraged.
- Instructor may also set one assignment or mini-project that is suitable to respective course beyond the scope of syllabus.

Operating System recommended :- 64-bit Open source Linux or its derivative
Programming Languages: C++/JAVA/PYTHON/R
Programming tools recommended: Front End: Java/Perl/PHP/Python/Ruby/.net, Backend : MongoDB/MYSQL/Oracle, Database Connectivity : ODBC/JDBC, Additional Tools: Octave, Matlab, WEKA.

Guidelines for Student Journal

The laboratory assignments are to be submitted by student in the form of journal. Journal may consists of prologue, Certificate, table of contents, and **handwritten write-up** of each assignment (Title, Objectives, Problem Statement, Outcomes, software and Hardware requirements, Date of Completion, Assessment grade/marks and assessor's sign, Theory- Concept in brief, Algorithm/Database design, test cases, conclusion/analysis). **Program codes with sample output of all performed assignments are to be submitted as softcopy.**

As a conscious effort and little contribution towards Green IT and environment awareness, attaching printed papers as part of write-ups and program listing to journal may be avoided. Use of digital storage media/DVD containing students programs maintained by lab In-charge is highly encouraged. For reference one or two journals may be maintained with program prints at Laboratory.

Guidelines for Assessment

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Continuous assessment of laboratory work is to be done based on overall performance and lab assignments performance of student. Each lab assignment assessment will assign grade/marks based on parameters with appropriate weightage. Suggested parameters for overall assessment as well as each lab assignment assessment include- timely completion, performance, innovation, efficient codes, punctuality and neatness **reserving weightage for successful mini-project completion and related documentation.**

Guidelines for Practical Examination

- Both internal and external examiners should jointly frame suitable problem statements for practical examination based on the term work completed.
- During practical assessment, the expert evaluator should give the maximum weightage to the satisfactory implementation of the problem statement.
- The supplementary and relevant questions may be asked at the time of evaluation to test the student's for advanced learning, understanding of the fundamentals, effective and efficient implementation.
- Encouraging efforts, transparent evaluation and fair approach of the evaluator will not create any uncertainty or doubt in the minds of the students. So adhering to these principles will consummate our team efforts to the promising boost to the student's academics.

Guidelines for Instructor's Manual

The instructor's manual is to be developed as a hands-on resource and as ready reference. The instructor's manual need to include prologue (about University/program/ institute/ department/foreword/ preface etc), University syllabus, conduction and Assessment guidelines, topics under consideration-concept, objectives, outcomes, set of typical applications/assignments/ guidelines, references among others.

Suggested List of Laboratory Assignments & Mini Projects

(any 04 assignments per High Performance Computing, AI, and Data Analytics and Mini-project per course)

410241:: High Performance Computing

Note: for all programming assignments of HPC-

- Select the suitable model of a parallel computation (Data parallel model, Task graph model, Work pool model, Master slave model , Producer consumer or pipeline model, Hybrid model or other) for algorithm to be developed by considering a strategy for dividing the data, processing method and suitable strategy to reduce interactions.
- Assume suitable processor model, topology, load distribution strategy and Communication.
- Utilize all available resources.
- Test on data set of sufficiently large size
- Compute Total cost and Efficiency as

  Total Cost = Time complexity × Number of processors used

  Efficiency = WCSA/ WCPA

  (WCSA--Worst case execution time of sequential algorithm and WCPA--Worst case execution time of the parallel algorithm)
- Compare performance by varying number of processors used and also with sequential algorithm.

1.	a) Implement Parallel Reduction using Min, Max, Sum and Average operations. b) Write a CUDA program that, given an N-element vector, find- • The maximum element in the vector • The minimum element in the vector

	•The arithmetic mean of the vector •The standard deviation of the values in the vector Test for input N and generate a randomized vector V of length N (N should be large). The program should generate output as the two computed maximum values as well as the time taken to find each value.
2.	**Vector and Matrix Operations-** Design parallel algorithm to 1. Add two large vectors 2. Multiply Vector and Matrix 3. Multiply two N × N arrays using n^2 processors
3.	**Parallel Sorting Algorithms-** For Bubble Sort and Merger Sort, based on existing sequential algorithms, design and implement parallel algorithm utilizing all resources available.
4.	**Parallel Search Algorithm-** Design and implement parallel algorithm utilizing all resources available. for • **Binary Search for Sorted Array** • **Depth-First Search (** tree or an undirected graph) **OR** • **Breadth-First Search (** tree or an undirected graph) **OR** • **Best-First Search that (** traversal of graph to reach a target in the shortest possible path)
5.	Parallel Implementation of the K Nearest Neighbors Classifier
	Sample Mini Projects
6.	**Compression Module (Image /Video)** Large amount of bandwidth is required for transmission or storage of images. This has driven the research area of image compression to develop parallel algorithms that compress images. **OR** For video: RGB To YUV Transform concurrently on many core GPU
7.	**Generic Compression** Run length encoding concurrently on many core GPU
8.	**Encoding** Huffman encoding concurrently on many core GPU
9.	**Database Query Optimization** Long running database Query processing in parallel
	410242: Artificial Intelligence and Robotics
1.	Implement Tic-Tac-Toe using A* algorithm
2.	Implement 3 missionaries and 3 cannibals problem depicting appropriate graph. Use A* algorithm.
3.	Solve 8-puzzle problem using A* algorithm. Assume any initial configuration and define goal configuration clearly.
4.	Define the operators for controlling domestic robot; use these operators to plan an activity to be executed by the robot. For example, transferring two/three objects one over the other from one place to another. Use Means-Ends analysis with all the steps revealed.
5.	Implement any one of the following Expert System , • Medical Diagnosis of 10 diseases based on adequate symptoms

- Identifying birds of India based on characteristics

6. Implement alpha-beta pruning graphically with proper example and justify the pruning.

7. Develop elementary chatbot for suggesting investment as per the customers need.

8. Solve following 6-tiles problem stepwise using A* algorithm,

Initial Configuration	B	W	B	W	B	W	
Final Configuration	B	B	B	W	W	W	

Constraint: Tiles can be shifted left or right 1 or 2 positions with cost 1 and 2 respectively.

9. Implement goal stack planning for the following configurations from the blocks world,

10. Use Heuristic Search Techniques to Implement Hill-Climbing Algorithm.

11. Use Heuristic Search Techniques to Implement Best first search (Best-Solution but not always optimal) and A* algorithm (Always gives optimal solution).

12. Constraint Satisfaction Problem:
Implement crypt-arithmetic problem or n-queens or graph coloring problem (Branch and Bound and Backtracking)

13. Implement syntax analysis for the assertive English statements. The stages to be executed are,

- Sentence segmentation
- Word tokenization
- Part-of-speech/morpho syntactic tagging
- Syntactic parsing (Use any of the parser like Stanford)

14. Mini Projects based on Robotics..

410243:: Data Analytics

1. Download the Iris flower dataset or any other dataset into a DataFrame. (eg https://archive.ics.uci.edu/ml/datasets/Iris) Use Python/R and Perform following –

- How many features are there and what are their types (e.g., numeric, nominal)?
- Compute and display summary statistics for each feature available in the dataset. (eg. minimum value, maximum value, mean, range, standard deviation, variance and percentiles
- Data Visualization-Create a histogram for each feature in the dataset to illustrate the feature distributions. Plot each histogram.
- Create a boxplot for each feature in the dataset. All of the boxplots should be combined into a single plot. Compare distributions and identify outliers.

2. Download Pima Indians Diabetes dataset. Use Naive Bayes' Algorithm for classification

- Load the data from CSV file and split it into training and test datasets.
- summarize the properties in the training dataset so that we can calculate probabilities and make predictions.
- Classify samples from a test dataset and a summarized training dataset.

3. Write a Hadoop program that counts the number of occurrences of each word in a text file.

4. Write a program that interacts with the weather database. Find the day and the station with the maximum snowfall in 2013.

5. Use Movies Dataset. Write the map and reduce methods to determine the average ratings of

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	movies. The input consists of a series of lines, each containing a movie number, user number, rating, and a timestamp: The map should emit movie number and list of rating, and reduce should return for each movie number a list of average rating.
6.	Trip History Analysis: Use trip history dataset that is from a bike sharing service in the United States. The data is provided quarter-wise from 2010 (Q4) onwards. Each file has 7 columns. Predict the class of user. Sample Test data set available here https://www.capitalbikeshare.com/trip-history-data
7.	Bigmart Sales Analysis: For data comprising of transaction records of a sales store. The data has 8523 rows of 12 variables. **Predict the sales of a store.** Sample Test data set available here https://datahack.analyticsvidhya.com/contest/practice-problem-big-mart-sales-iii/
8.	Twitter Data Analysis: **Use** Twitter data for sentiment analysis. The dataset is 3MB in size and has 31,962 tweets. **Identify the tweets which are hate tweets and which are not. S**ample Test data set available here https://datahack.analyticsvidhya.com/contest/practice-problem-twitter-sentiment-analysis/
9.	Time Series Analysis: Use time series and forecast traffic on a mode of transportation. Sample Test data set available here https://datahack.analyticsvidhya.com/contest/practice-problem-time-series-2/

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Savitribai Phule Pune University
Fourth Year of Computer Engineering (2015 Course)
410247:Laboratory Practice II

Teaching Scheme:	Credit	Examination Scheme:
Practical : 04 Hours/Week	02	Term Work: 50 Marks Presentation: 50 Marks

Companion Courses: 410244 and 410245

Course Objectives and Outcomes: Practical hands on is the absolute necessity as far as employability of the learner is concerned. The presented course is solely intended to enhance the competency by undertaking the laboratory assignments of the core courses. Enough choice is provided to the learner to choose an elective of one's interest.

Laboratory Practice II is companion lab for elective course I and elective course II.

Guidelines for Laboratory Conduction

- **List of recommended programming assignments and sample mini-projects is provided for reference.**
- Referring these, Course Teacher or Lab Instructor may frame the assignments/mini-project by understanding the prerequisites, technological aspects, utility and recent trends related to the respective courses.
- Preferably there should be multiple sets of assignments/mini-project and distribute among batches of students.
- Real world problems/application based assignments/mini-projects create interest among learners serving as foundation for future research or startup of business projects.
- Mini-project can be completed in group of 2 to 3 students.
- Software Engineering approach with proper documentation is to be strictly followed.
- Use of open source software is to be encouraged.
- Instructor may also set one assignment or mini-project that is suitable to respective course beyond the scope of syllabus.

Operating System recommended :- 64-bit Open source Linux or its derivative

Programming Languages: C++/JAVA/PYTHON/R

Programming tools recommended: Front End: Java/Perl/PHP/Python/Ruby/.net, Backend: MongoDB/MYSQL/Oracle, Database Connectivity : ODBC/JDBC, Additional Tools: Octave, Matlab, WEKA.

Guidelines for Student Journal

The laboratory assignments are to be submitted by student in the form of journal. Journal may consists of prologue, Certificate, table of contents, and **handwritten write-up** of each assignment (Title, Objectives, Problem Statement, Outcomes, software and Hardware requirements, Date of Completion, Assessment grade/marks and assessor's sign, Theory- Concept in brief, Algorithm/Database design, test cases, conclusion/analysis). **Program codes with sample output of all performed assignments are to be submitted as softcopy.**

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Guidelines for Practical Examination

- **It is recommended to conduct examination based on Mini-Project(s) Demonstration and related skill learned.** Team of 2 to 3 students may work on mini-project. During the assessment, the expert evaluator should give the maximum weightage to the satisfactory implementation and software engineering approach followed.
- The supplementary and relevant questions may be asked at the time of evaluation to test the student’s for advanced learning, understanding, effective and efficient implementation and demonstration skills.
- Encouraging efforts, transparent evaluation and fair approach of the evaluator will not create any uncertainty or doubt in the minds of the students. So adhering to these principles will consummate our team efforts to the promising start of the student's academics.

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Suggested List of Laboratory Assignments& Mini Projects

Recommended / Sample set of assignments and mini projects for reference for all four courses offered for Elective I and for all four courses offered for Elective II. Respective Student have to complete laboratory work for elective I and II that he/she has opted.

410244: Elective I

410244(A) : Digital Signal Processing

1.	Develop a program to generate samples of sine, Cosine and exponential signals at specified sampling frequency and signal parameters. (Test the results for different analog frequency (F) and sampling frequency (Fs)).
2.	Find the output of a system described by given difference equation and initial conditions for given input sequence. (Solution of difference equation) (Obtain the response for different systems by changing Degree of difference equation (N) and coefficients and also for different input sequence x(n). Observe the response by considering system as FIR and IIR system).
3.	Write a program to plot the magnitude and phase response of a Fourier Transform (FT). (Observe the spectrum for different inputs. Observe the Periodicity).
4.	Find the N point DFT / IDFT of the given sequence x (n). Plot the magnitude spectrum |X(K)| Vs K. (Analyze the output for different N and the same input sequence x(n). Also observe the periodicity and symmetry property).
5.	Find the N point circular convolution of given two sequences. Test it for Linear convolution. Compute the circular convolution of given two sequences using DFT and IDFT.
6.	Develop a program to plot the magnitude and phase response of a given system (given: h(n): impulse response of system S) (Observe the frequency response for different systems.

	Compare the frequency response of a system (filter) for different length h(n) i.e filter coefficients).
7.	**Mini-Project 1:** Design and Develop the N-point radix-2 DIT or DIF FFT algorithm to find DFT or IDFT of given sequence x (n). (Analyze the output for different N. Program should work for any value of N and output should be generated for all intermediate stages.)
8.	**Mini-Project 2:** Obtain the Fourier transform of different window functions to plot the magnitude and phase spectrums. (Window functions: Rectangular, Triangular, Bartlett, Hamming, Henning, Kaiser. Observe and compare the desirable features of window sequences for different length. Observe the main and side lobes).
9.	**Mini-Project 3:** Design an FIR filter from given specifications using windowing method. (Application should work for different types of filter specifications i.e. LPF, HPF, BPF etc and all window sequences. Plot the frequency response for different frequency terms i.e. analog and DT frequency).
10.	**Mini-Project 4:** Design of IIR filter for given specifications using Bilinear Transformation. (Generalized code to accept any filter length for a transfer function H(Z). Application should work for different types of filter specifications that is LPF, HPF, BPF etc. and for different transfer functions of an analog filter).
410244(B): Software Architecture and Design Patterns	
1.	**Mini-Project 1**: Narrate concise System Requirements Specification and organize the problem domain area into broad subject areas and identify the boundaries of problem/system. Identify and categorize the target system services with detailed service specifications modeled with component diagram incorporating appropriate architectural style and coupling. Design the service layers and tiers modeled with deployment diagram accommodating abstraction, autonomy, statelessness and reuse. Map the service levels and primitives to appropriate Strategies for data processing using Client-Server Technologies as applicable.
2.	**Mini-Project 2:** Select a moderately complex system and narrate concise requirement specification for the same. Design the system indicating system elements organizations using applicable architectural styles and design patterns with the help of a detailed Class diagram depicting logical architecture. Specify and document the architecture and design pattern with the help of templates. Implement the system features and judge the benefits of the design patterns accommodated.
410244(C): Pervasive and Ubiquitous Computing	
Mini-Projects are to be designed so as to use, • No / minimal extra hardware, • uses open source software's, • need hardly any subscription / telephony / data charges.	
1.	Design and build a sensing system using micro-controllers like - Arduino / Raspberry Pi / Intel Galileo to sense the environment around them and act accordingly.
2.	Design and build a mobile application with context awareness to determine the remaining battery level depending on the users current usage patterns.
3.	Design and build a music streaming system and a smart mobile application to use the speakers or headphones of the smart phone of multiple phones to stream stored / live music during a party (instead of using large speakers).
4.	Smart Mobile Application with orientation sensing for users to put the phone in meeting / silent mode- OR- outdoor/ loud mode based on the orientation of the device. -OR- Smart Mobile Application with ambient sound / noise sensing to adjust the volume of the phone automatically. -OR- Smart Mobile Application with ambient light sensing to adjust the screen brightness automatically.

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5.	**Mini-Project 1:** Smart Mobile Application for Location-Based Messaging Design and build a Location-Based Messaging system where users have commented on various eating joints in the area you currently are. The mobile application should give you inputs / recommendations / suggestions on which eating joints are preferred by whom and for what eating items, with their ratings etc.
6.	**Mini-Project 2:** Smart Mobile Application as a Museum Guide Build a Mobile Application as a museum guide, the device scans the QR codes on the artifacts and gives an interactive detailed explanation using Audio / Text / Video about the museum artifact. using location of the user and the list of previously seen artifacts, the mobile application can suggest / recommend which next artifacts to be seen be the user
7.	**Mini-Project 3:** Smart Mobile Application as a Travel / Route Guide, Scenario - You are visiting an ancient monument. There is no local guide available. The previous users have commented on various locations where artifacts can be seen, photo are uploaded. The smart mobile application will give you directions / recommendations / suggestions on what to see and where, including narratives on the same.
8.	**Mini-Project 4:** Design and build a 'Multifunctional Application' in the Mobile and Pervasive domain. The choice of application is to be determined so as to leverage the capabilities of typical smart devices. These include such characteristics as, • Location awareness and GPS systems • Accelerometers • Messaging • Sensor detection capability • Microphone and Camera • Media Player • Touch screen • Mapping Technology • Mobile Web Services
410244(D): Data Mining and Warehousing	
1.	For an organization of your choice, choose a set of business processes. Design star / snow flake schemas for analyzing these processes. Create a fact constellation schema by combining them. Extract data from different data sources, apply suitable transformations and load into destination tables using an ETL tool. **For Example:** Business Origination: Sales, Order, Marketing Process.
2.	Consider a suitable dataset. For clustering of data instances in different groups, apply different clustering techniques (minimum 2). Visualize the clusters using suitable tool.
3.	Apply a-priori algorithm to find frequently occurring items from given data and generate strong association rules using support and confidence thresholds. **For Example:** Market Basket Analysis
4.	Consider a suitable text dataset. Remove stop words, apply stemming and feature selection techniques to represent documents as vectors. Classify documents and evaluate precision, recall.
5.	**Mini project on classification:** Consider a labeled dataset belonging to an application domain. Apply suitable data preprocessing steps such as handling of null values, data reduction, discretization. For prediction of class labels of given data instances, build classifier models using different techniques (minimum 3), analyze the confusion matrix and compare these models. Also apply cross validation while preparing the training and testing datasets.

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	For Example: Health Care Domain for predicting disease.
	410245: Elective II
	410245(A): Distributed Systems
1.	Design and develop a basic prototype distributed system (e.g. a DFS).
2.	Design and implement client server application using RPC/ RMI mechanism (Java)
3.	Design and implement a clock synchronization algorithm for prototype DS
4.	Implement Ring or Bully election algorithm for prototype DS.
5.	Implement Ricart Agrawala's distributed algorithm for mutual exclusion.
6.	Problem solving of Wait-die and Wait –wound scheme for deadlock prevention.
7.	Simulate Wait for Graph based Centralized or Hierarchical or Distributed algorithm for deadlock detection.
8.	Implementation of 2PC / Byzantine Generals Problem
	Mini-Projects
	Important properties your system should have: • The system must support multiple, autonomous agents (either human or automated) contending for shared resources and performing real-time updates to some form of shared state. • The state of the system should be distributed across multiple client or server nodes. The only centralized service should be one that supports users logging on, adding or removing clients or servers, and other housekeeping tasks. •The system should be robust The system should be able to continue operation even if one of the participant nodes crashes. It should be possible to recover the state of a node following a crash, so that it can resume operation. We will let you choose your own application, and we will give you wide latitude in the overall and the detailed design of your implementation.
	Design, implement, and thoroughly test a distributed system, implementing - Shared document editing, in the style of Google docs. The system should support real-time editing and viewing by multiple participants. Multiple replicas would be maintained for fault tolerance. Caching and/or copy migration would be useful to minimize application response time.
	Design, implement, and thoroughly test a distributed system, implementing - A low-latency notification system. E.g., watch a whole bunch of RSS feeds and send all subscribers an email when one is updated. Interface with both the raw RSS feeds and Google's update notification service. Replicate and partition the state of the monitoring system so that it can scale and survive node failures.
	Design, implement, and thoroughly test a distributed system, implementing - An airline reservation system. Each airline would maintain its own collection of servers, with enough state replication to enable automatic fail-over. It would be possible to book travel that involves multiple airlines.
	Design, implement, and thoroughly test a distributed system, implementing - Implement a distributed file system that does something interesting. Maybe you want one for storing your MP3s or movies. Or perhaps for something entirely different.
	410245(B): Software Testing and Quality Assurance
1.	**Mini-Project 1:** Create a small application by selecting relevant system environment / platform and programming languages. Narrate concise Test Plan consisting features to be tested and bug taxonomy. Prepare Test Cases inclusive of Test Procedures for identified Test Scenarios. Perform selective Black-box and White-box testing covering Unit and Integration test by using suitable Testing tools. Prepare Test Reports based on Test Pass/Fail Criteria and judge the acceptance of application developed.

2. **Mini-Project 2:** Create a small web-based application by selecting relevant system environment / platform and programming languages. Narrate concise Test Plan consisting features to be tested and bug taxonomy. Narrate scripts in order to perform regression tests. Identify the bugs using Selenium WebDriver and IDEand generate test reports encompassing exploratory testing.

410245(C):: Operations Research

1. **The Transportation Problem:**

Milk in a milk shed area is collected on three routes A, B and C. There are four chilling centers P, Q, R and S where milk is kept before transporting it to a milk plant. Each route is able to supply on an average one thousand liters of milk per day. The supply of milk on routes A, B and C are 150, 160 and 90 thousand liters respectively. Daily capacity in thousand liters of chilling centers is 140, 120, 90 and 50 respectively. The cost of transporting 1000 liters of milk from each route (source) to each chilling center (destination) differs according to the distance. These costs (in Rs.) are shown in the following table

Routes	Chilling Centers			
	P	Q	R	S
A	16	18	21	12
B	17	19	14	13
C	32	11	15	10

The problem is to determine how many thousand liters of milk is to be transported from each route on daily basis in order to minimize the total cost of transportation.

2. **Investment Problem:**

A portfolio manager with a fixed budget of $100 million is considering the eight investment opportunities shown in Table 1. The manager must choose an investment level for each alternative ranging from $0 to $40 million. Although an acceptable investment may assume any value within the range, we discretize the permissible allocations to intervals of $10 million to facilitate the modeling. This restriction is important to what follows. For convenience we define a unit of investment to be $10 million. In these terms, the budget is 10 and the amounts to invest are the integers in the range from 0 to 4. Following table provides the net annual returns from the investment opportunities expressed in millions of dollars. A ninth opportunity, not shown in the table, is available for funds left over from the first eight investments. The return is 5% per year for the amount invested, or equivalently, $0.5 million for each $10 million invested. The manager's goal is to maximize the total annual return without exceeding the budget

Returns from Investment Opportunities

Amount	*Opportunity*							
Invested ($10 million)	1	2	3	4	5	6	7	8
0	0	0	0	0	0	0	0	0
1	4.1	1.8	1.5	2.2	1.3	4.2	2.2	1.0
2	5.8	3.0	2.5	3.8	2.4	5.9	3.5	1.7
3	6.5	3.9	3.3	4.8	3.2	6.6	4.2	2.3
4	6.8	4.5	3.8	5.5	3.9	6.8	4.6	2.8

410245(D):: Mobile Communication

1. Design simple GUI application with activity and intents e.g. Design an android Application for Phone Call or Calculator

2. Design an android application for media player.

3. Design an android Application for SMS Manager

4.	Design an android Application using Google Map To Trace The Location of Device
5.	Design an android Application for Frame Animation
6.	**Mini-Project 1:** Design mobile app to perform the task of creating the splash screen for the application using timer, camera options and integrate Google map API on the first page of the application. Make sure map has following features: • Zoom and View change • Navigation to specific locations • Marker and getting location with touch • Monitoring of location
7.	**Mini-Project 2:** Create an app to add of a product to SQLite database and make sure to add following features • SMS messaging and email provision • Bluetooth options • Accessing Web services • Asynchronous remote method call • Use Alert box for user notification
8.	**Mini-Project 3:** Create the module for collecting cellular mobile network performance parameters using telephony API Manager • Nearest Base Station • Signal Strengths • SIM Module Details • Mobility Management Information
9.	**Mini-Project 4:** Create an application for Bank using spinner, intent • Form 1: Create a new account for customer, Form 2: Deposit money in customer account. Link both forms, after completing of first form the user should be directed to the second form. Provide different menu options
10.	**Mini-Project 5:** Create the module for payment of fees for College by demonstrating the following methods. • Fees Method()- for calculation of fees, Use customized Toast for successful payment of fees, Implement an alarm in case someone misses out on the fee submission deadline • Demonstrate the online payment gateway.

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Savitribai Phule Pune University
Fourth Year of Computer Engineering (2015 Course)
410248:Project Work Stage I

Home

Teaching Scheme: Practical : 02 Hours/Week	Credit 02	Examination Scheme: Presentation: 50 Marks

Course Objectives:

- To Apply the knowledge for solving realistic problem
- To develop problem solving ability
- To Organize, sustain and report on a substantial piece of team work over a period of several months
- To Evaluate alternative approaches, and justify the use of selected tools and methods,
- To Reflect upon the experience gained and lessons learned,
- To Consider relevant social, ethical and legal issues,
- To find information for yourself from appropriate sources such as manuals, books, research journals and from other sources, and in turn increase analytical skills.
- To Work in TEAM and learn professionalism.

Course Outcomes:

On completion of the course, student will be able to–

- Solve real life problems by applying knowledge.
- Analyze alternative approaches, apply and use most appropriate one for feasible solution.
- Write precise reports and technical documents in a nutshell.
- Participate effectively in multi-disciplinary and heterogeneous teams exhibiting team work, Inter-personal relationships, conflict management and leadership quality.

Guidelines

Project work Stage – I is an integral part of the Project work. In this, the student shall complete the partial work of the Project which will consist of problem statement, literature review, SRS, Model and Design. The student is expected to complete the project at least up to the design phase. As a part of the progress report of project work Stage-I, the candidate shall deliver a presentation on the advancement in Technology pertaining to the selected project topic. The student shall submit the duly certified progress report of Project work Stage-I in standard format for satisfactory completion of the work by the concerned guide and head of the Department/Institute.

The examinee will be assessed by a panel of examiners of which one is necessarily an external examiner. The assessment will be broadly based on work undergone, content delivery, presentation skills, documentation, question-answers and report.

Follow guidelines and formats as mentioned in Project Workbook recommended by Board of Studies.

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In addition to credits, it is recommended that there should be audit course in preferably in each semester from second year to supplement their knowledge and skills. Student will be awarded the bachelor‘s degree if he/she earns 190 credits and clears all the audit courses specified in the syllabus. The student will be awarded grade as AP on successful completion of audit course. The student may opt for one of the audit courses per semester, starting in second year first semester. Though not mandatory, such a selection of the audit courses helps the learner to explore the subject of interest in greater detail resulting in achieving the very objective of audit course's inclusion. List of options offered is provided. Each student has to choose one audit course from the list per semester. Evaluation of audit course will be done at institute level itself. Method of conduction and method of assessment for audit courses are suggested.

Criteria:

The student registered for audit course shall be awarded the grade AP (Audit Course Pass) and shall be included such AP grade in the Semester grade report for that course, provided student has the minimum attendance as prescribed by the Savitribai Phule Pune University and satisfactory in-semester performance and secured a passing grade in that audit course. No grade points are associated with this 'AP' grade and performance in these courses is not accounted in the calculation of the performance indices SGPA and CGPA. Evaluation of audit course will be done at institute level itself. (Ref- http://www.unipune.ac.in/Syllabi_PDF/revised-2015/engineering/UG_RULE_REGULATIONS_FOR_CREDIT_SYSTEM-2015_18June.pdf)

Guidelines for Conduction and Assessment(Any one or more of following but not limited to)

- Lectures/ Guest Lectures
- Visits (Social/Field) and reports
- Demonstrations
- Surveys
- Mini Project
- Hands on experience on specific focused topic

Guidelines for Assessment (Any one or more of following but not limited to)

- Written Test
- Demonstrations/ Practical Test
- Presentations
- IPR/Publication
- Report

Audit Course 3 Options

AC5- I	Entrepreneurship Development
AC5-II	Botnet of Things
AC5-III	3D Printing
AC5-IV	Industrial Safety and Environment Consciousness
AC5-V	Emotional Intelligence
AC5-VI	MOOC-Learn New Skill

Note: It is permitted to opt one of the audit courses listed at SPPU website too, if not opted earlier http://collegecirculars.unipune.ac.in/sites/documents/Syllabus%202017/Forms/AllItems.aspx

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410249: Audit Course 5
AC5 – I: Entrepreneurship Development

This Course Aims at Instituting Entrepreneurial skills in the students by giving an overview of, who the entrepreneurs are and what competences are needed to become an entrepreneur.

Course Objectives:

- To introduce the aspects of Entrepreneurship
- To acquaint with legalities in product development
- To understand IPR, Trademarks, Copyright and patenting
- To know the facets of functional plans, Entrepreneurial Finance and Enterprise Management

Course Outcomes:

On completion of the course, learner will be able to–

- Understand the legalities in product development
- Undertake the process of IPR, Trademarks, Copyright and patenting
- Understand and apply functional plans
- Manage Entrepreneurial Finance
- Inculcate managerial skill as an entrepreneur

Course Contents:

1. **Introduction:** Concept and Definitions, Entrepreneur v/s Intrapreneur; Role of entrepreneurship in economic development; Entrepreneurship process; Factors impacting emergence of entrepreneurship; Managerial versus entrepreneurial Decision Making; Entrepreneur v/s Investors; Entrepreneurial attributes and characteristics; Entrepreneurs versus inventors; Entrepreneurial Culture; Women Entrepreneurs; Social Entrepreneurship; Classification and Types of Entrepreneurs; EDP Programmers; Entrepreneurial Training; Traits/Qualities of an Entrepreneurs.
2. **Creating Entrepreneurial Venture :** Generating Business idea- Sources of Innovation, methods of generating ideas, Creativity and Entrepreneurship; Business planning process; Drawing business plan; Business plan failures; Entrepreneurial leadership – components of entrepreneurial leadership; Entrepreneurial Challenges; Legal issues – forming business entity, considerations and Criteria, requirements for formation of a Private/Public Limited Company, Intellectual Property Protection - Patents Trademarks and Copyrights.
3. **Functional plans:** Marketing plan–for the new venture, environmental analysis, steps in preparing marketing plan, marketing mix, contingency planning; Organizational plan – designing organization structure and Systems; Financial plan – pro forma income statements, Ratio Analysis.
4. **Entrepreneurial Finance:** Debt or equity financing, Sources of Finance - Commercial banks, private placements, venture capital, financial institutions supporting entrepreneurs; Lease Financing; Funding opportunities for Startups in India.
5. **Enterprise Management:** Managing growth and sustenance- growth norms; Factors for growth; Time management, Negotiations, Joint ventures, Mergers and acquisitions

Books:

1. Kumar, Arya,`` Entrepreneurship: Creating and Leading an Entrepreneurial Organization'', Pearson ISBN-10: 8131765784; ISBN-13: 978-8131765784 ...
2. Hishrich., Peters, ``Entrepreneurship: Starting, Developing and Managing a New Enterprise'', ISBN 0-256-14147- 9
3. Irwin Taneja, ``Entrepreneurship,'' Galgotia Publishers. ISBN: 978-93-84044-82-4
4. Charantimath, Poornima, ``Entrepreneurship Development and Small Business Enterprises,'' Pearson Education, ISBN, 8177582607, 9788177582604.

Savitribai Phule Pune University, Pune
Fourth Year of Computer Engineering (2015 Course)
410249: Audit Course 5
AC5 – II: Botnet of Things

Home

This course aims to provide an understanding of the various security attacks and knowledge to recognize and remove common coding errors that lead to vulnerabilities. It gives an outline of the techniques for developing a secure application.

Course Objectives:

- To Understand the various IoT Protocols
- To Understand the IoT Reference Architecture and Real World Design Constraints
- To learn the concept of Botnet

Course Outcomes:

On completion of the course, learner will be able to–

- Implement security as a culture and show mistakes that make applications vulnerable to attacks.
- Understand various attacks like DoS, buffer overflow, web specific, database specific, web - spoofing attacks.
- Demonstrate skills needed to deal with common programming errors that lead to most security problems and to learn how to develop secure applications

Course Contents:

1. **Introduction**
2. **IRC-Based Bot Networks**
3. **Anatomy of a Botnet: The Gaobot Worm**
4. **IoT Senosors and Security :** Sensors and actuators in IoT, Communication and networking in IoT, Real-time data collection in IoT, Data analytics in IoT , IoT applications and requirements, Security threats and techniques in IoT, Data trustworthiness and privacy in IoT, Balancing utility and other design goals in IoT , Future of Botnets in the Internet of Things, Thingbots, Elements of Typical IRC Bot Attack , Malicious use of Bots and Botnet
5. **Service Layer Protocols and Security :** Security: PHP Exploits, Cross-Site Scripting and Other Browser-Side Exploits, Bots and Botnets, Service Layer -oneM2M, ETSI M2M, OMA, BBF – Security in IoT Protocols –MAC 802.15.4 , 6LoWPAN, RPL, Application Layer Transport and Session layer protocols- transport Layer (TCP, MPTCP, UDP, DCCP, SCTP) - (TLS, DTLS) – Session Layer - HTTP, CoAP, XMPP, AMQP, MQTT

Books:

1. Bernd Scholz - Reiter, Florian Michahelles, “Architecting the Internet of Things”, Springer ISBN 978 – 3 – 642 – 19156 - 5 e - ISBN 978 – 3 -642 - 19157 - 2,
2. Threat Modeling, Frank Swiderski and Window Snyder,Microsoft Professional, 1 st Edition 2004
3. Gunter Ollmann 2007. The Phishing Guide Understanding and Preventing Phishing Attacks. IBM Internet Security Systems.
4. Daniel Minoli, “Building the Internet of Things with IPv6 and MIPv6: The Evolving World of M2M Communications”, ISBN: 978 – 1 – 118 – 47347 - 4, Willy Publications
5. White Papers :- https://www.sans.org/reading-room/whitepapers/malicious/bots-botnet-overview-1299
6. https://www-01.ibm.com/marketing/iwm/dre
7. Mike Kuniavsky, “Smart Things: Ubiquitous Computing User Experience Design,” Morgan Kaufmann Publishers.

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410249: Audit Course 5
AC5 – III: 3D Printing

Home

Course Objectives:
- To understand the principle of 3D printing
- To understand resource requirements of 3D printing
- To know the basic artwork needed for 3D printing

Course Outcomes:

On completion of the course, learner will be able to–
- Apply models for 3D printing
- Plan the resources for 3D printing
- Apply principles in 3D printing in real world

Course Contents:

1. Getting Started with 3D Printing: How 3D Printers Fit into Modern Manufacturing, Exploring the Types of 3D Printing, Exploring Applications of 3D Printing.

2. Outlining 3D Printing Resources: Identifying Available Materials for 3D Printing, Identifying Available Sources for 3D Printable Objects.

3. Exploring the Business Side of 3D Printing: Commoditizing 3D Printing, Understanding 3D Printing's Effect on Traditional lines of Business, Reviewing 3D Printing Research.

4. Employing Personal 3D printing Devices: Exploring 3D printed Artwork, Considering Consumer level 3D Printers, Deciding on RepEap of Your Own.

Books:

1. Richard Horne, Kalani Kirk Hausman, “ 3D Printing for Dummies”, Taschenbuch, ISBN: 9781119386315
2. Greg Norton, “3D Printing Business - 3D Printing for Beginners - How to 3D Print” ,ISBN:9781514785669
3. Liza Wallach Kloski and Nick Kloski, “ Getting Started with 3D Printing: A Hands-on Guide to the Hardware, Software, and Services Behind the New Manufacturing Revolution”, Maker Media, ISBN: 1680450204
4. Jeff Heldrich , “3D Printing: Tips on Getting Started with 3D Printing to Help you make Passive income for your Business”

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Savitribai Phule Pune University, Pune
Fourth Year of Computer Engineering (2015 Course)
410249: Audit Course 5
AC5 – IV: Industrial Safety and Environment Consciousness

Objective of Industrial Safety, Health Environment and Security covers virtually every important area in administration of SHE. It broadly discusses the major problems in safety management, occupational health and today's dynamic environment management of rapidly changing ambience, technological advances, whole gamut of safety laws, safety policy and it's designing and their meticulous implementation.

Course Objectives:

- To understand Industrial hazards and Safety requirements with norms
- To learn the basics of Safety performance planning
- To know the means of accident prevention
- To understand the impact of industrialization on environment
- To know the diversified industrial requirements of safety and security

Course Outcomes:

On completion of the course, learner will be able to–

- Formulate the plan for Safety performance
- Formulate the action plan for accidents and hazards
- Follow the safety and security norms in the industry
- Consider critically the environmental issues of Industrialization

Course Contents:

1. Introduction: Elements of safety programming, safety management, Upgrading developmental programmers: safety procedures and performance measures, education, training and development in safety.

2. Safety Performance Planning

Safety Performance: An overview of an accident, It is an accident, injury or incident, The safety professional, Occupational health and industrial hygiene. Understanding the risk: Emergency preparedness and response, prevention of accidents involving hazardous substances.

3. Accident Prevention

What is accident prevention?, Maintenance and Inspection, Monitoring Techniques, General Accident Prevention, Safety Education and Training.

4. Safety Organization

Basic Elements of Organized Safety, Duties of Safety Officer, Safe work Practices, Safety Sampling and Inspection, Job Safety Analysis(JSA), Safety Survey, On- site and Off-site Emergency Plan, Reporting of Accidents and Dangerous Occurrences.

5. Environment

Introduction, Work Environment, Remedy, pollution of Marine Environment and Prevention, Basic Environmental Protection Procedures, Protection of Environment in Global Scenario, Greenhouse Gases, Climate Change Impacts, GHG Mitigation Options, Sinks and Barriers,

6. Industrial Security(Industry wise)

General security Systems in Factories, Activation Security, Computer Security, Banking Security, V.I.P. Security, Women Security, Event Security, Security in Open Environments.

Books:

1. Basudev Panda ,"Industrial Safety, Health Environment and Security",Laxmi Publications, ISBN-10: 9381159432, 13: 978-9381159439
2. L.M. Deshmukh, "Industrial Safety Management", TMH , ISBN: 9780070617681

Savitribai Phule Pune University, Pune
Fourth Year of Computer Engineering (2015 Course)
410249: Audit Course 5
AC5 – V: Emotional Intelligence

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This Emotional Intelligence (EI) training course will focus on the five core competencies of emotional intelligence: self-awareness, self-regulation, motivation, empathy and interpersonal skills. Participants will learn to develop and implement these to enhance their relationships in work and life by increasing their understanding of social and emotional behaviors, and learning how to adapt and manage their responses to particular situations. Various models of emotional intelligence will be covered.

Course Objectives:

- To develop an awareness of EI models
- To recognize the benefits of EI
- To understand how you use emotion to facilitate thought and behavior
- To know and utilize the difference between reaction and considered response

Course Outcomes:

On completion of the course, learner will be able to–

- Expand your knowledge of emotional patterns in yourself and others
- Discover how you can manage your emotions, and positively influence yourself and others
- Build more effective relationships with people at work and at home
- Positively influence and motivate colleagues, team members, managers
- Increase the leadership effectiveness by creating an atmosphere that engages others

Course Contents:

1. **Introduction to Emotional Intelligence (EI) :** Emotional Intelligence and various EI models, The EQ competencies of self-awareness, self-regulation, motivation, empathy, and interpersonal skills, Understand EQ and its importance in life and the workplace
2. **Know and manage your emotions:** emotions, The different levels of emotional awareness, Increase your emotional knowledge of yourself, Recognize 'negative' and 'positive' emotions. The relationship between emotions, thought and behavior, Discover the importance of values, The impact of not managing and processing 'negative' emotions, Techniques to manage your emotions in challenging situations
3. **Recognize emotions in others :**The universality of emotional expression, Learn tools to enhance your ability to recognize and appropriately respond to others' emotions, Perceiving emotions accurately in others to build empathy
4. **Relate to others**: Applying EI in the workplace, the role of empathy and trust in relationships, Increase your ability to create effective working relationships with others (peers, subordinates, managers, clients, Find out how to deal with conflict, Tools to lead, motivate others and create a high performing team.

Books:

1. Daniel Goleman," Emotional Intelligence – Why It Matters More Than IQ," , Bantam Books, ISBN-10: 055338371X13: 978-0553383713
2. Steven Stein , "The EQ Edge" , Jossey-Bass, ISBN : 978-0-470-68161-9
3. Drew Bird , "The Leader's Guide to Emotional Intelligence" , ISBN: 9781535176002

Savitribai Phule Pune University, Pune
Third Year of Computer Engineering (2015 Course)
410249: Audit Course 5
410257: Audit Course 6
AC5 – VI & AC6-VI: MOOC-Learn New Skill

Course Objectives:

- To promote interactive user forums to support community interactions among students, professors, and experts
- To promote learn additional skills anytime and anywhere
- To enhance teaching and learning on campus and online

Course Outcomes:

On completion of the course, learner will acquire additional knowledge and skill.

About Course:

MOOCs (Massive Open Online Courses) provide affordable and flexible way to learn new skills, pursue lifelong interests and deliver quality educational experiences at scale. Whether you're interested in learning for yourself, advancing your career or leveraging online courses to educate your workforce, SWYAM, NPTEL, edx or similar ones can help.

World's largest SWAYAM MOOCs, a new paradigm of education for anyone, anywhere, anytime, as per your convenience, aimed to provide digital education free of cost and to facilitate hosting of all the interactive courses prepared by the best more than 1000 specially chosen faculty and teachers in the country. SWAYAM MOOCs enhances active learning for improving lifelong learning skills by providing easy access to global resources.

SWAYAM is a programme initiated by Government of India and designed to achieve the three cardinal principles of Education Policy viz., access, equity and quality. The objective of this effort is to take the best teaching learning resources to all, including the most disadvantaged. SWAYAM seeks to bridge the digital divide for students who have hitherto remained untouched by the digital revolution and have not been able to join the mainstream of the knowledge economy.

This is done through an indigenous developed IT platform that facilitates hosting of all the courses, taught in classrooms from 9th class till post-graduation to be accessed by anyone, anywhere at any time. All the courses are interactive, prepared by the best teachers in the country and are available, free of cost to the residents in India. More than 1,000 specially chosen faculty and teachers from across the Country have participated in preparing these courses.
The courses hosted on SWAYAM is generally in 4 quadrants – (1) video lecture, (2) specially prepared reading material that can be downloaded/printed (3) self-assessment tests through tests and quizzes and (4) an online discussion forum for clearing the doubts. Steps have been taken to enrich the learning experience by using audio-video and multi-media and state of the art pedagogy / technology. In order to ensure best quality content are produced and delivered, seven National Coordinators have been appointed: They are NPTEL for engineering and UGC for post-graduation education.

Guidelines:

Instructors are requested to promote students to opt for courses (not opted earlier) with proper mentoring. The departments will take care of providing necessary infrastructural and facilities for the learners.

References:

1. https://swayam.gov.in/
2. https://onlinecourses.nptel.ac.in/
3. https://www.edx.org

SEMESTER II

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Savitribai Phule Pune University
Fourth Year of Computer Engineering (2015 Course)
410250: Machine Learning

Teaching Scheme:	Credit	Examination Scheme:
TH: 03 Hours/Week	03	In-Sem (Paper): 30 Marks End-Sem (Paper): 70 Marks

Prerequisite Courses: 207003- Engineering Mathematics III

Companion Course: 410254- Laboratory Practice III

Course Objectives:

- To understand human learning aspects and relate it with machine learning concepts.
- To understand nature of the problem and apply machine learning algorithm.
- To find optimized solution for given problem.

Course Outcomes:

On completion of the course, student will be able to–

- Distinguish different learning based applications
- Apply different preprocessing methods to prepare training data set for machine learning.
- Design and implement supervised and unsupervised machine learning algorithm.
- Implement different learning models
- Learn Meta classifiers and deep learning concepts

Course Contents

Unit I	Introduction to Machine learning	08 Hours

Classic and adaptive machines, Machine learning matters, Beyond machine learning-deep learning and bio inspired adaptive systems, Machine learning and Big data.

Important Elements of Machine Learning- Data formats, Learnability, Statistical learning approaches, Elements of information theory.

Unit II	Feature Selection	08 Hours

Scikit- learn Dataset, Creating training and test sets, managing categorical data, Managing missing features, Data scaling and normalization, Feature selection and Filtering, Principle Component Analysis(PCA)-non negative matrix factorization, Sparse PCA, Kernel PCA. Atom Extraction and Dictionary Learning.

Unit III	Regression	08 Hours

Linear regression- Linear models, A bi-dimensional example, Linear Regression and higher dimensionality, Ridge, Lasso and ElasticNet, Robust regression with random sample consensus, Polynomial regression, Isotonic regression,

Logistic regression-Linear classification, Logistic regression, Implementation and Optimizations, Stochastic gradient descendent algorithms, Finding the optimal hyper-parameters through grid search, Classification metric, ROC Curve.

Unit IV	Naïve Bayes and Support Vector Machine	08 Hours

Bayes' Theorom, Naïve Bayes' Classifiers, Naïve Bayes in Scikit- learn- Bernoulli Naïve Bayes, Multinomial Naïve Bayes, and Gaussian Naïve Bayes.

Support Vector Machine(SVM)- Linear Support Vector Machines, Scikit- learn implementation- Linear Classification, Kernel based classification, Non- linear Examples. Controlled Support Vector Machines, Support Vector Regression.

Unit V	Decision Trees and Ensemble Learning	08 Hours

Decision Trees- Impurity measures, Feature Importance. Decision Tree Classification with Scikit-learn, Ensemble Learning-Random Forest, AdaBoost, Gradient Tree Boosting, Voting Classifier.

Clustering Fundamentals- Basics, K-means: Finding optimal number of clusters, DBSCAN, Spectral Clustering. Evaluation methods based on Ground Truth- Homogeneity, Completeness, Adjusted Rand Index.

Introduction to Meta Classifier: Concepts of Weak and eager learner, Ensemble methods, Bagging, Boosting, Random Forests.

Unit VI	Clustering Techniques	08 Hours

Hierarchical Clustering, Expectation maximization clustering, Agglomerative Clustering- Dendrograms, Agglomerative clustering in Scikit- learn, Connectivity Constraints.

Introduction to Recommendation Systems- Naïve User based systems, Content based Systems, Model free collaborative filtering-singular value decomposition, alternating least squares.

Fundamentals of Deep Networks-Defining Deep learning, common architectural principles of deep networks, building blocks of deep networks.

Books:

Text:

1. Giuseppe Bonaccorso, "Machine Learning Algorithms", Packt Publishing Limited**,** ISBN-10: 1785889621, ISBN-13: 978-1785889622
2. Josh Patterson, Adam Gibson, "Deep Learning: A Practitioners Approach", O'REILLY, SPD, ISBN: 978-93-5213-604-9, 2017 Edition 1st.

References:

1. Ethem Alpaydin, " Introduction to Machine Learning", PHI 2nd Edition-2013, ISBN 978-0-262-01243-0
2. Peter Flach, "Machine Learning: The Art and Science of Algorithms that Make Sense of Data", Cambridge University Press, Edition 2012, *ISBN*-10: 1107422221; ISBN-13: 978-1107422223
3. Tom Mitchell "Machine Learning" McGraw Hill Publication, ISBN :0070428077 9780070428072
4. Nikhil Buduma, "Fundamentals of Deep Learning", O'REILLY publication, second edition 2017, ISBN: 1491925612

Home

Savitribai Phule Pune University
Fourth Year of Computer Engineering (2015 Course)
410251: Information and Cyber Security

Teaching Scheme:	Credit	Examination Scheme:
TH: 03 Hours/Week	03	In-Sem (Paper): 30 Marks End-Sem (Paper): 70 Marks

Prerequisite Courses: 310245-Computer Networks

Companion Course: 410254: Laboratory Practice III

Course Objectives:

- To offer an understanding of principle concepts, central topics and basic approaches in information and cyber security.
- To know the basics of cryptography.
- To acquire knowledge of standard algorithms and protocols employed to provide confidentiality, integrity and authenticity.
- To enhance awareness about Personally Identifiable Information (PII), Information Management, cyber forensics.

Course Outcomes:

On completion of the course, student will be able to–

- Gauge the security protections and limitations provided by today's technology.
- Identify information security and cyber security threats.
- Analyze threats in order to protect or defend it in cyberspace from cyber-attacks.
- Build appropriate security solutions against cyber-attacks.

Course Contents

Unit I	Security Basics	08 Hours

Introduction, Elements of Information Security, Security Policy, Techniques, Steps, Categories, Operational Model of Network Security, Basic Terminologies in Network Security. Threats and Vulnerability, Difference between Security and Privacy.

Unit II	Data Encryption Techniques And Standards	08 Hours

Introduction, Encryption Methods: Symmetric, Asymmetric, Cryptography, Substitution Ciphers. Transposition Ciphers, Stenography applications and limitations, Block Ciphers and methods of operations, Feistal Cipher, Data Encryption Standard (DES), Triple DES, DES Design Criteria, Weak Keys in DES Algorithms, Advance Encryption Standard (AES).

Unit III	Public Key And Management	08 Hours

Public Key Cryptography, RSA Algorithm: Working, Key length, Security, Key Distribution, Deffie-Hellman Key Exchange, Elliptic Curve: Arithmetic, Cryptography, Security, Authentication methods, Message Digest, Kerberos, X.509 Authentication service.

Digital Signatures: Implementation, Algorithms, Standards (DSS), Authentication Protocol.

Unit IV	Security Requirements	08 Hours

IP Security: Introduction, Architecture, IPV6, IPv4, IPSec protocols, and Operations, AH Protocol, ESP Protocol, ISAKMP Protocol, Oakkey determination Protocol, VPN. WEB Security: Introduction, Secure Socket Layer (SSL), SSL Session and Connection, SSL Record Protocol, Change Cipher Spec Protocol, Alert Protocol, Handshake Protocol. Electronic Mail Security: Introduction, Pretty Good Privacy, MIME, S/MIME, Comparison. Secure Electronic Transaction (SET).

Unit V	Firewall And Intrusion	08 Hours

Introduction, Computer Intrusions. Firewall Introduction, Characteristics and types, Benefits and limitations. Firewall architecture, Trusted Systems, Access Control. Intrusion detection, IDS: Need, Methods, Types of IDS, Password Management, Limitations and Challenges.

Unit VI	Confidentiality And Cyber Forensic	08 Hours

Introduction to Personally Identifiable Information (PII), Cyber Stalking, PII impact levels with examples Cyber Stalking, Cybercrime, PII Confidentiality Safeguards, Information Protection Law: Indian Perspective.

Books:

Text:

1. Bernard Menezes, “Network Security and Cryptography”, Cengage Learning India, 2014, ISBN No.: 8131513491
2. Nina Godbole, Sunit Belapure, “Cyber Security”, Wiley India, 2014, ISBN No.: 978-81-345-2179-1

References:

1. Eoghan Casey, “Digital Evidence and Computer Crime Forensic Science, Computers and the Internet”, ELSEVIER, 2011, ISBN 978-0-12-374268-1
2. Atul Kahate, “Cryptography and Network Security”, Mc Graw Hill Publication, 2nd Edition, 2008, ISBN : 978-0-07-064823-4
3. William Stallings, “Cryptography and network security principles and practices”, Pearson, 6th Edition, ISBN : 978-93-325-1877-3
4. Forouzan, “Cryptography and Network Security (SIE)”, Mc Graw Hill, ISBN, 007070208X, 9780070702080
5. Dr. Nilakshi Jain-Digital Forensic: The Fascinating World of Digital Evidences-Wiley India-ISBN: 9788126565740

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Savitribai Phule Pune University
Fourth Year of Computer Engineering (2015 Course)
Elective III
410252(A): Advanced Digital Signal Processing

Teaching Scheme: TH: 03 Hours/Week	Credit 03	Examination Scheme: In-Sem (Paper): 30 Marks End-Sem (Paper): 70 Marks

Prerequisite Courses: 410244(A)Digital Signal Processing

Companion Course: 410255-Laboratory Practice IV

Course Objectives:

- To study the parametric methods for power spectrum estimation.
- To study adaptive filtering techniques and applications of adaptive filtering.
- To learn and understand Multi-rate DSP and applications
- To explore appropriate transforms
- Understand basic concepts of speech production, speech analysis, speech coding and parametric representation of speech
- Acquire knowledge about different methods used for speech coding and understand various applications of speech processing
- Learn and understand basics of Image Processing and various image filters with its applications

Course Outcomes:

On completion of the course, student will be able to–

- Understand and apply different transforms for the design of DT/Digital systems
- Explore the knowledge of adaptive filtering and Multi-rate DSP
- Design DT systems in the field/area of adaptive filtering, spectral estimation and multi-rate DSP
- Explore use of DCT and WT in speech and image processing
- Develop algorithms in the field of speech , image processing and other DSP applications

Course Contents

Unit I	DFT and Applications	08 Hours

DFT and Applications – Linear filtering, spectral leakage, Spectral resolution and selection of Window Length, Frequency analysis, 2-D DFT, applications in Image and Speech Processing

Unit II	Adaptive FIR and IIR filter Design	08 Hours

Adaptive FIR and IIR filter Design – DT Filters, FIR and IIR filters, Adaptive FIR Filter design: Steepest descent and Newton method, LMS method, Applications, Adaptive IIR Filter design: Pade Approximation, Least square design, Applications

Unit III	Multi-rate DSP and applications	08 Hours

Multi-rate DSP and applications – Decimation, Interpolation, sampling rate conversion, polyphone filter structures, multistage filter design, applications

Unit IV	Spectral Estimation	08 Hours

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Spectral Estimation – Estimation of density spectrum, Nonparametric method, Parametric method, Evaluation ,DCT and WT – DCT and KL transform, STFT, WT, Harr Wavelet and Dubecheis Wavelet, Applications of DCT and WT.

Unit V	Speech processing	08 Hours

Speech processing - Speech coding: Phase Vocoder, LPC, Sub-band coding, Adaptive Transform Coding, Harmonic Coding, Vector Quantization based Coders. Fundamentals of Speech recognition, Speech segmentation, Text-to-speech conversion, speech enhancement, Speaker Verification, Applications.

Unit VI	Image Processing	08 Hours

Image Processing – Image as 2D signal and image enhancement techniques, filter design: low pass, highpass and bandpass for image smoothing and edge detection, Optimum linear filter and order statistic filter, Examples – Wiener and Median filters, Applications

Books:

Text:

1. J. G. Proakis, D. G. Manolakis, " Digital Signal Processing: Principles, Algorithms, and Applications," Prentice Hall, 2007, 4th edition, ISBN: 10: 0131873741
2. Dr. Shaila D. Apate , " Advanced Digital Signal Processing," Wiley Publ., 2013, *ISBN*-10: 8126541245
3. S. K. Mitra, "Digital Signal Processing : A Computer Based Approach", McGraw Hill Higher Education, 2006, 3rd edition, *ISBN*-10: 0070429537
4. Rabiner and Juang, "Fundamentals of Speech Recognition", Prentice Hall, 1994, ISBN:0-13-015157-2 .
5. Rafael C. Gonzalez, Richard E. Woods, "Digital Image Processing and Analysis", Pearson Education, 3d Ed., 2007, ISBN: 81-7808-629-8

References:

1. Chanda, Muzumdar, "Digital Image Processing and Analysis," Estern Economy Edition, PHI, 2nd Ed., ISBN: 978-81-203-4096-*1*
2. TarunRawat, "Digital Signal Processing", Oxford University Press, 2015, ISBN-10: 0198062281
3. Roberto Crist, "Modern Digital Signal Processing," Thomson Brooks/Cole 2004, ISBN:978-93-80026-55-8.
4. Nelson Morgan and Ben Gold, " Speech and Audio Signal Processing: Processing and Perception Speech and Music", 1999, John Wiley and Sons, ISBN: 0387951547
5. Raghuveer. M. Rao, AjitS.Bopardikar, "Wavelet Transforms: Introduction to Theory and applications," Pearson Education, Asia, 2000.Dale Grover and John R. (Jack) Deller, "Digital Signal Processing and the Microcontroller", Prentice Hall, ISBN:0-13-754920-2

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Savitribai Phule Pune University

Fourth Year of Computer Engineering (2015 Course)

Elective III

410252(B): Compilers

Teaching Scheme: **TH: 03 Hours/Week**	**Credit** **03**	**Examination Scheme:** **In-Sem (Paper): 30 Marks** **End-Sem (Paper): 70 Marks**

Prerequisite Courses: Theory of Computation(310241), 310251-Systems Programming and Operating System

Companion Course: 410255-Laboratory Practice IV

Course Objectives:

- To introduce process of compilation
- To introduce complier writing tools
- To address issues in code generation and optimization

Course Outcomes:

On completion of the course, student will be able to–

- Design and implement a lexical analyzer and a syntax analyzer
- Specify appropriate translations to generate intermediate code for the given programming language construct
- Compare and contrast different storage management schemes
- Identify sources for code optimization

Course Contents

Unit I	**Notion and Concepts**	**08 Hours**

Introduction to compilers Design issues, passes, phases, symbol table Preliminaries Memory management, Operating system support for compiler, Lexical Analysis Tokens, Regular Expressions, Process of Lexical analysis, Block Schematic, Automatic construction of lexical analyzer using LEX, LEX features and specification.

Unit II	**Parsing**	**08 Hours**

Syntax Analysis CFG, top-down and bottom-up parsers, RDP, Predictive parser, SLR, LR(1), LALR parsers, using ambiguous grammar, Error detection and recovery, automatic construction of parsers using YACC, Introduction to Semantic analysis, Need of semantic analysis, type checking and type conversion.

Unit III	**Syntax Translation Schemes**	**08 Hours**

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Syntax Directed Translation - Attribute grammar, S and L attributed grammar, bottom up and top down evaluations of S and L attributed grammar, Syntax directed translation scheme, Intermediate code - need, types: Syntax Trees, DAG, Three-Address codes: Quadruples, Triples and Indirect Triples, Intermediate code generation of declaration statement and assignment statement.

Unit IV	**Run-time Storage Management**	**08 Hours**

Storage Management – Static, Stack and Heap, Activation Record, static and control links, parameter passing, return value, passing array and variable number of arguments, Static and Dynamic scope, Dangling Pointers, translation of control structures – if, if-else statement, Switch-case, while, do -while statements, for, nested blocks, display mechanism, array assignment, pointers, function call and return. Translation of OO constructs: Class, members and Methods.

Unit V	**Code Generation**	**08 Hours**

Code Generation - Issues in code generation, basic blocks, flow graphs, DAG representation of basic blocks, Target machine description, peephole optimization, Register allocation and Assignment, Simple code generator, Code generation from labeled tree, Concept of code generator.

Unit VI	**Code Optimization**	**08 Hours**

Need for Optimization, local, global and loop optimization, Optimizing transformations, compile time evaluation, common sub-expression elimination, variable propagation, code movement, strength reduction, dead code elimination, DAG based local optimization, Introduction to global data flow analysis, Data flow equations and iterative data flow analysis.

Books:

Text:

1. V Aho, R Sethi, J D Ullman, “Compilers: Principles, Techniques, and Tools", Pearson Edition, ISBN 81-7758-590-8
2. Dick Grune, Bal, Jacobs, Langendoen, “ Modern Compiler Design”, Wiley, ISBN 81-265-0418-8

References:

1. Anthony J. Dos Reis, “Compiler Construction Using Java”, JavaCC and Yacc Wiley, ISBN 978-0-470-94959-7
2. K Muneeswaran, “Compiler Design", Oxford University press, ISBN 0-19-806664-3
3. J R Levin, T Mason, D Brown, “Lex and Yacc", O'Reilly, 2000 ISBN 81-7366-061-X

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Savitribai Phule Pune University
Fourth Year of Computer Engineering (2015 Course)
Elective III
410252(C): Embedded and Real Time Operating Systems

Teaching Scheme:	Credit	Examination Scheme:
TH: 03 Hours/Week	03	In-Sem (Paper): 30 Marks End-Sem (Paper): 70 Marks

Prerequisite Courses: 310251-Systems Programming and Operating System

Companion Course: 410255-Laboratory Practice IV

Course Objectives:

- To understand a typical embedded system and its constituents
- To learn the selection process of processor and memory for the embedded systems
- To learn communication buses and protocols used in the embedded and real-time systems
- To understand real-time operating system (RTOS) and the types of RTOS
- To learn various approaches to real-time scheduling
- To learn software development process and tools for RTOS applications

Course Outcomes:

On completion of the course, student will be able to–

- Recognize and classify embedded and real-time systems
- Explain communication bus protocols used for embedded and real-time systems
- Classify and exemplify scheduling algorithms
- Apply software development process to a given RTOS application
- Design a given RTOS based application

Course Contents

Unit I	Embedded Systems	08 Hours

Introduction to Embedded systems, Characteristics, Challenges, Processors in Embedded systems, hardware Unit s and devices in an embedded system – Power source, memory, real-time clocks, timers, reset circuits, watchdog-timer reset, Input-output ports, buses and interfaces, ADC, DAC, LCD, LED, Keypad, pulse dialer, modem, transceivers, embedded software, software are tools for designing an embedded system.

Unit II	Embedded System On Chip (SOC)	08 Hours

Embedded SOC, ASIC, IP core, ASIP, ASSP, examples of embedded systems. Advanced architectures/processors for embedded systems- ARM, SHARC, DSP, Superscalar Units. Processor organization, Memory organization, Performance metrics for a processor, memory map and addresses, Processor selection and memory selection for real-time applications.

Networked embedded systems- I2C, CAN, USB, Fire wire. Internet enabled systems- TCP, IP, UDP. Wireless and mobile system Protocols- IrDA, Bluetooth, 802.11, ZigBee.

Unit III	I/O Communication	08 Hours

Devices and communication buses: Types of I/O communication, types of serial communication, Serial protocols, Devices and buses- RS-232C, RS-485, HDLC, SPI, SCI, SI, SDIO. Parallel ports and interfacing. Parallel device protocols: ISA, PCI, PCI/X, ARM bus, Wireless devices.

Unit IV	Real Time Operating System	08 Hours

Introduction to real-time operating systems. Hard versus soft real-time systems and their timing constraints. Temporal parameters of real-time process: Fixed, Jittered and sporadic release times, execution time. Types of real-time tasks, Precedence constraints and data dependency among real-time tasks, other types of dependencies for real-time tasks. Functional parameters and Resource parameters of real-time process, Real-time applications: Guidance and control, Signal processing, Multimedia, real-time databases.

Real-time task and task states, task and data. Approaches to real-time scheduling: clock driver, weighted round-robin, priority-driven- Fixed priority and dynamic priority algorithms –Rate Monotonic (RM), Earliest-Deadline-First (EDF), Latest-Release-Time (LRT), Least-Slack-Time-First (LST). Static and Dynamic systems, on-line and off-line scheduling, Scheduling a-periodic and sporadic real-time tasks.

Unit V	Inter-process communication	08 Hours

Resources and resource access control-Assumption on resources and their usage, Enforcing mutual exclusion and critical sections, resource conflicts and blocking, Effects of resource contention and resource access control - priority inversion, priority inheritance.

Inter-process communication-semaphores, message queues, mailboxes and pipes. Other RTOS services-Timer function, events, Interrupts - enabling and disabling interrupts, saving and restoring context, interrupt latency, shared data problem while handling interrupts. Interrupt routines in an RTOS environment.

Unit VI	Multiprocessor Scheduling	08Hours

Multiprocessor Scheduling, resource access control and synchronization in Real-time Operating system. Real-time communication: Model, priority-based service disciplines for switched networks, weighted round-robin service disciplines, Medium access-control protocols for broadcast networks, internet and resource reservation protocols, real-time protocols. Software development process for embedded system: Requirements engineering, Architecture and design of an embedded system, Implementation aspects in an embedded system, estimation modeling in embedded software. Validation and debugging of embedded systems. Embedded software development tools. Debugging techniques. Real-time operating systems: Capabilities of commercial real-time operating systems, QNX/Neutrino, Microc/OS-II, VxWorks, Windows CE and RTLinux.

Books:

Text:

1. Raj Kamal, “Embedded Systems: Architecture, programming and Design”, 2nd Edition, McGraw-Hill, ISBN: 13: 9780070151253
2. Jane W. S. Liu, “Real-Time Systems”, Pearson Education, ISBN: 10: 0130996513
1. David E. Simon, “An Embedded Software Primer”, Pearson Education, ISBN: :8177581546

References:

1. Sriram V. Iyer, Pankaj Gupta, “Embedded Real-time Systems Programming”, Tata McGraw-Hill, ISBN: 13: 9780070482845
2. Dr. K. V. K. K. Prasad, “Embedded Real-Time Systems: Concepts: Design and Programming”, Black Book, Dreamtech Press, ISBN: 10: 8177224611,13: 9788177224610

Savitribai Phule Pune University
Fourth Year of Computer Engineering (2015 Course)
Elective III
410252(D): Soft Computing and Optimization Algorithms

Teaching Scheme:	Credit	Examination Scheme:
TH: 03 Hours/Week	03	In-Sem (Paper): 30 Marks End-Sem (Paper): 70 Marks

Prerequisite Courses: 310250-Design and Analysis of Algorithm

Companion Course: 410255-Laboratory Practice IV

Course Objectives:

- To know the basics behind the Design and development intelligent systems in the framework of soft computing
- To acquire knowledge of Artificial Neural Networks Fuzzy sets, Fuzzy Logic, Evolutionary computing and swarm intelligence
- To explore the applications of soft computing
- To understand the need of optimization

Course Outcomes:

On completion of the course, student will be able to–

- Apply soft computing methodologies, including artificial neural networks, fuzzy sets, fuzzy logic, fuzzy inference systems and genetic algorithms
- Design and development of certain scientific and commercial application using computational neural network models, fuzzy models, fuzzy clustering applications and genetic algorithms in specified applications.

Course Contents

Unit I	Introduction	08 Hours

Introduction, soft computing vs. hard computing, various types of soft computing techniques, and applications of soft computing. Basic tools of soft computing – Fuzzy logic, neural network, evolutionary computing. Introduction: Neural networks, application scope of neural networks, fuzzy logic, genetic algorithm, and hybrid systems.

Unit II	Fuzzy Sets and Logic	08 Hours

Basic concepts of fuzzy logic, Fuzzy sets and Crisp sets, Fuzzy set theory and operations, Properties of fuzzy sets, Fuzzy and Crisp relations, Fuzzy to Crisp conversion. Membership functions, interference in fuzzy logic, fuzzy if-then rules, Fuzzy implications and Fuzzy algorithms, Fuzzyfications and Defuzzifications.

Unit III	Fuzzy Systems	08 Hours

Fuzzy Controller, Fuzzy rule base and approximate reasoning: truth values and tables in fuzzy logic, fuzzy propositions formation of rules, decomposition of compound rules, aggregation of fuzzy rules, fuzzy reasoning, fuzzy inference system, fuzzy expert systems.

Unit IV	Evolutionary Computing	08 Hours

Basic Evolutionary Processes, EV : A Simple Evolutionary System, Evolutionary Systems as Problem Solvers, A Historical Perspective, Canonical Evolutionary Algorithms - Evolutionary Programming, Evolution Strategies, A Unified View of Simple EAs- A Common Framework, Population Size.

Unit V	**Genetic Algorithm**	**08 Hours**

Basic concepts, working principle, procedures of GA, flow chart of GA, Genetic representations, (encoding) Initialization and selection, Genetic operators, Mutation, Generational Cycle, Traditional algorithm vs genetic algorithm, simple GA, general genetic algorithm, schema theorem, Classification of genetic algorithm, Holland classifier systems, genetic programming, applications of genetic algorithm, Convergence of GA. Applications and advances in GA, Differences and similarities between GA and other traditional method, applications.

Unit VI	**Swarm Intelligence**	**08 Hours**

Swarm intelligence , Particle Swarm Optimization (PSO) Algorithm- Formulations, Pseudo-code, parameters, premature convergence, topology, biases, Real valued and binary PSO, Ant colony optimization (ACO)- Formulations, Pseudo-code. Applications of PSO and ACO.

Books:

Text:

1. S.N. Sivanandam- "Principles of Soft Computing", Wiley India- ISBN- 9788126527410
2. S. Rajsekaran and G.A. Vijayalakshmi Pai, "Neural Networks, Fuzzy Logic and Genetic Algorithm: Synthesis and Applications" , Prentice Hall of India, ISBN: 0451211243
3. J S R Jang, CT Sun and E.Mizutani, "Neuro-Fuzzy and Soft Computing" , PHI PVT LTD, ISBN 0-13-261066-3.
4. De Jong , "Evolutionary Computation: A Unified Approach", Cambridge (Massachusetts): MIT Press. ISBN: 0-262-04194-4. 2006
5. Maurice Clerc, "Particle Swarm Optimization", ISTE, Print ISBN:9781905209040 |Online ISBN:9780470612163 |DOI:10.1002/9780470612163

References:

1. Andries P. Engelbrecht, "Computational Intelligence: An Introduction", 2nd Edition-Wiley India- ISBN: 978-0-470-51250-0
2. N.P.Padhy, "Artificial Intelligence and Intelligent Systems" Oxford University Press, ISBN 10: 0195671546
3. Siman Haykin, "Neural Networks", Prentice Hall of India, ISBN: 0-7923-9475-5
4. Timothy J. Ross, "Fuzzy Logic with Engineering Applications" , Wiley India, ISBN: 978-0-470-74376-8
5. Eiben and Smith, "Introduction to Evolutionary Computation", Springer, ISBN-10: 3642072852

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Savitribai Phule Pune University
Fourth Year of Computer Engineering (2015 Course)
Elective IV
410253(A): Software Defined Networks

Teaching Scheme: TH: 03 Hours/Week	Credit 03	Examination Scheme: In-Sem (Paper): 30 Marks End-Sem (Paper): 70 Marks

Prerequisite Courses: 310245-Computer Networks

Companion Course: 410255-Laboratory Practice IV

Course Objectives:

- To understand the challenges of the traditional networks and evolution of next generation networks.
- To gain conceptual understanding of Software Defined Networking (SDN) and its role in Data Center.
- To understand role of Open Flow protocol and SDN Controllers.
- To study industrial deployment use-cases of SDN
- To Understand the Network Functions Virtualization and SDN.

Course Outcomes:

On completion of the course, student will be able to–

- Interpret the need of Software Defined Networking solutions.
- Analyze different methodologies for sustainable Software Defined Networking solutions.
- Select best practices for design, deploy and troubleshoot of next generation networks.
- Develop programmability of network elements.
- Demonstrate virtualization and SDN Controllers using OpenFlow protocol

Course Contents

Unit I	Introduction to Software Defined Networking (SDN)	08 Hours

Challenges of traditional networks, Traditional Switch Architecture - Control, Data and management Planes, Introduction to SDN, Need of SDN, History of SDN, Fundamental characteristics of SDN (Plane Separation, Simplified Device and Centralized control, Network Automation and Virtualization, and Openness), SDN Operation/Architecture, SDN API's (Northbound API's, Southbound API's, East/West API's), ONF, SDN Devices and SDN Applications.

Unit II	Open Flow	08 Hours

Home

OpenFlow Overview, The OpenFlow Switch, The OpenFlow Controller, ,OpenFlow Ports, Message Types, Pipeline Processing, Flow Tables, Matching, Instructions, Action Set and List, OpenFlow Protocol, Proactive and Reactive Flow, Timers, OpenFlow Limitations, OpenFlow Advantages and Disadvantages, Open v Switch Features

Unit III	SDN Controllers	08 Hours

SDN OpenFlow Controllers: Open Source Controllers - NOX, POX, Beacon, Maestro, Floodlight, Ryu and Open Daylight, Applicability of OpenFlow protocol in SDN Controllers, Mininet, and implementing software-defined network (SDN) based firewall.

Unit IV	SDN in Data Centre	08 Hours

Data Center Definition, Data Center Demands (Adding, Moving, Deleting Resources, Failure Recovery, Multitenancy, Traffic Engineering and Path Efficiency), Tunneling Technologies for the Data Center, SDN Use Cases in the Data Center, Comparison of Open SDN, Overlays, and APIs, Real-World Data Center Implementations.

Unit V	Network Functions Virtualization (NFV)	08 Hours

Definition of NFV, SDN Vs NFV, In-line network functions, Benefits of Network Functions Virtualization, Challenges for Network Functions Virtualization, Leading NFV Vendors, Comparison of NFV and NV.

Unit VI	SDN Use Cases	08 Hours

Wide Area Networks, Service Provider and Carrier Networks, Campus Networks, Hospitality Networks, Mobile Networks, Optical Networks, SDN vs P2P/Overlay Networks.

Books:

Text:

1. Paul Goransson and Chuck Black, “Software Defined Networks: A Comprehensive Approach”, Morgan Kaufmann, 2014, ISBN: 9780124166752, 9780124166844.
2. Siamak Azodolmolky, “Software Defined Networking with Open Flow, Packt Publishing, 2013, ISBN: 9781849698726
3. Thomas D. Nadeau, Ken Gray, “SDN: Software Defined Networks, An Authoritative Review of Network Programmability Technologies”, 2013, ISBN : 10:1-4493-4230-2, 978-1-4493-4230-2

References:

1. Vivek Tiwari, “SDN and OpenFlow for Beginners”, Digital Services, 2013, ISBN: 10: 1-940686-00-8, 13: 978-1-940686-00-4
2. Fei Hu, “Network Innovation through OpenFlow and SDN: Principles and Design”, CRC Press, 2014, ISBN: 10: 1466572094
3. Open Networking Foundation (ONF) Documents, https://www.opennetworking.org, 2015

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Savitribai Phule Pune University
Fourth Year of Computer Engineering (2015 Course)
Elective IV
410253(B): Human Computer Interface

Teaching Scheme:	Credit	Examination Scheme:
TH: 03 Hours/Week	03	In-Sem (Paper): 30 Marks End-Sem (Paper): 70 Marks

Prerequisite Courses: 210251-Computer Graphics

Companion Course: 410255-Laboratory Practice IV

Course Objectives:

- To design, implement and evaluate effective and usable Human Computer Interfaces.
- To describe and apply core theories, models and methodologies from the field of HCI.
- Learn a variety of methods for evaluating the quality of a user interface
- To implement simple graphical user interfaces based on principles of HCI.

Course Outcomes:

On completion of the course, student will be able to–

- Evaluate the basics of human and computational abilities and limitations.
- Inculcate basic theory, tools and techniques in HCI.
- Apply the fundamental aspects of designing and evaluating interfaces.
- Apply appropriate HCI techniques to design systems that are usable by people

Course Contents

Unit I	Foundations of Human–Computer Interaction	08 Hours

What is HCI – design, models, evaluation, Need to understand people, computers and methods. Basic human abilities - vision, hearing, touch, memory.

Computers – speed, interfaces, widgets, and effects on interaction. Humans – Memory, Attention Span, Visual Perception, psychology, ergonomics. Understanding Users.

Methods for evaluation of interfaces with users: goals of evaluation, approaches, ethics, introspection, extracting the conceptual model, direct observation, constructive interaction, interviews and questionnaires, continuous evaluation via user feedback and field studies, choosing an evaluation method.

Unit II	The Design Process	08 Hours

Interaction Design Basics, Interaction Styles. HCI in the Software Process. HCI design principles and rules: design principles, principles to support usability, golden rules and heuristics, HCI patterns, design rules, HCI design standards. Direct Manipulation - Overview, Scope, Applications. Universal Design, User-centered design, task analysis/GOMS, Graphic Design

Unit III	Implementation	08 Hours

Home

Implementation Tools, Technology and change designing for the Web, designing for portable devices. Handling errors and Designing Help. Prototyping and UI Software.

Unit IV	**Evaluation and User Support**	**08 Hours**

Evaluation of User Interfaces. Web Browsers - Fonts, Color Palette, Color Depth, Resolution, Layout, Size, Orientation. Mobile devices issues – design, limitations, what next. User Support.

Unit V	**Users Models**	**08 Hours**

Predictive Models, Cognitive Models. Interaction with Natural Languages, Next Generation Interface. Socio-organizational Issues and Stakeholder Requirements. Heuristic Evaluation, Evaluation with Cognitive Models, Evaluation with Users.

Unit VI	**Task Models and Dialogs**	**08 Hours**

Task Analysis, DOET (Design of Everyday Things). Design Dialogs Notations, Warnings, and Error messages. Model-based Evaluation. User Testing, Usability Testing, User Acceptance Testing.

Books:

Text:

1. Alan J, Dix. Janet Finlay, Rusell Beale, "Human Computer Interaction", Pearson Education, 3rd Edition, 2004, ISBN 81-297-0409-9
2. Jenny Preece, Rogers, Sharp, "Interaction Design-beyond human-computer interaction", WILEY-INDIA, ISBN 81-265-0393-9

References:

3. Jonathan Lazar, Jinjuan Feng, Harry Hochheiser, "Research Methods in Human-Computer Interaction", Third Edition, Morgan Kaufmann, 2017, ISBN: 9780128053904.
4. Mary Beth Rosson and John M. Carroll, "Usability Engineering: Scenario-Based Development of Human-Computer Interaction", Morgan Kaufmann, 2001, ISBN-13**:** 978-1558607125

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Savitribai Phule Pune University
Fourth Year of Computer Engineering (2015 Course)
Elective IV
410253(C): Cloud Computing

Teaching Scheme:	Credit	Examination Scheme:
TH: 03 Hours/Week	03	In-Sem (Paper): 30 Marks End-Sem (Paper): 70 Marks

Prerequisite Courses: 310245 Computer Networks

Companion Course: 410255-Laboratory Practice IV

Course Objectives:

- To understand cloud computing concepts;
- To study various platforms for cloud computing
- To explore the applications based on cloud computing

Course Outcomes:

On completion of the course, student will be able to–

- To install cloud computing environments.
- To develop any one type of cloud
- To explore future trends of cloud computing

Course Contents

Unit I	Basics of Cloud Computing	08 Hours

Overview, Applications, Intranets and the Cloud. Your Organization and Cloud Computing- Benefits, Limitations, Security Concerns. Software as a Service (SaaS)- Understanding the Multitenant Nature of SaaS Solutions, Understanding SOA. Platform as a Service (PaaS)-IT Evolution Leading to the Cloud, Benefits of Paas Solutions, Disadvantages of PaaS Solutions. Infrastructure as a Service (IaaS)-Understanding IaaS, Improving Performance through Load Balancing, System and Storage Redundancy, Utilizing Cloud-Based NAS Devices, Advantages, Server Types. Identity as a Service (IDaaS).

Unit II	Data Storage and Security in Cloud	08 Hours

Cloud file systems: GFS and HDFS, BigTable, HBase and Dynamo Cloud data stores: Datastore and Simple DB Gautam Shrauf, Cloud Storage-Overview, Cloud Storage Providers. [Anthony T. Velte]3 Securing the Cloud- General Security Advantages of Cloud-Based Solutions, Introducing Business Continuity and Disaster Recovery. Disaster Recovery- Understanding the Threats.

Unit III	Virtualization	08 Hours

Implementation Levels of Virtualization, Virtualization Structures/Tools and Mechanisms, Types of Hypervisors, Virtualization of CPU, Memory, and I/O Devices, Virtual Clusters and Resource Management, Virtualization for Data-Center Automation. Common Standards: The Open Cloud Consortium, Open Virtualization Format, Standards for Application Developers: Browsers (Ajax), Data (XML, JSON), Solution Stacks (LAMP and LAPP),Syndication (Atom, Atom Publishing Protocol, and RSS), Standards for Security.

Unit IV	Amazon Web Services	08 Hours

Home

Services offered by Amazon Hands-on Amazon, EC2 - Configuring a server, Virtual Amazon Cloud, AWS Storage and Content Delivery Identify key AWS storage options Describe Amazon EBS Creating an Elastic Block Store Volume Adding an EBS Volume to an Instance Snap shotting an EBS Volume and Increasing Performance Create an Amazon S3 bucket and manage associated objects. AWS Load Balancing Service Introduction Elastic Load Balancer Creating and Verifying Elastic Load Balancer.

Unit V	**Ubiquitous Clouds and the Internet of Things**	**08 Hours**

Cloud Trends in Supporting Ubiquitous Computing, Performance of Distributed Systems and the Cloud, Enabling Technologies for the Internet of Things (RFID, Sensor Networks and ZigBee Technology, GPS), Innovative Applications of the Internet of Things (Smart Buildings and Smart Power Grid, Retailing and Supply-Chain Management, Cyber-Physical System), Online Social and Professional Networking.

Unit VI	**Future of Cloud Computing**	**08 Hours**

How the Cloud Will Change Operating Systems, Location-Aware Applications, Intelligent Fabrics, Paints, and More, The Future of Cloud TV, Future of Cloud-Based Smart Devices, Faster Time to Market for Software Applications, Home-Based Cloud Computing, Mobile Cloud, Autonomic Cloud Engine, Multimedia Cloud, Energy Aware Cloud Computing, Jungle Computing. Docker at a Glance: Process Simplification, Broad Support and Adoption, Architecture, Getting the Most from Docker, The Docker Workflow.

Books:

Text:

1. Anthony T. Velte Toby J. Velte, Robert Elsenpeter, “Cloud Computing: A Practical Approach”, 2010, The McGraw-Hill.
2. Dr. Kris Jamsa, “ Cloud Computing: SaaS, PaaS, IaaS, Virtualization and more” , Wiley Publications, ISBN*:* 978-0-470-97389-9
3. Gautam Shrof, “ENTERPRISE CLOUD COMPUTING Technology Architecture, Applications, Cambridge University Press, *ISBN*: 9780511778476

References:

1. Dr. Kumar Saurabh,"Cloud Computing", Wiley Publication, ISBN10: 8126536039
2. Buyya, “Mastering Cloud Computing”, Tata McGraw Hill, ISBN-13: 978-1-25-902995-0,
3. Barrie Sosinsky,"Cloud Computing", Wiley India, ISBN: 978-0-470-90356-8
4. Kailash Jayaswal, “Cloud computing", Black Book, Dreamtech Press
5. Thomas Erl, Zaigham Mahmood and Ricardo Puttini, “Cloud Computing: Concepts, Technology and Architecture”, Pearson, 1st Edition, ISBN :978 9332535923, 9332535922
4. Tim Mather, Subra K, Shahid L.,Cloud Security and Privacy, Oreilly, ISBN-13 978-81-8404-815-5

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Savitribai Phule Pune University
Fourth Year of Computer Engineering (2015 Course)
Elective IV
410253(D): Open Elective

Teaching Scheme:	Credit	Examination Scheme:
TH: 03 Hours/Week	03	In-Sem (Paper): 30 Marks End-Sem (Paper): 70 Marks

Companion Course: 410255-Laboratory Practice IV

The open elective included, so as to give the student a wide choice of subjects from other Engineering Programs. To inculcate the out of box thinking and to feed the inquisitive minds of the learners the idea of open elective is need of the time.

Flexibility is extended with the choice of open elective allows the learner to choose interdisciplinary/exotic/future technology related courses to expand the knowledge horizons.

With this idea learner opts for the course without any boundaries to choose the approved by academic council and Board of Studies.

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Savitribai Phule Pune University
Fourth Year of Computer Engineering (2015 Course)
410254:Laboratory Practice III

Teaching Scheme:	Credit	Examination Scheme:
Practical : 04 Hours/Week	02	Term Work: 50 Marks Practical: 50 Marks

Companion Courses: 410250 and 410251

Course Objectives and Outcomes: Practical hands on is the absolute necessity as far as employability of the learner is concerned. The presented course is solely intended to enhance the competency by undertaking the laboratory assignments of the core courses.

About

Laboratory Practice III is for practical hands on for core courses Machine Learning and Information & Cyber Security.

Guidelines for Laboratory Conduction

- **List of recommended programming assignments and sample mini-projects is provided for reference.**
- Referring these, Course Teacher or Lab Instructor may frame the assignments/mini-project by understanding the prerequisites, technological aspects, utility and recent trends related to the respective courses.
- Preferably there should be multiple sets of assignments/mini-project and distribute among batches of students.
- Real world problems/application based assignments/mini-projects create interest among learners serving as foundation for future research or startup of business projects.
- Mini-project can be completed in group of 2 to 3 students.
- Software Engineering approach with proper documentation is to be strictly followed.
- Use of open source software is to be encouraged.
- Instructor may also set one assignment or mini-project that is suitable to respective course beyond the scope of syllabus.

Operating System recommended :- 64-bit Open source Linux or its derivative

Programming Languages: C++/JAVA/PYTHON/R

Programming tools recommended: Front End: Java/Perl/PHP/Python/Ruby/.net, Backend : MongoDB/MYSQL/Oracle, Database Connectivity : ODBC/JDBC, Additional Tools: Octave, Matlab, WEKA.

Guidelines for Student Journal

The laboratory assignments are to be submitted by student in the form of journal. Journal may consists of prologue, Certificate, table of contents, and **handwritten write-up** of each assignment (Title, Objectives, Problem Statement, Outcomes, software and Hardware requirements, Date of Completion, Assessment grade/marks and assessor's sign, Theory- Concept in brief, Algorithm/Database design, test cases, conclusion/analysis). **Program codes with sample output of all performed assignments are to be submitted as softcopy.**

As a conscious effort and little contribution towards Green IT and environment awareness, attaching printed papers as part of write-ups and program listing to journal may be avoided. Use of digital storage media/DVD containing students programs maintained by lab In-charge is highly encouraged. For reference one or two journals may be maintained with program prints at Laboratory.

Guidelines for Assessment

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Continuous assessment of laboratory work is to be done based on overall performance and lab assignments performance of student. Each lab assignment assessment will assign grade/marks based on parameters with appropriate weightage. Suggested parameters for overall assessment as well as each lab assignment assessment include- timely completion, performance, innovation, efficient codes, punctuality and neatness **reserving weightage for successful mini-project completion and related documentation.**

Guidelines for Practical Examination

- Both internal and external examiners should jointly frame suitable problem statements for practical examination based on the term work completed.
- During practical assessment, the expert evaluator should give the maximum weightage to the satisfactory implementation of the problem statement.
- The supplementary and relevant questions may be asked at the time of evaluation to test the student's for advanced learning, understanding of the fundamentals, effective and efficient implementation.
- Encouraging efforts, transparent evaluation and fair approach of the evaluator will not create any uncertainty or doubt in the minds of the students. So adhering to these principles will consummate our team efforts to the promising boost to the student's academics.

Guidelines for Instructor's Manual

The instructor's manual is to be developed as a hands-on resource and as ready reference. The instructor's manual need to include prologue (about University/program/ institute/ department/foreword/ preface etc), University syllabus, conduction and Assessment guidelines, topics under consideration-concept, objectives, outcomes, set of typical applications/assignments/ guidelines, references among others.

Suggested List of Laboratory Assignments& Mini Projects

(any 04 assignments Machine Learning and Information & Cyber Security AND Mini-project per course)

410250: Machine Learning

1. Assignment on Linear Regression:

The following table shows the results of a recently conducted study on the correlation of the number of hours spent driving with the risk of developing acute backache. Find the equation of the best fit line for this data.

Number of hours spent driving (x)	Risk score on a scale of 0-100 (y)
10	95
9	80
2	10
15	50
10	45
16	98
11	38
16	93

2. Assignment on Decision Tree Classifier:

A dataset collected in a cosmetics shop showing details of customers and whether or not they responded to a special offer to buy a new lip-stick is shown in table below. Use this dataset to

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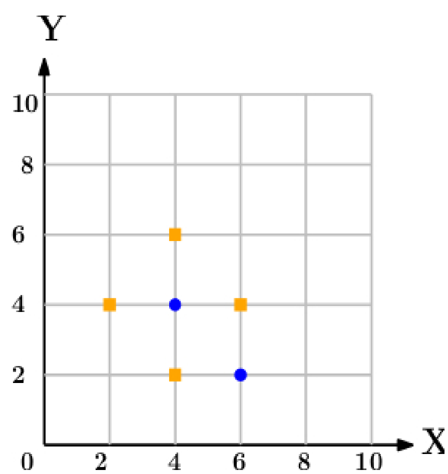
build a decision tree, with Buys as the target variable, to help in buying lip-sticks in the future. Find the root node of decision tree. According to the decision tree you have made from previous training data set, what is the decision for the test data: [Age < 21, Income = Low, Gender = Female, Marital Status = Married]?

ID	Age	Income	Gender	Marital Status	Buys
1	< 21	High	Male	Single	No
2	< 21	High	Male	Married	No
3	21-35	High	Male	Single	Yes
4	>35	Medium	Male	Single	Yes
5	>35	Low	Female	Single	Yes
6	>35	Low	Female	Married	No
7	21-35	Low	Female	Married	Yes
8	< 21	Medium	Male	Single	No
9	<21	Low	Female	Married	Yes
10	> 35	Medium	Female	Single	Yes
11	< 21	Medium	Female	Married	Yes
12	21-35	Medium	Male	Married	Yes
13	21-35	High	Female	Single	Yes
14	> 35	Medium	Male	Married	No

3. Assignment on k-NN Classification:

In the following diagram let blue circles indicate positive examples and orange squares indicate negative examples. We want to use k-NN algorithm for classifying the points. If k=3, find the class of the point (6,6). Extend the same example for Distance-Weighted k-NN and Locally weighted Averaging



4. Assignment on K-Means Clustering:

We have given a collection of 8 points. P1=[0.1,0.6] P2=[0.15,0.71] P3=[0.08,0.9] P4=[0.16, 0.85] P5=[0.2,0.3] P6=[0.25,0.5] P7=[0.24,0.1] P8=[0.3,0.2]. Perform the k-mean clustering with initial centroids as m1=P1 =Cluster#1=C1 and m2=P8=cluster#2=C2. Answer the following

1] Which cluster does P6 belongs to?
2] What is the population of cluster around m2?
3] What is updated value of m1 and m2?

5. Mini-Project 1 on Genetic Algorithm:

Apply the Genetic Algorithm for optimization on a dataset obtained from UCI ML repository. For Example: IRIS Dataset or Travelling Salesman Problem or KDD Dataset

6.	**Mini-Project 2** on SVM: Apply the Support vector machine for classification on a dataset obtained from UCI ML repository. For Example: Fruits Classification or Soil Classification or Leaf Disease Classification
7.	**Mini-Project 3** on PCA: Apply the Principal Component Analysis for feature reduction on any Company Stock Market Dataset
410251:: : Information and Cyber Security	
1.	Implementation of S-DES
2.	Implementation of S-AES
3.	Implementation of Diffie-Hellman key exchange
4.	Implementation of RSA.
5.	Implementation of ECC algorithm.
6.	**Mini Project 1:** SQL Injection attacks and Cross -Site Scripting attacks are the two most common attacks on web application. Develop a new policy based Proxy Agent, which classifies the request as a scripted request or query based request, and then, detects the respective type of attack, if any in the request. It should detect both SQL injection attack as well as the Cross-Site Scripting attacks.
7.	**Mini Project 2:**This task is to demonstrate insecure and secured website. Develop a web site and demonstrate how the contents of the site can be changed by the attackers if it is http based and not secured. You can also add payment gateway and demonstrate how money transactions can be hacked by the hackers. Then support your website having https with SSL and demonstrate how secured website is.

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Savitribai Phule Pune University
Fourth Year of Computer Engineering (2015 Course)
410255:Laboratory Practice IV

Teaching Scheme:	Credit	Examination Scheme:
Practical : 04 Hours/Week	02	Term Work: 50 Marks Presentation: 50 Marks

Companion Courses: 410252 and 410253

Course Objectives and Outcomes: Practical hands on is the absolute necessity as far as employability of the learner is concerned. The presented course is solely intended to enhance the competency by undertaking the laboratory assignments of the elective courses. Enough choice is provided to the learner to choose an elective of one's interest.

Laboratory Practice II is companion lab for elective course III and elective course IV.

Guidelines for Laboratory Conduction

- **List of recommended programming assignments and sample mini-projects is provided for reference.**
- Referring these, Course Teacher or Lab Instructor may frame the assignments/mini-project by understanding the prerequisites, technological aspects, utility and recent trends related to the respective courses.
- Preferably there should be multiple sets of assignments/mini-project and distribute among batches of students.
- Real world problems/application based assignments/mini-projects create interest among learners serving as foundation for future research or startup of business projects.
- Mini-project can be completed in group of 2 to 3 students.
- Software Engineering approach with proper documentation is to be strictly followed.
- Use of open source software is to be encouraged.
- Instructor may also set one assignment or mini-project that is suitable to respective course beyond the scope of syllabus.

Operating System recommended :- 64-bit Open source Linux or its derivative

Programming Languages: C++/JAVA/PYTHON/R

Programming tools recommended: Front End: Java/Perl/PHP/Python/Ruby/.net, Backend : MongoDB/MYSQL/Oracle, Database Connectivity : ODBC/JDBC, Additional Tools: Octave, Matlab, WEKA.

Guidelines for Student Journal

The laboratory assignments are to be submitted by student in the form of journal. Journal may consists of prologue, Certificate, table of contents, and **handwritten write-up** of each assignment (Title, Objectives, Problem Statement, Outcomes, software and Hardware requirements, Date of Completion, Assessment grade/marks and assessor's sign, Theory- Concept in brief, Algorithm/Database design, test cases, conclusion/analysis). **Program codes with sample output of all performed assignments are to be submitted as softcopy.**

As a conscious effort and little contribution towards Green IT and environment awareness, attaching printed papers as part of write-ups and program listing to journal may be avoided. Use of digital storage media/DVD containing students programs maintained by lab In-charge is highly encouraged. For reference one or two journals may be maintained with program prints at Laboratory.

Guidelines for Assessment

Continuous assessment of laboratory work is to be done based on overall performance and lab

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assignments performance of student. Each lab assignment assessment will assign grade/marks based on parameters with appropriate weightage. Suggested parameters for overall assessment as well as each lab assignment assessment include- timely completion, performance, innovation, efficient codes, punctuality and neatness **reserving weightage for successful mini-project completion and related documentation.**

Guidelines for Practical Examination

- **It is recommended to conduct examination based on Mini-Project(s) Demonstration and related skill learned.** Team of 2 to 3 students may work on mini-project. During the assessment, the expert evaluator should give the maximum weightage to the satisfactory implementation and software engineering approach followed.
- The supplementary and relevant questions may be asked at the time of evaluation to test the student's for advanced learning, understanding, effective and efficient implementation and demonstration skills.
- Encouraging efforts, transparent evaluation and fair approach of the evaluator will not create any uncertainty or doubt in the minds of the students. So adhering to these principles will consummate our team efforts to the promising start of the student's academics.

Guidelines for Instructor's Manual

The instructor's manual is to be developed as a hands-on resource and as ready reference. The instructor's manual need to include prologue (about University/program/ institute/ department/foreword/ preface etc), University syllabus, conduction and Assessment guidelines, topics under consideration-concept, objectives, outcomes, set of typical applications/assignments/ guidelines, references among others.

Suggested List of Laboratory Assignments & Mini Projects

Recommended / Sample set of assignments and mini projects for reference for four courses offered for Elective I and for four courses offered for Elective II. Respective Student have to complete laboratory work for elective I and II that he/she has opted.

410252: Elective III

410252 (A) Advanced Digital Signal Processing

Use -
A] MATLAB or other equivalent software working with speech and image signals/files and for analysis purpose.
B] C++ or JAVA for working with sampled data (n – point data samples of DT/Digital signal)
C] JAVA or other for image processing assignments

1.	Apply 1-D DFT to observe spectral leakage and frequency analysis of different window sequences, plot the frequency spectrums.
2.	Adaptive FIR and IIR filter design: A] Steepest descent and Newton method, LMS method, B] Adaptive IIR Filter design: Pade Approximation, Least square design
3.	Power spectrum estimation and analysis: Take a speech signal and perform A] Non parametric method: DFT and window sequences B] Parametric methods: AR model parameters
4.	Multi-rate DSP and applications – Decimation, Interpolation, sampling rate conversion A] Take a speech signal with specified sampling frequency. Decimate by factor D(e.g. factor B] Take a speech signal with specified sampling frequency. Interpolate by factor I(e.g. factor)

	C] Sampling rate conversion by factor of I/D
5.	Write a program to calculate LPC coefficients, reflection coefficients using Levinson Durbin algorithm
6.	Feature Extraction of speech signal A] Using LPC and other methods B] Apply different coding methods: harmonic coding, vector quantization
7.	**Mini-Project 1:** Discrete Cosine Transform (DCT) A] To find DCT of NxN image block B] To plot spectrum of the speech signal using DCT and find the correlation of DCT transformed signal C] Image filtering using DCT : LPF, edge detection D] Image compression using DCT, Image resizing
8.	**Mini-Project 2:** Wavelet Transform (WT) A] To get compression using wavelet decomposition of a signal B] Denoising using wavelet decomposition C] To get compression using wavelet decomposition of a signal (Harr Wavelet) D] To get low-pass filtered and high pass filtered speech signal using Haar wavelet E] Image filtering using WT
9.	**Mini-Project 3:** Image Processing A] Histogram and Equalization B] Image Enhancement Techniques C] Image Filtering: LPF, HPF, Sobel/Prewitt Masks D] Image Smoothing with special filters: Median, Weiner, Homomorphic filters
Course: 410252 (B) Compiler Construction	
1.	Implement a Lexical Analyzer using LEX for a subset of C. Cross check your output with Stanford LEX.
2.	Implement a parser for an expression grammar using YACC and LEX for the subset of C. Cross check your output with Stanford LEX and YACC.
3.	Generate and populate appropriate Symbol Table.
4.	Implementation of Semantic Analysis Operations (like type checking, verification of function parameters, variable declarations and coercions) possibly using an Attributed Translation Grammar.
5.	Implement the front end of a compiler that generates the three address code for a simple language.
6.	A Register Allocation algorithm that translates the given code into one with a fixed number of registers.
7.	Implementation of Instruction Scheduling Algorithm.
8.	Implement Local and Global Code Optimizations such as Common Sub-expression Elimination, Copy Propagation, Dead-Code Elimination, Loop and Basic-Block Optimizations. (Optional)
9.	**Mini-Project 1:** Implement POS tagging for simple sentences written Hindi or any Indian Language
Course: 410252 (C) Embedded and Real Time Operating Systems	
1.	Simulation/ Design, planning and modeling of a Real-Time / Embedded System for- (any one) • Alarm system for elderly people (Fall detection, Heart attack) • Medication machine for patients in ICU • Smart traffic control • Autonomous car • Smart home (sound system, temperature, light)

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- Control of an autonomous quadrocopter (e.g. for surveillance tasks)
- Control of a rail station
- Video conference system
- Washing machine

Course: 410252 (D) Soft Computing and Optimization Algorithms

1. Implement Union, Intersection, Complement and Difference operations on fuzzy sets. Also create fuzzy relation by Cartesian product of any two fuzzy sets and perform max-min composition on any two fuzzy relations.

2. Implement genetic algorithm for benchmark function (eg. Square, Rosenbrock function etc) Initialize the population from the Standard Normal Distribution. Evaluate the fitness of all its individuals. Then you will do multiple generation of a genetic algorithm. A generation consists of applying selection, crossover, mutation, and replacement.

Use:

- Tournament selection without replacement with tournament size s
- One point crossover with probability Pc
- bit-flip mutation with probability Pm
- use full replacement strategy

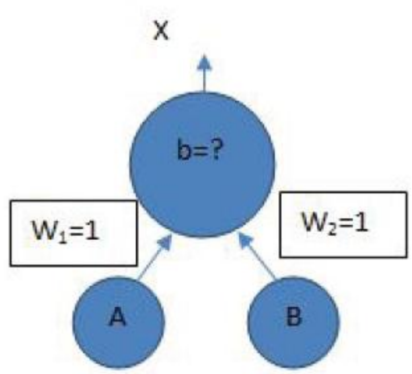
3. Implement Particle swarm optimization for benchmark function (eg. Square, Rosenbrock function). Initialize the population from the Standard Normal Distribution. Evaluate fitness of all particles.

Use :

- c1=c2 = 2
- Inertia weight is linearly varied between 0.9 to 0.4.
- Global best variation

4. Implement basic logic gates using Mc-Culoch-Pitts or Hebbnet neural networks

5. Write a program to find the Boolean function to implement following single layer perceptron. Assume all activation functions to be the threshold function which is 1 for all input values greater than zero and 0, otherwise.



6. Implement Union, Intersection, Complement and Difference operations on fuzzy sets. Also create fuzzy relation by Cartesian product of any two fuzzy sets and perform max-min composition on any two fuzzy relations.

7. The figure shows a single hidden layer neural network. The weights are initialized to 1's as shown in the diagram and all biases are initialized to 0's. Assume all the neurons have linear activation functions. The neural network is to be trained with stochastic (online) gradient descent. The first training example is [x1=1, x2=0] and the desired output is 1. Design the back-propagation algorithm to find the updated value for W11 after backpropagation. Choose the value that is the closest to the options given below: [learning rate =0.1]

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	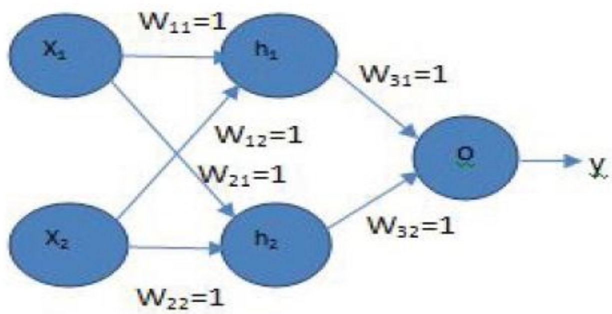
8.	**Mini-Project 1** on Genetic Algorithm: Apply the Genetic Algorithm for optimization on a dataset obtained from UCI ML repository. For Example: IRIS Dataset or Travelling Salesman Problem or KDD Dataset
9.	Apply the Particle swarm optimization for Travelling Salesman Problem
10.	**Mini-Project 2** on Fuzzy Logic: Solve Greg Viot's fuzzy cruise controller using MATLAB Fuzzy logic toolbox or Octave or Python.
11.	**Mini-Project 3** on Fuzzy Logic: Solve Air Conditioner Controller using MATLAB Fuzzy logic toolbox or Octave or Python.
	410253: Elective III
	Course: 410253 (A) Software Defined Networks
1.	Phase I:Set up Mininet network emulation environment using Virtual Box and Mininet. Demonstrate the basic commands in Mininet and emulate different custom network topology (Simple, Linear, and Tree).View flow tables.
2.	Phase II:Study open source POX and Floodlight controller. Install controller and run custom topology using remote controller like POX and floodlight controller. Identify inserted flows by the controllers.
3.	Phase III:Create a SDN environment on Mininet and configure a switch to provide a firewall functionality using POX controller. Ref:https://github.com/mininet/openflow-tutorial/wiki/Create- Firewall
4.	Phase IV:Build your own Internet Router using Mininet as an Emulator and POX controller. Write a simple router with a static routing table. The router will receive raw Ethernet frames. It will process the packets just like a real router, and then forward them to the correct outgoing interface. Make sure you receive the Ethernet frame and create the forwarding logic so packets go to the correct interface. Ref:https://github.com/mininet/mininet/wiki/Simple-Router
5.	Phase V: Emulate a Data Center and manage it via a Cloud Network Controller: create a multi-rooted tree-like (Clos) topology in Mininet to emulate a data center. Your second task is to implement specific SDN applications on top of the network controller in order to orchestrate multiple network tenants within a data center environment, in the context of network virtualization and management. Ref: https://opencourses.uoc.gr/courses/pluginfile.php/13576/mod_resource/content/2/exercise5.pdf
	Course:410253 (B) Human Computer Interface
1.	Identify specialized users and related facilities for a selected product / system and make necessary suggestions for its improved accessibility design.

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2.	Design user persona for the users of selected product / system.
3.	Conduct a contextual inquiry for selected product / system.
4.	Design an interface prototype for selected product / system.
5.	Evaluate an interface using usability evaluation technique.
Course: 410253 (C) Cloud Computing	
1.	1. Installation and configuration of own Cloud 2. Implementation of Virtualization in Cloud Computing to Learn Virtualization Basics, Benefits of Virtualization in Cloud using Open Source Operating System. 3. Study and implementation of infrastructure as Service using Open Stack. 4. Write a program for Web feed using PHP and HTML. 5. Write a Program to Create, Manage and groups User accounts in own Cloud by Installing Administrative Features. 6. Case study on Amazon EC2 to learn about Amazon EC2,Amazon Elastic Compute Cloud is a central part of Amazon.com's cloud computing platform, Amazon Web Services. How EC2 allows users torrent virtual computers on which to run their own computer applications. 7. Case study on Microsoft azure to learn about Microsoft Azure is a cloud computing platform and infrastructure, created by Microsoft, forbuilding, deploying and managing applications and services through a global network of Microsoft-managed datacenters. How it work, different services provided by it. 8. Design and develop custom Application (Mini Project) using Salesforce Cloud. 9. Assignment to install and configure Google App Engine. 10. Design an Assignment to retrieve, verify, and store user credentials using Firebase Authentication, the Google App Engine standard environment, and Google Cloud Data store. 11. Creating an Application in SalesForce.com using Apex programming Language. **12.** Design an Assignment based on Working with Mangrasoft Aneka Software.
2.	**Mini-Project 1:** Setup your own cloud for Software as a Service (SaaS) over the existing LAN in your laboratory. In this assignment you have to write your own code for cloud controller using open source technologies **without HDFS**. Implement the basic operations may be like to upload and download file on/from cloud in encrypted form.
3.	**Mini-Project 2:** Setup your own cloud for Software as a Service (SaaS) over the existing LAN in your laboratory. In this assignment you have to write your own code for cloud controller using open source technologies to implement **with HDFS**. Implement the basic operations may be like to divide the file in segments/blocks and upload/ download file on/from cloud in encrypted form.
Course: 410253 (D) Open Elective	
Suitable set of programming assignments/Mini-projects for open elective Opted.	

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Savitribai Phule Pune University
Fourth Year of Computer Engineering (2015 Course)
410256:Project Work Stage II

Teaching Scheme:	Credit	Examination Scheme:
Practical : 06 Hours/Week	06	Term Work: 100 Marks Presentation: 50 Marks

Course Objectives:

- To follow SDLC meticulously and meet the objectives of proposed work
- To test rigorously before deployment of system
- To validate the work undertaken
- To consolidate the work as furnished report.

Course Outcomes:

On completion of the course, student will be able to–

- Show evidence of independent investigation
- Critically analyze the results and their interpretation.
- Report and present the original results in an orderly way and placing the open questions in the right perspective.
- Link techniques and results from literature as well as actual research and future research lines with the research.
- Appreciate practical implications and constraints of the specialist subject

Guidelines

In Project Work Stage–II, the student shall complete the remaining project work which consists of Selection of Technology and Tools, Installations, UML implementations, testing, Results, performance discussions using data tables per parameter considered for the improvement with existing/known algorithms/systems and comparative analysis and validation of results and conclusions. The student shall prepare and submit the report of Project work in standard format for satisfactory completion of the work that is the duly certified by the concerned guide and head of the Department/Institute.

Follow guidelines and formats as mentioned in Project Workbook recommended by Board of Studies.

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Fourth Year of Computer Engineering (2015 Course)
410257: Audit Course 6

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In addition to credits, it is recommended that there should be audit course in preferably in each semester from second year to supplement their knowledge and skills. Student will be awarded the bachelor‘s degree if he/she earns 190 credits and clears all the audit courses specified in the syllabus. The student will be awarded grade as AP on successful completion of audit course. The student may opt for one of the audit courses per semester, starting in second year first semester. Though not mandatory, such a selection of the audit courses helps the learner to explore the subject of interest in greater detail resulting in achieving the very objective of audit course's inclusion. List of options offered is provided. Each student has to choose one audit course from the list per semester. Evaluation of audit course will be done at institute level itself. Method of conduction and method of assessment for audit courses are suggested.

Criteria:

The student registered for audit course shall be awarded the grade AP (Audit Course Pass) and shall be included such AP grade in the Semester grade report for that course, provided student has the minimum attendance as prescribed by the Savitribai Phule Pune University and satisfactory in-semester performance and secured a passing grade in that audit course. No grade points are associated with this 'AP' grade and performance in these courses is not accounted in the calculation of the performance indices SGPA and CGPA. Evaluation of audit course will be done at institute level itself. (Ref- http://www.unipune.ac.in/Syllabi_PDF/revised-2015/engineering/UG_RULE_REGULATIONS_FOR_CREDIT_SYSTEM-2015_18June.pdf)

Guidelines for Conduction and Assessment(Any one or more of following but not limited to)

- Lectures/ Guest Lectures
- Visits (Social/Field) and reports
- Demonstrations
- Surveys
- Mini Project
- Hands on experience on specific focused topic

Guidelines for Assessment (Any one or more of following but not limited to)

- Written Test
- Demonstrations/ Practical Test
- Presentations
- IPR/Publication
- Report

Audit Course 3 Options

AC6- I	Business Intelligence
AC6-II	Gamification
AC6-III	Quantum Computing
AC6-IV	Usability Engineering
AC6-V	Conversational Interfaces
AC6-VI	MOOC- Learn New Skills (Refer Page 48)

Note: It is permitted to opt one of the audit courses listed at SPPU website too, if not opted earlier
http://collegecirculars.unipune.ac.in/sites/documents/Syllabus%202017/Forms/AllItems.aspx

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Savitribai Phule Pune University, Pune
Fourth Year of Computer Engineering (2015 Course)
410257: Audit Course 6
AC6 – I: Business Intelligence

The course aims at examining Business Intelligence (BI) as a broad category of applications and technologies for gathering, storing, analyzing, sharing and providing access to data to help enterprise users make better managerial decisions.

Course Objectives:

- To understand the concept of Business Intelligence
- To know the details of Decision Support System
- To inculcate the concepts of Data Warehousing
- To understand the basics of design and management of BI systems

Course Outcome:

On completion of the course, learner will be able to–

- Apply the concepts of Business Intelligence in real world applications
- Explore and use the data warehousing wherever necessary
- Design and manage practical BI systems

Course Contents:

1.Concepts with Mathematical treatment : Introduction to data, Information and knowledge, Decision Support System, Theory of Operational data and informational data, Introduction to Business Intelligence, Determining BI Cycle, BI Environment and Architecture, Identify BI opportunities, Benefits of BI. Role of Mathematical model in BI, Factors Responsible for successful BI Project, Obstacle to Business Intelligence in an Organization

2. Decision Making Concepts : Concepts of Decision Making, Techniques of Decision Support System (DSS), Development of Decision Support System (DSS), Applications of DSS, Role of Business Intelligence in DSS.

3. Data-Warehouse : Introduction: Data warehouse Modeling, data warehouse design, data-warehouse technology, Distributed data warehouse, and materialized view

4.Data Pre-processing and outliers: Data Analytics life cycle, Discovery, Data preparation, Preprocessing requirements, data cleaning, data integration, data reduction, data transformation, Data discretization, and concept hierarchy generation, Model Planning, Model building, Communicating Results and Findings, Operationalizing, Introduction to OLAP. Real-world Applications, types of outliers, outlier challenges, Outlier detection Methods, Proximity-Based Outlier analysis, Clustering Based Outlier analysis.

5.Designing and managing BI systems : Determining infrastructure requirements, planning for scalability and availability, managing and maintenance of BI systems, managing BI operations or business continuity

Books:

1. R. Sharda, D. Delen, and E. Turban, Business Intelligence and Analytics. Systems for Decision Support,10th Edition. Pearson/Prentice Hall, 2015. ISBN-13: 978-0-13-305090-5, ISBN-10: 0-13-305090-4;

2. Business Process Automation, Sanjay Mohapatra, PHI.

3. Introduction to business Intelligence and data warehousing, IBM, PHI, ISBN: 9788120339279

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Savitribai Phule Pune University, Pune
Fourth Year of Computer Engineering (2015 Course)
410257: Audit Course 6
AC6 – II: Gamification

Gamification is the application of game-design elements and game principles in non-game contexts. Gamification commonly employs game design elements to improve user engagement, organizational productivity, flow, crowd sourcing, employee recruitment and evaluation, ease of use, usefulness of systems, exercise, traffic violations, voter apathy, and more.

Course Objectives:

- To develop problem solving abilities using gamification
- To apply gamifications for Web Applications
- To apply gamifications for Mobile Applications

Course Outcome:

On completion of the course, learner will be able to–

- To write survey on the gamification paradigms.
- To write programs to solve problems using gamification and open source tools.
- To solve problems for multi-core or distributed, concurrent/Parallel environments

Course Contents:

1. **Gaming Foundations:** Introduction, Resetting Behavior, Replaying History, Gaming foundations: Fun Quotient, Evolution by loyalty, status at the wheel, the House always wins.
2. **Developing Thinking:** Re-framing Context, Player Motivation, Case studies for Thinking: Tower of Hanoi.
3. **Opponent Moves in Gamification:** Reclaiming Opposition, Gamed Agencies, Remodeling design, Game Mechanics, Case study of Maze Problem.
4. **Game Design:** Game Mechanics and Dynamics: Feedback and Re-enforcement, Game Mechanics in depth, putting it together, Case study of 8 queens problem.
5. **Advanced tools, techniques and applications:** Gamification case Studies, Coding basic game Mechanics, Instant Gamification Platforms, Mambo.io(Ref:http://mambi.io), Installation and use of BigDoor (Open Source http://bigdoor.com),ngageoint/gamification-server (ref: https://github.com/ngageoint/gamification-server

Books:

1. Mathias Fuchs, Sonia Fizek,Paolo Ruffino, Niklas Schrape, Rethinking Gamification, Meson Press, ISBN (Print): 978-3-95796-000-9 , http://projects.digital-cultures.net/meson-press/files/2014/06/9783957960016-rethinking-gamification.pdf, ISBN (PDF): 978-3-95796-001-6,
2. , Gabe Zechermann, Christopher Cunningham, Gamification Design, Oreilly, ISBN: 978-1-449-39767-8, ftp://ftp.ivacuum.ru/i/WooLF/%B2011%5D%20Gamification%20by%20Design.pdf
3. http://press.etc.cmu.edu/files/MobileMediaLearning-DikkersMartinCoulter-web.pdf

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Savitribai Phule Pune University, Pune
Fourth Year of Computer Engineering (2015 Course)
410257: Audit Course 6
AC6 – III: Quantum Computing

Quantum computation and quantum information is the study of the information processing tasks that can be accomplished using quantum mechanical systems. Sounds pretty simple and obvious, doesn't it? Like many simple but profound ideas it was a long time before anybody thought of doing information processing using quantum mechanical sys- tems. To see why this is the case, we must go back in time and look in turn at each of the fields which have contributed fundamental ideas to quantum computation and quantum information -quantum mechanics, computer science, information theory, and cryptography.

Course Objectives:

- To understand basic concepts of quantum computing
- To learn quantum search algorithms
- To apply quantum information for solving real world problem

Course Outcome:

On completion of the course, learner will be able to–

- design efficient quantum algorithms
- apply quantum algorithms for several basic promise problems
- learn the hidden subgroup problems and their role in quantum computing

Course Contents:

1. **Fundamental concepts:** Introduction and overview, Quantum computation, quantum algorithm, Introduction to quantum mechanics, The postulates of quantum mechanics
2. **Quantum computation:** Quantum circuits, The quantum Fourier transform and its applications, Quantum search algorithms, Quantum computers: physical realization
3. **Quantum information:** Quantum noise and quantum operations, Distance measures for quantum information, Quantum error-correction, mEntropy and information, Quantum information theory

Books:

1. Michael A. Nielsen and Isaac L. Chuang, “Quantum Computation and Quantum Information”, ISBN: 9780521635035.
2. Mikio Nakahara and Tetsuo Ohmi, "Quantum Computing", CRC Press 2008.
3. N. David Mermin, "Quantum Computer Science", Cambridge 2007

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Savitribai Phule Pune University, Pune
Fourth Year of Computer Engineering (2015 Course)
410257: Audit Course 6
AC6 – IV: Usability Engineering

In this course you will have a hands-on experience with usability evaluation and user-centered design. This course will not help to learn how to implement user interfaces, but rather how to design based on the needs of users, which you will determine, and learn how toevaluate your designs rigorously. This help in knowing more about the usability; human computer interaction, the psychological aspects of computing, evaluation.

Course Objectives:

- To understand the human centered design process and usability engineering process and their roles in system design and development.
- To know usability design guidelines, their foundations, assumptions, advantages, and weaknesses
- Understand the user interface based on analysis of human needs and prepare a prototype system

Course Outcome:

On completion of the course, learner will be able to–

- Describe the human centered design process and usability engineering process and their roles in system design and development.
- Discuss usability design guidelines, their foundations, assumptions, advantages, and weaknesses.
- Design a user interface based on analysis of human needs and prepare a prototype system.
- Assess user interfaces using different usability engineering techniques.
- Present the design decisions

Course Contents:

1. Introduction: Usability and Other Considerations, Definition of Usability, Example: Measuring the Usability of Icons, Usability Trade-Offs, Categories of Users and Individual User Differences
2. Usability in Software Development : The Emergence of Usability, Human Computer Interaction, Usability Engineering
3. The usability Engineering Lifecycle: Requirement Analysis, Design, Testing, Development
4. Usability Assessment Methods beyond Testing
5. International User Interfaces

Books:

1. Mary Beth Rosson, John Millar Carroll, “Usability Engineering: Scenario- based Development of Human- Computer Interaction”
2. Jakob Nielsen, “Usability Engineering”
1. Deborah J. Mayhew, “ The usability engineering lifecycle”

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Savitribai Phule Pune University, Pune
Fourth Year of Computer Engineering (2015 Course)
410257: Audit Course 6
AC6 – V: Conversational Interfaces

Effective information security at the enterprise level requires participation, planning, and practice. It is an ongoing effort that requires management and staff to work together from the same script. Fortunately, the information security community has developed a variety of resources, methods, and best practices to help modern enterprises address the challenge. Unfortunately, employing these tools demands a high degree of commitment, understanding, and skill attributes that must be sustained through constant awareness and training.

Course Objectives:

- To understand the basics of conversation
- To know the interactive environments for conversational skills
- To acquaint with the speech to text and text to speech techniques

Course Outcome:

On completion of the course, learner will be able to–

- Develop an effective interface for conversation
- Explore advanced concepts in user interface

Course Contents:

1. **Introduction to Conversational Interface:** Preliminaries, Developing a speech based Conversational Interface, Conversational Interface and devices.
2. **A technology of Conversation:** Introduction, Conversation as Action, The structure of Conversation, The language of Conversation.
3. **Developing a Speech-Based Conversational Interface:** Implementing Text to Speech: Text Analysis, Wave Synthesis, Implementing Speech Recognition: Language Model, Acoustic Model, Decoding. Speech Synthesis Markup Language.
4. **Advanced voice user interface design**

Books:

1. Cathy Pearl, “Designing Voice User Interfaces: Principles of Conversational Experiences”
2. Michael McTear, ZoraidaCallejas, David Griol, “ The Conversational Interface: Talking to Smart Devices”
3. Martin Mitrevski, “Developing Conversational Interfaces for iOS: Add Responsive Voice Control”
4. SriniJanarthanam, “ Hands-On Chatbots and Conversational UI Development: Build chatbots”

Savitribai Phule Pune University
Bachelor of Computer Engineering (2015 Course)
(Total 190 Credit)

First Year		Second Year		Third Year		Forth Year	
Credit =50		**Credit =50**		**Credit =46**		**Credit =44**	
Semester I							
Course Code	**Course**	**Course Code**	**Course**	**Course Code**	**Course**	**Course Code**	**Course**
107001	Engineering Mathematics I	210241	Discrete Mathematics	310241	Theory of Computation	410241	High Performance Computing
107002 / 107009	Engineering Physics / Engineering Chemistry	210242	Digital Electronics and Logic Design	310242	Database Management Systems (DBMS)	410242	Artificial Intelligence and Robotics
102006	Engineering Graphics I	210243	Data Structures and Algorithms	310243	Software Engineering & Project Management	410243	Data Analytics
103004 / 104012	Basic Electrical Engineering /Basic Electronics Engineering	210244	Computer Organization and Architecture	310244	Information Systems & Engineering Economics	410244	Elective I • Digital Signal Processing • Software Architecture and Design • Pervasive and Ubiquitous Computing • Data Mining and Warehousing
101005	Basic Civil and Environmental Engineering	210245	Object Oriented Programming	310245	Computer Networks (CN)	410245	Elective II • Distributed Systems • Software Testing and Quality Assurance • Operations Research • Mobile Communication
110003	Fundamentals of Programming Languages I	210246	Digital Electronics Lab	310246	Skills Development Lab	410246	Laboratory Practice I
111007	Workshop Practice	210247	Data Structures Lab	310247	DBMS Lab	410247	Laboratory Practice II
		210248	Object Oriented Programming Lab	310248	CN Lab	410248	Project Work Stage I
		210249	Soft Skills	310249	Audit Course 3	410249	Audit Course 3
		210250	Audit Course 1				

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Semester II							
Course Code	**Course**	**Course Code**	**Course**	**Course Code**	**Course**	**Course Code**	**Course**
107008	Engineering Mathematics II	207003	Engineering Mathematics III	310250	Design & Analysis of Algorithms	410250	Machine Learning
107009 / 107002	Engineering Chemistry / Engineering Physics	210251	Computer Graphics	310251	Systems Programming & Operating System (SP & OS)	410251	Information and Cyber Security
102013	Basic Mechanical Engineering	210252	Advanced Data Structures	310252	Embedded Systems & Internet of Things (ES & IoT)	410252	Elective III Advanced Digital Signal Processing Compilers Embedded and Real Time Operating Systems Soft Computing and Optimization Algorithms
101011	Engineering Mechanics	210253	Microprocessor	310253	Software Modeling and Design	410253	Elective IV Software Defined Networks Human Computer Interface Cloud Computing Open Elective
104012 / 103004	Basic Electronics Engineering / Basic Electrical Engineering	210254	Principles of Programming Languages	310254	Web Technology	410254	Laboratory Practice III
110010	Fundamentals of Programming Languages II	210255	Computer Graphics Lab	310255	Seminar & Technical Communication	410255	Laboratory Practice IV
102014	Engineering Graphics II	210256	Advanced Data Structures Lab	310256	Web Technology Lab	410256	Project Work Stage II
		210257	Microprocessor Lab	310257	SP & OS Lab	410257	Audit Course 3
		210258	Audit Course 2	310258	ES & IoT Lab		
				310259	Audit Course 4		

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Faculty of Science and Technology
Savitribai Phule Pune University
Maharashtra, India

http://unipune.ac.in

Curriculum
for
Second Year of Computer Engineering
(2019 Course)
(With effect from 2020-21)

Savitribai Phule Pune University

Second Year of Computer Engineering (2019 Course)

(With effect from Academic Year 2020-21)

Table of Contents

Savitribai Phule Pune University
Bachelor of Computer Engineering

Program Outcomes (POs)

Learners are expected to know and be able to–

PO1	**Engineering knowledge**	Apply the knowledge of mathematics, science, Engineering fundamentals, and an Engineering specialization to the solution of complex Engineering problems.
PO2	**Problem analysis**	Identify, formulate, review research literature and analyze complex Engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences and Engineering sciences.
PO3	**Design / Development of Solutions**	Design solutions for complex Engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and Environmental considerations.
PO4	**Conduct Investigations of Complex Problems**	Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
PO5	**Modern Tool Usage**	Create, select, and apply appropriate techniques, resources, and modern Engineering and IT tools including prediction and modeling to complex Engineering activities with an understanding of the limitations.
PO6	**The Engineer and Society**	Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
PO7	**Environment and Sustainability**	Understand the impact of the professional Engineering solutions in societal and Environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
PO8	**Ethics**	Apply ethical principles and commit to professional ethics and responsibilities and norms of Engineering practice.
PO9	**Individual and Team Work**	Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
PO10	**Communication Skills**	Communicate effectively on complex Engineering activities with the Engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
PO11	**Project Management and Finance**	Demonstrate knowledge and understanding of Engineering and management principles and apply these to one’s own work, as a member and leader in a team, to manage projects and in multidisciplinary Environments.
PO12	**Life-long Learning**	Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

Program Specific Outcomes (PSO)

A graduate of the Computer Engineering Program will demonstrate-

PSO1	**Professional Skills**-The ability to understand, analyze and develop computer programs in the areas related to algorithms, system software, multimedia, web design, big data analytics, and networking for efficient design of computer-based systems of varying complexities.
PSO2	**Problem-Solving Skills**- The ability to apply standard practices and strategies in software project development using open-ended programming environments to deliver a quality product for business success.
PSO3	**Successful Career and Entrepreneurship**- The ability to employ modern computer languages, environments and platforms in creating innovative career paths to be an entrepreneur and to have a zest for higher studies.

Savitribai Phule Pune University

Second Year of Computer Engineering (2019 Course)

(With effect from Academic Year 2020-21)

Semester-III

Course Code	Course Name	Teaching Scheme (Hours/Week)			Examination Scheme and Marks						Credit Scheme			
		Lecture	Practical	Tutorial	Mid-Sem	End-Sem	Term work	Practical	Oral	Total	Lecture	Practical	Tutorial	Total
210241	Discrete Mathematics	03	-	-	30	70	-	-	-	100	03	--	-	03
210242	Fundamentals of Data Structures	03	-	-	30	70	-	-	-	100	03	-	-	03
210243	Object Oriented Programming (OOP)	03	-	-	30	70	-	-	-	100	03	-	-	03
210244	Computer Graphics	03	-	-	30	70	-	-	-	100	03	-	-	03
210245	Digital Electronics and Logic Design	03	-	-	30	70	-	-	-	100	03	-	-	03
210246	Data Structures Laboratory	-	04	-	-	-	25	50	-	75	-	02	-	02
210247	OOP and Computer Graphics Laboratory	-	04	-	-	-	25	25	-	50	-	02	-	02
210248	Digital Electronics Laboratory	-	02	-	-	-	25	-	-	25	-	01	-	01
210249	Business Communication Skills	-	02	-	-	-	25	-	-	25	-	01	-	01
210250	Humanity and Social Science	-	-	01	-	-	25	-	-	25	-	-	01	01
210251	Audit Course 3													
										Total Credit	**15**	**06**	**01**	**22**
	Total	**15**	**12**	**01**	**150**	**350**	**125**	**75**	**-**	**700**	**-**	**-**	**-**	**-**

Semester-IV

Course Code	Course Name	Teaching Scheme (Hours/Week)			Examination Scheme and Marks						Credit Scheme			
		Lecture	Practical	Tutorial	Mid-Sem	End-Sem	Term work	Practical	Oral	Total	Lecture	Practical	Tutorial	Total
207003	Engineering Mathematics III	03	-	01	30	70	25	-	-	125	03	--	01	04
210252	Data Structures and Algorithms	03	-	-	30	70	-	-	-	100	03	-	-	03
210253	Software Engineering	03	-	-	30	70	-	-	-	100	03	-	-	03
210254	Microprocessor	03	-	-	30	70	-	-	-	100	03	-	-	03
210255	Principles of Programming Languages	03	-	-	30	70	-	-	-	100	03	-	-	03
210256	Data Structures and Algorithms Laboratory	-	04	-	-	-	25	25	-	50	-	02	-	02
210257	Microprocessor Laboratory	-	02	-	-	-	25	-	25	50	-	01	-	01
210258	Project Based Learning II	-	04	-	-	-	50	-	-	50	-	02	-	02
210259	Code of Conduct	-	-	01	-	-	25	-	-	25	-	-	01	01
210260	Audit Course 4													
										Total Credit	**15**	**05**	**02**	**22**
	Total	**15**	**10**	**02**	**150**	**350**	**150**	**25**	**25**	**700**	**-**	**-**	**-**	**-**

General Guidelines

1. Every undergraduate program has its own objectives and educational outcomes. These objectives and outcomes are furnished by considering various aspects and impacts of the curriculum. These **Program Outcomes (POs)** are categorically mentioned at the beginning of the curriculum (ref: NBA Manual). There should always be a rationale and a goal behind the inclusion of a course in the curriculum. Course Outcomes though highly rely on the contents of the course; many-a-times are generic and bundled. The **Course Objectives**, **Course Outcomes** and **CO-PO mappings matrix** justifies the motives, accomplishment and prospect behind learning the course. The Course Objectives, Course Outcomes and CO-PO Mapping Matrix are provided for reference and these are indicative only. The course instructor may modify them as per his or her perspective.

2. @:**CO and PO Mapping Matrix** (Course Outcomes and Program Outcomes)- The **expected** attainment mapping matrix at end of course contents, indicates the correlation levels of 3, 2, 1 and '-'. The notation of 3, 2 and 1 denotes substantially (high), moderately (medium) and slightly (low). The mark '-' indicates that there is no correlation between the respective CO and PO.

3. **#:Elaborated examples/Case Studies-** For each course, contents are divided into six units-I, II, III, IV, V and VI. Elaborated examples/Case Studies are included at the end of each unit to explore how the learned topics apply to real world situations and need to be explored so as to assist students to increase their competencies, inculcating the specific skills, building the knowledge to be applicable in any given situation along with an articulation. One or two sample exemplars or case studies are included for each unit; instructor may extend the same with more. **Exemplar/Case Studies** may be assigned as self-study by students and to be excluded from theory examinations.

4. *:For each unit contents, the desired content attainment mapping is indicated with Course Outcome(s). Instructor may revise the same as per their viewpoint.

5. For laboratory courses, set of suggested assignments is provided for reference. Laboratory Instructors may design suitable set of assignments for respective course at their level. Beyond curriculum assignments and mini-project may be included as a part of laboratory work. The Inclusion of few optional assignments that are intricate and/or beyond the scope of curriculum will surely be the value addition for the students and it will satisfy the intellectuals within the group of the learners and will add to the perspective of the learners.

6. For each laboratory assignment, it is essential for students to draw/write/generate flowchart, algorithm, test cases, mathematical model, Test data set and comparative/complexity analysis (as applicable). Batch size for practical and tutorial may be as per guidelines of authority.

7. For each course, irrespective of the examination head, the instructor should motivate students to read and publish articles, research papers related to recent development and invention in the field.

8. For laboratory, instructions have been included about the conduction and assessment of laboratory work. These guidelines are to be strictly followed. Use of open source software is appreciated.

9. **Term Work[1]**–Term work is continuous assessment that evaluates a student's progress throughout the semester[1]. Term work assessment criteria specify the standards that must be met and the evidence that will be gathered to demonstrate the achievement of course outcomes. Categorical assessment criteria for the term work should establish unambiguous

standards of achievement for each course outcome. They should describe what the learner is expected to perform in the laboratories or on the fields to show that the course outcomes have been achieved. It is recommended to conduct internal monthly practical examination as part of continuous assessment.

Students' work will be evaluated typically based on the criteria like attentiveness, proficiency in execution of the task, regularity, punctuality, use of referencing, accuracy of language, use of supporting evidence in drawing conclusions, quality of critical thinking and similar performance measuring criteria.

10. **Laboratory Journal-** Program codes with sample output of all performed assignments are to be submitted as softcopy. Use of DVD or similar media containing students programs maintained by Laboratory In-charge is highly encouraged. For reference one or two journals may be maintained with program prints in the Laboratory. As a conscious effort and little contribution towards Green IT and environment awareness, attaching printed papers as part of write-ups and program listing to journal may be avoided. Submission of journal/ term work in the form of softcopy is desirable and appreciated.

11. **Tutorial**[1] **-** Tutorials can never be an individual course but an additional aid to the learners. Tutorials help the learners to inculcate the contents of the course with focused efforts on small group of the learners. Tutorial conduction should concentrate more on simplifying the intricacies converging to clear understanding and application. **Assessment of tutorial work is to be done in a manner similar to assessment of term-work; do follow same guidelines.**

12. **Audit Course**[1]: The student registered for audit course shall be awarded the grade AP/PP (Audit Course Pass) and the grade 'AP'/'PP' shall be included in the Semester grade report for that course, provided student has the minimum attendance as prescribed by the Savitribai Phule Pune University and satisfactory performance and secured a passing grade in that audit course. No grade points are associated with this 'AP'/'PP'' grade and performance in these courses is not accounted in the calculation of the performance indices SGPA and CGPA. Evaluation of audit course will be done at institute level itself.

13. $:For courses 210249: Business Communication Skills, 210250: Humanity and Social Science and 210260: Code of Conduct, one credit can be earned by student if student successfully completes the Swayam course as listed in curriculum of respective course in this document.

    UGC has issued the UGC (Credit Framework for online learning courses through SWAYAM) Regulation 2016 advising the Universities to identify courses where credits can be transferred on to the academic record of the students for courses done on SWAYAM. AICTE has also put out gazette notification in 2016 and subsequently for adoption of these courses for credit transfer [2].

    SWAYAM is a programme initiated by Government of India and designed to achieve the three cardinal principles of Education Policy viz., access, equity and quality. This is done through a platform that facilitates hosting of the courses to be accessed by anyone, anywhere at any time. Courses delivered through SWAYAM are interactive, prepared by the best teachers in the country and are available, free of cost to any learner. However, learners wanting a SWAYAM certificate should register for the final proctored exams that come at a fee and attend in-person at designated center on specified dates. Eligibility for the certificate is generally announced on the course page. Universities/colleges approving credit transfer for these courses can use the marks/certificate obtained in these courses for the same.[2]

Note: For more rules, pattern and assessment of semester examination refer [1]

[1]http://collegecirculars.unipune.ac.in/sites/documents/Syllabus%202019/Rules%20and%20Regulations%20F.E.%202019%20Patt_10.012020.pdf
[2] https://swayam.gov.in/about

Abbreviations		
TW: Term Work	**TH: Theory**	**PR: Practical**
OR: Oral	**TUT: Tutorial**	**Sem: Semester**

Semester III

Home

Savitribai Phule Pune University
Second Year of Computer Engineering (2019 Course)
210241: Discrete Mathematics

Teaching Scheme	Credit Scheme	Examination Scheme and Marks
Lecture: 03 Hours/Week	03	**Mid_Semester(TH):** 30 Marks **End_Semester(TH):** 70 Marks

Prerequisites: Basic Mathematics

Companion Course : ---

Course Objectives:

To introduce several Discrete Mathematical Structures found to be serving as tools even today in the development of theoretical computer science.

- To introduce students to understand, explain, and apply the foundational mathematical concepts at the core of computer science.
- To understand use of set, function and relation models to understand practical examples, and interpret the associated operations and terminologies in context.
- To acquire knowledge of logic and proof techniques to expand mathematical maturity.
- To learn the fundamental counting principle, permutations, and combinations.
- To study how to model problem using graph and tree.
- To learn how abstract algebra is used in coding theory.

Course Outcomes:

On completion of the course, learner will be able to–

CO1: Formulate problems precisely, solve the problems, apply formal proof techniques, and explain the reasoning clearly.

CO2: Apply appropriate mathematical concepts and skills to solve problems in both familiar and unfamiliar situations including those in real-life contexts.

CO3: Design and analyze real world engineering problems by applying set theory, propositional logic and to construct proofs using mathematical induction.

CO4: Specify, manipulate and apply equivalence relations; construct and use functions and apply these concepts to solve new problems.

CO5: Calculate numbers of possible outcomes using permutations and combinations; to model and analyze computational processes using combinatorics.

CO6: Model and solve computing problem using tree and graph and solve problems using appropriate algorithms.

CO7: Analyze the properties of binary operations, apply abstract algebra in coding theory and evaluate the algebraic structures.

Course Contents

Unit I	Set Theory and Logic	(07 Hours)

Introduction and significance of Discrete Mathematics, **Sets–** Naïve Set Theory (Cantorian Set Theory), Axiomatic Set Theory, Set Operations, Cardinality of set, Principle of inclusion and exclusion. **Types of Sets** – Bounded and Unbounded Sets, Diagonalization Argument, Countable and Uncountable Sets, Finite and Infinite Sets, Countably Infinite and Uncountably Infinite Sets, Power set, **Propositional Logic-** logic, Propositional Equivalences, Application of Propositional Logic-Translating English Sentences, Proof by Mathematical Induction and Strong Mathematical Induction.

#Exemplar/Case Studies	Know about the great philosophers- Georg Cantor, Richard Dedekind and Aristotle
*Mapping of Course Outcomes for Unit I	CO1, CO2, CO3

Unit II	Relations and Functions	(07 Hours)

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Relations and their Properties, n-ary relations and their applications, Representing relations, Closures of relations, Equivalence relations, Partial orderings, Partitions, Hasse diagram, Lattices, Chains and Anti-Chains, Transitive closure and Warshall's algorithm. **Functions-** Surjective, Injective and Bijective functions, Identity function, Partial function, Invertible function, Constant function, Inverse functions and Compositions of functions, The Pigeonhole Principle.		
#Exemplar/Case Studies	Know about the great philosophers-Dirichlet	
*Mapping of Course Outcomes for Unit II	CO2,CO4	
Unit III	**Counting Principles**	**(07 Hours)**
The Basics of Counting, rule of Sum and Product, Permutations and Combinations, Binomial Coefficients and Identities, Generalized Permutations and Combinations, Algorithms for generating Permutations and Combinations.		
#Exemplar/Case Studies	Study Sudoku solving algorithms and algorithm for generation of new SUDOKU. Study Hank-shake Puzzle and algorithm to solve it.	
*Mapping of Course Outcomes for Unit III	CO2,CO5	
Unit IV	**Graph Theory**	**(07 Hours)**
Graph Terminology and Special Types of Graphs, Representing Graphs and Graph Isomorphism, Connectivity, Euler and Hamilton Paths, the handshaking lemma, Single source shortest path-Dijkstra's Algorithm, Planar Graphs, Graph Colouring.		
#Exemplar/Case Studies	Three utility problem, Web Graph, Google map	
*Mapping of Course Outcomes for Unit IV	CO1,CO2,CO6	
Unit V	**Trees**	**(07 Hours)**
Introduction, properties of trees, Binary search tree, tree traversal, decision tree, prefix codes and Huffman coding, cut sets, Spanning Trees and Minimum Spanning Tree, Kruskal's and Prim's algorithms, The Max flow- Min Cut Theorem (Transport network).		
#Exemplar/Case Studies	Algebraic Expression Tree, Tic-Tac-Toe Game Tree	
*Mapping of Course Outcomes for Unit V	CO1,CO2,CO6	
Unit VI	**Algebraic Structures and Coding Theory**	**(07 Hours)**
The structure of algebra, Algebraic Systems, Semi Groups, Monoids, Groups, Homomorphism and Normal Subgroups, and Congruence relations, Rings, Integral Domains and Fields, Coding theory, Polynomial Rings and polynomial Codes, Galois Theory –Field Theory and Group Theory.		
#Exemplar/Case Studies	Cryptography used in world war II	
*Mapping of Course Outcomes for Unit VI	CO1, CO2, CO7	
Learning Resources		

Text Books:

1. C. L. Liu, "Elements of Discrete Mathematics"‖, TMH, ISBN 10:0-07-066913-9.
2. N. Biggs, "Discrete Mathematics", 3rd Ed, Oxford University Press, ISBN 0 –19-850717–8.

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Reference Books:

1. Kenneth H. Rosen, "Discrete Mathematics and its Applications"‖, Tata McGraw-Hill, ISBN 978-0-07-288008-3
2. Bernard Kolman, Robert C. Busby and Sharon Ross, "Discrete Mathematical Structures"‖, Prentice-Hall of India /Pearson, ISBN: 0132078457, 9780132078450.
3. Narsingh Deo, "Graph with application to Engineering and Computer Science", Prentice Hall of India, 1990, 0 – 87692 – 145 – 4.
4. Eric Gossett, "Discrete Mathematical Structures with Proofs", Wiley India Ltd, ISBN:978-81-265-2758-8.
5. Sriram P.and Steven S., "Computational Discrete Mathematics", Cambridge University Press, ISBN 13: 978-0-521-73311-3.

e-Books:

- https://www.ebookphp.com/discrete-mathematical-structures-6th-edition-epub-pdf/
- http://discrete.openmathbooks.org/pdfs/dmoi-tablet.pdf
- http://home.iitk.ac.in/~arlal/book/mth202.pdf
- https://web.stanford.edu/class/cs103x/cs103x-notes.pdf
- http://home.iitk.ac.in/~arlal/book/mth202.pdf

MOOC/ Video Lectures available at:

- https://www.nptel.ac.in/courses/106/106/106106094/
- https://nptel.ac.in/courses/106/106/106106183/
- https://nptel.ac.in/courses/106/103/106103205/
- https://nptel.ac.in/courses/106/105/106105192/
- https://nptel.ac.in/courses/111/106/111106050/
- https://nptel.ac.in/courses/111/106/111106102/

@The CO-PO Mapping Matrix

CO\PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	1	2	1	-	-	-	-	-	-	-	-
CO2	1	2	-	2	-	-	-	-	-	-	-	-
CO3	2	1	2	1	-	-	-	-	-	-	-	-
CO4	1	2	-	2	-	-	-	-	-	-	-	-
CO5	-	-	2	-	-	-	-	-	-	-	-	-
CO6	-	2	1	2	-	-	-	-	-	-	-	-
CO7	1	2	2	-	-	-	-	-	-	-	-	-

Home

Savitribai Phule Pune University
Second Year of Computer Engineering (2019 Course)
210242: Fundamentals of Data Structures

Teaching Scheme	Credit Scheme	Examination Scheme and Marks
Lecture: 03 Hours/Week	03	**Mid_Semester(TH):** 30 Marks **End_Semester(TH):** 70 Marks

Prerequisite Courses : 110005: Programming and Problem Solving

Companion Course : 210247: Data Structures Laboratory

Course Objectives:

The course is intended to provide the foundations of the practical implementation and usage of Data Structures and Algorithms to ensure that the learner evolves into a competent programmer capable of designing and analyzing implementations of data structures and algorithms for different kinds of problems.

- To understand the standard and abstract data representation methods.
- To acquaint with the structural constraints and advantages in usage of the data.
- To understand various data structures, operations on it and the memory requirements
- To understand various data searching and sorting methods.
- To understand various algorithmic strategies to approach the problem solution.

Course Outcomes:

On completion of the course, learner will be able to–

CO1: Design the algorithms to solve the programming problems, **identify** appropriate algorithmic strategy for specific application, and **analyze** the time and space complexity.

CO2: Discriminate the usage of various structures, **Design/Program/Implement** the appropriate data structures; use them in implementations of abstract data types and Identity the appropriate data structure in approaching the problem solution.

CO3: Demonstrate use of sequential data structures- Array and Linked lists to store and process data.

CO4: Understand the computational efficiency of the principal algorithms for searching and sorting and choose the most efficient one for the application.

CO5: Compare and **contrast** different implementations of data structures (dynamic and static).

CO6: Understand, Implement and apply principles of data structures-stack and queue to solve computational problems.

Course Contents

Unit I	Introduction to Algorithm and Data Structures	(07 Hours)

Introduction: From Problem to Program (Problem, Solution, Algorithm, Data Structure and Program). Data Structures: Data, Information, Knowledge, and Data structure, Abstract Data Types (ADT), Data Structure Classification (Linear and Non-linear, Static and Dynamic, Persistent and Ephemeral data structures).

Algorithms: Problem Solving, Introduction to algorithm, Characteristics of algorithm, Algorithm design tools: Pseudo-code and flowchart. **Complexity of algorithm:** Space complexity, Time complexity, Asymptotic notation- Big-O, Theta and Omega, finding complexity using step count method, Analysis of programming constructs-Linear, Quadratic, Cubic, Logarithmic. **Algorithmic Strategies:** Introduction to algorithm design strategies- Divide and Conquer, and Greedy strategy.

#Exemplar/Case Studies	Multiplication technique by the mathematician Carl Friedrich Gauss and Karatsuba algorithm for fast multiplication.
*Mapping of Course Outcomes for Unit I	CO1, CO2

Home

Unit II	Linear Data Structure Using Sequential Organization	(07 Hours)
Concept of Sequential Organization, Overview of Array, Array as an Abstract Data Type, Operations on Array, Merging of two arrays, Storage Representation and their Address Calculation: Row major and Column Major, Multidimensional Arrays: Two-dimensional arrays, n-dimensional arrays. Concept of Ordered List, **Single Variable Polynomial**: Representation using arrays, Polynomial as array of structure, Polynomial addition, Polynomial multiplication. **Sparse Matrix:** Sparse matrix representation using array, Sparse matrix addition, Transpose of sparse matrix- Simple and Fast Transpose, Time and Space tradeoff.		
#Exemplar/Case Studies	Study use of sparse matrix in Social Networks and Maps. Study how Economists use polynomials to model economic growth patterns, how medical researchers use them to describe the behaviour of Covid-19 virus.	
***Mapping of Course Outcomes for Unit II**	CO1, CO2, CO3	
Unit III	**Searching and Sorting**	**(07 Hours)**
Searching: Search Techniques-Sequential Search/Linear Search, Variant of Sequential Search- Sentinel Search, Binary Search, Fibonacci Search, and Indexed Sequential Search. **Sorting:** Types of Sorting-Internal and External Sorting, General Sort Concepts-Sort Order, Stability, Efficiency, and Number of Passes, Comparison Based Sorting Methods-Bubble Sort, Insertion Sort, Selection Sort, Quick Sort, Shell Sort, Non-comparison Based Sorting Methods-Radix Sort, Counting Sort, and Bucket Sort, Comparison of All Sorting Methods and their complexities.		
#Exemplar/Case Studies	Use of Fibonacci search in non-uniform access memory storage and in Optimization of Unimodal Functions. Timsort as a hybrid stable sorting algorithm	
***Mapping of Course Outcomes for Unit III**	CO1, CO2, CO4	
Unit IV	**Linked List**	**(07 Hours)**
Introduction to Static and Dynamic Memory Allocation, **Linked List:** Introduction, of Linked Lists, Realization of linked list using dynamic memory management,operations, Linked List as ADT, **Types of Linked List:** singly linked, linear and Circular Linked Lists, Doubly Linked List, Doubly Circular Linked List, Primitive Operations on Linked List- Create, Traverse, Search, Insert, Delete, Sort, Concatenate. Polynomial Manipulations-Polynomial addition. Generalized Linked List (GLL) concept, Representation of Polynomial using GLL.		
#Exemplar/Case Studies	Garbage Collection	
***Mapping of Course Outcomes for Unit IV**	CO1, CO2, CO3, CO5	
Unit V	**Stack**	**(07 Hours)**
Basic concept, stack Abstract Data Type, Representation of Stacks Using Sequential Organization, stack operations, Multiple Stacks, Applications of Stack- Expression Evaluation and Conversion, Polish notation and expression conversion, Need for prefix and postfix expressions, Postfix expression evaluation, Linked Stack and Operations. **Recursion-** concept, variants of recursion- direct, indirect, tail and tree, backtracking algorithmic strategy, use of stack in backtracking.		
#Exemplar/Case Studies	Android- multiple tasks/multiple activities and back-stack, Tower of Hanoi, 4 Queens problem.	
***Mapping of Course Outcomes for Unit V**	CO1, CO2, CO3, CO5, CO6	

Unit VI	Queue	(07 Hours)
Basic concept, Queue as Abstract Data Type, Representation of Queue using Sequential organization,Queue Operations, Circular Queue and its advantages, Multi-queues,Linked Queue and Operations. **Deque**-Basic concept, types (Input restricted and Output restricted), Priority Queue-Basic concept, types (Ascending and Descending).		
#Exemplar/Case Studies	Priority queue in bandwidth management	
***Mapping of Course Outcomes for Unit VI**	CO1, CO2, CO3, CO5, CO6	

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Learning Resources

Text Books:

1. Horowitz and Sahani, “Fundamentals of Data Structures in C++”, University Press, ISBN 10: 0716782928 ISBN 13: 9780716782926.
2. Michael T. Goodrich, Roberto Tamassia, Michael H. Goldwasser, “Data Structures and Algorithms in Python”, Wiley Publication, ISBN: 978-1-118-29027-9

Reference Books:

1. Steven S S. Skiena, “The Algorithm Design Manual”, Springer, 2nd ed. 2008 Edition, ISBN-13: 978-1849967204, ISBN-10: 1849967202.
2. Allen Downey, Jeffery Elkner, Chris Meyers, “How to think like a Computer Scientist: Learning with Python”, Dreamtech Press, ISBN: 9789351198147.
3. M. Weiss, “Data Structures and Algorithm Analysis in C++”, 2nd edition, Pearson Education, 2002, ISBN-81-7808-670-0.
4. Brassard and Bratley, “Fundamentals of Algorithmic”, Prentice Hall India/Pearson Education, ISBN 13-9788120311312.
5. Yashwant Kanetkar & A. Kanetkar, “Let us Python”, BPB Publisher, ISBN: 9789389845006

e-Books:

- https://www.ebooks.com/en-us/book/95777110/Python-data-structures-and-algorithms/benjamin-baka/
- https://www.ebookphp.com/advanced-data-structures-epub-pdf/
- https://www.ebookphp.com/data-structures-and-algorithms-professional-edition-beginners-guide-epub-pdf/

MOOC Links/Video Lectures available at:

- https://nptel.ac.in/courses/106/102/106102064/
- https://nptel.ac.in/courses/106/105/106105085
- https:// nptel.ac.in/courses/106/106/106106127

Other:

3. Know Thy Complexities! (https://www.bigocheatsheet.com/) (https://github.com/RehanSaeed/.NET-Big-O-Algorithm-Complexity-Cheat-Sheet)

@The CO-PO Mapping Matrix

CO\PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	2	1	2	-	-	-	-	-	-	-	-
CO2	1	2	2	1	-	-	-	-	-	-	-	-
CO3	1	1	1	-	-	-	-	-	-	-	-	-
CO4	1	-	1	-	-	-	-	-	-	-	-	-
CO5	1	1	-	1	-	-	-	-	-	-	-	-
CO6	1	1	1	1	1	-	-	-	-	-	-	-

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Savitribai Phule Pune University Second Year of Computer Engineering (2019 Course) 210243: Object Oriented Programming(OOP)		
Teaching Scheme	**Credit Scheme**	**Examination Scheme and Marks**
Lecture: 03 Hours/Week	03	**Mid_Semester(TH):** 30 Marks **End_Semester(TH):** 70 Marks

Prerequisite Courses : 110005: Programming and Problem Solving

Companion Course : 210247: OOP and Computer Graphics Laboratory

Course Objectives:

The course is intended to provide the foundations and in-depth understanding of a modern object-oriented language and develop skills in software development, through an algorithmic approach and the application of principles of objected oriented programming.

- To learn the object-oriented programming paradigm, focusing on the definition and use of classes along with the fundamentals of object-oriented design.
- To learn the syntax and semantics of the C++ programming language.
- To understand the concept of data abstraction and encapsulation, how to design C++ classes for code reuse, how to implement copy constructors and class member functions, to overload functions and operators in C++.
- To learn how inheritance and virtual functions implement dynamic binding with polymorphism.
- To learn how to design and implement generic classes with C++ templates and how to use exception handling in C++ programs.

Course Outcomes:

On completion of the course, learner will be able to–

CO1: Apply constructs- sequence, selection and iteration; classes and objects, inheritance, use of predefined classes from libraries while developing software.

CO2: Design object-oriented solutions for small systems involving multiple objects.

CO3: Use virtual and pure virtual function and complex programming situations.

CO4: Apply object-oriented software principles in problem solving.

CO5: Analyze the strengths of object-oriented programming.

CO6: Develop the application using object oriented programming language(C++).

Course Contents

Unit I	Fundamentals of Object Oriented Programming	(07 Hours)

Introduction to object-oriented programming, Need of object-oriented programming, Fundamentals of object-oriented programming: Namespaces, objects, classes, data members, methods, messages, data encapsulation, data abstraction and information hiding, inheritance, polymorphism. Benefits of OOP, C++ as object oriented programming language.

C++ Programming- C++ programming Basics, Data Types, Structures, Enumerations, control structures, Arrays and Strings, Class, Object, class and data abstraction, Access specifiers, separating interface from implementation. **Functions**- Function, function prototype, accessing function and utility function, Constructors and destructor, Types of constructor, Objects and Memory requirements, Static members: variable and functions, inline function, friend function.

#Exemplar/Case Studies	Story of C++ invention by Bjarne Stroustrup
*Mapping of Course Outcomes for Unit I	CO1, CO5

Unit II	Inheritance and Pointers	(07 Hours)

Inheritance- Base Class and derived Class, protected members, relationship between base Class and

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derived Class, Constructor and destructor in Derived Class, Overriding Member Functions, Class Hierarchies, Public and Private Inheritance, Types of Inheritance, Ambiguity in Multiple Inheritance, Virtual Base Class, Abstract class, Friend Class, Nested Class. **Pointers:** declaring and initializing pointers, indirection Operators, Memory Management: new and delete, Pointers to Objects, this pointer, Pointers Vs Arrays, accessing Arrays using pointers, Arrays of Pointers, Function pointers, Pointers to Pointers, Pointers to Derived classes, Passing pointers to functions, Return pointers from functions, Null pointer, void pointer.		
#Exemplar/Case Studies	Know about Firefox and Thunderbird as one of the popular softwares developed using C++	
***Mapping of Course Outcomes for Unit II**	CO2, CO4	
Unit III	**Polymorphism**	**(07 Hours)**
Polymorphism- Introduction to Polymorphism, Types of Polymorphism, Operator Overloading-concept of overloading, operator overloading, Overloading Unary Operators, Overloading Binary Operators, Data Conversion, Type casting (implicit and explicit), Pitfalls of Operator Overloading and Conversion, Keywords explicit and mutable. Function overloading, **Run Time Polymorphism**- Pointers to Base class, virtual function and its significance in C++, pure virtual function and virtual table, virtual destructor, abstract base class.		
#Exemplar/Case Studies	Study about use of C++ SDKs wrappers for Java and .Net.	
***Mapping of Course Outcomes for Unit III**	CO2, CO3, CO4	
Unit IV	**Files and Streams**	**(07 Hours)**
Data hierarchy, Stream and files, Stream Classes, Stream Errors, Disk File I/O with Streams, File Pointers, and Error Handling in File I/O, File I/O with Member Functions, Overloading the Extraction and Insertion Operators, memory as a Stream Object, Command-Line Arguments, Printer output.		
#Exemplar/Case Studies	Study features used for Microsoft Office, Internet Explorer and Visual Studio that are written in Visual C++	
***Mapping of Course Outcomes for Unit IV**	CO2, CO4	
Unit V	**Exception Handling and Templates**	**(07 Hours)**
Exception Handling- Fundamentals, other error handling techniques, simple exception handling-Divide by Zero, Multiple catching, re-throwing an exception, exception specifications, user defined exceptions, processing unexpected exceptions, constructor, destructor and exception handling, exception and inheritance. **Templates**- The Power of Templates, Function template, overloading Function templates, and class template, class template and Nontype parameters, template and friends Generic Functions, The type name and export keywords.		
#Exemplar/Case Studies	Study about use of exception handling in Symbian Operating System (discontinued mobile operating system) that was developed using C++.	
***Mapping of Course Outcomes for Unit V**	CO2, CO4, CO6	
Unit VI	**Standard Template Library (STL)**	**(07 Hours)**
Introduction to STL, STL Components, Containers- Sequence container and associative containers, container adapters, Application of Container classes: vector, list, **Algorithms**- basic searching and sorting algorithms, min-max algorithm, set operations, heap sort, **Iterators**- input, output, forward, bidirectional and random access. Object Oriented Programming – a road map to future		
#Exemplar/Case Studies	Study MySQL open source C++ code available at GitHub.	
***Mapping of Course Outcomes for Unit VI**	CO2, CO4, CO6	

Learning Resources

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Text Books:

1. Deitel,"C++ How to Program", 4th Edition, Pearson Education, ISBN:81-297-0276-2
2. Robert Lafore, "Object-Oriented Programming in C++‖", fourth edition, Sams Publishing, ISBN:0672323087 (ISBN 13: 9780672323089

Reference Books:

1. Herbert Schildt, "C++-The complete reference"‖, Eighth Edition, McGraw Hill Professional, 2011, ISBN:978-00-72226805
2. Matt Weisfeld, "The Object-Oriented Thought Process", Third Edition Pearson ISBN-13:075-2063330166
3. E.Balagurusamy, "Object-Oriented Programming with C++", 7th edition, Graw-Hill Publication, ISBN 10: 9352607996 ISBN 13: 9789352607990
4. Cox Brad, Andrew J. Novobilski, "Object –Oriented Programming: An Evolutionary Approach"‖, Second Edition, Addison–Wesley, ISBN:13:978-020-1548341

e-Books:

- https://www.springer.com/gp/book/9781852334505
- https://www.ebookphp.com/object-oriented-programming-in-c-epub-pdf/
- https://www.springer.com/gp/book/9781447133780

MOOC/ Video Lectures available at:

- https://nptel.ac.in/courses/106/105/106105151/
- https://swayam.gov.in/nd1_noc20_cs07/preview
- https://www.classcentral.com/course/swayam-programming-in-c-6704

@The CO-PO Mapping Matrix

CO\PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	1	1	1	-	-	-	-	-	-	-	-
CO2	1	2	1	1	-	-	-	-	-	-	-	1
CO3	2	1	2	2	-	-	-	-	-	-	-	-
CO4	2	1	2	1	-	-	-	-	-	-	-	1
CO5	-	1	-	1	-	-	-	-	-	-	-	-
CO6	-	-	1	-	-	-	-	-	-	-	-	1

Savitribai Phule Pune University
Second Year of Computer Engineering (2019 Course)
210244: Computer Graphics

Teaching Scheme	Credit Scheme	Examination Scheme and Marks
Lecture: 03 Hours/Week	03	**Mid_Semester(TH):** 30 Marks **End_Semester(TH):** 70 Marks

Prerequisite : Basic Mathematics

Companion Course : 210247: OOP and Computer Graphics Laboratory

Course Objectives:

The Computer Graphics course prepares students for activities involving the design, development, and testing of modeling, rendering, and animation solutions to a broad variety of problems found in entertainment, sciences, and engineering.

- **Remembering:** To acquaint the learner with the basic concepts of Computer Graphics.
- **Understanding:** To learn the various algorithms for generating and rendering graphical figures.
- **Applying:** To get familiar with mathematics behind the graphical transformations.
- **Understanding:** To understand and apply various methods and techniques regarding projections, animation, shading, illumination and lighting.
- **Creating:** To generate Interactive graphics using OpenGL.

Course Outcomes:

On completion of the course, learner will be able to–

CO1: **Identify** the basic terminologies of Computer Graphics and interpret the mathematical foundation of the concepts of computer graphics.

CO2: **Apply** mathematics to develop Computer programs for elementary graphic operations.

CO3: **Illustrate** the concepts of windowing and clipping and **apply** various algorithms to fill and clip polygons.

CO4: **Understand** and **apply** the core concepts of computer graphics, including transformation in two and three dimensions, viewing and projection.

CO5: **Understand** the concepts of color models, lighting, shading models and hidden surface elimination.

CO6: **Create** effective programs using concepts of curves, fractals, animation and gaming.

Course Contents

Unit I	Graphics Primitives and Scan Conversion Algorithms	(07 Hours)

Introduction, graphics primitives - pixel, resolution, aspect ratio, frame buffer. Display devices, applications of computer graphics.

Introduction to OpenGL - OpenGL architecture, primitives and attributes, simple modelling and rendering of two- and three-dimensional geometric objects, GLUT, interaction, events and call-backs picking. (**Simple Interaction with the Mouse and Keyboard)**

Scan conversion: Line drawing algorithms: Digital Differential Analyzer (DDA), Bresenham. Circle drawing algorithms: DDA, Bresenham, and Midpoint.

#Exemplar/Case Studies	Study about OpenGL Architecture Review Board (ARB)
*Mapping of Course Outcomes for Unit I	CO1, CO2

Unit II	Polygon, Windowing and Clipping	(07 Hours)

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Polygons: Introduction to polygon, types: convex, concave and complex. Inside test. **Polygon Filling:** flood fill, seed fill, scan line fill. **Windowing and clipping:** viewing transformations, 2-D clipping: Cohen – Sutherland algorithm line Clipping algorithm, Sutherland Hodgeman Polygon clipping algorithm, Weiler Atherton Polygon Clipping algorithm.		
#Exemplar/Case Studies	Study Guard-band clipping Technique and it's use in various rendering softwares, Use of 3D pipeline/ polygonal modelling and applications.	
***Mapping of Course Outcomes for Unit II**	CO2, CO3	
Unit III	**2D, 3D Transformations and Projections**	**(07 Hours)**
2-D transformations: introduction, homogeneous coordinates, 2-D transformations - Translation, scaling, rotation and shear, rotation about an arbitrary point. **3-D transformations:** introduction, 3-D transformations - Translation, scaling, rotation and shear, rotation about an arbitrary axis. **Projections :** Parallel (Oblique: Cavalier, Cabinet and orthographic: isometric, diametric, trimetric) and Perspective (Vanishing Points – 1 point, 2 point and 3 point)		
#Exemplar/Case Studies	Study use of transformations and projections in education and training software.	
***Mapping of Course Outcomes for Unit III**	CO2, CO4	
Unit IV	**Light, Colour, Shading and Hidden Surfaces**	**(07 Hours)**
Colour models: Properties of Light, CIE chromaticity Diagram, RGB, HSV, CMY. **Illumination Models**: Ambient Light, Diffuse reflection, Specular Reflection, and the Phong model, Combined diffuse and Specular reflections with multiple light sources, warn model, **Shading Algorithms**: Halftone, Gauraud and Phong Shading. **Hidden Surfaces** Introduction, Back face detection and removal, Algorithms: Depth buffer (z), Depth sorts (Painter), Area subdivision (Warnock)		
#Exemplar/Case Studies	Study any popular graphics designing software	
***Mapping of Course Outcomes for Unit IV**	CO5	
Unit V	**Curves and Fractals**	**(07 Hours)**
Curves: Introduction, Interpolation and Approximation, Blending function, B-Spline curve, Bezier curve, **Fractals**: Introduction, Classification, Fractal generation: snowflake, Triadic curve, Hilbert curve, Applications.		
#Exemplar/Case Studies	Case study on measuring the length of coastline using fractals	
***Mapping of Course Outcomes for Unit V**	CO2, CO6	
Unit VI	**Introduction to Animation and Gaming**	**(07 Hours)**
Segment: Introduction, Segment table, Segment creation, closing, deleting and renaming, Visibility. **Animation:** Introduction, Conventional and computer based animation, Design of animation sequences, Animation languages, Key- frame, Morphing, Motion specification. **Gaming:** Introduction, Gaming platform (NVIDIA, i8060), Advances in Gaming.		
#Exemplar/Case Studies	Study of any open source tools- Unity/Maya/Blender	
***Mapping of Course Outcomes for Unit VI**	CO6	

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Learning Resources

Text Books:

1. S. Harrington, "Computer Graphics"‖, 2nd Edition, McGraw-Hill Publications, 1987, ISBN 0 – 07 – 100472 – 6.
2. Donald D. Hearn and Baker, "Computer Graphics with OpenGL", 4th Edition, ISBN-13: 9780136053583.
3. D. Rogers, "Procedural Elements for Computer Graphics", 2nd Edition, Tata McGraw-Hill Publication, 2001, ISBN 0 – 07 – 047371 – 4.

Reference Books:

1. J. Foley, V. Dam, S. Feiner, J. Hughes, "Computer Graphics Principles and Practice"‖, 2nd Edition, Pearson Education, 2003, ISBN 81 – 7808 – 038 – 9.
2. D. Rogers, J. Adams, "Mathematical Elements for Computer Graphics"‖, 2nd Edition, Tata McGraw Hill Publication, 2002, ISBN 0 – 07 – 048677 – 8.

e-Books:

- https://open.umn.edu/opentextbooks/textbooks/introduction-to-computer-graphics
- http://www2.cs.uidaho.edu/~jeffery/courses/324/lecture.html

MOOC/ Video Lectures available at:

- https://nptel.ac.in/courses/106/106/106106090/
- https://nptel.ac.in/courses/106/102/106102065/

@The CO-PO Mapping Matrix

CO\PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	1	1	-	-	-	-	-	-	-	-	-
CO2	3	-	1	1	-	-	-	-	-	-	-	-
CO3	1	2	-	1	-	-	-	-	-	-	-	-
CO4	2	1	1	1	-	-	-	-	-	-	-	-
CO5	1	-	1	-	-	-	-	-	-	-	-	-
CO6	-	2	2	1	-	-	-	-	-	-	-	-

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Savitribai Phule Pune University Second Year of Computer Engineering (2019 Course) 210245: Digital Electronics and Logic Design		
Teaching Scheme	**Credit Scheme**	**Examination Scheme and Marks**
Lecture: 03 Hours/Week	03	**Mid_Semester(TH):** 30 Marks **End_Semester(TH):** 70 Marks

Prerequisite Courses : 104010: Basic Electronics Engineering

Companion Course : 210249: Digital Electronics Lab

Course Objectives:

The goal of this course is to impart the fundamentals of digital logic design; starting from learning the basic concepts of the different base number systems, to basic logic elements and deriving logical expressions to further optimize a circuit diagram. Objective is to see that learners are not only able to evaluate different combinational logic designs, but also design their own digital circuits given different parameters.

- To study number systems and develop skills for design and implementation of combinational logic circuits and sequential circuits
- To understand the functionalities, properties and applicability of Logic Families.
- To introduce programmable logic devices and ASM chart and synchronous state machines.
- To introduce students to basics of microprocessor.

Course Outcomes:

On completion of the course, learner will be able to–

CO1: Simplify Boolean Expressions using K Map.
CO2: Design and implement combinational circuits.
CO3: Design and implement sequential circuits.
CO4: Develop simple real-world application using ASM and PLD.
CO5: Differentiate and Choose appropriate logic families IC packages as per the given design specifications.
CO6: Explain organization and architecture of computer system

Course Contents

Unit I	Minimization Technique	(07 Hours)
Logic Design Minimization Technique: Minimization of Boolean function using K-map(up to 4 variables) and Quine Mc-Clusky Method, Representation of signed number- sign magnitude representation ,1's complement and 2's complement form (red marked can be removed), Sum of product and Product of sum form, Minimization of SOP and POS using K-map.		
#Exemplar/Case Studies	Digital locks using logic gates	
*Mapping of Course Outcomes for Unit I	CO1	
Unit II	**Combinational Logic Design**	**(07 Hours)**
Code converter -: BCD, Excess-3, Gray code, Binary Code. Half- Adder, Full Adder, Half Subtractor, Full Subtractor, Binary Adder (IC 7483), BCD adder, Look ahead carry generator, Multiplexers (MUX): MUX (IC 74153, 74151), Cascading multiplexers, Demultiplexers (DEMUX)- Decoder (IC 74138, IC 74154), Implementation of SOP and POS using MUX, DMUX, Comparators (2 bit), Parity generators and Checker.		
#Exemplar/Case Studies	Combinational Logic Design of BCD to 7-segment display Controller	
*Mapping of Course Outcomes for Unit II	CO2	

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Unit III	Sequential Logic Design	(07 Hours)
Flip-Flop: SR, JK,D,T, Preset and Clear, Master Slave JK Flip Flops, Truth Tables and Excitation tables, Conversion from one type to another type of Flip-Flop. Registers: SISO, SIPO, PISO, PIPO, Shift Registers, Bidirectional Shift Register, Ring Counter , Universal Shift Register Counters: Asynchronous Counter, Synchronous Counter, BCD Counter, Johnson Counter, Modulus of the counter (IC 7490),Synchronous Sequential Circuit Design :Models- Moore and Mealy, State diagram and State Table ,Design Procedure, Sequence Generator and detector.		
#Exemplar/Case Studies	Electronic Voting Machine (EVM)	
*Mapping of Course Outcomes for Unit III	CO3	
Unit IV	**Algorithmic State Machines and Programmable Logic Devices**	**(07 Hours)**
Algorithmic State Machines: Finite State Machines (FSM) and ASM, ASM charts, notations, construction of ASM chart and realization for sequential circuits. PLDS:PLD, ROM as PLD, Programmable Logic Array (PLA), Programmable Array Logic (PAL), Designing combinational circuits using PLDs.		
#Exemplar/Case Studies	Wave form generator using MUX controller method	
*Mapping of Course Outcomes for Unit IV	CO4	
Unit V	**Logic Families**	**(07 Hours)**
Classification of logic families: Unipolar and Bipolar Logic Families, Characteristics of Digital ICs: Fan-in, Fan-out, Current and voltage parameters, Noise immunity, Propagation Delay, Power Dissipation, Figure of Merits, Operating Temperature Range, power supply requirements. **Transistor**-Transistor Logic: Operation of TTL NAND Gate (Two input), TTL with active pull up, TTL with open collector output, Wired AND Connection, Tristate TTL Devices, TTL characteristics. CMOS: CMOS Inverter, CMOS characteristics, CMOS configurations- Wired Logic, Open drain outputs.		
#Exemplar/Case Studies	To study the various basic gate design using TTL/CMOS logic family	
*Mapping of Course Outcomes for Unit V	CO5	
Unit VI	**Introduction to Computer Architecture**	**(07 Hours)**
Introduction to Ideal Microprocessor – Data Bus, Address Bus, Control Bus. Microprocessor based Systems – Basic Operation, Microprocessor operation, Block Diagram of Microprocessor. Functional **Units of Microprocessor** – ALU using IC 74181, Basic Arithmetic operations using ALU IC 74181, 4-bit Multiplier circuit using ALU and shift registers. Memory Organization and Operations, digital circuit using decoder and registers for memory operations.		
#Exemplar/Case Studies	Microprocessor based system in Communication /Instrumentation Control	
*Mapping of Course Outcomes for Unit VI	CO6	

Learning Resources

Text Books:

1. R.P.Jain, " Modern Digital Electronics", Tata McGraw Hill 4th Edition, ISBN 978-0-07-06691-16
2. Moris Mano, "Digital Logic and Computer Design", Pearson , ISBN 978-93-325-4252-5
3. G. K. Kharate, "Digital Electronics", Oxford Press, ISBN-10: 0198061838

Reference Books:

1. John Yarbrough, "Digital Logic applications and Design", Cengage Learning, ISBN – 13: 978-81-315-0058-3

2. D. Leach, Malvino, Saha, "Digital Principles and Applications"‖, Tata McGraw Hill, ISBN –13:978-0-07-014170-4.
3. Anil Maini, "Digital Electronics: Principles and Integrated Circuits"‖, Wiley India Ltd, ISBN:978-81-265-1466-3.
4. Norman B and Bradley, "Digital Logic Design Principles", Wiley, ISBN:978-81-265-1258

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eBooks:

- https://www.springer.com/gp/book/9783030361952
- https://www.mheducation.co.uk/ebook-fundamentals-of-digital-logic-9780077144227-emea

MOOC/ Video Lectures available at:

- Digital Circuits, by Prof. Santanu Chattopadhyay, https://swayam.gov.in/nd1_noc19_ee51/preview (Unit I, II, III, IV)
- Digital Circuits and Systems, Prof. S. Srinivasan https://nptel.ac.in/courses/117/106/117106086/ (Unit I, II, III, IV)
- Microprocessors and Interfacing By Prof. Shaik Rafi Ahamed | IIT Guwahati https://swayam.gov.in/nd1_noc20_ee11/preview (Unit VI)
- Switching Circuits And Logic Design By Prof. Indranil Sengupta w https://swayam.gov.in/nd1_noc20_cs67/preview (Unit V)

@The CO-PO Mapping Matrix

CO\PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	-	2	-	-	-	-	-	-	-	-	-
CO2	2	1	2	-	-	-	-	-	-	-	-	-
CO3	2	1	2	-	-	-	-	-	-	-	-	-
CO4	2	-	2	1	-	-	-	-	-	-	-	-
CO5	2	2	-	-	-	-	-	-	-	-	-	-
CO6	2	-	-	-	-	-	-	-	-	-	-	-

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Savitribai Phule Pune University
Second Year of Computer Engineering (2019 Course)
210246: Data Structures Laboratory

Teaching Scheme	Credit Scheme	Examination Scheme and Marks
Practical: 04 Hours/Week	02	Term Work: 25 Marks Practical: 50 Marks

Companion Course : 210242: Fundamentals of Data Structures

Course Objectives:

To understand basic techniques and strategies of algorithm analysis, the memory requirement for various data structures like array, linked list, stack, queue etc using concepts of python and C++ programming language.

Course Outcomes:

On completion of the course, learner will be able to–

CO1: Use algorithms on various linear data structure using sequential organization to solve real life problems.

CO2: Analyze problems to **apply** suitable searching and sorting algorithm to various applications.

CO3: Analyze problems to **use variants of** linked list and solve various real life problems.

CO4: Designing and implement data structures and algorithms for solving different kinds of problems.

Guidelines for Instructor's Manual

The instructor‘s manual is to be developed as a hands-on resource and reference. The instructor's manual need to include prologue (about University/program/ institute/ department/foreword/ preface), University syllabus, conduction and Assessment guidelines, topics under consideration-concept, objectives, outcomes, set of typical applications/assignments/ guidelines, and references.

Guidelines for Student's Laboratory Journal

The laboratory assignments are to be submitted by student in the form of journal. Journal consists of prologue, Certificate, table of contents, and **handwritten write-up** of each assignment (Title, Objectives, Problem Statement, Outcomes, software and Hardware requirements, Date of Completion, Assessment grade/marks and assessor's sign, Theory- Concept in brief, algorithm, flowchart, test cases, Test Data Set(if applicable), mathematical model (if applicable), conclusion/analysis. **Program codes with sample output of all performed assignments are to be submitted as softcopy.**

As a conscious effort and little contribution towards Green IT and environment awareness, attaching printed papers as part of write-ups and program listing to journal may be avoided. Use of DVD containing students programs maintained by Laboratory In-charge is highly encouraged. For reference one or two journals may be maintained with program prints at Laboratory.

Guidelines for Laboratory /Term Work Assessment

Continuous assessment of laboratory work is done based on overall performance and Laboratory assignments performance of student. Each Laboratory assignment assessment will assign grade/marks based on parameters with appropriate weightage. Suggested parameters for overall assessment as well as each Laboratory assignment assessment include- timely completion, performance, innovation, efficient codes, punctuality and neatness.

Guidelines for Laboratory Conduction

The instructor is expected to frame the assignments by understanding the prerequisites, technological aspects, utility and recent trends related to the topic. The assignment framing policy need to address the average students and inclusive of an element to attract and promote the intelligent students. The instructor may set multiple sets of assignments and distribute among batches of students. It is appreciated if the assignments are based on real world problems/applications. Encourage students for appropriate use of Hungarian notation, proper indentation and comments. Use of open source software is to be encouraged. In addition to these, instructor may assign one real life application in the form of a mini-project based on the concepts

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learned. Instructor may also set one assignment or mini-project that is suitable to respective branch **beyond the scope of syllabus.**

Set of suggested assignment list is provided in groups- A, B, C, D, and E. Each student must perform at least 13 assignments (at least 3 from group A, 3 from group B, 2 from group C, 2 from group D and 3 from group E.)

Group A and B assignments should be implemented in Python without using built-in methods for major functionality of assignment. Use List data structure of Python as array. Group C, D and E assignments should be implemented in C++ language.

Operating System recommended:- 64-bit Open source Linux or its derivative

Programming tools recommended: - Open Source Python, Programming tool like Jupyter Notebook, Pycharm, Spyder, G++/GCC.

Guidelines for Practical Examination

Both internal and external examiners should jointly set problem statements. During practical assessment, the expert evaluator should give the maximum weightage to the satisfactory implementation of the problem statement. The supplementary and relevant questions may be asked at the time of evaluation to test the student's for advanced learning, understanding of the fundamentals, effective and efficient implementation. So encouraging efforts, transparent evaluation and fair approach of the evaluator will not create any uncertainty or doubt in the minds of the students. So adhering to these principles will consummate our team efforts to the promising start of the student's academics.

Virtual Laboratory:

- http://cse01-iiith.vlabs.ac.in/Courses%20Aligned.html?domain=Computer%20Science

Suggested List of Laboratory Experiments/Assignments

Sr. No.	Group A
1	In second year computer engineering class, group A student's play cricket, group B students play badminton and group C students play football. Write a Python program using functions to compute following: - a) List of students who play both cricket and badminton b) List of students who play either cricket or badminton but not both c) Number of students who play neither cricket nor badminton d) Number of students who play cricket and football but not badminton. (Note- While realizing the group, duplicate entries should be avoided, Do not use SET built-in functions)
2	Write a Python program to store marks scored in subject "Fundamental of Data Structure" by N students in the class. Write functions to compute following: a) The average score of class b) Highest score and lowest score of class c) Count of students who were absent for the test d) Display mark with highest frequency
3	Write a **Python** program for department library which has N books, write functions for following: a) Delete the duplicate entries b) Display books in ascending order based on cost of books c) Count number of books with cost more than 500. d) Copy books in a new list which has cost less than 500.
4	Write a **Python** program that computes the net amount of a bank account based a transaction log from console input. The transaction log format is shown as following: D 100 W 200 (Withdrawal is not allowed if balance is going negative. Write functions for withdraw and deposit) D means deposit while W means withdrawal. Suppose the following input is supplied to the program: D 300, D 300 , W 200, D 100 Then, the output should be: 500

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<table>
<tr><td>5</td><td>Write a Python program to compute following operations on String:
a) To display word with the longest length
b) To determines the frequency of occurrence of particular character in the string
c) To check whether given string is palindrome or not
d) To display index of first appearance of the substring
e) To count the occurrences of each word in a given string</td></tr>
<tr><td>6</td><td>It is decided that weekly greetings are to be furnished to wish the students having their birthdays in that week. The consolidated sorted list with desired categorical information is to be provided to the authority. Write a Python program to store students PRNs with date and month of birth. Let List_A and List_B be the two list for two SE Computer divisions. Lists are sorted on date and month. Merge these two lists into third list “List_SE_Comp_DOB” resulting in sorted information about Date of Birth of SE Computer students</td></tr>
<tr><td>7</td><td>Write a Python Program for magic square. A magic square is an n * n matrix of the integers 1 to n2 such that the sum of each row, column, and diagonal is the same. The figure given below is an example of magic square for case n=5. In this example, the common sum is 65.
<table>
<tr><td>15</td><td>8</td><td>1</td><td>24</td><td>17</td></tr>
<tr><td>16</td><td>14</td><td>7</td><td>5</td><td>23</td></tr>
<tr><td>22</td><td>20</td><td>13</td><td>6</td><td>4</td></tr>
<tr><td>3</td><td>21</td><td>19</td><td>12</td><td>10</td></tr>
<tr><td>9</td><td>2</td><td>25</td><td>18</td><td>11</td></tr>
</table></td></tr>
<tr><td>8</td><td>Write a Python program that determines the location of a saddle point of matrix if one exists. An m x n matrix is said to have a saddle point if some entry a[i][j] is the smallest value in row i and the largest value in j.</td></tr>
<tr><td>9</td><td>Write a Python program to compute following computation on matrix:
a) Addition of two matrices B) Subtraction of two matrices
c) Multiplication of two matrices d) Transpose of a matrix</td></tr>
<tr><td>10</td><td>Write a Python program for sparse matrix realization and operations on it- Transpose, Fast Transpose and addition of two matrices</td></tr>
<tr><td></td><td>Group B</td></tr>
<tr><td>11</td><td>a) Write a Python program to store roll numbers of student in array who attended training program in random order. Write function for searching whether particular student attended training program or not, using Linear search and Sentinel search.
b) Write a Python program to store roll numbers of student array who attended training program in sorted order. Write function for searching whether particular student attended training program or not, using Binary search and Fibonacci search</td></tr>
<tr><td>12</td><td>a) Write a Python program to store names and mobile numbers of your friends in sorted order on names. Search your friend from list using binary search (recursive and non-recursive). Insert friend if not present in phonebook
b) Write a Python program to store names and mobile numbers of your friends in sorted order on names. Search your friend from list using Fibonacci search. Insert friend if not present in phonebook.</td></tr>
<tr><td>13</td><td>Write a Python program to maintain club members, sort on roll numbers in ascending order. Write function “Ternary_Search” to search whether particular student is member of club or not. Ternary search is modified binary search that divides array into 3 halves instead of two.</td></tr>
<tr><td>14</td><td>Write a Python program to store first year percentage of students in array. Write function for sorting array of floating point numbers in ascending order using
a) Selection Sort
b) Bubble sort and display top five scores.</td></tr>
</table>

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15	Write a **Python** program to store second year percentage of students in array. Write function for sorting array of floating point numbers in ascending order using a) Insertion sort b) Shell Sort and display top five scores
16	Write a **Python** program to store first year percentage of students in array. Write function for sorting array of floating point numbers in ascending order using quick sort and display top five scores.
17	Write a **Python** program to store 12^{th} class percentage of students in array. Write function for sorting array of floating point numbers in ascending order using bucket sort and display top five scores.
18	Write **Python** program to store 10^{th} class percentage of students in array. Write function for sorting array of floating point numbers in ascending order using radix sort and display top five scores
	Group C
19	Department of Computer Engineering has student's club named 'Pinnacle Club'. Students of second, third and final year of department can be granted membership on request. Similarly one may cancel the membership of club. First node is reserved for president of club and last node is reserved for secretary of club. Write C++ program to maintain club member's information using singly linked list. Store student PRN and Name. Write functions to: a) Add and delete the members as well as president or even secretary. b) Compute total number of members of club c) Display members d) Two linked lists exists for two divisions. Concatenate two lists.
20	The ticket booking system of Cinemax theater has to be implemented using C++ program. There are 10 rows and 7 seats in each row. Doubly circular linked list has to be maintained to keep track of free seats at rows. Assume some random booking to start with. Use array to store pointers (Head pointer) to each row. On demand a) The list of available seats is to be displayed b) The seats are to be booked c) The booking can be cancelled.
21	Write C++ program for storing appointment schedule for day. Appointments are booked randomly using linked list. Set start and end time and min and max duration for visit slot. Write functions for- A) Display free slots B) Book appointment C) Sort list based on time D) Cancel appointment (check validity, time bounds, availability) E) Sort list based on time using pointer manipulation
22	Second year Computer Engineering class, set A of students like Vanilla Ice-cream and set B of students like butterscotch ice-cream. Write C++ program to store two sets using linked list. compute and display- a) Set of students who like both vanilla and butterscotch b) Set of students who like either vanilla or butterscotch or not both c) Number of students who like neither vanilla nor butterscotch
23	Write C++ program for storing binary number using doubly linked lists. Write functions- a) To compute 1's and 2's complement b) Add two binary numbers
24	Write C++ program to realize Set using Generalized Liked List (GLL) e.g. A ={ a, b, {c, d,e, {}, {f,g}, h, I, {j,k}, l, m}. Store and print as set notation.
	Group D

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25	A palindrome is a string of character that's the same forward and backward. Typically, punctuation, capitalization, and spaces are ignored. For example, "Poor Dan is in a droop" is a palindrome, as can be seen by examining the characters "poor danisina droop" and observing that they are the same forward and backward. One way to check for a palindrome is to reverse the characters in the string and then compare with them the original-in a palindrome, the sequence will be identical. Write C++ program with functions- a) To print original string followed by reversed string using stack b) To check whether given string is palindrome or not
26	In any language program mostly syntax error occurs due to unbalancing delimiter such as (),{},[]. Write C++ program using stack to check whether given expression is well parenthesized or not.
27	Implement C++ program for expression conversion as infix to postfix and its evaluation using stack based on given conditions: 1. Operands and operator, both must be single character. 2. Input Postfix expression must be in a desired format. 3. Only '+', '-', '*' and '/ ' operators are expected.
28	A classic problem that can be solved by backtracking is called the Eight Queens problem, which comes from the game of chess. The chess board consists of 64 square arranged in an 8 by 8 grid. The board normally alternates between black and white square, but this is not relevant for the present problem. The queen can move as far as she wants in any direction, as long as she follows a straight line, Vertically, horizontally, or diagonally. Write C++ program with recursive function for generating all possible configurations for 4-queen's problem.
	Group E
29	Queues are frequently used in computer programming, and a typical example is the creation of a job queue by an operating system. If the operating system does not use priorities, then the jobs are processed in the order they enter the system. Write C++ program for simulating job queue. Write functions to add job and delete job from queue.
30	Write program to implement a priority queue in C++ using an inorder list to store the items in the queue. Create a class that includes the data items (which should be template) and the priority (which should be int). The inorder list should contain these objects, with operator <= overloaded so that the items with highest priority appear at the start of the list (which will make it relatively easy to retrieve the highest item.)
31	A double-ended queue (deque) is a linear list in which additions and deletions may be made at either end. Obtain a data representation mapping a deque into a one-dimensional array. Write C++ program to simulate deque with functions to add and delete elements from either end of the deque.
32	Pizza parlor accepting maximum M orders. Orders are served in first come first served basis. Order once placed cannot be cancelled. Write C++ program to simulate the system using circular queue using array.

@The CO-PO Mapping Matrix

CO\PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	1	2	1	-	-	-	-	-	-	-	-
CO2	2	2	2	1	-	-	-	-	-	-	-	-
CO3	-	2	1	1	-	-	-	-	-	-	-	-
CO4	1	2	2	1	-	-	-	-	-	-	-	-

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Savitribai Phule Pune University
Second Year of Computer Engineering (2019 Course)
210247: OOP and Computer Graphics Laboratory

Teaching Scheme	Credit Scheme	Examination Scheme and Marks
Practical: 04 Hours/Week	02	**Term Work:** 25 Marks **Practical:** 25Marks

Companion Course : 210243: Object Oriented Programming(OOP), 210244: Computer Graphics

Course Objectives:

To understand basics of Computer Graphics, apply various methods and techniques for implementing line-circle drawing, projections, animation, shading, illumination and lighting using concepts of Object Oriented Programming.

Course Outcomes:

On completion of the course, learner will be able to–

CO1: Understand and **apply** the concepts like inheritance, polymorphism, exception handling and generic structures for implementing reusable programming codes.

CO2: Analyze the concept of file and **apply** it while storing and retrieving the data from secondary storages.

CO3: Analyze and **apply** computer graphics algorithms for line-circle drawing, scan conversion and filling with the help of object oriented programming concepts.

CO4: Understand the concept of windowing and clipping and **apply** various algorithms to fill and clip polygons.

CO5: Apply logic to implement, curves, fractals, animation and gaming programs.

Guidelines for Instructor's Manual

The instructor‘s manual is to be developed as a reference and hands-on resource. It should include prologue (about University/program/ institute/ department/foreword/ preface), curriculum of the course, conduction and Assessment guidelines, topics under consideration, concept, objectives, outcomes, set of typical applications/assignments/ guidelines, and references.

Guidelines for Student's Laboratory Journal

The laboratory assignments are to be submitted by student in the form of journal. Journal consists of Certificate, table of contents, and handwritten write-up of each assignment (Title, Date of Completion, Objectives, Problem Statement, Software and Hardware requirements, Assessment grade/marks and assessor's sign, Theory- Concept in brief, algorithm, flowchart, test cases, Test Data Set(if applicable), mathematical model (if applicable), conclusion/analysis. Program codes with sample output of all performed assignments are to be submitted as softcopy. As a conscious effort and little contribution towards Green IT and environment awareness, attaching printed papers as part of write-ups and program listing to journal must be avoided. Use of DVD containing students programs maintained by Laboratory In-charge is highly encouraged. For reference one or two journals may be maintained with program prints in the Laboratory.

Guidelines for Laboratory /Term Work Assessment

Continuous assessment of laboratory work should be based on overall performance of Laboratory assignments by a student. Each Laboratory assignment assessment will assign grade/marks based on parameters, such as timely completion, performance, innovation, efficient codes, punctuality and

Guidelines for Practical Examination

Problem statements must be decided jointly by the internal examiner and external examiner. During practical assessment, maximum weightage should be given to satisfactory implementation of the problem statement. Relevant questions may be asked at the time of evaluation to test the student‘s understanding of the fundamentals, effective and efficient implementation. This will encourage, transparent evaluation and fair approach, and hence will not create any uncertainty or doubt in the minds of the students. So adhering to these principles will consummate our team efforts to the promising start of student's academics.

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Guidelines for Laboratory Conduction

The instructor is expected to frame the assignments by understanding the prerequisites, technological aspects, utility and recent trends related to the topic. The assignment framing policy need to address the average students and inclusive of an element to attract and promote the intelligent students. Use of open source software is encouraged. Based on the concepts learned. Instructor may also set one assignment or mini-project that is suitable to respective branch beyond the scope of syllabus.

Operating System recommended :- 64-bit Open source Linux or its derivative

Programming tools recommended: - Open Source C++ Programming tool like G++/GCC, OPENGL.

Virtual Laboratory:

- http://cse18- iiith.vlabs.ac.in/Introduction.html?domain=Computer%20Scie nce
- http://vlabs.iitb.ac.in/vlabs-dev/labs/cglab/index.php

Part I : Object Oriented Programming

Suggested List of Laboratory Experiments/Assignments

(All assignments are compulsory)

Sr. No.	Group A
1.	Implement a class Complex which represents the Complex Number data type. Implement the following 1. Constructor (including a default constructor which creates the complex number 0+0i). 2. Overload operator+ to add two complex numbers. 3. Overload operator* to multiply two complex numbers. 4. Overload operators << and >> to print and read Complex Numbers.
2.	Develop a program in C++ to create a database of student's information system containing the following information: Name, Roll number, Class, Division, Date of Birth, Blood group, Contact address, Telephone number, Driving license no. and other. Construct the database with suitable member functions. Make use of constructor, default constructor, copy constructor, destructor, static member functions, friend class, this pointer, inline code and dynamic memory allocation operators-new and delete as well as exception handling.
3.	Imagine a publishing company which does marketing for book and audio cassette versions. Create a class publication that stores the title (a string) and price (type float) of publications. From this class derive two classes: book which adds a page count (type int) and tape which adds a playing time in minutes (type float). Write a program that instantiates the book and tape class, allows user to enter data and displays the data members. If an exception is caught, replace all the data member values with zero values.
	Group B
4.	Write a C++ program that creates an output file, writes information to it, closes the file, open it again as an input file and read the information from the file.
5.	Write a function template for selection sort that inputs, sorts and outputs an integer array and a float array.
	Group C
6.	Write C++ program using STL for sorting and searching user defined records such as personal records (Name, DOB, Telephone number etc) using vector container. **OR** Write C++ program using STL for sorting and searching user defined records such as Item records (Item code, name, cost, quantity etc) using vector container.

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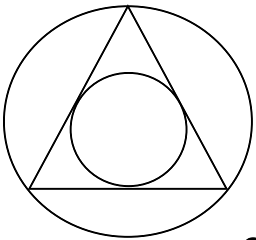
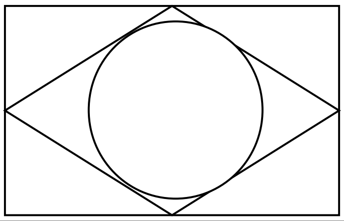
7.	Write a program in C++ to use map associative container. The keys will be the names of states and the values will be the populations of the states. When the program runs, the user is prompted to type the name of a state. The program then looks in the map, using the state name as an index and returns the population of the state.
	Part II : Computer Graphics
	Suggested List of Laboratory Experiments/Assignments (All assignments are compulsory)
Sr. No.	**Group A**
1.	Write C++ program to draw a concave polygon and fill it with desired color using scan fill algorithm. Apply the concept of inheritance.
2.	Write C++ program to implement Cohen Southerland line clipping algorithm.
3.	a) Write C++ program to draw the following pattern. Use DDA line and Bresenham's circle drawing algorithm. Apply the concept of encapsulation.  **OR** b) Write C++ program to draw the following pattern. Use DDA line and Bresenham's circle drawing algorithm. Apply the concept of encapsulation. 
	Group B
4.	a) Write C++ program to draw 2-D object and perform following basic transformations, Scaling b) Translation c) Rotation. Apply the concept of operator overloading. **OR** b) Write C++ program to implement translation, rotation and scaling transformations on equilateral triangle and rhombus. Apply the concept of operator overloading.
5.	a) Write C++ program to generate snowflake using concept of fractals. **OR** b) Write C++ program to generate Hilbert curve using concept of fractals. **OR** c) Write C++ program to generate fractal patterns by using Koch curves.
	Group C
6.	a) Design and simulate any data structure like stack or queue visualization using graphics. Simulation should include all operations performed on designed data structure. Implement the same using OpenGL. **OR** b) Write C++ program to draw 3-D cube and perform following transformations on it using OpenGL i) Scaling ii) Translation iii) Rotation about an axis (X/Y/Z). **OR** c) Write OpenGL program to draw Sun Rise and Sunset.

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7.	a) Write a C++ program to control a ball using arrow keys. Apply the concept of polymorphism. **OR** b) Write a C++ program to implement bouncing ball using sine wave form. Apply the concept of polymorphism. **OR** c) Write C++ program to draw man walking in the rain with an umbrella. Apply the concept of polymorphism. **OR** Write a C++ program to implement the game of 8 puzzle. Apply the concept of polymorphism. **OR** d) Write a C++ program to implement the game Tic Tac Toe. Apply the concept of polymorphism.

Mini-Projects/ Case Study

8.	Design and implement game / animation clip / Graphics Editor using open source graphics library. Make use of maximum features of Object Oriented Programming.

@The CO-PO Mapping Matrix

PO/CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	-	1	2	1	-	-	-	-	-	-	-	-
CO2	-	1	2	1	-	-	-	-	-	-	-	-
CO3	2	1	1	-	-	-	-	-	-	-	-	-
CO4	1	2	2	1	-	-	-	-	-	-	-	-
CO5	-	2	2	1	-	-	-	-	-	-	-	-

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Savitribai Phule Pune University
Second Year of Computer Engineering (2019 Course)
210248: Digital Electronics Laboratory

Teaching Scheme	Credit Scheme	Examination Scheme and Marks
Practical: 02 Hours/Week	01	Term Work: 25 Marks

Companion Course : 210245: Digital Electronics and Logic Design

Course Objectives:

To understand fundamentals and functionality of electronic circuits, design and implement combinational circuits like MUX, comparator, adder/subtractor, design and implement sequential circuits like flip-flop, registers, and counters using different integrated circuits.

Course Outcomes:

On completion of the course, learner will be able to–

CO1: **Understand** the working of digital electronic circuits.
CO2: **Apply** the knowledge to appropriate IC as per the design specifications.
CO3: **Design** and **implement** Sequential and Combinational digital circuits as per the specifications.

Guidelines for Instructor's Manual

The instructor's manual is to be developed as a hands-on resource and reference. The instructor's manual need to include prologue (about University/program/ institute/ department/foreword/ preface), curriculum of course, conduction and Assessment guidelines, topics under consideration-concept, objectives, outcomes, data sheets of various ICs.

Guidelines for Student's Laboratory Journal

The laboratory assignments are to be submitted by student in the form of journal. Journal consists of prologue, Certificate, table of contents, and **handwritten write-up** of each assignment (Title, Objectives, Problem Statement, Outcomes, software and Hardware requirements, Date of Completion, Assessment grade/marks and assessor's sign, Theory- Concept, circuit diagram, pin configuration, conclusion/analysis).

As a conscious effort and little contribution towards Green IT and environment awareness, attaching printed papers as part of write-ups and program listing to journal may be avoided.

Guidelines for Laboratory /Term Work Assessment

Continuous assessment of laboratory work is done based on overall performance and Laboratory performance of student. Each Laboratory assignment assessment should assign grade/marks based on parameters with appropriate weightage.

Suggested parameters for overall assessment as well as each Laboratory assignment assessment include- timely completion, performance, innovation, efficiency, punctuality and neatness.

Guidelines for Laboratory Conduction

The instructor is expected to frame the assignments by understanding the prerequisites, technological aspects, utility and recent trends related to the topic. The assignment framing policy need to address the average students and inclusive of an element to attract and promote the intelligent students.

The instructor may set multiple sets of assignments and distribute among batches of students. It is appreciated if the assignments are based on real world problems/applications. Student should perform at least 12 experiments with all experiments from group A and any 5 assignments from group Band one from group C assignments.

Virtual Laboratory:

- http://vlabs.iitb.ac.in/vlabs-dev/labs/dldgates/index.html
- http://vlabs.iitb.ac.in/vlabs-dev/labs/dldesignlab/index.html

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Suggested List of Laboratory Experiments/Assignments

Sr. No.	Group A
1	To Realize Full Adder/ Subtractor using a) Basic Gates and b) Universal Gates
2	Design and implement Code Converters-Binary to Gray and BCD to Excess-3
3	Design and Realization of BCD Adder using 4-bit Binary Adder (IC 7483).
4	Realization of Boolean Expression for suitable combination logic using MUX 74151 /74153, DMUX 74154/74138
5	To Verify the truth table of two bit comparators using logic gates.
6	Design and Implement Parity Generator and checker using EX-OR.
	Group B
7	Design and Realization: Flip Flop conversion
8	Design of 2 bit and 3 bit Ripple Counter using MS JK flip-flop.
9	Design of Synchronous 3 bit Up and Down Counter using MSJK Flip Flop / D Flip Flop
10	Realization of Mod -N counter using (Decade Counter IC 7490) .
11	Design and implement Sequence generator (for Prime Number/odd and even) using MS JK flip-flop.
12	Design and implement Sequence detector using MS JK flip-flop.
	Group C
13	Study of Shift Registers (SISO,SIPO, PISO, PIPO)
14	Design of ASM chart using MUX controller Method.

@The CO-PO Mapping Matrix

PO/CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	2	-	-	-	-	-	-	-	-	-
CO2	3	2	3	-	-	-	-	-	-	-	-	-
CO3	3	2	2	1	-	-	-	-	-	-	-	-

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Savitribai Phule Pune University
Second Year of Computer Engineering (2019 Course)
210249: Business Communication Skills

Teaching Scheme	Credit Scheme	Examination Scheme and Marks
Practical: 02 Hours/Week	01$	Term Work$: 25 Marks

Course Objectives:

- To facilitate Holistic growth ;
- To make the engineering students aware, about the importance, the role and the content of business communication skills ;
- To develop the ability of effective communication through individual and group activities;
- To expose students to right attitudinal and behavioural aspects and to build the same through various activities;

Course Outcomes:

On completion of the course, learner will be able to–

CO1: Express effectively through verbal/oral communication and improve listening skills
CO2: Write precise briefs or reports and technical documents.
CO3: Prepare for group discussion / meetings / interviews and presentations.
CO4: Explore goal/target setting, self-motivation and practicing creative thinking.
CO5: Operate effectively in multi-disciplinary and heterogeneous teams through the knowledge of team work, Inter-personal relationships, conflict management and leadership qualities.

Guidelines for Instructor's Manual

The instructor‘s manual is to be developed as a hands-on resource and reference. The instructor's manual needs to include prologue (about University/program/ institute/ department/foreword/preface), curriculum of course, conduction and Assessment guidelines, topics under consideration concept objectives, outcomes, guidelines, references.

Guidelines for Student's Laboratory Journal and Term Work Assessment

The student must prepare the journal in the form of report elaborating the activities performed. Continuous assessment of laboratory work is to be done based on overall performance and performance of student at each assignments. Each Laboratory assignment assessment will assign grade/marks based on parameters with appropriate weightage.

Suggested parameters for overall assessment as well as each Laboratory assignment assessment include- timely completion of assignment, performance, punctuality, neatness, enthusiasm, participation and contribution in various activities- SWOT analysis, presentations, team activity, event management, group discussion, Group exercises and interpersonal skills and similar other activities/assignments and Well presented, timely and complete report.

Recommended Assessment and Weightage Parameters:

(Attendance 30%, Assignments/activities-Active participation and proactive learning 50% and report 20%)

Students must submit the report of all conducted activities conducted. The brief guidelines for report preparations are as follows:

1. One activity report must be of maximum 3 pages;
2. Combined Report of all activities with cover pages, table of contents and certificate (signed by instructor) is to be submitted in soft copy (pdf) format only.
3. The report must contain:
    - General information about the activity;
    - Define the purpose of the activity;
    - Detail out the activities carried out during the visit in chronological order;
    - Summarize the operations / process (methods) during the activities;
    - Describe what you learned (outcomes) during the activities as a student;

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Guidelines for Laboratory Conduction

The instructor may frame assignments to enhance skills supporting career aspects. Multiple set of activity based assignments can be prepared and distributed among batches.
Every student must be given adequate opportunity to participate actively in each activity. An exercise can be designed to allow multiple skills exposure for example a group task encouraging discussions, team building, value sharing, leadership and role play all at the same time.

MOOC at Swayam:[$]

https://swayam.gov.in/nd2_imb19_mg14/preview

Virtual Laboratory:

- https://ve-iitg.vlabs.ac.in/

Sr. No.	Suggested List of Laboratory Experiments/Assignments
1	**SWOT analysis** The students should be made aware of their goals, strengths and weaknesses, attitude, moral values, self-confidence, etiquettes, non-verbal skills, achievements. through this activity. SWOT Analysis, Confidence improvement, values, positive attitude, positive thinking and self-esteem. The concern teacher should prepare a questionnaire which evaluate students in all the above areas and make them aware about these aspects
2	**Personal and Career Goal setting – Short term and Long term** The teacher should explain to them on how to set goals and provide template to write their short term and long term goals.
3	**Public Speaking** Any one of the following activities may be conducted : **1. Prepared speech (**Topics are given in advance, students get 10 minutes to prepare the speech and 5 minutes to deliver.) **2. Extempore speech (**Students deliver speeches spontaneously for 5 minutes each on a given topic) **3. Story telling** (Each student narrates a fictional or real life story for 5 minutes each) **4. Oral review** (Each student orally presents a review on a story or a book read by them)
4	**Reading and Listening skills** The batch can be divided into pairs. Each pair will be given an article (any topic) by the teacher. Each pair would come on the stage and read aloud the article one by one. After reading by each pair, the other students will be for correct answers and also for their reading skills. This will evaluate their reading and listening skills. The teacher should give them guidelines on improving their reading and listening skills. The teacher should also give passages asked questions on the article by the readers. Students will get marks on various topics to students for evaluating their reading comprehension.
5	**Group discussion** Group discussions could be done for groups of 5-8 students at a time Two rounds of a GD for each group should be conducted and teacher should give them feedback.
6	**Letter/Application writing** Each student will write one formal letter, and one application. The teacher should teach the students how to write the letter and application. The teacher should give proper format and layouts.
7	**Report writing** The teacher should teach the students how to write report .The teacher should give proper format and layouts. Each student will write one report based on visit / project / business proposal.
8	**Resume writing-** Guide students and instruct them to write resume

9	**Presentation Skill** Students should make a presentation on any informative topic of their choice. The topic may be technical or non-technical. The teacher should guide them on effective presentation skills. Each student should make a presentation for at least 10 minutes.
10	**Team games for team building -** Students should make to participate in team activity.
11	**Situational games for role playing as leaders**
12	**Faculty may arrange one or more sessions from following:** Yoga and meditation. Stress management, relaxation exercises, and fitness exercises. Time management and personal planning sessions.
13	**Mock interviews-** guide students and conduct mock interviews
14	**Telephonic etiquettes** -To teach students the skills to communicate effectively over the phone. Students will be divided into pairs. Each pair will be given different situations, such as phone call to enquire about job vacancy, scheduling a meeting with team members, phone call for requesting of urgent leave from higher authorities. Students will be given 10 min to prepare. Assessment will be done on the basis of performance during the telephone call.
15	**Email etiquettes** -To provide students with an in-depth understanding of email skills. Students will be made to send e-mails for different situations such as sending an e-mail to the principal for a leave, inviting a friend for a party, e-mail to enquire about room tariff of a hotel. Students will be assessed on the basis of e-mail such as clarity, purpose and proof reading of e-mail.

@The CO-PO Mapping Matrix

CO\PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	-	-	-	-	-	-	-	-	-	2	-	-
CO2	-	-	-	-	-	-	-	-	-	2	1	-
CO3	-	-	-	-	-	-	-	-	2	-	-	1
CO4	-	-	-	-	-	-	-	-	-	2	-	2
CO5	-	-	-	-	-	-	-	-	3	-	-	2

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Savitribai Phule Pune University Second Year of Computer Engineering (2019 Course) 210250: Humanity and Social Science		
Teaching Scheme	**Credit Scheme**	**Examination Scheme and Marks**
Tutorial: 01 Hours/Week	01[$]	**Term work[$]:** 25 Marks

Course Objectives:

To enable the students to explore aspects of human society and to acquire the intellectual, communication skills and develop characteristics that encourages personal fulfilment, meaningful professional life and responsible citizenship.

- To facilitate Holistic growth;
- To Educate about Contemporary, National and International affairs;
- To bring awareness about the responsibility towards society.
- To give an insight about the emergence of Indian society and the relevance of Economics.

Course Outcomes:

On completion of the course, learner will be–

CO1: **Aware** of the various issues concerning humans and society.
CO2: **Aware** about their responsibilities towards society.
CO3: Sensitized about broader issues regarding the social, cultural, economic and human aspects, involved in social changes.
CO4: **Able** to understand the nature of the individual and the relationship between self and the community.
CO5: **Able** to understand major ideas, values, beliefs, and experiences that have shaped human history and cultures.

Course Contents

Preamble:

As applied sciences, Engineering and Technology are meant to come up with effective solutions to social problems making it imperative that the present generation of engineers and technologists understand the society they live in. Studying the social sciences can provide individuals with crucial answers and observations that could certainly help in understanding of one's life which can alleviate social relations. A broad perspective of nationalistic thinking will provide the students with the ability to be socially conscientious, more resilient and open to building an inclusive society.
Experiencing real-life situations and complex scenarios that arise in each situation will help the budding professions to contribute their skills and knowledge to helping people improve and understand their behaviour or psychological processes. Understanding how the world works begins with an understanding of oneself and gaining hands-on experience and/or thinking about human values and ethics will help trigger a sense of responsibility among the students and lead them to finding effective solutions.

Course Structure: The tutorial sessions to be divided into 2 groups

1. Interactive Sessions to be conducted in classroom
2. Interactive Activities to be conducted Outside Classroom

MOOC/ Video Lectures available at[$]:

- https://nptel.ac.in/courses/109/103/109103023/
- https://nptel.ac.in/courses/109/107/109107131/

- Teachers will play the role of interventionists and instigating students to apply their thinking abilities on social concepts
- As facilitators and mentors teachers will coax the students to thinking out-of-the-box to come up with creative solutions
- Teachers should focus on instilling a sense of social consciousness through the activities conducted indoors and outdoors.

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Change of Mindset

- Since the course deviates from technical subjects, students will have to be counseled into the importance of social sciences
- A background understanding of the importance of this course in their professional and personal life will have to be enumerated to the students
- Teachers will have to rationalize the course outcomes to get the students invested in the activities being conducted

Designing of Course

- Since students lack prior knowledge, it is imperative that the tutorials conducted be engaging in its activities
- Focus of the sessions should be the learning outcome of each activity conducted either in the class or outside the class
- All activities designed should be as close to real-life making them relatable and applicable
- Student-engagement should be a priority so that the knowledge internalized will be higher
- The activities chosen can be modified to cater to the college location and social context
- The learning should be focused on application of ethics and values during each activity
- The chosen sessions should cater to giving the students the opportunity to be involved and engaged in their role as contributors to society and the nation at large

Basic function of the tutor

- To present a holistic view of the curriculum and the role of this course in it and emphasizing the benefit of the sessions towards developing communications kills, critical thinking and problems solving

Grouping

- The class will be divided into groups of 20 students
- The blend of cultural and social diversity will enhance the learning at the end of each activity
- Teachers will have to be mentored to handle sensitive issues diplomatically while encouraging students to stand up for their beliefs
- The groups will have to have inter-personal sessions so that they get to understand their team members better and work cohesively
- Management support and encouragement to engage students in life-enriching experiences is important

Assessment of Learning

- It is important for tutors to make sure that assessment is consistent with learning objectives of each activity
- Assessment of students should be focused on the students' ability to internalize the learning
- Tutors need to understand meaningful ways of assessing students' work to motivate learning

Tutorial Conduction and Term Work guidelines

Interactive Sessions to be conducted during Tutorial (in classroom)

1. PREPARED SPEECH ON CURRENT AFFAIRS
   a. Purpose – Get students to stay abreast and invested in national current affairs
   b. Method – Each student has to read an editorial from any national paper (English), find out more information on the topic and present it to the class; ending the session with his/her opinion on the matter
   c. Outcome – Awareness of national state of affairs. Improve on oratory skills. Instil the thinking and contemplative skills and form non-judgmental opinions about an issue
2. UNDERSTANDING INDIA'S CULTURAL DIVERSITY
   a. Purpose – Expose students to the intricacies of Indian cultural across various states
   b. Method – Each student (or a small group of students in case the number of students is large) has to pick a state and come to the tutorial session prepared with a PPT that will showcase the demographic, sociographic and cultural information of that state
   c. Outcome – Information about the beauty of Indian cultural diversity. Enhance exploratory skill, communication skills and learn to present using technological tools.

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3. Writing an Article on any Social Issue
    a. Purpose – Highlight various social and cultural evil malevolence existing in our country and express one's opinion on how it can be changed
    b. Method – Each student will have to write a 200 word essay on any of existing social malice that is prevalent in society. On evaluation, the top 5 essays can be displayed on the college wall magazine and rewarded if deemed appropriate
    c. Outcome – Learn to raise one's voice against the wrong doings in communities. Build writing skills, improve language and gain knowledge about how to write an impactful essay
4. Group Discussion on Communal Topic
    a. Purpose – Make students aware of the issues that are pertinent in a society and express a learned opinion about it
    b. Method – Students in groups of 20 each will discuss a relevant and grave issue that is dogging the nation. Alternatively, topics from current affairs (National budget, democratic process, economical strengthening of the country).
    c. Outcome – Develop group communication skills. Learn to speak up one's opinion in a forum. Cultivate the habit of presenting solution-driven arguments making them contributors in any team
5. Quiz on Social Behavior
    a. Purpose – Augment proper social etiquette among students and make them responsible citizens
    b. Method – Conduct a quiz on traffic rules using audio-visual aids or using dumb charades where one student has to enact the traffic rule and the others have to guess that rule
    c. Outcome – Grasp of various traffic rules and driving etiquette. Build verbal and non-verbal communication skills
6. Screen a Movie (Focus on positivity and power of the mind)
    a. Purpose – Expose students to introspective skills and try to develop a positive thinking in life
    b. Method – Screen a movie / a documentary / a video that focuses on the power of the mind and how to create affirmations in one's life. At the end of the movie, students can be asked to express their opinions and write down what changes / improvements they plan to take in their choices thereafter. This can be followed by a guest lecture by expert/s or workshop
    c. Outcome – Comprehend the areas of improvement within themselves. Understand the importance of staying positive and develop affirmations

7. Quiz on Social Behavior
    a. Purpose – Augment proper social etiquette among students and make them responsible citizens
    b. Method – Conduct a quiz on traffic rules using audio-visual aids or using dumb charades where one student has to enact the traffic rule and the others have to guess that rule
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c. Outcome – Comprehend the areas of improvement within themselves. Understand the importance of staying positive and develop affirmations

9. DEBATE ON A TOPIC FROM SOCIAL SCIENCES
    a. Purpose – Educate students about various domains in social sciences and develop an interest towards gaining knowledge about these topics
    b. Method – Various topics from various domains of social sciences can be chosen and students in pairs can pick a topic and present their arguments for or against the topic. Time for each debate will be 10 minutes maximum
    c. Outcome – Recognize the significance of social sciences in our lives. Cultivate the habit to present forceful arguments while respecting the opponents perspective and enhance verbal skills.

Interactive Activities to be conducted during Tutorial (Outside Classroom)

1. WASTE MANAGEMENT and CLEAN CAMPUS
    a. Purpose: Create awareness among students about the significance of a clean environment and social responsibility to deter littering and segregate waste
    b. Method: Students (in groups) will be given charge of areas of campus and will be expected to clean that segment. Also, they will be entrusted with the responsibility to collect, separate waste and hand over to the housekeeping authority
    c. Outcome: Develop the habit to maintain cleanliness at home as well as learn to respect community areas at college or workplace. It will also encourage them become ambassadors among their peers to advocate protection of the environment
2. MAKING A VIDEO ON SOCIAL WASTAGES.
    a. Purpose: Instil among students a sense of responsibility towards judiciously using natural resources like water and electricity
    b. Method: Using their phones / hand-held devices, groups of students will make a 3 – 4 minute short film that will highlight irresponsible behavior in terms of wastage of water, leaving lights, fans and other electrical appliances on when not in use, defacing public and campus property by scribbling on walls and common areas. They will make awareness for the same among students. The creative videos will be posted on the college website and social media as an encouragement
    c. Outcome: Conscientious behavior towards saving public utility resources. Explore the use of audio-visual tools to create more meaningful messages that can effect a change in society
3. RELAY MARATHON (3 – 5 kms)
    a. Purpose: Propagate a social message by way of a sport activity
    b. Method: A group of students will begin the race with banner / placard in hand that contains a social message. The group runs for 500 meters and hands over the banner / placard to the next group of students. This chain of exchange will continue for 3 – 5 kms.
    c. Outcome: Become aware of the need for fitness and encouragement towards healthier lifestyle. Students will also be able to express their creativity in terms of meaningful messages and gain attention towards worthy social causes from the community in and around the campus.
4. TREE PLANTATION ON CAMPUS
    a. Purpose: Involve students to actively participate in environment protection and develop greener surroundings
    b. Method: Each student will plant a sapling and take care of that plant until it is able to sustain itself. Alternatively, students can organize a tree plantation drive in a public area and nurture it
    c. Outcome: Besides increase in plants in the locality, students will feel a sense of empowerment and become social contributors towards protecting the environment.
5. VISIT TO AN OLD AGE HOME / ORPHANAGE
    a. Purpose: Build a sense of responsibility towards the less fortunate in our society and feel privileged to be able to effect real change in the world around us

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b. Method: Students have to visit an old age home or orphanage in the vicinity of the college. They can interact with the inmates, probably donate utilities to the charity organization and/or probably stage a few inclusive activities with the residents of the place. After the visit, students can submit a brief report about their experience
c. Outcome: Learn first-hand about the conditions and social situations that the no-so-privileged members of our society have to endure to survive and go beyond their embarrassment to interact with the destitute which will help students appreciate the importance of Indian family values

6. STREET PLAY ACTIVITY
   a. Purpose: Create awareness in themselves as well as people in the community on various social evils that need to be eradicated
   b. Method: Students will prepare and enact a street play on any pertinent issues in society. The topics suggested can be perils of mobile phones / online fraud / safety for girls / mental and physical health of the youth.
   c. Outcome: Allow students to deliberate and think deeply about the looming issues that is dogging our society and the future of the youth. This will also bring out the creative skills among the students and allow them to showcase their talent.

7. BUDDY / BIG BROTHER SYSTEM
a. Purpose: Include and involve the less fortunate children making them feel wanted and cared for as well as use the opportunity to share knowledge among school students.
b. Method: Students have to go to nearby schools after procuring appropriate permissions to teach a particular topic on either technical or non technical domains. Each student can choose to adopt 5 students from the class to be their mentor over a period of 1 year by staying in touch with them and helping them resolve their issues on academic or other matters.
c. Outcome: Appreciation and respect towards the responsibility of teaching. They will learn to be accountable as social contributors and bring about some change in the lives of the young students they mentor as Buddies or Big Brother.

Term Work Assessment Guidelines

Students must submit the report of all conducted activities conducted during Tutorial (Outside Classroom) of at least 04 activities (out of 07 activities) from group (of 02-03) students.

The brief guidelines for report preparations are as follows:

1. One activity report must be of maximum 3 pages;
2. Combined Report of all activities with cover pages, table of contents and certificate (signed by instructor) is to be submitted in soft copy (pdf) format only.
3. The report must contain:
   - General information about the activity;
   - Define the purpose of the activity;
   - Detail out the activities carried out during the visit in chronological order;
   - Summarize the operations / process (methods) during the activities;
   - Describe what you learned (outcomes) during the activities as a student;
   - Add photos of the activity;(optional)
   - Add a title page to the beginning of your report;
   - Write in clear and objective language; and
   - Get well presented, timely and complete report submitted.

Recommended Assessment and Weightage Parameters:
(Attendance 30%, Assignments/Activities-Active participation and proactive learning 50% and report 20%)

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Learning Resources

Books:

1. A. Alavudeen, M. Jayakumaran, and R Kalil Rahman, “Professional Ethics and Human Values”
2. Ram Ahuja, “Social Problems in India” (third edition)
3. Shastry, T. S. N., “India and Human rights: Reflections”, Concept Publishing Company India Pvt. Ltd., 2005.
4. Nirmal, C.J., “Human Rights in India: Historical, Social and Political Perspectives (Law in India)”, Oxford India
5. Rangarajan, “Environmental Issues in India”, Pearson Education.
6. University of Delhi, The Individual and Society, Pearson Education.
7. Wikipedia.org / wiki /social studies.
8. M. N. Srinivas, “Social change in modern India”, 1991, Orient Longman.
9. David Mandelbaum, Society in India, 1990, Popular.
10. Dr. Abha Singh, “Behavioral Science: Achieving Behavioral Excellence for Success”, Wiley.

e-Books:

- https://www.moteoo.org/en/products/social-science-and-humanities-student-book-english
- https://www.springeropen.com/books
  (SpringerOpen open access books; download them free of charge from SpringerLink)
- https://muse.jhu.edu/article/541846/pdf
  (This content has been declared *free* to read by the publisher during the COVID-19)

@The CO-PO Mapping Matrix

CO\PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	-	-	-	-	-	-	2	2	2	-	-	-
CO2	-	-	-	-	-	-	2	-	-	-	-	-
CO3	-	-	-	-	-	-	-	2	2	-	-	1
CO4	-	-	-	-	-	-	2	2	2	-	-	-
CO5	-	-	-	-	-	-	-	2	-	-	-	-
CO6	-	-	-	-	-	-	-	-	-	-	-	-

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Savitribai Phule Pune University
Second Year of Engineering (2019 Course)
210251: Audit Course 3

In addition to credits, it is recommended that there should be audit course, in preferably in each semester starting from second year in order to supplement students' knowledge and skills. Student will be awarded the bachelor's degree if he/she earns specified total credit [1] and clears all the audit courses specified in the curriculum. The student will be awarded grade as AP on successful completion of audit course. The student may opt for one of the audit courses per semester, starting in second year first semester. Though not mandatory, such a selection of the audit courses helps the learner to explore the subject of interest in greater detail resulting in achieving the very objective of audit course's inclusion. List of options offered is provided. Each student has to choose one audit course from the list per semester. Evaluation of audit course will be done at institute level itself. Method of conduction and method of assessment for audit courses are suggested.

Criteria:

The student registered for audit course shall be awarded the grade AP (Audit Course Pass) and shall be included such AP grade in the Semester grade report for that course, provided student has the minimum attendance as prescribed by the Savitribai Phule Pune University and satisfactory performance and secured a passing grade in that audit course. No grade points are associated with this 'AP' grade and performance in these courses is not accounted in the calculation of the performance indices SGPA and CGPA. Evaluation of audit course will be done at institute level itself [1]

Guidelines for Conduction and Assessment (Any one or more of following but not limited to):

- Lectures/ Guest Lectures
- Visits (Social/Field) and reports
- Demonstrations
- Surveys
- Mini-Project
- Hands on experience on focused topic

Course Guidelines for Assessment (Any one or more of following but not limited to):

- Written Test
- Demonstrations/ Practical Test
- Presentations, IPR/Publication and Report

Audit Course 3 Options

Audit Course Code	Audit Course Title
AC3-I	Green Construction and Design
AC3-II	Social Awareness and Governance Program
AC3-III	Environmental Studies
AC3-IV	Smart Cities
AC3-V	Foreign Language (one of Japanese/Spanish/French/German). Course contents for **Japanese(Module 1)** are provided. For other languages institute may design suitably.

Note: It is permitted to opt one of the audit courses listed at SPPU website too, if not opted earlier.
http://collegecirculars.unipune.ac.in/sites/documents/Syllabus%202017/Forms/AllItems.aspx
http://www.unipune.ac.in/university_files/syllabi.htm

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AC3-I: Green Construction and Design

Prerequisites: General awareness of environment and eco system.

Course Objectives:

1. To motivate students for undertaking green construction projects, technical aspects of their design, obstacles to getting them done, and future directions of the field.
2. To increase awareness of green construction issues, so that students will know the range of existing knowledge and issues.
3. Proper use of energy, water and other resources without harming environment.
4. To reduce waste pollution and Environment Degradation.

Course Outcomes:

On completion of the course, learner will be able to–

CO1: Understand the importance of environment friendly society.

CO2: Apply primary measures to reduce carbon emissions from their surroundings.

CO3: Learn role of IT solutions in design of green buildings.

CO4: Understand the use of software systems to complete statutory compliances involved in the design of a new home or office building through green construction.

Course Contents

1. Introduction to Green Construction, need of green construction, Importance, Government Initiatives, your role in the Green Environment.
2. How to do Green Construction, Project Definition, Team Building, Education and Goal Setting, Documents and Specification.
3. Elements of Green Construction, Materials Construction Waste Management, Indoor Air Quality, Energy Efficiency.
4. Indian Green Building Council (IGBC), Introduction to IGBC, IGBC rating system, Green building projects in India, Benefits of green building, effects on natural resources.

Team Projects:

Students will be formed into groups to research green construction and design in a particular construction context and report their results to the class. What are the particular obstacles and opportunities to integrating green construction techniques into the following sectors? Be sure to consider technical, social, political and economic issues:

Hotels (economy, luxury, resorts), Hospitals, Retail(big box, malls, small scale downtown retail), Office, Government, ,Schools, Universities, Housing, Transportation Stations (Airport Terminals, Train Stations).

References :

1. Kibert, C. (2008) Sustainable Construction: Green Building Design and Delivery, 2nd edition(Hoboken, NJ: John Wiley and Sons.
2. Handbook of Green Building Design and Construction 1st Edition, by Sam Kubba, eBook ISBN:9780123851291.

IGBC Green New Buildings Rating System, Version 3.0, Abridged Reference Guide September 2014. Available:https://igbc.in/igbc/html_pdfs/abridged/IGBC%20Green%20New%20Buildings%20Rating%20System%20(Version%203.0).pdf

@The CO-PO Mapping Matrix

CO\PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12
CO1	-	-	2	-	-	3	3	-	-	-	-	-
CO2	-	-	2	-	-	3	3	-	-	-	-	-
CO3	-	-	-	-	3	-	2	-	-	-	-	-
CO4	-	-	1	-	3	-	2	-	-	-	-	-

AC3-II: Social Awareness and Governance Program

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Prerequisites:

Awareness about basic terms in Social Science and Governance

Course Objectives:

1. To Increase community awareness about social issues and to promote the practice of good governance in both private and public institutions, through policy advocacy and awareness creation in order to ensure proper utilization of public resources and good service delivery.
2. Increase community awareness on health, education, and human rights.
3. Transferring costs of social activities to other various segments of society.
4. To enhance youth participation in decision-making, democracy and economic development.

Course Outcomes:

On completion of the course, learner will be able to–

CO1: Understand social issues and responsibilities as member of society.

CO2: Apply social values and ethics in decision making at social or organizational level

CO3:Promote obstacles in national integration and role of youth for National Integration

CO4: Demonstrate basic features of Indian Constitution.

Course Contents

1. Indian Society as Pluralistic, Fundamentals of unity in diversity, diversity and disparity in Indian society, women in mass media, disparities due to disability.
2. The Indian constitution as unifying factor, Introduction Making of Indian Constitution, Basic features of Indian Constitution, Strengths of Indian Constitution, and Fundamental Duties.
3. National Integration: Introduction, The Value of Tolerance, Minority Classes And Constitution, Pre-Requisites of National Integration, Obstacles To National Integration, Promotion of National Integration, Role of Youth In Promoting Communal Harmony.
4. Socialization, Ethics, Values and Prejudices, Meaning of Socialization, Functions of Socialization, Agents of Socialization, Importance of Socialization, Role of Ethics In Individual Development, Role of Basic Human Values In Individual Development, Relative Value System.

Activities:

1. Conducting training/workshops/debates on HIV/AIDS prevention and stigma reduction.
2. Public shows on girls' education and empowerment.
3. Conducting campaigns on adult/disabled education.
4. To support the government to develop policy that encourages youth participation in decision-making through government agencies.

References:

1. Devidas M. Muley , S Chand, " Social Awareness and Personality Development", ISBN: 812193074X.
2. Bhagabati Prosad Banerjee, Durga Das Basu, Shakeel Ahmad Khan, V. R. Manohar, "Introduction to the Constitution of India", ISBN : 9788180385599.

@The CO-PO Mapping Matrix

CO\PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12
CO1	-	-	-	-	-	-	-	2	-	-	-	-
CO2	-	-	-	-	-	-	-	3	2	-	-	-
CO3	-	-	-	-	-	-	-	2	2	-	-	-
CO4	-	-	-	-	-	-	-	1	1	-	-	-

AC3-III: Environmental Studies

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Environmental studies are the field that examines this relationship between people and the environment. An environmental study is an interdisciplinary subject examining the interplay between the social, legal, management, and scientific aspects of environmental issues.

Course Objectives:

1. Understanding the importance of ecological balance for sustainable development.
2. Understanding the impacts of developmental activities and mitigation measures.
3. Understand and realize the multi-disciplinary nature of the environment, its components, and inter-relationship between man and environment
4. Understand the relevance and importance of the natural resources in the sustenance of life on earth and living standard

Course Outcomes:

On completion of the course, learner will be able to–

CO1: Comprehend the importance of ecosystem and biodiversity

CO2: Correlate the human population growth and its trend to the environmental degradation and develop the awareness about his/her role towards environmental protection and prevention

CO3: Identify different types of environmental pollution and control measures

CO4: Correlate the exploitation and utilization of conventional and non-conventional resources

Course Contents

1. **Natural Resources:** Introduction, Renewable and non-renewable, Forest, water, mineral, food, energy and land resources, Individual and conservation of resources, Equitable use of resources.
2. **Ecosystems:** Concept, Structure, Function, Energy flow, Ecological succession, Forest, grassland, desert and aquatic ecosystems - Introduction, characteristic features, structure and function.
3. **Biodiversity:** Genetic, Species and ecological diversity, Bio Geographical classification of India, Value and hot spots, Biodiversity at global, national and local levels, India as mega-biodiversity nation, Threats to biodiversity, Endangered and endemic species of India, Conservation of Biodiversity, Endangered and endemic species, Conservation of biodiversity.
4. **Pollution:** Definition, Causes, effects and control measures of the pollution – Air, soil, Noise, Water, Marine and Thermal and Nuclear Pollution, Solid waste management, Role of Individual in Prevention of Pollution, Pollution #Exemplar/Case Studies, Disaster management

Reference:

1. Bharucha, E.,–Textbook of "Environmental Studies", Universities Press(2005),ISBN-10:8173715408
2. Mahua Basu, "Environmental Studies", Cambridge University Press, ISBN-978-1-107-5317-3

@The CO-PO Mapping Matrix

CO\PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	-	-	-	-	-	-	3	-	-	-	-	-
CO2	-	-	-	-	-	3	3	-	-	-	-	1
CO3	-	2	-	-	-	2	3	-	-	-	-	-
CO4	-	-	-	-	-	2	2	-	-	-	-	-

AC3-IV: Smart Cities

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We breathe in a world defined by urbanization and digital ubiquity, where mobile broadband connections outnumber fixed ones, machines dominate a new "internet of things," and more people live in cities than in the countryside. This course enables us to take a broad historical look at the forces that have shaped the planning and design of cities and information technologies from the rise of the great industrial cities of the nineteenth century to the present. This course considers the motivations, aspirations, and shortcomings of them all while offering a new civics to guide our efforts as we build the future together, one click at a time.

Course Objectives

- To identify urban problems
- To study Effective and feasible ways to coordinate urban technologies.
- To study models and methods for effective implementation of Smart Cities.
- To study new technologies for Communication and Dissemination.
- To study new forms of Urban Governance and Organization.

Course Outcomes

On completion of the course, learner will be able to–

CO1: Understand the dynamic behavior of the urban system by going beyond the physical appearance and by focusing on representations, properties and impact factors

CO2: Explore the city as the most complex human-made organism with a metabolism that can be modeled in terms of stocks and flows

CO3: Knowledge about data-informed approaches for the development of the future city, based on crowd sourcing and sensing

CO4: Knowledge about the latest research results in for the development and management of future cities

CO5: Understand how citizens can benefit from data-informed design to develop smart and responsive cities

Course Contents

Urbanization and Ubiquity - The slow emergence of learning cities in an urbanizing world. Cities as collective learners, what do we know?- Framing a view -A gamut of learning types - Secrets of knowing and accelerating change - Why some cities learn and others do not.

References:

1. Anthony M. Townsend, W. W. Nortonand Company “Smart Cities: Big Data, Civic Hackers, and the Quest for a New Utopia”, ISBN: 0393082873,9780393082876.
2. Tim Campbell, Routledge, “Beyond Smart Cities: How Cities Network, Learn and Innovate”||, Routledge, ISBN:9781849714266.
3. StanGeertman, JosephFerreira, Jr.Robert Goodspeed, JohnStillwell, “Planning Support System ms and Smart Cities”, Lecture notes in Geo information and Cartography, Springer.

@The CO-PO Mapping Matrix

CO\PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	-	2	2	-	-	2	2	1	-	-	-	-
CO2	1	2	1	-	-	1	1	-	-	-	-	-
CO3	2	1	3	3	2	-	1	-	1	1	1	
CO4	-	3	2	-	-	-	-	-	-	-	1	2

AC3-V: Foreign Language- Japanese (Module 1)

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About course:

With changing times, the competitiveness has gotten into the nerves and "Being the Best"at all times is only the proof of it. Nonetheless, 'being the best' differs significantly from 'Communicating the best'! The best can merely be communicated whilst using the best… suited Language!!

Japanese is the new trend of 21st century. Not only youngsters but even the professionals seek value in it. It is the engineer's companion in current times with an assertion of a thriving future. Pune has indisputably grown to become a major center of Japanese Education in India while increasing the precedence for Japanese connoisseurs.

Japanese certainly serves a great platform to unlock a notoriously tough market and find a booming career. While the companies prefer candidates having the knowledge of the language, it can additionally help connect better with the native people thus prospering in their professional journey. Learning Japanese gives an extra edge to the 'resume' since the recruiters consciously make note of the fact it requires real perseverance and self-discipline to tackle one of the most complex languages.

It would be easy for all time to quit the impossible; however it takes immense courage to reiterate the desired outcomes, recognize that improvement is an ongoing process and ultimately soldier on it.

The need of an hour is to introduce Japanese language with utmost professionalism to create awareness about the bright prospects and to enhance the proficiency and commitment. It will then prove to be the ultimate path to the quest for professional excellence!

Course Objectives:

- To meet the needs of ever growing industry with respect to language support.
- To get introduced to Japanese society and culture through anguage.

Course Outcomes:

On completion of the course learner will able to-

CO1: Will have ability of basic communication.
CO2: Will have the knowledge of Japanese script.
CO3: Will get introduced to reading , writing and listening skills
CO4: Will develop interest to pursue professional Japanese Language course.

Course Contents

1. Introduction to Japanese Language. Hiragana basic Script, colors, Days of the week
2. Hiragana : modified Kana, double consonant, Letters combined with ya, yu, yoLong vowels, Greetings and expressions
3. Self Introduction, Introducing other person, Numbers, Months, Dates, Telephone numbers, Stating on'sage.

Reference:

1. Minna No Nihongo,"Japanese for Everyone", Elementary Main Text book1-1 (Indian Edition), Goyal Publishers and Distributors Pvt.Ltd.
2. http://www.tcs.com (http://www.tcs.com/news_events/press_releases/Pages/TCS-Inaugurates-Japan-centric-Delivery-Center-Pune.aspx)

@The CO-PO Mapping Matrix

CO\PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO 12
CO1	-	-	-	-	-	-	-	-	1	3	1	1
CO2	-	-	-	-	1	-	-	-	-	3	1	1
CO3	-	-	-	-	1	-	-	-	-	3	2	2
CO4	-	-	-	-	-	-	-	-	-	1	-	1

Semester IV

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Savitribai Phule Pune University
Second Year of Engineering (2019 Course)
207003: Engineering Mathematics III

Teaching Scheme	Credit Scheme	Examination Scheme and Marks
Lecture: 03 Hours/Week **Tutorial:** 01 Hour/ Week	**Theory:** 03 **Tutorial:** 01	**Mid_Semester(TH):** 30 Marks **End_Semester(TH):** 70 Marks **Term Work:** 25 Marks

Prerequisites: Differential & Integral calculus, Taylor series, Differential equations of first order and first degree, Fourier series, Collection, Classification and Representation of data.

Companion Course : ---

Course Objectives:

To make the students familiar with concepts and techniques in Linear differential equations, Fourier transform and Z-transform, Statistical methods, Probability theory and Numerical methods. The aim is to equip them with the techniques to understand advanced level mathematics and its applications that would enhance thinking power, useful in their disciplines.

Course Outcomes:

On completion of the course learner will able to-

- CO1: Solve Linear differential equations, essential in modelling and design of computer-based systems.
- CO2: Apply concept of Fourier transform and Z-transform and its applications to continuous and discrete systems and image processing.
- CO3: Apply Statistical methods like correlation and regression analysis and probability theory for data analysis and predictions in machine learning.
- CO4: Solve Algebraic and Transcendental equations and System of linear equations using numerical techniques.
- CO5: Obtain Interpolating polynomials, numerical differentiation and integration, numerical solutions of ordinary differential equations used in modern scientific computing.

Course Contents

Unit I	Linear Differential Equations (LDE)	(08 Hours)

LDE of n^{th} order with constant coefficients, Complementary function, Particular integral, General method, Short methods, Method of variation of parameters, Cauchy's and Legendre's DE, Simultaneous and Symmetric simultaneous DE.

Unit II	Transforms	(08 Hours)

Fourier Transform (FT): Complex exponential form of Fourier series, Fourier integral theorem, Fourier Sine and Cosine integrals, Fourier transform, Fourier Sine and Cosine transforms and their inverses, Discrete Fourier Transform.

Z - Transform (ZT): Introduction, Definition, Standard properties, ZT of standard sequences and their inverses. Solution of difference equations.

Unit III	Statistics	(07 Hours)

Measures of central tendency, Measures of dispersion, Coefficient of variation, Moments, Skewness and Kurtosis, Curve fitting: fitting of straight line, parabola and related curves, Correlation and Regression, Reliability of Regression Estimates.

Unit IV	Probability and Probability Distributions	(07 Hours)

Probability, Theorems on Probability, Bayes theorem, Random variables, Mathematical Expectation, Probability density function, Probability distributions: Binomial, Poisson, Normal and Hypergeometric, Sampling distributions, Test of Hypothesis: Chi-Square test, t-test.

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Unit V	Numerical Methods	(08 Hours)

Numerical Solution of Algebraic and Transcendental equations: Bisection, Secant, Regula-Falsi, Newton–Raphson and Successive Approximation Methods, Convergence and Stability.

Numerical Solutions of System of linear equations: Gauss elimination, LU Decomposition, Cholesky, Jacobi and Gauss-Seidel Methods.

Unit VI	Numerical Methods	(08 Hours)

Interpolation: Finite Differences, Newton's and Lagrange's Interpolation formulae, Numerical Differentiation. Numerical Integration: Trapezoidal and Simpson's rules, Bound of truncation error. Solution of Ordinary differential equations: Euler's, Modified Euler's, Runge-Kutta 4th order methods and Predictor-Corrector methods.

Learning Resources

Text Books:

1. Higher Engineering Mathematics by B.V. Ramana (Tata McGraw-Hill).
2. Higher Engineering Mathematics by B. S. Grewal (Khanna Publication, Delhi).

Reference Books:

1. Advanced Engineering Mathematics, 10e, by Erwin Kreyszig (Wiley India).
2. Advanced Engineering Mathematics, 2e, by M. D. Greenberg (Pearson Education).
3. Advanced Engineering Mathematics, 7e, by Peter V. O'Neil (Cengage Learning).
4. Differential Equations, 3e by S. L. Ross (Wiley India).
5. Introduction to Probability and Statistics for Engineers and Scientists, 5e, by Sheldon M. Ross (Elsevier Academic Press).
6. Numerical Methods for Scientific and Engineering Computation, by M. K. Jain, S. R. K. Iyengar And R. K. Jain, 5e, (New Age International Publication)

MOOC Link:

1. NPTEL Course "Transform Calculus And its applications in differential equations" https://nptel.ac.in/courses/111/105/111105123/
2. NPTEL Course on "Numerical Methods" https://nptel.ac.in/courses/111/107/111107105/

Virtual LAB Link:

1. Numerical Methods: http://vlabs.iitb.ac.in/vlabs-dev/labs/numerical_lab/index.php

Guidelines for Tutorial and Term Work:

i) Tutorial shall be engaged in batches (batch size as per norms) per division.
ii) Term work shall be based on continuous assessment of six assignments (one per each unit) and performance in internal tests.

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<table>
<tr><td colspan="3">Savitribai Phule Pune University
Second Year of Engineering (2019 Course)
210252: Data Structures and Algorithms</td></tr>
<tr><td>Teaching Scheme</td><td>Credit Scheme</td><td>Examination Scheme and Marks</td></tr>
<tr><td>Lecture: 03 Hours/Week</td><td>03</td><td>Mid_Semester(TH): 30 Marks
End_Semester(TH): 70 Marks</td></tr>
</table>

Prerequisite Courses: 110005: Programming and Problem Solving
210242: Fundamentals of Data Structures

Companion Course: 210257: Data Structures and Algorithms Laboratory

Course Objectives:

The course is intended to provide the foundations of the practical implementation and usage of Data Structures and Algorithms to ensure that the learner evolves into a competent programmer capable of designing and analyzing implementations of data structures and algorithms for different kinds of problems.

- To develop a logic for graphical modeling of the real life problems.
- To suggest appropriate data structure and algorithm for graphical solutions of the problems.
- To understand advanced data structures to solve complex problems in various domains.
- To operate on the various structured data
- To build the logic to use appropriate data structure in logical and computational solutions.
- To understand various algorithmic strategies to approach the problem solution.

Course Outcomes:

On completion of the course, learner will be able to–

CO1: **Identify and articulate** the complexity goals and benefits of a good hashing scheme for real-world applications.

CO2: **Apply** non-linear data structures for solving problems of various domain.

CO3: **Design and specify** the operations of a nonlinear-based abstract data type and implement them in a high-level programming language.

CO4: **Analyze** the algorithmic solutions for resource requirements and optimization

CO5: **Use** efficient indexing methods and multiway search techniques to store and maintain data.

CO6: **Use** appropriate modern tools to understand and analyze the functionalities confined to the secondary storage.

Course Contents

Unit I	**Hashing**	**(07 Hours)**
Hash Table- Concepts-hash table, hash function, basic operations, bucket, collision, probe, synonym, overflow, open hashing, closed hashing, perfect hash function, load density, full table, load factor, rehashing, issues in hashing, hash functions- properties of good hash function, division, multiplication, extraction, mid-square, folding and universal, Collision resolution strategies- open addressing and chaining, Hash table overflow- open addressing and chaining, extendible hashing, closed addressing and separate chaining. **Skip List-** representation, searching and operations- insertion, removal		
#Exemplar/Case Studies	Book Call Number and Dictionary	
***Mapping of Course Outcomes for Unit I**	CO1, CO4	
Unit II	**Trees**	**(08 Hours)**

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Tree- basic terminology, General tree and its representation, representation using sequential and linked organization, Binary tree- properties, converting tree to binary tree, binary tree traversals(recursive and non-recursive)- inorder, preorder, post order, depth first and breadth first, Operations on binary tree. Huffman Tree (Concept and Use), Binary Search Tree (BST), BST operations, Threaded binary search tree- concepts, threading, insertion and deletion of nodes in in-order threaded binary search tree, in order traversal of in-order threaded binary search tree.		
#Exemplar/Case Studies	Use of binary tree in expression tree-evaluation and Huffman's coding	
*Mapping of Course Outcomes for Unit II	CO2, CO3,CO4	
Unit III	**Graphs**	**(07 Hours)**
Basic Concepts, Storage representation, Adjacency matrix, adjacency list, adjacency multi list, inverse adjacency list. **Traversals**-depth first and breadth first, Minimum spanning Tree, Greedy algorithms for computing minimum spanning tree- Prims and Kruskal Algorithms, Dikjtra's Single source shortest path, All pairs shortest paths- Flyod-Warshall Algorithm Topological ordering.		
#Exemplar/Case Studies	Data structure used in Webgraph and Google map	
*Mapping of Course Outcomes for Unit III	CO2,CO3, CO4	
Unit IV	**Search Trees**	**(08 Hours)**
Symbol Table-Representation of Symbol Tables- Static tree table and Dynamic tree table, Weight balanced tree - Optimal Binary Search Tree (OBST), OBST as an example of Dynamic Programming, Height Balanced Tree- AVL tree. Red-Black Tree, AA tree, K-dimensional tree, Splay Tree		
#Exemplar/Case Studies	Keyword search in a document using OBST	
*Mapping of Course Outcomes for Unit IV	CO2, CO3, CO5	
Unit V	**Indexing and Multiway Trees**	**(07 Hours)**
Indexing and Multiway Trees- Indexing, indexing techniques-primary, secondary, dense, sparse, Multiway search trees, B-Tree- insertion, deletion, B+Tree - insertion, deletion, use of B+ tree in Indexing, Trie Tree.		
#Exemplar/Case Studies	Heap as a Priority Queue	
*Mapping of Course Outcomes for Unit V	CO2, CO3, CO5	
Unit VI	**File Organization**	**(07 Hours)**
Files: concept, need, primitive operations. **Sequential file organization-** concept and primitive operations, **Direct Access File-** Concepts and Primitive operations, **Indexed sequential file organization-**concept, types of indices, structure of index sequential file, **Linked Organization-** multi list files, coral rings, inverted files and cellular partitions.		
#Exemplar/Case Studies	**External Sort-** Consequential processing and merging two lists, multiway merging- a k way merge algorithm	
*Mapping of Course Outcomes for Unit VI	CO4, CO6	
Learning Resources		

Text Books:

1. Horowitz, Sahani, Dinesh Mehata, “Fundamentals of Data Structures in C++”‖, Galgotia Publisher, ISBN: 8175152788, 9788175152786.
2. M Folk, B Zoellick, G. Riccardi, “File Structures‖, Pearson Education”, ISBN:81-7758-37-5
3. Peter Brass, “Advanced Data Structures”‖, Cambridge University Press, ISBN: 978-1-107-43982-5

Home

Reference Books:

1. A. Aho, J. Hopcroft, J. Ulman, “Data Structures and Algorithms”‖, Pearson Education, 1998, ISBN-0-201-43578-0.
2. Michael J Folk, “File Structures an Object Oriented Approach with C++‖”, Pearson Education, ISBN: 81-7758-373-5.
3. Sartaj Sahani, “Data Structures, Algorithms and Applications in C++”‖, Second Edition, University Press, ISBN:81-7371522 X.
4. G A V Pai, “Data Structures and Algorithms”‖, McGraw-Hill Companies, ISBN -9780070667266.
5. Goodrich, Tamassia, Goldwasser, “Data Structures and Algorithms in Java”‖, Wiley Publication, ISBN: 9788126551903

e-Books:

- https://www.ebooks.com/en-us/book/95777110/Python-data-structures-and-algorithms/benjamin-baka/
- https://www.ebookphp.com/advanced-data-structures-epub-pdf/
- https://www.ebookphp.com/data-structures-and-algorithms-professional-edition-beginners-guide-epub-pdf/

MOOC/ Video Lectures available at:

- https://nptel.ac.in/courses/106/102/106102064/
- https://nptel.ac.in/courses/106/105/106105085
- https:// nptel.ac.in/courses/106/106/106106127

@The CO-PO Mapping Matrix

CO\PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	1	2	1	-	-	-	-	-	-	-	-
CO2	1	2	-	-	-	-	-	-	-	-	-	-
CO3	2	-	-	-	-	-	-	-	-	-	-	-
CO4	-	2	-	1	-	-	-	-	-	-	-	-
CO5	1	-	1	1	-	-	-	-	-	-	-	-
CO6	2	1	1	1	-	-	-	-	-	-	-	-

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Savitribai Phule Pune University
Second Year of Engineering (2019 Course)
210253: Software Engineering

Teaching Scheme	Credit Scheme	Examination Scheme and Marks
Lecture: 03 Hours/Week	03	Mid_Semester(TH): 30 Marks End_Semester(TH): 70 Marks

Prerequisite Courses : 110005: Programming and Problem Solving

Companion Course : ---

Course Objectives:

The main objective of this course is to introduce the students to software engineering- the fundaments of software engineering principles and practices, including project management, configurations management, requirements definition, system analysis, design, testing, and deployment with hands-on experience in a group software development project.

- To learn and understand the principles of Software Engineering.
- To be acquainted with methods of capturing, specifying, visualizing and analyzing software requirements.
- To apply design and testing principles to software project development.
- To understand project management through life cycle of the project.

Course Outcomes:

On completion of the course, learner will be able to-

CO1: Analyze software requirements and formulate design solution for a software.

CO2: Design applicable solutions in one or more application domains using software engineering approaches that integrate ethical, social, legal and economic concerns.

CO3: Apply new software models, techniques and technologies to bring out innovative and novelistic solutions for the growth of the society in all aspects and evolving into their continuous professional development.

CO4: Model and design User interface and component-level.

CO5: Identify and handle risk management and software configuration management.

CO6: Utilize knowledge of software testing approaches, approaches to verification and validation.

CO7: Construct software of high quality – software that is reliable, and that is reasonably easy to understand, modify and maintain efficient, reliable, robust and cost-effective software solutions.

Course Contents

Unit I	Introduction to Software Engineering and Software Process Models	(06Hours)

Software Engineering Fundamentals: Introduction to software engineering, The Nature of Software, Defining Software, Software Engineering Practice. **Software Process:** A Generic Process Model, defining a Framework Activity, Identifying a Task Set, Process Patterns, Process Assessment and Improvement, Prescriptive Process Models, The Waterfall Model, Incremental Process Models, Evolutionary Process Models, Concurrent Models, A Final Word on Evolutionary Processes. Unified Process, Agile software development: Agile methods, plan driven and agile development.

#Exemplar/Case Studies	Agile Tools- JIRA
*Mapping of Course Outcomes for Unit I	CO1, CO3, CO7

Unit II	Software Requirements Engineering and Analysis	(07 Hours)

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Modeling: Requirements Engineering, Establishing the Groundwork, Identifying Stakeholders, Recognizing Multiple Viewpoints, working toward Collaboration, Asking the First Questions, Eliciting Requirements, Collaborative Requirements Gathering, Usage Scenarios, Elicitation Work Products, Developing Use Cases, Building the Requirements Model, Elements of the Requirements Model, Negotiating Requirements, Validating Requirements. **Suggested Free Open Source tools:** StarUML, Modelio, SmartDraw.		
#Exemplar/Case Studies	Write SRS in IEEE format for selected Project Statement/ case study Study SRS of Online Voting system (http://dos.iitm.ac.in/OOSD_Material/CaseStudies/CaseStudy2/eVote-srs.pdf), Library management System, Develop use case model for any software applications.	
***Mapping of Course Outcomes for Unit II**	CO1, CO3, CO7	
Unit III	**Estimation and Scheduling**	**(07 Hours)**
Estimation for Software Projects: The Project Planning Process, Defining Software Scope and Checking Feasibility, Resources management, Reusable Software Resources, Environmental Resources, Software Project Estimation, Decomposition Techniques, Software Sizing, Problem-Based Estimation, LOC-Based Estimation, FP-Based Estimation, Object Point (OP)-based estimation, Process-Based Estimation, Process-Based Estimation, Estimation with Use Cases, Use-Case–Based Estimation, Reconciling Estimates, Empirical Estimation Models, The Structure of Estimation Models, The COCOMO II Mode, Preparing Requirement Traceability Matrix **Project Scheduling:** Project Scheduling, Defining a Task for the Software Project, Scheduling. **Suggested Free Open Source Tools:** Gantt Project, Agantty, Project Libre.		
#Exemplar/Case Studies	Write SRS in IEEE format for selected Project Statement/ case study, Study SRS of Online Voting system, Library management System (http://dos.iitm.ac.in/OOSD_Material/CaseStudies/CaseStudy2/eVote-srs.pdf),	
***Mapping of Course Outcomes for Unit III**	CO1, CO3, CO7	
Unit IV	**Design Engineering**	**(07 Hours)**
Design Concepts: Design within the Context of Software Engineering, The Design Process, Software Quality Guidelines and Attributes, Design Concepts - Abstraction, Architecture, design Patterns, Separation of Concerns, Modularity, Information Hiding, Functional Independence, Refinement, Aspects, Refactoring, Object-Oriented Design Concept, Design Classes, The Design Model , Data Design Elements, Architectural Design Elements, Interface Design Elements, Component-Level Design Elements, Component Level Design for Web Apps, Content Design at the Component Level, Functional Design at the Component Level, Deployment-Level Design Elements. **Architectural Design:** Software Architecture, What is Architecture, Why is Architecture Important, Architectural Styles, A brief Taxonomy of Architectural Styles. **Suggested Free Open Source Tool:** Smart Draw		
#Exemplar/Case Studies	Study design of Biometric Authentication software	
***Mapping of Course Outcomes for Unit IV**	CO1,CO2 CO3, CO7	
Unit V	**Risks and Configuration Management**	**(07 Hours)**
Risk Management: Software Risks, Risk Identification, Risk Projection, Risk Refinement, Risk Mitigation, Monitoring, and Management, The RMMM Plan. **Software Configuration Management**: Software Configuration Management, The SCM Repository The SCM Process, Configuration Management for any suitable software system. Suggested Free Open Source Tools: CF Engine Configuration Tool, Puppet Configuration Tool.		
#Exemplar/Case Studies	Risk management in Food delivery software	

*Mapping of Course Outcomes for Unit V	CO1,CO2 CO3, CO7

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Unit VI — Software Testing — (07 Hours)

A Strategic Approach to Software Testing, Verification and Validation, Organizing for Software Testing, Software Testing Strategy—The Big Picture, Criteria for Completion of Testing, Strategic Issues, Test Strategies for Conventional Software, Unit Testing, Integration Testing, Test Strategies for Object-Oriented Software, Unit Testing in the OO Context, Integration Testing in the OO Context, Test Strategies forWebApps, Validation Testing, Validation-Test Criteria, Configuration Review.

Suggested Free Open Source Tools: Selenium, JUnit.

#Exemplar/Case Studies	Selemium Testing with any online application
*Mapping of Course Outcomes for Unit VI	CO1,CO2 CO3, CO6

Learning Resources

Text Books:

1. Roger Pressman, "Software Engineering: A Practitioner's Approach"‖, McGraw Hill, ISBN 0–07–337597–7
2. Ian Sommerville, "Software Engineering"‖, Addison and Wesley, ISBN 0-13-703515-2

Reference Books:

1. Carlo Ghezzi, "Fundamentals of Software Engineering", PHI, ISBN-10: 0133056996
2. Rajib Mall, "Fundamentals of Software Engineering"‖, PHI, ISBN-13: 978-8120348981
3. Pankaj Jalote, "An Integrated Approach to Software Engineering"‖, Springer, ISBN 13: 9788173192715.
4. S K Chang, "Handbook of Software Engineering and Knowledge Engineering"‖, World Scientific, Vol I, II, ISBN: 978-981-02-4973-1
5. Tom Halt, "Handbook of Software Engineering", Clanye International ISBN-10: 1632402939

e-books:

- https://ebookpdf.com/roger-s-pressman-software-engineering

MOOC/ Video Lectures available at:

- https://swayam.gov.in/nd1_noc19_cs69/preview
- https://swayam.gov.in/nd2_cec20_cs07/preview

@The CO-PO Mapping Matrix

CO\PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	-	2	-	-	-	-	-	-	-	-	-	-
CO2	1	-	-	-	-	2	2	2	-	-	-	-
CO3	-	-	2	-	-	2	-	-	-	-	-	-
CO4	-	2	2	-	-	-	-	-	-	-	-	
CO5	-	2	2	-	-	-	-	-	-	-	-	-
CO6	-	2	2	-	-	-	-	-	-	-	-	-
CO7	1	-	1	1	-	-	-	-	-	-	-	-

Home

Savitribai Phule Pune University
Second Year of Engineering (2019 Course)
210254: Microprocessor

Teaching Scheme	Credit Scheme	Examination Scheme and Marks
Lecture: 03 Hours/Week	03	**Mid_Semester(TH):** 30 Marks **End_Semester(TH):** 70 Marks

Prerequisite Courses : 210248: Digital Electronics and Logic Design

Companion Course : 210258: Microprocessor Laboratory

Course Objectives:

The course is intended to provide practical exposure to the students on microprocessors, design and coding knowledge on 80386 and introduction to microcontrollers.

- To learn and distinguish the architecture and programmer's model of advanced processor.
- To identify the system level features and processes of advanced processors.
- To acquaint the learner with application instruction set and logic to build assembly language programs.

Course Outcomes:

After successful completion of the course, the learner will be able to-

CO1: Exhibit skill of assembly language programming for the application.
CO2: **Classify** Processor architectures.
CO3: **Illustrate** advanced features of 80386 Microprocessor.
CO4: **Compare** and **contrast** different processor modes.
CO5: **Use** interrupts mechanism in applications
CO6: **Differentiate** between Microprocessors and Microcontrollers.
CO7: **Identify** and **analyze** the tools and techniques used to design, implement, and debug microprocessor-based systems.

Course Contents

Unit I	Introduction to 80386	(07 Hours)

Brief History of Intel Processors, 80386 DX Features and Architecture, Programmers Model, Operating modes, Addressing modes and data types.

Applications Instruction Set: Data Movement Instructions, Binary Arithmetic Instructions, Decimal Arithmetic Instructions, Logical Instructions, Control Transfer Instructions, String and Character Transfer Instructions, Instructions for Block Structured Language, Flag Control Instructions, Coprocessor Interface Instructions, Segment Register Instructions, Miscellaneous Instructions.

#Exemplar/Case Studies	Study-Evolution of Microprocessor
***Mapping of Course Outcomes for Unit I**	CO1,CO2

Unit II	Bus Cycles and System Architecture	(07 Hours)

Initialization- Processor State after Reset. Functional pin Diagram, functionality of various pins, I/O Organization, Memory Organization (Memory banks), Basic memory read and writes cycles with timing diagram.

Systems Architecture- Systems Registers (Systems flags, Memory Management registers, Control registers, Debug registers, Test registers), System Instructions.

#Exemplar/Case Studies	Study-Motherboard of Computer and it's components.
***Mapping of Course Outcomes for Unit II**	CO3

Unit III	Memory Management	(08 Hours)

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Global Descriptor Table, Local Descriptor Table, Interrupt Descriptor Table, GDTR, LDTR, IDTR. Formats of Descriptors and Selector, Segment Translation, Page Translation, Combining Segment and Page Translation.		
#Exemplar/Case Studies	Try creating an animation by using any of /Study of the tools to create and access all the type of possible segments in 80386DX.	
***Mapping of Course Outcomes for Unit III**	CO1,CO2	
Unit IV	**Protection**	**(08 Hours)**
Need of Protection, Overview of 80386DX Protection Mechanisms: Protection rings and levels, Privileged Instructions, Concept of DPL, CPL, RPL, EPL. Inter privilege level transfers using Call gates, Conforming code segment, Privilege levels and stacks. Page Level Protection, Combining Segment and Page Level Protection.		
#Exemplar/Case Studies	Study about- can the security of the system be compromised using CALL gates?	
***Mapping of Course Outcomes for Unit IV**	CO4, , CO6	
Unit V	**Multitasking and Virtual 8086 Mode**	**(08Hours)**
Multitasking- Task State Segment, TSS Descriptor, Task Register, Task Gate Descriptor, Task Switching, Task Linking, Task Address Space. **Virtual Mode** – Features, Memory management in Virtual Mode , Entering and leaving Virtual mode.		
#Exemplar/Case Studies	Study about multitasking implemented by using timing interrupt generated by internal clock of the system. Consider three different tasks: One displaying a string at first row accessing VRAM directly; Second Blinking the string with certain time interval and; Third clearing the screen.	
***Mapping of Course Outcomes for Unit V**	CO4, CO5, CO6	
Unit VI	**Interrupts, Exceptions, and Introduction to Microcontrollers**	**(07 Hours)**
Interrupts and Exceptions: Identifying Interrupts, Enabling and Disabling Interrupts, Priority among Simultaneous Interrupts and Exceptions, Interrupt Descriptor Table (IDT), IDT Descriptors, Interrupt Tasks and Interrupt Procedures, Error Code, and Exception Conditions. **Introduction to Microcontrollers**: Architecture of typical Microcontroller, Difference between Microprocessor and Microcontroller, Characteristics of microcontrollers, Application of Microcontrollers.		
#Exemplar/Case Studies	Try building a Minimum System using 8051 microcontroller (Provide complete architecture and component selection with rationale). Indicate Memory Map explicitly.	
***Mapping of Course Outcomes for Unit VI**	CO4,CO6, CO7	
Learning Resources		

Text Books:

1. Douglas Hall, "Microprocessors & Interfacing", McGraw Hill, Revised 2 Edition, 2006 ISBN 0-07-100462-9
2. A.Ray, K.Bhurchandi, "Advanced Microprocessors and peripherals: Arch, Programming & Interfacing", Tata McGraw Hill,2004 ISBN 0-07-463841-6
3. Intel 80386 Programmer's Reference Manual 1986, Intel Corporation, Order no.: 231630-011, December 1995.
4. Intel 80386 Hardware Reference Manual 1986, Intel Corporation, Order no.: 231732-001, 1986.
5. James Turley- "Advanced 80386 Programming Techniques", McGraw-Hill,
   ISBN: 10:0078813425, 13: 978-0078813429.

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Reference Books:

1. Chris H. Pappas, William H. Murray, "80386 Microprocessor Handbooks", McGraw-Hill Osborne Media, ISBN-10: 0078812429, 13: 978-0078812422.
2. Walter A. Triebel, "The 80386Dx Microprocessor: Hardware", Software, and Interfacing, Pearson Education, ISBN: 0137877307, 9780137877300.
3. Brey, Barry B, "8086/8088, 80286, 80386 and 80486 Assembly Language Programming", Prentice Hall, ISBN: 13: 9780023142475.
4. Mohammad Rafiquzzaman, "Microprocessors: Theory and Applications: Intel and Motorola", Prentice Hall, ISBN:-10:0966498011, 13:978:0966498011.
5. Introduction to 64 bit Intel Assembly Language Programming for Linux, 2nd Edition, Ray Seyfarth, ISBN10: 1478119209, ISBN-13: 9781478119203, 2012.
6. Assembly Language Step-by-step: Programming with Linux, 3rd Edition, Jeff Duntemann, Wiley ISBN:-10 0470497025, ISBN-13: 978-0470497029, 2009.

Intel 80386 Programmer's Reference Manual:

- http://intel80386.com/386htm/toc.htm
- https://css.csail.mit.edu/6.858/2014/readings/i386.pdf

MOOC/ Video Lectures available at:

- https://nptel.ac.in/courses/106/108/106108100/
- https://nptel.ac.in/courses/108/107/108107029/

@The CO-PO Mapping Matrix

CO\PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	2	2	2	-	-	-	-	-	-	-	-
CO2	2	-	1	-	-	-	-	-	-	-	-	-
CO3	2	-	2	-	-	-	-	-	-	-	-	-
CO4	2	-	2	-	-	-	-	-	-	-	-	-
CO5	2	-	2	-	-	-	-	-	-	-	-	-
CO6	2	1	-	-	-	-	-	-	-	-	-	-
CO7	2	1	1	1	-	-	-	-	-	-	-	-

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Savitribai Phule Pune University Second Year of Engineering (2019 Course) 210255: Principles of Programming Languages		
Teaching Scheme	**Credit Scheme**	**Examination Scheme and Marks**
Lecture: 03 Hours/Week	03	**Mid_Semester(TH):** 30 Marks **End_Semester(TH):** 70 Marks

Prerequisite Courses : 110005: Programming and Problem Solving, 210253: Object Oriented Programming

Companion Course : 210257: Data Structures and Algorithms Laboratory

Course Objectives:

- To learn basic principles of programming languages and programming paradigms.
- To learn structuring the data and manipulation of data, computation and program structure.
- To learn Object Oriented Programming (OOP) principles using Java Programming Language.
- To learn basic concepts of logical and functional programming language.

Course Outcomes:

On completion of the course, learner will be able to–

CO1: **Make** use of basic principles of programming languages.
CO2: **Develop** a program with Data representation and Computations.
CO3: **Develop** programs using Object Oriented Programming language : Java.
CO4: **Develop** application using inheritance, encapsulation, and polymorphism.
CO5: **Demonstrate** Multithreading for robust application development.
CO6: **Develop** a simple program using basic concepts of Functional and Logical programming paradigm.

Course Contents

Unit I	**Fundamentals of Programming**	**(06Hours)**
Importance of Studying Programming Languages, History of Programming Languages, Impact of Programming Paradigms, Role of Programming Languages, Programming Environments. Impact of Machine Architectures: The operation of a computer, Virtual Computers and Binding Times. **Programming paradigms-** Introduction to programming paradigms, Introduction to four main Programming paradigms- procedural, object oriented, functional, and logic and rule based.		
#Exemplar/Case Studies	A case study: Retail Sales application	
***Mapping of Course Outcomes for Unit I**	CO1	
Unit II	**Structuring the Data, Computations and Program**	**(07 Hours)**
Elementary Data Types : Primitive data Types, Character String types, User Defined Ordinal Types, Array types, Associative Arrays, Record Types, Union Types, Pointer and reference Type. **Expression and Assignment Statements:** Arithmetic expression, Overloaded Operators, Type conversions, Relational and Boolean Expressions, Short Circuit Evaluation, Assignment Statements, Mixed mode Assignment. **Statement level Control Statements:** Selection Statements, Iterative Statements, Unconditional Branching. **Subprograms:** Fundamentals of Sub Programs, Design Issues for Subprograms, Local referencing Environments, Parameter passing methods. **Abstract Data Types and Encapsulation Construct:** Design issues for Abstraction, Parameterized Abstract Data types, Encapsulation Constructs, Naming Encapsulations.		
#Exemplar/Case Studies	Data representation and computations in Retail Sales	
***Mapping of Course Outcomes for Unit II**	CO2	

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Unit III	Java as Object Oriented Programming Language-Overview	(07 Hours)
Fundamentals of JAVA, Arrays: one dimensional array, multi-dimensional array, alternative array declaration statements, **String Handling:** String class methods, **Classes and Methods**: class fundamentals, declaring objects, assigning object reference variables, adding methods to a class, returning a value, constructors, this keyword, garbage collection, finalize() method, overloading methods, argument passing, object as parameter, returning objects, access control, static, final, nested and inner classes, command line arguments, variable - length arguments.		
#Exemplar/Case Studies	Demonstrate classes , objects, data, methods for Online Banking System using Java.	
*Mapping of Course Outcomes for Unit III	CO3	
Unit IV	**Inheritance, Packages and Exception Handling using Java**	**(07 Hours)**
Inheritances: member access and inheritance, super class references, Using super, multilevel hierarchy, constructor call sequence, method overriding, dynamic method dispatch, abstract classes, Object class. **Packages and Interfaces:** defining a package, finding packages and CLASSPATH, access protection, importing packages, interfaces (defining, implementation, nesting, applying), variables in interfaces, extending interfaces, instance of operator. fundamental, exception types, uncaught exceptions, try, catch, throw, throws, finally, multiple catch clauses, nested try statements, built-in exceptions, custom exceptions (creating your own exception sub classes). **Managing I/O:** Streams, Byte Streams and Character Streams, Predefined Streams, Reading console Input, Writing Console Output, Print Writer class.		
#Exemplar/Case Studies	Demonstrate inheritance, Packages and interface for Online Banking System using Java.	
*Mapping of Course Outcomes for Unit IV	CO4	
Unit V	**Multithreading in Java**	**(07 Hours)**
Concurrency and Synchronization, Java Thread Model: Thread priorities, Synchronization, Messaging, Main Thread, Creating thread: Implementing Thread using thread class and Runnable interface. Creating multiple threads using is Alive() and join(). **Web Based Application in Java:** Use of JavaScript for creating web based applications in Java, Introduction to Java script frameworks- ReactJS, VueJS, AngularJS (open source).		
#Exemplar/Case Studies	Demonstrate Multithreading for Gaming.	
*Mapping of Course Outcomes for Unit V	CO5	
Unit VI	**Logical and Functional Programming**	**(07 Hours)**
Functional Programming Paradigm: Understanding symbol manipulation, Basic LISP functions, definitions, predicates, conditionals and scoping, Recursion and iteration, Properties List array and access functions, Using lambda definitions, printing, reading and atom manipulation. **Logic Programming Paradigm:** An Overview of Prolog, Syntax and Meaning of Prolog Programs, Lists, Operators, Arithmetic, Using Structures.		
#Exemplar/Case Studies	Demonstrate Functional and Logic Programming for Software Project Management.	
*Mapping of Course Outcomes for Unit VI	CO6	

Learning Resources

Text Books:

1. T. W. Pratt, M. V. Zelkowitz, "Programming Languages Design and Implementation‖, 4th Ed, PHI, ISBN 81-203-2035-2.
2. Sebesta R., "Concepts of Programming Languages", 4th Edition, Pearson Education, ISBN-81-7808-161-X.
3. Herbert Schildt, "The Complete Reference Java", 9th Ed, TMH,ISBN: 978-0-07-180856-9.

Reference Books:

1. Deugo, ―Java Gems‖, Cambridge University Press, ISBN 10: 0521648246 ISBN 13: 9780521648240
2. Carl Townsend ,"Programming in turbo PROLOG", Tata-McGraw Hill
3. Ivan Bratko, " Prolog Programming for Artificial Intelligence", Wesley Publishers Limited
4. Winston P., Klaus B., Horn P., "LISP", 3rd Edition, Pearson Education, 81 - 7808 -155-5
5. Carlo Ghezzi, Mehdi Jazayeri, ―Programming Language Concepts‖,3rd Ed, Wiley Publication ISBN : 978-81-265-1861-6.

eBooks:

- https://www.springer.com/gp/book/9781848820319
- https://www.springer.com/gp/book/9781848829138

eBooks:

- https://nptel.ac.in/courses/106/102/106102067/
- https://swayam.gov.in/nd1_noc20_cs08/preview
- https://swayam.gov.in/nd2_aic20_sp13/preview
- https://swayam.gov.in/nd1_noc19_cs84/preview

@The CO-PO Mapping Matrix

CO\PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	2	2	2	-	-	-	-	-	-	-	-
CO2	2	-	1	-	-	-	-	-	-	-	-	-
CO3	2	-	2	-	-	-	-	-	-	-	-	-
CO4	2	-	2	-	-	-	-	-	-	-	-	-
CO5	2	-	2	-	-	-	-	-	-	-	-	-
CO6	2	1	-	-	-	-	-	-	-	-	-	-

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Savitribai Phule Pune University
Second Year of Computer Engineering (2019 Course)
210256: Data Structures and Algorithms Laboratory

Teaching Scheme	Credit Scheme	Examination Scheme and Marks
Practical: 04 Hours/Week	02	Term Work: 25 Marks Practical: 25 Marks

Companion Course : 210252: Data Structures and Algorithms, 210255:Priciples of Programming Languages

Course Objectives:

- To **understand** practical implementation and usage of non linear data structures for solving problems of different domain.
- To strengthen the ability to identify and **apply** the suitable data structure for the given real world problems.
- To **analyze** advanced data structures including hash table, dictionary, trees, graphs, sorting algorithms and file organization.

Course Outcomes:

On completion of the course, learner will be able to–

CO1: Understand the ADT/libraries, hash tables and dictionary to design algorithms for a specific problem.

CO2: Choose most appropriate data structures and **apply** algorithms for graphical solutions of the problems.

CO3: Apply and **analyze** non linear data structures to solve real world complex problems.

CO4: Apply and **analyze** algorithm design techniques for indexing, sorting, multi-way searching, file organization and compression.

CO5: Analyze the efficiency of most appropriate data structure for creating efficient solutions for engineering design situations.

Guidelines for Instructor's Manual

The instructor's manual is to be developed as a hands-on resource and reference. The instructor's manual need to include prologue (about University/program/ institute/ department/foreword/ preface), curriculum of course, conduction and Assessment guidelines, topics under consideration-concept, objectives, outcomes, set of typical applications/assignments/ guidelines, and references.

Guidelines for Student's Laboratory Journal

The laboratory assignments are to be submitted by student in the form of journal. Journal consists of prologue, Certificate, table of contents, and **handwritten write-up** of each assignment (Title, Objectives, Problem Statement, Outcomes, software and Hardware requirements, Date of Completion, Assessment grade/marks and assessor's sign, Theory- Concept in brief, algorithm, flowchart, test cases, Test Data Set(if applicable), mathematical model (if applicable), conclusion/analysis. **Program codes with sample output of all performed assignments are to be submitted as softcopy.**

As a conscious effort and little contribution towards Green IT and environment awareness, attaching printed papers as part of write-ups and program listing to journal may be avoided. Use of DVD containing students programs maintained by Laboratory In-charge is highly encouraged. For reference one or two journals may be maintained with program prints at Laboratory.

Guidelines for Laboratory / Term Work Assessment

Continuous assessment of laboratory work should be done based on overall performance and Laboratory assignments performance of student. Each Laboratory assignment assessment should be assigned grade/marks based on parameters with appropriate weightage. Suggested parameters for overall assessment as well as each Laboratory assignment assessment include- timely completion, performance, innovation, efficient codes, punctuality and neatness.

Guidelines for Laboratory Conduction

The instructor is expected to frame the assignments by understanding the prerequisites, technological aspects, utility and recent trends related to the topic. The assignment framing policy need to address the

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average students and inclusive of an element to attract and promote the intelligent students. The instructor may set multiple sets of assignments and distribute among batches of students. It is appreciated if the assignments are based on real world problems/applications. Encourage students for appropriate use of Hungarian notation, proper indentation and comments. Use of open source software is to be encouraged.

In addition to these, instructor may assign one real life application in the form of a mini-project based on the concepts learned. Instructor may also set one assignment or mini-project that is suitable to respective branch beyond the scope of syllabus.

Set of suggested assignment list is provided in groups- A, B, C, D, E, F and G. Each student must perform at least 12 assignments(at least 02 from group A, 03 from group B, 02 from group C, 2 from group D, 01 from group E, 02 from group F.)

Operating System recommended :- 64-bit Open source Linux or its derivative

Programming tools recommended: - Open Source Python - Group A assignments, C++ Programming tool like G++/GCC

Guidelines for Practical Examination

Both internal and external examiners should jointly set problem statements. During practical assessment, the expert evaluator should give the maximum weightage to the satisfactory implementation of the problem statement. The supplementary and relevant questions may be asked at the time of evaluation to test the student's for advanced learning, understanding of the fundamentals, effective and efficient implementation. Consequently encouraging efforts, transparent evaluation and fair approach of the evaluator will not create any uncertainty or doubt in the minds of the students. Therefore adhering to these principles will consummate our team efforts to the promising start of the student's academics.

Virtual Laboratory:

- http://cse01-iiith.vlabs.ac.in/Courses%20Aligned.html?domain=Computer%20Science

Suggested List of Laboratory Experiments/Assignments

Sr. No	Group A
1	Consider telephone book database of N clients. Make use of a hash table implementation to quickly look up client's telephone number. Make use of two collision handling techniques and compare them using number of comparisons required to find a set of telephone numbers
2	Implement all the functions of a dictionary (ADT) using hashing and handle collisions using chaining with / without replacement. Data: Set of (key, value) pairs, Keys are mapped to values, Keys must be comparable, Keys must be unique. Standard Operations: Insert(key, value), Find(key), Delete(key)
3	For given set of elements create skip list. Find the element in the set that is closest to some given value. (note: Decide the level of element in the list Randomly with some upper limit)
4	To create ADT that implement the "set" concept. a. Add (new Element) -Place a value into the set , b. Remove (element) Remove the value c. Contains (element) Return true if element is in collection, d. Size () Return number of values in collection Iterator () Return an iterator used to loop over collection, e. Intersection of two sets , f. Union of two sets, g. Difference between two sets, h. Subset
	Group B
5	A book consists of chapters, chapters consist of sections and sections consist of subsections. Construct a tree and print the nodes. Find the time and space requirements of your method.
6	Beginning with an empty binary search tree, Construct binary search tree by inserting the values in the order given. After constructing a binary tree - i. Insert new node, ii. Find number of nodes in longest path from root, iii. Minimum data value found in the tree, iv. Change a tree so that the roles of the left and right pointers are swapped at every node, v. Search a value

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7	Construct an expression tree from the given prefix expression eg. +--a*bc/def and traverse it using post order traversal (non recursive) and then delete the entire tree.
8	Read for the formulas in propositional calculus. Write a function that reads such a formula and creates its binary tree representation. What is the complexity of your function?
9	Convert given binary tree into threaded binary tree. Analyze time and space complexity of the algorithm.
10	Consider threading a binary tree using preorder threads rather than inorder threads. Design an algorithm for traversal without using stack and analyze its complexity. _
11	A Dictionary stores keywords and its meanings. Provide facility for adding new keywords, deleting keywords, updating values of any entry. Provide facility to display whole data sorted in ascending/ Descending order. Also find how many maximum comparisons may require for finding any keyword. Use Binary Search Tree for implementation.
12	Implement a file compression algorithm that uses binary tree. Your program should allow the user to compress and decompress messages containing alphabets using the standard Huffman algorithm for encoding and decoding.
	Group C
13	Represent a given graph using adjacency matrix/list to perform DFS and using adjacency list to perform BFS. Use the map of the area around the college as the graph. Identify the prominent land marks as nodes and perform DFS and BFS on that.
14	There are flight paths between cities. If there is a flight between city A and city B then there is an edge between the cities. The cost of the edge can be the time that flight take to reach city B from A, or the amount of fuel used for the journey. Represent this as a graph. The node can be represented by airport name or name of the city. Use adjacency list representation of the graph or use adjacency matrix representation of the graph. Check whether the graph is connected or not. Justify the storage representation used.
15	You have a business with several offices; you want to lease phone lines to connect them up with each other; and the phone company charges different amounts of money to connect different pairs of cities. You want a set of lines that connects all your offices with a minimum total cost. Solve the problem by suggesting appropriate data structures.
16	Tour operator organizes guided bus trips across the Maharashtra. Tourists may have different preferences. Tour operator offers a choice from many different routes. Every day the bus moves from starting city S to another city F as chosen by client. On this way, the tourists can see the sights alongside the route travelled from S to F. Client may have preference to choose route. There is a restriction on the routes that the tourists may choose from, the bus has to take a short route from S to F or a route having one distance unit longer than the minimal distance. Two routes from S to F are considered different if there is at least one road from a city A to a city B which is part of one route, but not of the other route.
17	Consider the scheduling problem. n tasks to be scheduled on single processor. Let t1, ...,tn be durations required to execute on single processor is known. The tasks can be executed in any order but one task at a time. Design a greedy algorithm for this problem and find a schedule that minimizes the total time spent by all the tasks in the system. (The time spent by one is the sum of the waiting time of task and the time spent on its execution.)
	Group D
18	Given sequence k = k1 <k2 < … <kn of n sorted keys, with a search probability pi for each key ki . Build the Binary search tree that has the least search cost given the access probability for each key?

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19	A Dictionary stores keywords and its meanings. Provide facility for adding new keywords, deleting keywords, updating values of any entry. Provide facility to display whole data sorted in ascending/ Descending order. Also find how many maximum comparisons may require for finding any keyword. Use Height balance tree and find the complexity for finding a keyword
	Group E
20	Consider a scenario for Hospital to cater services to different kinds of patients as Serious (top priority), b) non-serious (medium priority), c) General Checkup (Least priority). Implement the priority queue to cater services to the patients.
21	Implement the Heap/Shell sort algorithm implemented in Java demonstrating heap/shell data structure with modularity of programming language
22	Read the marks obtained by students of second year in an online examination of particular subject. Find out maximum and minimum marks obtained in that subject. Use heap data structure. Analyze the algorithm.
	Group F
23	Department maintains a student information. The file contains roll number, name, division and address. Allow user to add, delete information of student. Display information of particular employee. If record of student does not exist an appropriate message is displayed. If it is, then the system displays the student details. Use sequential file to main the data.
24	Company maintains employee information as employee ID, name, designation and salary. Allow user to add, delete information of employee. Display information of particular employee. If employee does not exist an appropriate message is displayed. If it is, then the system displays the employee details. Use index sequential file to maintain the data.
25	Implementation of a direct access file -Insertion and deletion of a record from a direct access file
26	Assume we have two input and two output tapes to perform the sorting. The internal memory can hold and sort m records at a time. Write a program in java for external sorting. Find out time complexity.
	Mini-Projects/ Case Study
27	Design a mini project using JAVA which will use the different data structure with or without Java collection library and show the use of specific data structure on the efficiency (performance) of the code.
28	Design a mini project to implement Snake and Ladders Game using Python.
29	Design a mini project to implement a Smart text editor.
30	Design a mini project for automated Term work assessment of student based on parameters like daily attendance, Unit Test / Prelim performance, Students achievements if any, Mock Practical.

@The CO-PO Mapping Matrix

PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	2	2	-	-	-	-	-	-	-	-	-
CO2	-	2	2	-	-	-	-	-	-	-	-	-
CO3	-	2	2	1	-	-	-	-	-	-	-	-
CO4	1	2	1	1	-	-	-	-	-	-	-	-
CO5	1	1	2	2	-	-	-	-	-	-	-	-

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Savitribai Phule Pune University
Second Year of Computer Engineering (2019 Course)
210257: Microprocessor Laboratory

Teaching Scheme	Credit Scheme	Examination Scheme and Marks
Practical: 02 Hours/Week	01	Term Work: 25 Marks Practical: 25 Marks

Companion Course : 210254: Microprocessor

Course Objectives:

- To understand assembly language programming instruction set
- To understand different assembler directives with example
- To apply instruction set for implementing X86/64 bit assembly language programs

Course Outcomes:

On completion of the course, learner will be able to–

CO1. **Understand** and **apply** various addressing modes and instruction set to implement assembly language programs

CO2. **Apply** logic to **implement** code conversion

CO3. **Analyze** and **apply** logic to **demonstrate** processor mode of operation

Guidelines for Laboratory /Term Work Assessment

Continuous assessment of laboratory work is based on overall performance and Laboratory assignments performance of student. Each Laboratory assignment assessment will assign grade/marks based on parameters with appropriate weightage. Suggested parameters for overall assessment as well as each Laboratory assignment assessment include- timely completion, performance, innovation, efficient codes, punctuality and neatness.

Guidelines for Laboratory Conduction

The instructor is expected to frame the assignments by understanding the prerequisites, technological aspects, utility and recent trends related to the topic. The assignment framing policy need to address the average students and inclusive of an element to attract and promote the intelligent students. The instructor may set multiple sets of assignments and distribute among batches of students. It is appreciated if the assignments are based on real world problems/applications. Use of open source software is encouraged.

In addition to these, instructor may assign one real life application in the form of a mini-project based on the concepts learned. Instructor may also set one assignment or mini-project that is suitable to respective branch beyond the scope of syllabus.

Operating System: 64-bit Open source Linux or its derivative.

Programming Tools: Preferably using Linux equivalent or MASM/TASM/NASM/FASM.

Guidelines for Practical Examination

Both internal and external examiners should jointly set problem statements. During practical assessment, the expert evaluator should give the maximum weightage to the satisfactory implementation of the problem statement. The supplementary and relevant questions may be asked at the time of evaluation to test the student's for advanced learning, understanding of the fundamentals, effective and efficient implementation. So encouraging efforts, transparent evaluation and fair approach of the evaluator will not create any uncertainty or doubt in the minds of the students. So adhering to these principles will consummate our team efforts to the promising start of the student's academics.

Virtual Laboratory:

- http://209.211.220.205/vlabiitece/mi/MI3.php

Suggested List of Laboratory Experiments/Assignments(any 10)

Sr. No.	Assignments

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1	Write an X86/64 ALP to accept five 64 bit Hexadecimal numbers from user and store them in an array and display the accepted numbers.
2	Write an X86/64 ALP to accept a string and to display its length.
3	Write an X86/64 ALP to find the largest of given Byte/Word/Dword/64-bit numbers.
4	Write a switch case driven X86/64 ALP to perform 64-bit hexadecimal arithmetic operations (+,-,*, /) using suitable macros. Define procedure for each operation.
5	Write an X86/64 ALP to count number of positive and negative numbers from the array.
6	Write X86/64 ALP to convert 4-digit Hex number into its equivalent BCD number and 5-digit BCD number into its equivalent HEX number. Make your program user friendly to accept the choice from user for: (a) HEX to BCD b) BCD to HEX (c) EXIT. Display proper strings to prompt the user while accepting the input and displaying the result. (Wherever necessary, use 64-bit registers).
7	Write X86/64 ALP to detect protected mode and display the values of GDTR, LDTR, IDTR, TR and MSW Registers also identify CPU type using CPUID instruction.
8	Write X86/64 ALP to perform non-overlapped block transfer without string specific instructions. Block containing data can be defined in the data segment.
9	Write X86/64 ALP to perform overlapped block transfer with string specific instructions Block containing data can be defined in the data segment.
10	Write X86/64 ALP to perform multiplication of two 8-bit hexadecimal numbers. Use successive addition and add and shift method. (use of 64-bit registers is expected).
11	Write X86 Assembly Language Program (ALP) to implement following OS commands i) COPY, ii) TYPE Using file operations. User is supposed to provide command line arguments
12	Write X86 ALP to find, a) Number of Blank spaces b) Number of lines c) Occurrence of a particular character. Accept the data from the text file. The text file has to be accessed during Program_1 execution and write FAR PROCEDURES in Program_2 for the rest of the processing. Use of PUBLIC and EXTERN directives is mandatory.
13	Write x86 ALP to find the factorial of a given integer number on a command line by using recursion. Explicit stack manipulation is expected in the code.
14	Write an X86/64 ALP password program that operates as follows: a. Do not display what is actually typed instead display asterisk ("*"). If the password is correct display, "access is granted" else display "Access not Granted"
15	Study Assignment: Motherboards are complex. Break them down, component by component, and Understand how they work. Choosing a motherboard is a hugely important part of building a PC. Study- Block diagram, Processor Socket, Expansion Slots, SATA, RAM, Form Factor, BIOS, Internal Connectors, External Ports, Peripherals and Data Transfer, Display, Audio, Networking, Overclocking, and Cooling. 4. https://www.intel.in/content/www/in/en/support/articles/000006014/boards-and-kits/desktop-boards.html

@The CO-PO Mapping Matrix

CO\PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	-	1	2	1	-	-	-	-	-	-	-	-
CO2	2	1	-	1	-	-	-	-	-	-	-	-
CO3	-	1	-	1	-	-	-	-	-	-	-	-

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Savitribai Phule Pune University
Second Year of Computer Engineering (2019 Course)
210258: Project Based Learning II

Teaching Scheme	Credit Scheme	Examination Scheme and Marks
Practical: 04 Hours/Week	02	Term Work: 50 Marks

Course Objectives:

- To develop critical thinking and problem solving ability by exploring and proposing solutions to realistic/social problem.
- To Evaluate alternative approaches, and justify the use of selected tools and methods.
- To emphasizes learning activities that are long-term, inter-disciplinary and student-centric.
- To engages students in rich and authentic learning experiences.
- To provide every student the opportunity to get involved either individually or as a group so as to develop team skills and learn professionalism.
- To develop an ecosystem that promotes entrepreneurship and research culture among the students.

Course Outcomes:

CO1: Identify the real life problem from societal need point of view
CO2: Choose and compare alternative approaches to select most feasible one
CO3: Analyze and synthesize the identified problem from technological perspective
CO4: Design the reliable and scalable solution to meet challenges
CO5: Evaluate the solution based on the criteria specified
CO6: Inculcate long life learning attitude towards the societal problems

Course Contents

Preamble:

Project-based learning is an instructional approach designed to give students the opportunity to develop knowledge and skills through engaging projects set around challenges and problems they may face in the real world. PBL, is more than just projects. With PBL students "investigate and respond to an authentic, engaging, and complex problem, or challenge" with deep and sustained attention. PBL is "learning by doing." The truth is, many in education are recognizing we live in a modern world sustained and advanced through the successful completion of projects. In short, If students are prepared for success in life, we need to prepare them for a project-based world. It is a style of active learning and inquiry-based learning. (Reference: Wikipedia). Project based learning will also redefine the role of teacher as mentor in learning process. Along with communicating knowledge to students, often in a lecture setting, the teacher will also to act as an initiator and facilitator in the collaborative process of knowledge transfer and development. The PBL model focuses the student on a big open-ended question, challenge, or problem to research and respond to and/or solve. It Brings what students should academically know, understand, and be able to do and requires students to present their problems, research process, methods, and results.[1]

Project based learning (PBL) requires regular mentoring by faculty throughout the semester for successful completion of the idea/project tasks selected by the students per batch. For the faculty involved in PBL , teaching workload of 4 Hrs/week/batch needs to be considered. The Batch should be divided into sub-groups of 4 to 5 students. Idea implementation /Real life problem/Complex assignments / activities / projects. under project based learning is to be carried throughout semester and Credit for PBL has to be awarded on the basis of internal continuous assessment and evaluation at the end of semester

Group Structure:

Working in supervisor/mentor monitored groups; the students plan, manage, and complete a task/project/activity which addresses the stated problem.

1. There should be team/group of 4-5 students
2. A supervisor/mentor teacher assigned to individual groups

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Selection of Project/Problem:

The problem-based project oriented model for learning is recommended. The model begins with the identifying of a problem, often growing out of a question or "wondering". This formulated problem then stands as the starting point for learning. Students design and analyze the problem/project within an articulated interdisciplinary or subject frame.

A problem can be theoretical, practical, social, technical, symbolic, cultural, and/or scientific and grows out of students' wondering within different disciplines and professional environments. A chosen problem has to be exemplary. The problem may involve an interdisciplinary approach in both the analysis and solving phases.

By exemplarity, a problem needs to refer back to a particular practical, scientific, social and/or technical domain. The problem should stand as one specific example or manifestation of more general learning outcomes related to knowledge and/or modes of inquiry.

There are no commonly shared criteria for what constitutes an acceptable project. Projects vary greatly in the depth of the questions explored, the clarity of the learning goals, the content, and structure of the activity.

A few hands-on activities that may or may not be multidisciplinary.

Use of technology in meaningful ways to help them investigate, collaborate, analyse, synthesize, and present their learning.

Activities may include- Solving real life problem, investigation, /study and Writing reports of in depth study, field work.

Assessment:

The institution/head/mentor is committed to assessing and evaluating both student performance and program effectiveness.

Progress of PBL is monitored regularly on weekly basis. Weekly review of the work is necessary. During process of monitoring and continuous assessment and evaluation of the individual and the team performance is to be measured. PBL is monitored and continuous assessment is done by supervisor /mentor and authorities.

Students must maintain an institutional culture of authentic collaboration, self-motivation, peer-learning and personal responsibility. The institution/department should support students in this regard through guidance/orientation programs and the provision of appropriate resources and services. Supervisor/mentor and Students must actively participate in assessment and evaluation processes.

Group may demonstrate their knowledge and skills by developing a public product and/or report and/or presentation.

1. Individual assessment for each student (Understanding individual capacity, role and involvement in the project)
2. Group assessment (roles defined, distribution of work, intra-team communication and togetherness)
3. Documentation and presentation

Evaluation and Continuous Assessment:

It is recommended that all activities should to be recorded regularly, regular assessment of work need to be done and proper documents need to be maintained at college end by both students as well as mentor (PBL work book).

Continuous Assessment Sheet (CAS) is to be maintained by all mentors/department and institutes.

Recommended parameters for assessment/evaluation and weightage:

1. Idea Inception and Awareness /Consideration of -Environment/ Social /Ethics/ Safety measures/Legal aspects (10%)
2. Outcomes of PBL/ Problem Solving Skills/ Solution provided/ Final product (Individual assessment and team assessment) (40%)
3. Documentation (Gathering requirements, design and modelling, implementation/execution, use of technology and final report, other documents) (15%)
4. Demonstration (Presentation, User Interface, Usability) (20%)

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5. Contest Participation/ publication (15%)

PBL workbook will serve the purpose and facilitate the job of students, mentor and project coordinator. It will reflect accountability, punctuality, technical writing ability and work flow of the work undertaken.

Note :

- While planning for the assessment, choose a valid method based on your context. It should be able to understand by both the students as well as the faculty.
- The student group must follow the principles of Software Engineering (Scoping out the problem, the solution implementation and related documentation).
- Researching the problem and outlining various approaches is key here and should be emphasized by the tutor and the mentor.
- Aspects of design thinking (from the point of view of the person facing the problem) are very important. Students should not jump into the technology aspects first.
- The team can follow the principles of Agile Software Development. The weekly meetings could be used as a Scrum meeting.
- The tutor and mentor should actively help the students to scope the work and the approach. They must validate the technology choices.
- If the implementation code is well documented, the project can be continued by subsequent batch – which will help solve a bigger problem.

Text Books:

1. A new model of problem based learning. By Terry Barrett. All Ireland Society for higher education (AISHE). ISBN:978-0-9935254-6-9; 2017
2. Problem Based Learning. By Mahnazmoallem, woei hung and Nada Dabbagh, Wiley Publishers. 2019.
3. Stem Project based learning and integrated science, Technology, Engineering and mathematics approach. By Robert Capraro, Mary Margaret Capraro

Reference Books:

1. De Graaff E, Kolmos A., red.: Management of change: Implementation of problem-based and project-based learning in engineering. Rotterdam: Sense Publishers. 2007.
2. Gopalan," Project management core text book", 2 Indian Edition
3. James Shore and Shane Warden, " The Art of Agile Development"

Tutors Role in Project Based Learning

- The fundamentals of problem based learning, lies with the Tutors role.
- Tutors are not the source of solutions rather they act as the facilitator and mentor.
- The facilitator skills of the Tutors / Teacher are central to the success of PBL.

Change of Mindset

- Students are not used to the constructivist approach to learning, it is important that they are carefully told what to expect in PBL.
- Tutors need to explain the differences between PBL and traditional learning.
- Tutors need to explain the principals involved and role of the students in PBL learning.

Designing Problem

- Considering the prior knowledge of the students, their ability and creativity, problem statement should be designed.
- For 2nd year PBL students the tutor should place more emphasis on getting the students to perform higher-level tasks.
- It is important for tutors to design problems that are anchored in authentic contexts only
- Students should take ownership of the problem.
- Problems should not be over simplified or well defiled
- Learning should not be the sequencing of instructional events, but the application of principles for responding to the needs of the situation.
- The problems given to students in PBL should be realistic, complex, and should reflect, as

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much as possible, the actual problems that students would encounter in real life.

Basic function of the tutor

- A good understanding of the overall curriculum the students have to study, the principles of problems solving, critical thinking and meta-cognitive skills.

Grouping

- Study the background and profile of each student.
- Make sure that students of different backgrounds and experience are assigned in a group
- It is useful to group students of different abilities, gender, and nationalities together.
- Tutors must have the commitment to devote the time to the tutorial process.
- A good tutor is always interested in helping students to learn better.
- Sufficient resources should be made available for students to take part the PBL tutorial.
- Time management is important.

Assessment of Learning

- It is important for tutors to make sure that assessment is consistent with learning objectives of the groups in PBL
- Assessment of students should not be focused only on the final leaning product.
- PBL tutors need to understand meaningful ways of assessing students' work to motivate learning.
- For assessment to be implemented properly there should be well designed and clearly defined goals and objectives and well thought out strategies, techniques, criteria, and marking schemes.

Student's Role in PBL

- Prepare students for PBL before starting the sessions.
- Students must have ability to initiate the task/idea .they should not be mere imitators.
- They must learn to think.
- Students working in PBL must be responsible for their own learning.
- Throughout the PBL process, students have to define and analyze the problem, generate learning issues and apply what they have learned to solve the problem and act for themselves and be free.
- Students must quickly learn how to manage their own learning, Instead of passively receiving instruction.
- Students in PBL are actively constructing their knowledge and understanding of the situation in groups.
- Students in PBL are expected to work in groups.
- They have to develop interpersonal and group process skills, such as effective listening or coping creatively with conflicts.

Inquiry Skills

- Students in PBL are expected to develop critical thinking abilities by constantly relating:
- What they read to do?
- What they want to do with that information?
- They need to analyze information presented within the context of finding answers.
- Modeling is required so that the students can observe and build a conceptual model of the required processes.
- Formative and summative questions for evaluation:
- How effective is …….?
- How strong is the evidence for ………?
- How clear is ……?
- What are the justifications for thinking?
- Why is the method chosen?
- What is the evidence given to justify the solution?

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Information Literacy

- Information literacy is an integral part of self- directed learning

Information literacy involves the ability to:

- Know when there is a need for information
- Identify the information needed to solve a given problem or issue
- Be able to locate the needed information
- Use the information to solve the given problem effectively.
- Skills required by students in information literacy include:
- How to prepare the search , How to carry out the research,
- Sorting and assessing of information in general

Collaborative learning

- It is an educational approach to teaching and learning that involves
- groups of students working together to solve a problem or complete a project
- In collaborative learning, learners have the opportunity to talk with peers, exchange diverse beliefs present and defend ideas, as well as questioning other ideas.

Interpersonal Skills

- Interpersonal skills relating to group process are essential for effective problem solving and learning.
- It is important that students are made aware of these inter personal skills.
- Consensual decision making skills, Dialogue and discussion skills, Team maintenance skills
- Conflict management skills and Team leadership skills.
  Students who have these skills have a better opportunity to learn than students who do not have these skills and Time Management

Resources

- Students need to have the ability to evaluate the resources used

Students have to evaluate the source of the resources used by asking the following questions:

- How current is it?, Is there any reason to suspect bias in the source?
- How credible and accurate is it?

Meta-cognitive Skills

- Students need to reflect on the processes they are using during the learning process,
- Compare one strategy with another, and evaluate the effectiveness of the strategy used

Reflection Skills

- Reflection helps students refine and strengthen their high-level thinking skills and abilities through self-assessment.
- Reflection gives students opportunities to think about how they answered a question, made a decision, or solved a problem.
- What strategies were successful or unsuccessful? ,What issues need to be remembered for next time? , What could or should be done differently in the future?

@The CO-PO Mapping Matrix

CO\PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	-	-	-	-	-	-	-	-	-	-	-
CO2	-	2	-	-	-	-	-	-	-	-	-	-
CO3	-	-	-	3	-	-	-	-	-	-	-	-
CO4	-	-	-	-	2	-	-	-	-	-	-	-
CO5	-	-	-	-	-	3	-	-	-	-	-	-
CO6	-	-	-	-	-	-	-	-	-	-	-	2

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Savitribai Phule Pune University Second Year of Computer Engineering (2019 Course) 210259: Code of Conduct		
Teaching Scheme	**Credit Scheme**	**Examination Scheme and Marks**
Tutorial: 01 Hours/Week	01[$]	**Term work[$]:** 25 Marks

Preamble:

Engineering is one of the important and cultured professions. With respect to any engineering profession, engineers are expected to exhibit the reasonable standards of integrity and honesty. Engineering is directly or indirectly responsible to create a vital impact on the quality of life for the society. Acceptably, the services provided by engineers require impartiality, honesty, equity and fairness and must give paramount importance to the protection of the public health, safety, and welfare. Engineers must perform under a standard of professional behavior that requires adherence to the principles of ethical conduct.

Prime aim is to recognize and evaluate ethical challenges that they will face in their professional careers through knowledge and exercises that deeply challenge their decision making processes and ethics.

Course Objectives:

- To promote ethics, honesty and professionalism.
- To set standards that are expected to follow and to be aware that If one acts unethically what are the consequences.
- To provide basic knowledge about engineering Ethics, Variety of moral issues and Moral dilemmas, Professional Ideals and Virtues
- To provide basic familiarity about Engineers as responsible Experimenters, Research Ethics, Codes of Ethics, Industrial Standards, Exposure to Safety and Risk, Risk Benefit Analysis
- To have an idea about the Collegiality and Loyalty, Collective Bargaining, Confidentiality, Occupational Crime, Professional, Employee, Intellectual Property Rights.

Course Outcomes:

On completion of the course, learner will be able to–

CO1: Understand the basic perception of profession, professional ethics, various moral and social issues, industrial standards, code of ethics and role of professional ethics in engineering field.

CO2: Aware of professional rights and responsibilities of an engineer, responsibilities of an engineer for safety and risk benefit analysis.

CO3: Understand the impact of the professional Engineering solutions in societal and Environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

CO4: Acquire knowledge about various roles of engineers in variety of global issues and able to apply ethical principles to resolve situations that arise in their professional lives.

Course Contents

The following are the certain guidelines as far as ethics and code of conduct are concerned to be clearly and elaborately explained to the students,

Fundamental norms Engineers, in the fulfillment of their professional duties, should include paying utmost attention to the safety, health, and welfare of the society. Along with that engineers should execute the services only in their areas of competence. Whenever there is a need to issue public statements then such statements should be expressed in objective and truthful manner. Engineer should extend high sense of integrity by acting for each employer or client as faithful agents or trustees. Whatever may be the working scope engineer should conduct themselves honorably, responsibly, ethically, and lawfully so as to enhance the honor, reputation, and usefulness of the profession.

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As far as ethical practices are concerned engineers should not reveal facts, data, or information without the prior consent of the client or employer except as authorized or required by law or Code. Engineers should not permit the use of their name or associate in business ventures with any person or firm that they believe is engaged in fraudulent or dishonest enterprise moreover he/she should not aid or abet the unlawful practice of engineering by a person or firm.

Engineers having knowledge of any alleged violation of the Code should report thereon to appropriate professional bodies and, when relevant, also to public authorities, and cooperate with the proper authorities in furnishing such information or assistance as may be required. Engineers should disclose all known or potential conflicts of interest that could influence or appear to influence their judgment or the quality of their services. Engineers should not accept compensation, financial or otherwise, from more than one party for services on the same project, or for services pertaining to the same project, unless the circumstances are fully disclosed and agreed to by all interested parties. Engineers should not solicit or accept financial or other valuable consideration, directly or indirectly, from outside agents in connection with the work for which they are responsible.

Engineers should never falsify their qualifications or permit misrepresentation of their or their associates' qualifications. They shall not misrepresent or exaggerate their responsibility in or for the subject matter of prior assignments. Brochures or other presentations incident to the solicitation of employment shall not misrepresent pertinent facts concerning employers, employees, associates, joint ventures, or past accomplishments.

Engineers should not offer, give, solicit, or receive, either directly or indirectly, any contribution to influence the award of a contract by public authority, or which may be reasonably construed by the public as having the effect or intent of influencing the awarding of a contract. They should not offer any gift or other valuable consideration in order to secure work. They should not pay a commission, percentage, or brokerage fee in order to secure work, except to a bona fide employee or bona fide established commercial or marketing agencies retained by them.

There are certain obligations accompanied with engineering profession. Engineers should acknowledge their errors and should not distort or alter the facts. Candid advises in special cases are always welcome. Engineers should not accept outside employment to the detriment of their regular work or interest. Before accepting any outside engineering employment, they will notify their employers.

Engineers should not promote their own interest at the expense of the dignity and integrity of the profession furthermore they should treat all persons with dignity, respect, fairness, and without discrimination. Engineers should at all times strive to serve the public interest. Engineers are encouraged to participate in civic affairs; career guidance for youths; and work for the advancement of the safety, health, and well-being of their community. Engineers are encouraged to adhere to the principles of sustainable development in order to protect the environment for future generations. Engineers shall continue their professional development throughout their careers and should keep current in their specialty fields by engaging in professional practice, participating in continuing education courses, reading in the technical literature, and attending professional meetings and seminar.

Engineers should not, without consent, use equipment, supplies, laboratory, or office facilities of an employer to carry on outside private practice. They should not attempt to injure, maliciously or falsely, directly or indirectly, the professional reputation, prospects, practice, or employment of other engineers. Engineers who believe others are guilty of unethical or illegal practice shall present such information to the proper authority for action. "Sustainable development" is the challenge for the engineers meeting human needs for natural resources, industrial products, energy, food, transportation, shelter, and effective waste management while conserving and protecting environmental quality and the natural resource base essential for future development.

Following are contents to be covered in tutorial session-

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1. **Introduction to Ethical Reasoning and Engineer Ethics:** Senses of 'Engineering Ethics' – Variety of moral issues – Types of inquiry – Moral dilemmas –Moral Autonomy – Kohlberg's theory – Gilligan's theory – Consensus and Controversy –Professions and Professionalism – Professional Ideals and Virtues – Uses of Ethical Theories.
2. **Professional Practice in Engineering :** Global Issues -Multinational Corporations – Business Ethics - Environmental Ethics – Computer Ethics - Role in Technological Development – Weapons Development – Engineers as Managers – Consulting Engineers – Engineers as Expert Witnesses and Advisors – Honesty – Moral Leadership – Sample Code of Conduct
3. **Ethics as Design** - Doing Justice to Moral Problems : Engineer's Responsibility for Safety - Safety and Risk – Assessment of Safety and Risk – Risk Benefit Analysis – Reducing Risk – The Government Regulator's Approach to Risk
4. **Workplace Responsibilities and Rights** - Collegiality and Loyalty – Respect for Authority – Collective Bargaining – Confidentiality – Conflicts of Interest – Occupational Crime – Professional Rights – Employee Rights – Intellectual Property Rights (IPR) – Discrimination
5. **Computers, Software, and Digital Information**
6. **Responsibility for the Environment**

#Exemplar/Case Studies :

General Motors ignition switch recalls (2014), Space Shuttle Columbia disaster (2003), Space Shuttle Challenger disaster (1986), Therac-25 accidents (1985 to 1987), Chernobyl disaster (1986), Bhopal disaster (1984), Kansas City Hyatt Regency walkway collapse (1981)

Guidelines for Conduction:

The course will exemplify the budding engineers the Code of Conduct and ethics pertaining to their area and scope of their work. The Instructor/Teacher shall explain the students the importance and impact of the ethics and code of conduct.

Confined to various courses and project/mini-project development the possible vulnerabilities and threats need to be elaborated and the students' participation need to be encouraged in designing such document explicitly mentioning Code of Conduct and Disclaimers.

Suggested set of Activities

1. **Purpose**-Introduce the concept of Professional Code of Conduct
   Method – Using Group Discussion as a platform, ask students to share one practice in their family / home that everyone has to follow. For ex. not wearing footwear in the house, taking a bath first thing in the morning, seeking blessings from elders, etc. Connect this Code of Conduct in their family to one that exists in the professional world
   Outcome – Awareness of profession-specific code of conduct and importance of adherence of that code specified. Ability to express opinions verbally and be empathetic to diverse backgrounds and values
2. **Purpose**-Impress upon the students, the significance of morality
   Method – Role play a professional situation where an engineer is not competent and is trying to copy the work of a colleague and claim credit for that work. Ask observing students to react to that situation. Alternatively, a short video that clearly shows unethical behavior can be played and ask viewers their opinion about the situation. Note to teachers – read about Kohlber's theory and Gilligan's theory to understand levels of moral behavior
   Outcome – Incite students to contemplate their own immoral behavior in public space or academic environment (like copying homework or assignment). Will coax students to introspect their own values and encourage them to choose the right path
3. **Purpose**-Highlight the importance of professional ideals like conflict management, ambition, ethical manners and accountability
   Method – Each student will have to write a 200 word essay on any of above mentioned virtues of being a good professional. On evaluation, the top 5 essays can be displayed on the college wall magazine and rewarded if deemed appropriate
   Outcome – Learn to express one's ideas and identify and relate to good virtues. Build writing skills, improve language and gain knowledge about how to write an impactful essay

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4. **Purpose**-Make students aware of proper and globally accepted ethical way to handle work, colleagues and clients
   Method – Teacher can form groups of 6 – 7 students and assign them different cases (these can be accessed online from copyright free websites of B-school content)
   Outcome – Develop group communication skills. Learn to speak up one's opinion in a forum. Cultivate the habit of presenting solution-driven analytical arguments making them contributors in any team.
5. **Purpose** – Make students aware that technology can be harmful if not used wisely and ethically
   Method – Conduct a quiz on various ethical dilemmas that are relevant in today's world pertaining to privacy right, stalking, plagiarism, hacking, weaponizing technology, AI, electronic garbage creating environmental hazard etc
   Outcome – Make students aware of various adverse consequences of technology development and allow them to introspect on how to use technology responsibly.
6. **Purpose** – Expose students to professional situations where engineers must use their skills ethically and for the betterment of society and nation
   Method – Students in groups of 4 can be given an assignment in the earlier session to present in front of the class one specific case where they felt unethical treatment has been meted out to a person by an engineer – either as a witness, advisor, dishonesty, improper skills testimony etc. The group has to make a short presentation and also suggested plausible solutions to that situation. Q&A from other students must encouraged to allow healthy discussion
   Outcome – Become aware of unethical code of conduct in the professional world and how to follow a moral compass especially when one reaches positions of power.
7. **Purpose** – Provide an insight into rights and ethical behavior.
   Method – Movies like The Social Network can be played and students can be asked to discuss their opinion about collegiality, intellectual property, friendship and professional relationships
   Outcome – help them look at success stories from an ethical point of view. Develop critical thinking and evaluation of circumstances.
8. **Purpose** – Make students contemplate about ideal and safe professional environment and decide on making right decisions based on codes of conduct
   Method – Students can be asked to write down 5 most important codes of conduct that they feel that every computer engineer should follow. After evaluation by teacher / experts, the collection of codes can be converted into a handbook to be given to every student as a memoir to help them in their professional life.
   Outcome – Introspection and think about how to shape the professional environment. Also, when they carry back with them their own codes of conduct, they could feel bound to adhere to these ethics.

Term Work Assessment Guidelines

Students must submit the report of all conducted activities. The brief guidelines for report preparations are as follows:

1. One activity report must be of maximum 3 pages;
2. Combined Report of all activities with cover pages, table of contents and certificate (signed by instructor) is to be submitted in soft copy (pdf) format only.
3. The report must contain:
   - General information about the activity;
   - Define the purpose of the activity;
   - Detail out the activities carried out during the visit in chronological order;
   - Summarize the operations / process (methods) during the activities;
   - Describe what you learned (outcomes) during the activities as a student;
   - Add photos of the activity;(optional)
   - Add a title page to the beginning of your report;
   - Write in clear and objective language; and
   - Get well presented, timely and complete report submitted.

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Recommended Assessment and Weightage Parameters:
(Attendance 30%, Assignments/Activities- Active participation and proactive learning 50% and report 20%)

Term Work Assessment Guidelines

Students must submit the report of all conducted activities conducted during Tutorial (Outside Classroom) of at least 04 activities (out of 07 activities) from group (of 02-03) students.
The brief guidelines for report preparations are as follows:
1. One activity report must be of maximum 3 pages;
2. Combined Report of all activities with cover pages, table of contents and certificate (signed by instructor) is to be submitted in soft copy (pdf) format only.
3. The report must contain:
   - General information about the activity;
   - Define the purpose of the activity;
   - Detail out the activities carried out during the visit in chronological order;
   - Summarize the operations / process (methods) during the activities;
   - Describe what you learned (outcomes) during the activities as a student;
   - Add photos of the activity;(optional)
   - Add a title page to the beginning of your report;
   - Write in clear and objective language; and
   - Get well presented, timely and complete report submitted.

Recommended Assessment and Weightage Parameters:
(Attendance 30%, Active participation and proactive learning 50% and report 20%)

Web Links:
- https://www.ieee.org/about/compliance.html
- https://www.cs.cmu.edu/~bmclaren/ethics/caseframes/91-7.html
- https://www.nspe.org/
- http://www.ewh.ieee.org/soc/pes/switchgear/presentations/tp_files/2017-1_Thurs_Shiffbauer_Singer_Engineering_Ethics.pdf

MOOC/ Video lectures available at:
- https://swayam.gov.in/nd1_noc20_mg44/preview

@The CO-PO Mapping Matrix

CO\PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	-	-	-	-	-	-	2	2	-	-	-	-
CO2	-	-	-	-	-	-	2	2	-	-	-	-
CO3	-	-	-	-	-	-	3	2	-	-	-	-
CO4	-	-	-	-	-	-	2	3	-	-	-	-

Savitribai Phule Pune University
Second Year of Engineering (2019 Course)
210260: Audit Course 4

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In addition to credits, it is recommended that there should be audit course in preferably in each semester starting from second year in order to supplement student's knowledge and skills. Student will be awarded the bachelor's degree if he/she earns specified total credits [1] and clears all the audit courses specified in the syllabus. The student will be awarded grade as AP on successful completion of audit course. The student may opt for one of the audit courses per semester, starting in second year first semester. Though not mandatory, such a selection of the audit courses helps the learner to explore the subject of interest in greater detail resulting in achieving the very objective of audit course's inclusion. List of options offered is provided. Each student has to choose one audit course from the list per semester. Evaluation of audit course will be done at institute level itself. Method of conduction and method of assessment for audit courses are suggested.

Criteria:

The student registered for audit course shall be awarded the grade AP (Audit Course Pass) and shall be included such AP grade in the Semester grade report for that course, provided student has the minimum attendance as prescribed by the Savitribai Phule Pune University and satisfactory performance and secured a passing grade in that audit course. No grade points are associated with this 'AP' grade and performance in these courses is not accounted in the calculation of the performance indices SGPA and CGPA. Evaluation of audit course will be done at institute level itself. [1]

Guidelines for Conduction and Assessment (Any one or more of following but not limited to):

- Lectures/ Guest Lectures
- Visits (Social/Field) and reports
- Demonstrations
- Surveys
- Mini-Project
- Hands on experience on focused topic

Course Guidelines for Assessment (Any one or more of following but not limited to):

- Written Test
- Demonstrations/ Practical Test
- Presentations, IPR/Publication and Report

Audit Course 4 Options

Audit Course Code	Audit Course Title
AC4-I	Water Management
AC4-II	Intellectual Property Rights and Patents
AC4-III	The Science of Happiness
AC4-IV	Stress Relief: Yoga and Meditation
AC4-V	Foreign Language (one of Japanese/Spanish/French/German) Course contents for **Japanese(Module 2)** are provided. For other languages institute may design suitably.

Note: It is permitted to opt one of the audit courses listed at SPPU website too, if not opted earlier. [1]
http://collegecirculars.unipune.ac.in/sites/documents/Syllabus%202017/Forms/AllItems.aspx
http://www.unipune.ac.in/university_files/syllabi.htm

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AC4-I: Water Management

Water is a vital resource for all life on the planet. Only three percent of the water resources on Earth are fresh and two-thirds of the freshwater is locked up in ice caps and glaciers. One fifth of the remaining one percent is in remote, inaccessible areas. As time advances, water is becoming scarcer and having access to clean, safe, drinking water is limited among countries. Pure water supply and disinfected water treatment are prerequisites for the well-being of communities all over the world. One of the biggest concerns for our water-based resources in the future is the sustainability of the current and even future water resource allocation. This course will provide students a unique opportunity to study water management activities like planning, developing, distributing and optimum use of water resources. This course covers the topics that management of water treatment of drinking water, industrial water, sewage or Wastewater, management of water resources, management of flood protection.

Course Objectives

- To develop understanding of water recourses.
- To study global water cycle and factors that affect this cycle.
- To analyze the process for water resources and management.
- To study the research and development areas necessary for efficient utilization and management of water recourses.

Course Outcomes

On completion of the course, learner will be able to–

CO1: Understand the global water cycle and its various processes

CO2: Understand climate change and their effects on water systems

CO3: Understand Drinking treatment and quality of groundwater and surface water

CO4: Understand the Physical, chemical, and biological processes involved in water treatment and distribution.

Course Contents

1. Understanding 'water'-Climate change and the global water cycle, understanding global hydrology
2. Water resources planning and management-Water law and the search for sustainability: a comparative analysis, Risk and uncertainty in water resources planning and management
3. Agricultural water use -The role of research and development for agriculture water use
4. Urban water supply and management - The urban water challenge, Water sensitive urban design

References:

1. R. Quentin Graft, Karen Hussey, Quentin Graft, Karen Hussey, Publisher, "Water Resources Planning and Management", Cambridge University Press, ISBN: 9780511974304, 9780521762588.
2. P. C. Basil, "Water Management in India", ISBN: 8180690970, 2004.
3. C.A. Brebbia, "Water Resources Management", ISBN: 978-1-84564-960-9, 978-1-84564-961-6.

@The CO-PO Mapping Matrix

CO\PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	-	-	-	-	-	-	1	-	-	-	-	-
CO2	-	-	-	-	-	-	2	-	-	-	-	1
CO3	-	-	-	-	-	-	1	-	-	-	-	
CO4	-	-	-	-	-	2	2	-	-	-	-	2

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AC4-II: Intellectual Property Rights and Patents

Intellectual property is the area of law that deals with protecting the rights of those who create original works. It covers everything from original plays and novels to inventions and company identification marks. The purpose of intellectual property laws is to encourage new technologies, artistic expressions and inventions while promoting economic growth.
Innovation and originality have great potential value. Whatever line of activity you are engaged in, future success depends on them. The last few years have seen intellectual property rights become an issue of general interest: the smart phone "patent wars", the introduction of Digital Rights management (DRM) and the rise of generic pharmaceuticals and open-source software are just some examples that have been in the public eye. Protecting your intellectual rights appropriately should be at a priority. Yet too many people embark on their chosen professions without even a basic awareness of intellectual property.

Course Objectives:

- To encourage research, scholarship, and a spirit of inquiry
- To encourage students at all levels to develop patentable technologies.
- To provide environment to the students of the Institute for creation, protection, and commercialization of intellectual property and to stimulate innovation.

Course Outcomes:

On completion of the course, learner will be able to–

CO1: Understand the fundamental legal principles related to confidential information, copyright, patents, designs, trademarks and unfair competition

CO2: Identify, apply and **assess** principles of law relating to each of these areas of intellectual property

CO3: Apply the appropriate ownership rules to intellectual property you have been involved in creating

Course Contents

1. **IntroductiontoIntellectualPropertyLaw–**TheEvolutionaryPast-TheIPRToolKit-Para-Legal Tasks in Intellectual Property Law
2. **Introduction to Trade mark –** Trade mark Registration Process – Post registration Procedures -Trade mark maintenance - Transfer of Rights – Inter partes Proceeding – Infringement - Dilution Ownership of Trade mark
3. **Introduction to Copyrights –** Principles of Copyright Principles -The subjects Matter of Copy right – The Rights Afforded by Copyright Law – Copy right Ownership, Transfer and duration – Right to prepare Derivative works
4. **IntroductiontoTradeSecret–**MaintainingTradeSecret–PhysicalSecurity–EmployeeLimitation - Employee confidentiality agreement

Reference:

1. Debirag E. Bouchoux, "Intellectual Property" Cengage learning, New Delhi, ISBN-10:1111648573
2. Ferrera, Reder, Bird, Darrow, "Cyber Law. Texts and Cases", South-Western's Special Topics Collections,ISBN:0-324-39972-3
3. Prabhuddha Ganguli, "Intellectual Property Rights", Tata Mc-Graw–Hill, NewDelhi,ISBN-10:0070077177

@The CO-PO Mapping Matrix

CO\PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	-	-	-	-	-	-	-	1	-	-	-	1
CO2	-	-	-	-	-	-	-	2	-	-	-	1
CO3	-	-	-	-	-	-	-	1	-	-	-	1

Home

AC4-III: The Science of Happiness

Everybody wants to be happy. One can explore innumerable ideas about what happiness is and how we can get some. But not many of those ideas are based on science. That's where this course comes in. The subject "Science of Happiness" aims to teach the pioneering science of positive psychology, which explores the ancestry of a happy and meaningful life. Clinical psychologists have been dealing with miserable feelings since their discipline was established. In the last 30 years, neuroscientists have made major headway in the understanding of the sources of anger, depression, and fear.

Today, whole industries profit from this knowledge—producing pills for every sort of pathological mood disturbance. But until recently, few neuroscientists focused on the subject of happiness. This course focuses on discovering how cutting-edge research can be applied to their lives. Students will learn about the Intra-disciplinary research supporting this view, spanning the fields of psychology, neuroscience, evolutionary biology, and beyond. The course offers students practical strategies for tapping into and nurturing their own happiness, including trying several research-backed activities that foster social and emotional well-being, and exploring how their own happiness changes along the way.

Course Objectives

- To understand the feeling of happiness
- To study the sources of positive feelings
- To analyze the anatomy of the happiness system
- To study the effect of thoughts and emotions on the happiness system

Course Outcomes

On completion of the course, learner will be able to–

CO1: Understand what happiness is and why it matters to you

CO2: Learn how to increase your own happiness

CO3: Understand of the power of social connections and the science of empathy

CO4: Understand what is mindfulness and its real world applications

Course Contents

1. Happiness: what is it? , 2. The secret of smiling
3. The autonomy of positive feelings
4. Positive feelings as a compass
5. The happiness system
6. Foundations: Emotions, Motivation and nature of Wellbeing
7. Subjective well being
8. Love and well being
9. Optimal well being
10. Religion, Spirituality and wellbeing

References:

1. Happier, Stefan Klein, "The Science of Happiness, How Our Brains Make Us Happy and what We Can Do to Get", Da Capo Press, ISBN 10: 156924328X, 13: 978-1569243282.
2. C. Compton, Edward Hoffman, "Positive Psychology: The Science of Happiness and Flourishing", William, Cengage Learning, 2012, ISBN10: 1111834121.

@The CO-PO Mapping Matrix

CO\PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	-	-	-	1	-	-	-	-	-	-	-	1
CO2	-	-	-	1	-	-	-	-	-	-	-	2
CO3	-	-	-	-	-	-	1	-	1	-	-	2
CO4	-	-	-	-	-	-	-	-	-	-	-	2

AC4-IV: Yoga and Meditation

Home

The concepts and practices of Yoga originated in India about several thousand years ago. Its founders were great Saints and Sages. The great Yogis presented rational interpretation of their experiences of Yoga and brought about a practical and scientifically sound method within every one's reach. Yoga today, is no longer restricted to hermits, saints, and sages; it has entered into our everyday lives and has aroused a worldwide awakening and acceptance in the last few decades. The science of Yoga and its techniques have now been reoriented to suit modern sociological needs and lifestyles.

Yoga is one of the six systems of Vedic philosophy. The Yoga advocates certain restraints and observances, physical discipline, breathe regulations, restraining the sense organs, contemplation, meditation and Samadhi. The practice of Yoga prevents psychosomatic disorders and improves an individual's resistance and ability to endure stressful situations.

Course Objectives:

- To impart knowledge about the basic technique and practice of yoga, including instruction in breath control, meditation, and physical postures
- To gain an intellectual and theoretical understanding of the principles embodied in the Yoga Sutras, the Bhagavad-Gita, and other important texts and doctrines
- Relaxation and stress reduction ,Personal insight and self understanding, Personal empowerment, Gaining wisdom and spiritual discernment
- Awakening the abilities or powers of the Super conscious mind

Course Outcomes:

On completion of the course, learner will be able to–

CO1: Understand philosophy and religion as well as daily life issues will be challenged and enhanced.

CO2: Enhances the immune system.

CO3: Intellectual and philosophical understanding of the theory of yoga and basic related Hindu scriptures will be developed.

CO4: Powers of concentration, focus, and awareness will be heightened.

Course Contents

1. Meaning and definition of yoga – Scope of Yoga - Aims and Objectives of Yoga – Misconception about yoga.
2. Ayurveda: an introduction to this system of health care derived from the Vedic tradition Anatomy and Physiology as they relate to Yoga
3. Yoga Philosophy and Psychology

References:

1. B.K.S. Iyengar, "BKS Iyengar Yoga The Path to Holistic Health" , DK publisher, ISBN-13: 978-1409343479
2. Osho, "The Essence of Yoga", Osho International Foundation, ISBN: 9780918963093

@The CO-PO Mapping Matrix

CO\PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	1	-	-	-	2	-	-	2	-	-	-
CO2	-	-	-	-	-	2	1	-	-	-	-	-
CO3	-	2	-	-	-	2	-	-	-	-	-	-
CO4	-	2	-	-	-	-	-	2	-	-	-	-

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AC4-V: Foreign Language (Japanese) Module 2

W ith changing times, the competitiveness has gotten into the nerves and 'Being the Best' at all times is only the proof of it. Nonetheless, 'being the best' differs significantly from 'Communicating the best'! The best can merely be communicated whilst using the best… suited Language!!

Course Objectives:

- To meet the needs of ever growing industry with respect to language support.
- To get introduced to Japanese society and culture through language.

Course Outcomes:

On completion of the course learner will-

1. have ability of basic communication.
2. have the knowledge of Japanese script.
3. get introduced to reading , writing and listening skills
4. develop interest to pursue professional Japanese Language course

Course Contents

1. Katakana basic Script, Denoting things (nominal and pre nominal demonstratives), Purchasing at the Market / in a shop / mall (asking and stating price)
2. Katakana : Modified kana, double consonant, letters with ya, yu, yo, Long vowels, Describing time, describing starting and finishing time (kara ~ made), Point in time (denoting the time when any action or the movement occurs)
3. Means of transport (Vehicles), Places, Countries, Stating Birth date, Indicating movement to a certain place by a vehicle.

References:

1. Minna No Nihongo, "Japanese for Everyone", (Indian Edition), Goyal Publishers and Distributors Pvt. Ltd.
2. http://www.tcs.com (http://www.tcs.com/news_events/press_releases/Pages/TCS-Inaugurates- Japan-centric-Delivery-Center-Pune.aspx)

@The CO-PO Mapping Matrix

CO\PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	-	-	-	-	-	-	-	-	1	3	1	1
CO2	-	-	-	-	1	-	-	-	-	3	1	1
CO3	-	-	-	-	1	-	-	-	-	3	2	2
CO4	-	-	-	-	-	-	-	-	-	1	-	1

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Acknowledgement

It is with great pleasure and honor that I share the curriculum for Second Year of Computer Engineering (2019 Course) on behalf of Board of Studies (BoS), Computer Engineering. We, members of BoS are giving our best to streamline the processes and curricula design at both UG and PG programs.

It is always the strenuous task to balance the curriculum with the blend of core courses, current developments and courses to understand social and human values. By considering all the aspects with adequate prudence the contents are designed satisfying most of the necessities as per AICTE guidelines and to make the graduate competent enough as far as employability is concerned. I sincerely thank all the minds and hands who work adroitly to materialize these tasks. I really appreciate everyone's contribution and suggestions in finalizing the contents.

Success is sweet. But it's sweeter when it's achieved thorough co-ordination, cooperation and collaboration. I am overwhelmed and I feel very fortunate to be working with such a fabulous team- the Members of Board of Studies, Computer Engineering!

Even in these anxious situation, during the time of this unfortunate pandemic, each and every person, including the course coordinators and their team members, have worked seamlessly to come up with this all inclusive curriculum for Second Year of Computer Engineering.

Thank you to all of you for delivering such great teamwork. I don't think it would have been possible to achieve the goal without each and every one of your efforts! I would like to express my deep gratitude to Dr. Rajesh Prasad (SITS), member BoS, Computer Engineering, for coordinating the complete activity and getting it to completion in a smooth manner.

I deeply appreciate and thank the managements of various colleges affiliated to SPPU for helping us in this work. These colleges have helped us by arranging sessions for preliminary discussion in the initial stage and at the same time in conducting Faculty Development Programs for various courses of the revised curriculum. All your support is warmly appreciated.

I sincerely appreciate, the hard work put in by the course coordinators and their team members, without your intellectual work and creative mind, and it would have not been possible to complete this draft. You have been a valuable member of our team!

Special thanks are due to Dr. Parikshit Mahalle, Dr. Swati Bhavsar and Dr. Jayashri Prasad for helping with the formatting and crisp presentation of this draft. I would like to thank you from the core of my heart. Thank you for always being your best selves and contributing to the work.

I am thankful to Dr. Nuzhat Shaikh, for the time she has spent in critically reading the draft and giving the final touches. I appreciate her initiative and thank her for her time, patience and hard work!

Thank you all, for not only your good work but also for all the support you have given each other throughout the drafting process, that's what makes the team stronger! You took the meaning of teamwork to a whole new level.

Thank you for all your efforts!

Professor (Mrs) Varsha H. Patil

Chairman, Board of Studies (Computer Engineering), Faculty of Science and Technology, Savitribai Phule Pune University.

BoS Members- Dr. Shirish Sane, Dr. Manik Dhore, Dr. Rajesh Prasad, Dr. Girish Khilari, Dr. Sachin Lodha, Dr. Parikshit Mahalle, Dr. Pramod Patil, Dr. Venkatesharan, Dr. Geetanjali Kale, Dr. Suhasini Itkar, Dr. R. V. Patil and Dr. P. M. Yawalkar

Task Force at Curriculum Design

Home

1. Advisors, the Team of Board of Studies-

Dr. Varsha Patil (Chairman, BoS), Dr. Shirish Sane, Dr. Manik Dhore, Dr. Rajesh Prasad, Dr. Girish Khilari, Dr. Sachin Lodha, Dr. Parikshit Mahalle, Dr. Pramod Patil, Dr. Venkatesharan, Dr. Geetanjali Kale, Dr. Suhasini Itkar, Dr. R. V. Patil and Dr. P. M. Yawalkar.

2. Team Leader- **Dr. Rajesh Prasad**

3. Teams, Course Design-

Name of Course	Team Leaders	Team Members	
Discrete Mathematics	Dr. Nihar Ranjan Dr. Mrs. Archana Chaugule	Dr. S. K. Pathan Dr. Mrs. Snehal Kamlapur Dr. Mrs. Shital Sonawane	Dr. V. S. Pawar Dr. Kailash Shaw Prof. Ravindra Rathore
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Computer Graphics & Lab	Dr. Mrs. N. F. Shaikh	Prof. P. P. Vaidya Prof. Dr. Aparna Junnarkar	Dr. Shabnam Farook Sayyad Prof. Mrs. Laxmi Sisode
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Principles of Programming Languages	Dr. Mrs. Jyoti Rao	Dr. J. R. Pansare Prof. Mrs. P. P. Joshi Prof. Mrs. Sonali Lunavat Prof. Ms. Geeta R Gupta Prof. Mrs. Snehal Patil	Prof. Mrs. Vaishali Latke Prof. Santosh Nagargoje Prof. Vaibhav Muddebihalkar Prof. Phadtare Tushar T
Project Based Learning	Dr. Mrs. Manisha Bhende Dr. Chaudhari Manohar	Dr. Saumitra Das Dr. D. T. Mane Dr. Swati Bhavsar	Prof. Subhash Rathod Prof. Mrs. Swati Shinde Prof. Kushal P. Birla Mr. Pravin Andhale

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Savitribai Phule Pune University

Faculty of Science &Technology

B.E. (Electronics & Telecommunication)
(2015 Pattern) Syllabus
(With effect from Academic Year 2018-19)

Savitribai PhulePune University
Final Year E&TC Engineering (2015 Course)
(With effect from Academic Year 2018-19)

Semester I

Course Code	Course	Teaching Scheme Hours / Week			Semester Examination Scheme of Marks						Credits	
		Theory	Tut	Pract	In-Sem	End-Sem	TW	PR	OR	Total	TH/TW	PR+OR
404181	VLSI Design& Technology	3	--	--	30	70	--	--	--	100	3	--
404182	Computer Networks & Security	4	--	--	30	70	--	--	--	100	4	--
404183	Radiation & Microwave Techniques	3	--	--	30	70	--	--	--	100	3	--
404184	Elective I	3	--	--	30	70	--	--	--	100	3	--
404185	Elective II	3			30	70	--	--	--	100	3	--
404186	Lab Practice -I (CNS+ RMT)	--	--	4	--	--	50	--	50	100	--	2
404187	Lab Practice -II (VLSI + Elective I)	--	--	4	--	--	50	50		100	--	2
404188	Project Stage I	-	2	--	--	--	-	--	50	50	--	2
	Audit Course 5	--	--	--	--	--	--	--	--	--	----	
	Total	16	2	8	150	350	100	50	100	750	16	6
Total Credits											**22**	

<u>Elective I</u>

1 Digital Image and Video Processing

2. Industrial Drives and Control

3. Embedded Systems & RTOS

4. Internet of Things

<u>Elective II</u>

1. Wavelets

2. Electronics Product Design

3. Optimization Techniques

4. Artificial Intelligence

5. Electronics in agriculture

<u>Audit Course 5</u>

1. Green Energy

2. Human Behaviour

Final Year E&TC Engineering (2015 Course)

(With effect from Academic Year 2018-19)

Semester II

Course Code	Course	Teaching Scheme Hours / Week			Semester Examination Scheme of Marks						Credit	
		Theory	Tut	Pract	In-Sem	End-Sem	TW	PR	OR	Total	TH/TW	PR+OR
404189	Mobile Communication	3	--	--	30	70	--	--	--	100	3	--
404190	Broadband Communication Systems	4	--	--	30	70	--	--	--	100	4	--
404191	Elective III	3	--	--	30	70	--	--	--	100	3	--
404192	Elective IV	3	--	--	30	70	--	--	--	100	3	--
404193	Lab Practice –III (MC+BCS)	--	--	4	--	--	50	50	--	100	--	2
404194	Lab Practice –IV (Elective III)	--	--	2	--	--	--	--	50	50	--	1
404195	Project Stage II	--	6	-	--	--	150	--	50	200	--	6
	Audit Course 6	--	--	--	--	--	--	--	--	--		
Total		13	6	6	120	280	200	50	100	750	13	9
										Total Credits	22	

Elective III	Elective-IV	Audit Course 6
1. Machine Learning 2. PLC s and Automation 3. Audio and Speech Processing 4. Software Defined Radio 5. Audio Video Engineering	1. Robotics 2. Biomedical Electronics 3. Wireless Sensor Networks 4. Renewable Energy Systems 5. Open Elective*	1. Team Building, Leadership and Fitness 2. Environmental issues and Disaster Management

*Any one course from the list of Elective IV of computer/IT/Electrical/Instrumentation or Institute can offer elective IV based on any industry need with prior approval from BoS(Electronics & Telecommunication). Repetition of course or topics should be avoided.

404181 VLSI Design & Technology

Credits: 03

Teaching Scheme:	Examination Scheme:
Lecture : 03 Hr/Week	In-Sem : 30 Marks End-Sem: 70 Marks

Course Objectives:

- To explore HDL and related design approach.
- To nurture students with CMOS circuit designs.
- To realize importance of testability in logic circuit design.
- To overview ASIC issues and understand PLD architectures with advanced features.

Course Outcomes:

On completion of the course, student will be able to

1. Write effective HDL coding for digital design.
2. Apply knowledge of real time issues in digital design.
3. Model digital circuit with HDL, simulate, synthesis and prototype in PLDs.
4. Design CMOS circuits for specified applications.
5. Analyze various issues and constraints in design of an ASIC
6. Apply knowledge of testability in design and build self test circuit.

Unit I : HDL Design **7 Hrs**

Design Flow, Language constructs, Data objects, Data types, Entity, Architecture & types of modeling, Sequential statements, Concurrent statements, Packages, Sub programs, Attributes, HDL modeling of Combinational, Sequential circuits and FSM. Simulations, Synthesis, Efficient coding styles, Hierarchical and flat designs, Partitioning for synthesis, Pipelining, Resource sharing.

Unit II : Digital design and Issues **6 Hrs**

Sequential synchronous machine design, Moore and Mealy machines, HDL code for Machines, FIFO. Metastability and solutions, Noise margin, Fan-out, Skew, Timing considerations, Hazards, Clock distribution, Clock jitter, Supply and ground bounce, Power distribution techniques, Power optimization, Interconnect routing techniques; Wire parasitic, Signal integrity issues. I/O architecture.

Unit III : PLD Architectures and applications **6 Hrs**

Design Flow. CPLD Architecture, Features, Specifications, Applications. FPGA Architecture, Features, Specifications, Applications. The Simulation and Synthesis Tools, FPGA synthesis and implementation.

Unit IV:Digital CMOS circuits **7 Hrs**

N-MOS, P-MOS and CMOS, MOSFET parasitic, Technology scaling, Channel length modulation, Hot electron effect, Velocity saturation, CMOS Inverter, Device sizing, CMOS combinational logic design, Power dissipations, Power delay product, Body Effect, Rise and fall times, Latch Up effect, transmission gates.

Unit V : Application Specific Integrated Circuit **7 Hrs**

Design Flow, Cell design specifications, Spice simulation, AC and DC analysis, Transfer Characteristics, Transient responses, Noise analysis, Lambda rules, Design rule check, Fabrication methods of circuit elements, Layout of cell, Library cell designing for NAND & NOR, Circuit Extraction, Electrical rule check, Layout Vs. Schematic, Post-layout Simulation and Parasitic extraction, Design Issues like Antenna effect, Electro migration effect, Cross talk and Drain punch through, Timing analysis.

Unit VI : VLSI Testing and Analysis 6 Hrs Types of fault, Need of Design for Testability (DFT), DFT Guideline, Testability, Fault models, Path sensitizing, Test pattern generation,Sequential circuit test, Built-in Self Test, JTAG & Boundary scan, TAP Controller.
Text Books: 1. Charles H. Roth, "Digital systems design using VHDL", PWS. 2. Wyane Wolf, "Modern VLSI Design (IP-Based Design)", 4E,Prentice Hall. 3. Steve Kilts "Advanced FPGA Design Architecture, Implementation and Optimization", Wiley.
Reference Books: 1. E. Weste, David Money Harris, "CMOS VLSI Design: A Circuit &System Perspective", Pearson Publication. 2. R. Jacob Baker, "CMOS Circuit Design, Layout, and Simulation", 3E, Wiley-IEEE Press 3. John F. Wakerly, "Digital Design Principles and Practices" , 3E, Prentice Hall 4. M. Morris Mano , "Digital Design", 3E , Pearson 5. CemUnsalan, Bora Tar, "Digital System Design with FPGA: Implementation Using Verilog and VHDL", McGraw-Hill

404182Computer Networks & Security

Credits: 04

Teaching Scheme:				Examination Scheme:
Lecture : 04 Hrs/Week				**In-Sem: 30 Marks** **End-Sem: 70 Marks**

Course Objectives:

- To understand state-of-the-art in network protocols, architectures, and applications
- To provide students with a theoretical and practical base in computer networks issues
- To outline the basic network configurations
- To understand the transmission methods underlying LAN and WAN technologies.
- To understand security issues involved in LAN and Internet.

Course Outcomes:

On completion of the course, student will be able to

1. Understand fundamental underlying principles of computer networking
2. Describe and analyze the hardware, software, components of a network and their interrelations.
3. Analyze the requirements for a given organizational structure and select the most appropriate networking architecture and technologies
4. Have a basic knowledge of installing and configuring networking applications.
5. Specify and identify deficiencies in existing protocols, and then go onto select new and better protocols.
6. Have a basic knowledge of the use of cryptography and network security.
7.

Unit I : Introduction to Local Area Networks **6Hrs**

TCP/IP Protocol Suit, Media Access Control: Random Access, Controlled Access- Reservation, Channelization. Wired LAN: Ethernet Protocol, Standard Ethernet, Fast Ethernet (100 MBPS), Gigabit Ethernet, 10 Gigabit Ethernet. Wireless LAN : Introduction, IEEE 802.11 Project, Bluetooth

Unit II :Network Layer Part I **7Hrs**

Introduction to Network Layer: Network-Layer Services, Packet Switching, Network-Layer Performance, IPv4 Addresses, Forwarding Of IPPackets,Network Layer Protocols: Internet Protocol (IP), ICMPv4, Mobile IP

Unit III : Network Layer Part II **6 Hrs**

Unicast and Multicast Routing: Introduction, Routing Algorithms, Unicast Routing Protocols, Introduction, Multicasting Basics, Intra-domain Multicast Protocols, Inter-domain Multicast Protocols, IGMP. Next Generation IP:IPv6 Addressing, The Ipv6 Protocol, TheICMPv6 Protocol, Transition From IPv4 toIPv6.

Unit IV : Transport Layer **6 Hrs**

Introduction to Transport Layer:Introduction, Transport-Layer Protocols,Transport Layer Protocols:Introduction, User Datagram Protocol, Transmission Control Protocol, SCTP.

Unit V : Application Layer 7 Hrs

Introduction to Application Layer, Standard Client Server Protocols:World Wide Web and HTTP , FTP, Electronic Mail, Telenet, SSH, DNS.Network Management: Introduction, SNMP.

Unit VI : Network Security **7Hrs**

Cryptography & Network Security: Introduction Confidentiality, Other Aspects Of Security.
Internet Security:N etwork-Layer Security, Transport-Layer Security, Application-Layer Security, Firewalls.

Text Books:

1. Behrouz A. Forouzan, "Data Communications and Networking" MacGraw Hill, 5th edition
2. James F. Kurouse& W. Rouse, "Computer Networking: A Top down Approach", 6thEdition, Pearson Education.

Reference Books:

1. Andrew S. Tannenbaum, "Computer Networks", Pearson Education, Fourth Edition,2003
2. Wayne Tomasi, "Introduction to Data Communication and Networking", 1/e, Pearson Education
3. Natalia Olifer, Victor Olifer, "Computer Networks" Wiley Student Edition

404183 Radiation and Microwave Techniques

Credits: 03

Teaching Scheme:	**Examination Scheme:**
Lecture : 03 Hr/Week	**In-Sem : 30 Marks** **End-Sem : 70 Marks**

Course Objectives:

- To introduce fundamental theory of radiation and microwaves.
- To understand design principles of various radiating elements.
- To understand theory of passive and active components of microwave systems.
- To learn microwave measurement techniques.

Course Outcomes:

On completion of the course, student will be able to

1. Differentiate various performance parameters of radiating elements.
2. Analyze various radiating elements and arrays.
3. Apply the knowledge of waveguide fundamentals in design of transmission lines.
4. Design and set up a system consisting of various passive microwave components.
5. Analyze tube based and solid state active devices along with their applications.
6. Measure various performance parameters of microwave components.

Unit I : Fundamental Theory of Radiation and Radiating Elements 8Hrs

Fundamental equations for free space propagation, Friis transmission equation, Definition of antenna, radiation mechanism and types of antenna, performance parameters such as radiation pattern, directivity, gain, efficiency, half power beam width, bandwidth, polarization, input impedance, radiation efficiency, effective length, effective area, radiation sphere.

Unit II : Radiating elements and arrays7 Hrs

Comparison of various radiating elements such as infinitesimal dipole, small dipole, finite length dipole and half wave length dipole, analytical treatment of these elements. Planar, log periodic and YagiUda antenna. Types of arrays, two element array, N-element array, uniform amplitude uniformly spaced linear broad side and end-fire array.

Unit III : Transmission lines and Waveguides 6Hrs

General solution for TEM, TE and TM waves.Analysis of coaxial line and rectangular waveguides. Analysis of rectangular cavity resonators and their applications, Striplines: Structural details, types and applications.

Unit IV : Passive Microwave Components 6Hrs

Construction, working principle and scattering analysis of passive microwave components such as E-plane, H-plane and magic tee. Ferrite composition, characteristics and Faraday rotation principle. Construction, working principle and scattering analysis of isolator, circulator and directional coupler. Construction and operation of gyrator.

Unit V: Active Microwave Components 6Hrs

Limitations of conventional tubes, O and M type classification of microwave tubes, re-entrant cavity, velocity modulation.Construction, operation, performance analysis and applications of -Single cavity and two cavity klystron,Cylindrical wave magnetronandHelix traveling wave. Construction, working principle and applications of two terminal microwave devices such as tunnel diode, Gunn Diode, PIN Diode, Schottky Barrier Diode and Varactor.

Unit VI : Microwave Systems and Microwave Measurement Techniques 6Hrs

Microwave terrestrial and satellite communication system and industrial applications of microwaves such as microwave heating, thickness and moisture measurement, medical application such as microwave diathermy.Microwave measurement devices such as slotted line, tunable detector, VSWR meter, power meter, and their working principles. Microwave measurement techniques to measure S-parameters, frequency, power, attenuation, phase shift, VSWR, impedance.

Radiation hazards and protection.

Text Books:

1. C.A. Balanis, “Antenna Theory - Analysis and Design", John Wiley.
2. Samuel Y. Liao, “Microwave Devices and Circuits”, 3rd edition, Pearson
3. Annapurna Das and Sisir K. Das, “Microwave Engineering", Second edition, Tata McGraw Hill.

Reference Books:

1. David M. Pozar, “Microwave Engineering", Fourth edition, Wiley.
2. Ahmad Shahid Khan, “Microwave Engineering : Concepts and Fundamentals
3. K. D. Prasad, “Antenna &Wave Propagation”, SatyaPrakashan, New Delhi.
4. M. Kulkarni, “Microwave and Radar engineering”, 3rd edition, Umesh Publication
5. E.C. Jordon and E.G. Balman, “Electromagnetic Waves and Radiation Systems”, Prentice Hall India.

404184 Digital Image and Video Processing (Elective-I)

Credits: 03

Teaching Scheme:			Examination Scheme:	
Lecture : 03 Hr/Week				**In-Sem: 30 Marks** **End-Sem: 70 Marks**

Course Objectives:

- Understand the fundamental concepts of Digital Image Processing with basic relationship of pixels and mathematical operations on 2-D data.
- Learn design and integrate image enhancement and image restoration techniques
- Understand object segmentation and image analysis techniques
- Learn the need for effective use of resources such as storage and bandwidth and ways to provide effective use of them by data compression techniques
- Learn basic concepts of video processing

Course Outcomes:

On completion of the course, student will be able to

1. Develop and implement basic mathematical operations on digital images.
2. Analyze and solve image enhancement and image restoration problems.
3. Identify and design image processing techniques for object segmentation and recognition.
4. Represent objects and region of the image with appropriate method.
5. Apply 2-D data compression techniques for digital images.
6. Explore video signal representation and different algorithm for video processing.

Unit I : Fundamentals of Image Processing **5 Hrs**

Steps in Image processing, Human visual system, Sampling & quantization, Representing digital images, spatial and gray level resolution, Image file formats, Basic relationships between pixels, Distance Measures, Basic operations on images – image addition, subtraction, logical operations, scaling translation, rotation. Color fundamentals and models – RGB, HIS, YIQ

Unit II : Image Enhancement and Restoration **8 Hrs**

Point – Log transformation, Power law transformation, Piecewise linear transformation, Image histogram, histogram equalization, Mask processing of images, filtering operations- Image smoothing, image sharpening, frequency domains image enhancement: 2D DFT, smoothing and sharpening in frequency domein, Pseudo coloring. Image Restoration: Noise models, restoration using Inverse filtering and Wiener filtering

Unit III : Image Compression **6 Hrs**

Types of redundancy, Fidelity criteria, Compression models - Information theoretic perspective – Fundamental coding theorem, Lossless Compression: Huffman Coding- Arithmetic coding. Introduction to DCT, Lossy compression: DCT based compression, Wavelet based compression, Image compression standards JPEG and JPEG 2000.

Unit III : Image Segmentation **8 Hrs**

Pixel classification, Bi-level thresholding, Multi-level thresholding, Adaptive thresholding, Otsu's method, Edge detection – First order derivative Prewitt and Sobel, Second order derivative – LoG, DoG, Canny. Edge linking, Hough transform, Region growing and region merging. Morphological operators: Dilation, Erosion, Opening, Closing, Hit or Miss transform, Boundary detection, Thinning, Thicking, Skelton.

Unit V : Representation and Description 5 Hrs Representation – Chain codes, Polygonal approximation, Signatures, Boundary descriptors, Shape numbers, Fourier descriptors, Stastical moments, Regional descriptors – Topological, texture, Principal components for description
Unit VI : Video Processing 6 Hrs Fundamental Concepts in Video – Types of video signals, Analog video, Digital video, Color models in video, Motion Estimation; Video Filtering; Video Compression, Video coding standards MPEG.
Text Books: 1. Gonzalez and Woods, "Digital Image Processing", Pearson Education, 3rd edition 2. Iain E. G. Richardson, "H.264 and MPEG 3. Video Compression: Video Coding for Next Generation Multimedia", John Wiley and Son's Publication, 3rd Edition.
Reference Books: 1. A. K. Jain, Fundamentals of digital image processing, Prentice Hall of India, 1989. 2. Pratt William K. "Digital Image Processing", John Wiley & sons 3. A. Bovik, Handbook of Image & Video Processing, Academic Press, 2000

404184 Industrial Drives and Control (Elective-I)

Credits: 03

Teaching Scheme:	**Examination Scheme:**
Lecture : 3Hours / Week	**In-Sem : 30 Marks** **End-Sem: 70 Marks**

Course Objectives:

- Describe the structure of Electric Drive systems and their role in various applications such as flexible production systems, energy conservation, renewable energy, transportation etc., making Electric Drives an enabling technology
- Study and understand the operation of electric motor drives controlled from a power electronic converter and to introduce the design concepts of controllers for closed loop operation
- Study DC, AC, special machines like stepper motor, servo motor and brushless motor and their control.

Course Outcomes:

On completion of the course, student will be able to

1. Understand the basic principles of power electronics in drives and its control, types of drives and basic requirements placed by mechanical systems on electric drives for various applications
2. Understand the operation of 1ϕ & 3ϕ converter drives for separately excited & series DC motors, dual converter drives, 2 quadrant and 4 quadrant DC chopper drives, Open-loop & closed-loop control of DC drives with transfer function, Dynamic and regenerative braking. Protection circuits for DC drives.
3. Learn speed control of induction motor drives in an energy efficient manner using power electronics. To study and understand the operation of both classical and modern induction motor drives like FOC or Vector control.
4. Learn and understand working of various types of synchronous motors and their drive systems
5. Learn stepper motors & drives, BLDC and SRM motors and drives
6. Understand modern control techniques of Fuzzy logic and ANN in motor drive application

Unit I :Motor Drive as system 5 Hrs

Electrical drive as system, Parts of Electrical drives AC / DC drives, Components, nature and classification of load torques. Four quadrant operation of a motor drive. Control of Electrical drives, steady state stability Closed loop control, Selection of motor power rating

Unit II : DC Motors and drives6Hrs

Basic characteristics of DC motors, Operating modes, Motor performance parameters, 1ϕ & 3ϕ converter drives for separately excited & series DC motors for continuous & discontinuous operations. Chopper fed DC drives, Comparison of converter fed drive & chopper fed drive. Open loop & closed loop control of dc drives with transfer function PLL control, Microprocessor based control of dc drives, Dynamic and regenerative braking of DC motors

Unit III :Induction Motors and Drives 8Hrs

Induction motor characteristics, Control strategies like stator voltage control, v/f control, rotor resistance control, Variable frequency Square wave VSI Drives, Variable frequency PWM VSI Drives, Variable frequency CSI Drives, Closed loop control of Induction motors, v/f control of three phase IM using PWM inverter, Vector Control (Field oriented Control): Basic principle of vector control, Direct vector control & indirect vector control, DQ Transformation, Braking of induction motor, soft acceleration and deceleration, various protections.

Unit IV :AC and DC synchronous Motors and drives6Hrs

Cylindrical rotor motor Drive, Salient pole motor Drive, Switched reluctance motor (SRM) drive, Synchronous Reluctance motor drive, self-controlled synchronous motor drives Permanent magnet Brushless DC motor drive, Permanent magnet AC synchronous motor drive, Variable reluctance & permanent magnet stepper motor and drive. Servo motor Drives.

Unit V :Power Electronics applications inRenewable Energy 6Hrs

Wind power system: System component, Turbine rating, Electrical load matching, fixed speed and variable speed operation, System design features, Maximum power operations and System control requirement WECS: Principle of WECS, role of power electronics in WECS, Drive selection criteria for fixed speed and variable speed WECS, Stand-alone PV systems, Grid connected PV systems. Power Electronics for Photovoltaic Power Systems Basics of Photovoltaic: The PV cell, Module and array, I-V and P-V curves, PV system component, Stand-alone PV systems, Grid connected PV systems.

Unit VI :Artificial Intelligence in Motor Drives5Hrs

Fuzzy logic principle and applications: Introduction, Fuzzy sets, Fuzzy system, Fuzzy control, Fuzzy logic based induction motor speed control. Neural network principle and applications: Introduction, Neural network in identification and control, AI Applications in electrical machines and drives, Neural network based PWM controller.

Text Books:

1. Fundamental of Electrical Drives, Gopal K. Dubey, Narosa Publishing House .
2. Power Electronics, circuits, devises and applications by Muhammad Rashid, Pearson
3. Modern Power Electronics and AC Drives, Bimal K. Bose, Pearson

Reference Books:

1. Wind & Solar Power system, Mukund Patel , CRC Press
2. Thyristor DC drives, P. C Sen, John Wiley.
3. Power Electronics, Converters, Applications and Design, N. Mohan, T. M. Undeland &W. P. Robbins, John Wiley and Sons, 3rd Edition

404184 Embedded Systems and RTOS(Elective-I)				
Credits: 03				
Teaching Scheme:			**Examination Scheme:**	
Lecture : 03Hr/Week				**In-Sem : 30 Marks** **End-Sem: 70 Marks**

Course Objectives:

- To understand and able to design an application specific systems.
- To develop implementation skill for application specific systems.
- To understand design and implementation of real time system using RTOS.
- To understand open source platform for embedded system

Course Outcomes:

On completion of the course, student will be able to

1. Understand design of embedded system
2. Use RTOS in embedded application
3. Use modern architecture for embedded system
4. Use Linux for embedded system development
5. Use open platform for embedded system development

Unit I : Embedded System Overview 6 Hrs

Embedded System Introduction, Hardware and software architectures of ES, Design metrics(technical and techno- economical), Prototyping models, Development tool chain insights(GNU), guidelines for Selection of hardware and memory architecture, embedded C programming, embedded system design challenges, standard programming practices in embedded system.

Unit II :Real time system and RTOS 7 Hrs

Real time system, types, design approaches and considerations, Usage ofSharedresourcesand related issues**,** Concept of RTOS, Types of RTOS, differences from GPOS (Multitasking, Inter-process communication, Timers, Device drivers, protection mechanism etc.), real time scheduling algorithms, commercial RTOS , survey of RTOS.

Unit III :µcos-II –RTOS8 Hrs

µcos-II features, kernel structure, data structure, µcos-II services as task management, time management, inter-process communication (mailbox, queue,events,pipesetc.), memory management.µcos-II porting on ARM7/Cortex (M3/M4) architecture.

Unit IV : Advanced embedded architectures (Cortex-M3/M4)8 Hrs

Introduction to ARM CORTEX series, Design Philosophy, processors series, versions, features and applications. CMSIS standard for ARM Cortex. Survey of CORTEX M3/M4 based controllers. ARM-CM3 Based Microcontroller LPC1768: Features, Architecture (Block Diagram &itsDescription), System Control, Clock & Power Control, GPIO, Pin Connect Block, interfacing with RGB LED, Seven Segment, TFT Display, MOTOR control using PWM.

Unit V : Embedded Linux 8 Hrs

Linux for embedded systems, embedded Linux development system, kernel architecture and configuration, file systems, porting Linux on ARM architecture, boot loaders, tool utilities such as Minicomp, Busybox, Redboot, Libc, Device drivers- concept, architecture, types, sample character device driver.

Unit VI :Open hardware /development systems and Case study7 Hrs

Arduino open platform (IDE), development using ATMega328p based Uno board, structure of Arduino programs, introduction to Arduino library, sample GPIO program.
Case study of implementation with control, compute and communication modules using Arduino platform.

Text Books:

1. Jean J.Labrosse, “MicroC OS II, The Real-Time Kernel”, 2nd edition, CMP Books.
2. Christopher Hallinan, “Embedded Linux Primer -A Practical, Real-World Approach ”2nd edition, Prentice Hall.
3. Parag H Dave, Himanshu .H.Dave,” Embedded systems” Concepts, design and programming, Pearson India

Reference Books:

1. Frank Vahid and Tony Givargis, “ Embedded System Design – A Unified hardware/ Software introduction ” 3rd edition, Wiley
2. David Simon, ”Embedded system primer”
3. Raj Kamal, “Embedded Systems – Architecture, Programming and Design" 2nd edition,
4. http://www.ti.com/lit/an/slaa207/slaa207.pdf
5. MSP430x5xx: http://www.ti.com/product/msp430f5529
6. MSP430x4xx : http://www.ti.com/product/msp430f438
7. MSP430x2xx: http://www.ti.com/product/msp430g2302-ep

404184 Internet of Things (Elective-I)

Credits: 03

Teaching Scheme:	Examination Scheme:
Lecture : 03 Hr/Week	In-Sem: 30 Marks End-Sem: 70 Marks

Course Objectives:

- To study fundamental concepts of IoT
- To understand roles of sensors in IoT
- To Learn different protocols used for IoT design
- To be familiar with data handling and analytics tools in IoT

Course Outcomes:

1. On completion of the course, student will be able to
2. Understand the various concepts, terminologies and architecture of IoT systems.
3. Use sensors and actuators for design of IoT.
4. Understand and apply various protocols for design of IoT systems
5. Use various techniques of data storage and analytics in IoT
6. Understand various applications of IoT

Unit I : Fundamentals of IoT **6Hrs**

Introduction, Definitions & Characteristics of IoT, IoT Architectures, Physical & Logical Design of IoT, Enabling Technologies in IoT, History of IoT, About Things in IoT, The Identifiers in IoT, About the Internet in IoT, IoT frameworks, IoT and M2M.

Unit II :Sensors Networks **7Hrs**

Definition, Types of Sensors, Types of Actuators, Examples and Working, RFID Principles and components, Wireless Sensor Networks: History and Context, The node, Connecting nodes, Networking Nodes, WSN and IoT.

Unit III :Wireless Technologies for IoT **6 Hrs** WPAN Technologies for IoT: IEEE 802.15.4, Zigbee, HART, NFC, Z-Wave, BLE, Bacnet, Modbus.
Unit IV :IP Based Protocols for IoT **6 Hrs** IPv6, 6LowPAN, RPL, REST, AMPQ, CoAP, MQTT.
Unit V :Data Handling& Analytics6Hrs Introduction, Bigdata, Types of data, Characteristics of Big data, Data handling Technologies, Flow of data, Data acquisition, Data Storage, Introduction to Hadoop. Introduction to data Analytics, Types of Data analytics, Statistical Models, Analysis of Variance, Data Dispersion, Contingence and Correlation, Regression Analysis, Precision and Error limits.
Unit VI :Applications of IoT **7Hrs** Home Automation, Smart Cities, Energy, Retail Management, Logistics, Agriculture, Health and Lifestyle, Industrial IoT, IoT design Ethics, IoT in Environmental Protection.
Text Books: 1.Hakima Chaouchi, " The Internet of Things Connecting Objects to the Web" ISBN : 978-1-84821-140-7, Wiley Publications 2. Olivier Hersent, David Boswarthick, and Omar Elloumi, "The Internet of Things: Key Applications and Protocols", WileyPublications 3. Vijay Madisetti and ArshdeepBahga, "Internet of Things (A Hands-on-Approach)", 1st Edition, VPT, 2014.
References 1. Daniel Minoli, "Building the Internet of Things with IPv6 and MIPv6: The Evolving World of M2M Communications", ISBN: 978-1-118-47347-4, Willy Publications 2. by Pethuru Raj and Anupama C. Raman, "The Internet of Things: Enabling Technologies, Platforms, and Use Cases", CRC Press 3. http://www.cse.wustl.edu/~jain/cse570-15/ftp/iot_prot/index.html 4. https://onlinecourses.nptel.ac.in/noc17_cs22/course

404185 Wavelets (Elective-II)

Credits: 03				
Teaching Scheme:			**Examination Scheme:**	
Lecture : 03 Hr/Week				**In-Sem: 30 Marks** **End-Sem: 70 Marks**

Course Objectives:

- Learn and understand basic linear algebra
- Understand the need of time frequency resolution
- Understand the basics of Discrete Wavelet transform and various wavelets available
- Learn the signal analysis using multi-resolution analysis
- Study the applications of Wavelets in compression, enhancement, noise removal etc.

Course Outcomes:

1. On completion of the course, student will be able to
2. Explore and learn the basics of linear algebra.
3. Identify the need of Wavelet transform and its properties.
4. Analyze the 1-D and 2-D signal using discrete wavelet transform.
5. Analyze the signal using Multi resolution analysis
6. Use wavelet transform in different applications like data compression, denoising, enhancement etc.

Unit I : Fundamentals of Linear Algebra6 Hrs

Vector spaces, Orthogonality, Ortho-normality, Projection, Functions and function spaces. Orthogonal basis functions. Fourier series orthogonality of complex exponential bases, mathematical preliminaries for continuous and discrete Fourier transformer. Limitations of Fourier domain signal processing, Towards wavelet signal processing, signal representation with continuous and discrete Short Time Fourier Transform.

Unit II : Introduction to Wavelet 6 Hrs

Concept of time-frequency resolution, Resolution problem associated with STFT, Heisenberg's uncertainty principle and time frequency tiling, why wavelet transform? The origin of wavelets, Properties of Wavelet Transform, Wavelet and other wavelet like transformer, different communities and family of wavelets, different families of wavelets within wavelet communities, Continuous and discrete wavelet transform

Unit III : Discrete Wavelet Transform 8 Hrs

Haar scaling function and function spaces, translation and scaling of φ(t), function spaces V0 Finer Haar Scaling Functions, concept of nested vectopr spaces, Haar wavelet function, scaled and translated Haar wavelet functions, orthogonality of φ (t) and γ (t). Normalization of Haar bases at different scales, daubechies wavelets, plotting of Daubechies wavelets. 1-D and 2-D decomposition (analysis) of signals using Wavelet.

Unit IV : Multi-resolution Analysis 6 Hrs

Signal decomposition and its relation with filter banks, frequencies response, signal reconstruction course to fine scale, upsampling and filtering, QMF conditions, concepts of multi-Resolution analysis and multi-rate signal processing, Perfect matching filters, Vanishing moments of wavelet function and filter properties, introduction to wavelet lifting.

Unit V : Wavelet Transform in Data Compression 6 Hrs

Transform coding, image compression using DWT, Embedded tree image coding, comparison of JPEG and JPEG 2000, Audio masking, MPEG Coding for audio, Wavelet based audio coding, video coding using Multi-resolution technique (introduction).

Unit VI : Applications of Wavelet Transform 4 Hrs

Waveletdenoising, speckle removal, Edge detection and object isolation Image fusion, wavelet watermark, image enhancement. Communication application scaling functions as signaling pulses, Discrete Wavelet Multitone modulation.

Text Books:

1. K.P Soman, K I Ramchandran, N G Resmi, “Insights into Wavelets from theory to Practice”, Third edition, PHI publication.

2. Raghuveer M Rao, Ajit S. Bopardikar, “Wavelet Transforms, Introduction to Theory and Applications”, Seventh Indian Reprint 2005, Pearson Education.

Reference Books:

1. Jaideva C. Goswami, Andrew K. Chan, “Fundamentals of Wavelets”, Wiley Student Edition

2. V. M. Gadre, A. S. Abhyankar, “Multiresolution and Multirate Signal Processing, Introduction, Principles and Applications”, MGH Publication

404185 Electronic Product Design (Elective-II)

Teaching Scheme: Lectures: 3 Hrs./ Week		**Examination Scheme:** In Sem: 30 Marks End Sem: 70Marks

Course Objectives:

- To understand the stages of product (hardware/ software) design anddevelopment.
- To learn the different considerations of analog, digital and mixed circuitdesign.
- To be acquainted with methods of PCB design and different tools used for PCBDesign.
- To understand the importance of testing in product design cycle.`
- To understand the processes and importance ofdocumentation.

Course Outcomes:

After Successfully completing the course students will be able to

- Understand various stages of hardware, software and PCBdesign.
- Importance of product test &testspecifications.
- Special design considerations and importance ofdocumentation.

Unit I: Introduction to Electronic Product Design **6 Hrs**

Man machine dialog and Industrial design, user-centered design, five element of successful design, cognition, ergonomics. Packaging and factors, design for manufacture, assembly and disassembly, wiring, temperature, vibration and shock. Safety, noise, energy coupling, grounding, filtering and shielding.

Unit II: Hardware Design & testing methods **6 Hrs**

Design process. Identifying the requirements, formulating specifications, design specifications, Specifications verses requirements, System partitioning, Functional design, architectural design, Functional model verses architectural model. Prototyping. Performance and Efficiency measures. Formulating a test plan, writing specifications, Test procedure and test cases, Egoless design, design reviews. Module debug and test: black box test, white box test, grey box test.

Unit III: Software Design and Testing methods **6 Hrs**

Types of Software. Waterfall model of software development. Models, metrics andsoftware limitations. Risk abatement and failure preventions. Software bugs and testing. Good programming practice. User interface .Embedded, Real time software.

Unit IV: PCB design **6 Hrs**

Fundamental Definitions, Standards. Routing Topology Configurations, Layer Stack up assignment, Grounding Methodologies, Aspect Ratio, Image Planes, Functional Partitioning, Critical frequencies, Bypassing and decoupling. Design techniques for ESD Protection,Guard Band implementation.

Unit V: Product Debugging and Testing 6 Hrs Steps of Debugging, Techniques for troubleshooting, characterization, Electromechanical components, passive components, active components, active devices, operational amplifier, Analog-Digital Conversion, Digital Components, Inspection and test of components, Simulation, Prototyping and testing, Integration, validation and verification. EMI & EMC issues.
Unit VI : Documentation 6 Hrs Definition, need, and types of documentation. Records, Accountability, and Liability. Audience. Preparation, Presentation, and Preservation of documents. Methods of documentation, Visual techniques, Layout of documentation, Bill of material.
Text Books: 1. Kim Fowler," Electronic Instrument Design" Oxford universitypress. 2. Robert J. Herrick, "Printed Circuit board design Techniques for EMC Compliance", Second edition, IEEE press.
Reference Books: 1. James K. Peckol, "Embedded Systems – A Contemporary Design Tool", Wiley publication 2. J C Whitakar," The Electronics Handbook", CRCpress.

404185 Artificial Intelligence (Elective II)

Credits: 03

Teaching Scheme:	Examination Scheme:
Lecture : 03 hr/week	In-Sem : 30 Marks End-Sem: 70 Marks

Course Objectives:

- To learn various types of algorithms useful in Artificial Intelligence (AI).
- To convey the ideas in AI research and programming language related to emergingtechnology.
- To understand the concepts of machine learning, pattern recognition, and natural language processing.
- To understand the numerous applications and huge possibilities in the field of AI that gobeyond the normal human imagination.

Course Outcomes:

On completion of the course, student will be able to

1. Design and implement key components of intelligent agents and expert systems.
2. To apply knowledge representation techniques and problem solving strategies to common AI applications.
3. Applyand integrate various artificial intelligence techniques in intelligent system development as well as understand the importance of maintaining intelligent systems.
4. Build rule-based and other knowledge-intensive problem solvers.

Unit I :Foundation 6Hrs

Intelligent Agents, Agents and environments, Good behavior, The nature of environments, structure of agents, Problem Solving, problem solving agents, example problems, Searching for solutions, uniformed search strategies, avoiding repeated states, searching with partial information.

Unit II :Searching 6Hrs Search and exploration, Informed search strategies, heuristic function, local search algorithms and optimistic problems, local search in continuous spaces, online search agents and unknown environments, Constraint satisfaction problems (CSP), Backtracking search and Local search for CSP, Structure of problems, Games: Optimal decisions in games, Alpha- Beta Pruning, imperfect real-time decision, games that include an element of chance.
Unit III :Knowledge Representation 6Hrs First order logic, representation revisited, Syntax and semantics for first order logic, Using first order logic, Knowledge engineering in first order logic, Inference in First order logic, prepositional versus first order logic, unification and lifting, forward chaining, backward chaining, Resolution, Knowledge representation, Uncertainty and methods,Bayesian Probability and Belief network, probabilistic Reasoning,Bayesian networks, inferences in Bayesian networks,Temporalmodels,Hidden Markov models.
Unit IV :Learning 6Hrs Learning from observations: forms of learning, Inductive learning, Learning decision trees, Ensemble learning, Knowledge in learning, Logical formulation of learning, Explanation based learning, Learning using relevant information, Inductive logic programming, Statistical learning methods, Learning with complete data, Learning with hidden variable, EM algorithm, Instance based learning, Neural networks - Reinforcement learning, Passive reinforcement learning, Active reinforcement learning, Generalization in reinforcement learning.
Unit V :Pattern Recognition and Expert System6 Hrs Basic steps of pattern recognition system, Feature Extraction- Principal Component Analysis,Linear Discriminant Analysis, Classification, Object Recognition- Template Matching theory, Prototype Matching Theory, Speech Recognition, Pattern Mining- Apriori Algorithm,
Unit VI :Natural Language Understanding6Hrs Why NL, Formal grammar for a fragment of English, Syntactic analysis, Augmented grammars, Semantic interpretation, Ambiguity and disambiguation, Discourse understanding, Grammar induction, Probabilistic language processing, Probabilistic language models
Text Books: 1. Stuart Russell, Peter Norvig, "Artificial Intelligence", A Modern Approach, Pearson Education/Prentice Hall of India. 2. Elaine Rich and Kevin Knight, "Artificial Intelligence", Tata McGraw-Hill. Reference Books

404185 Optimization Techniques (Elective II)

Credits: 03

Teaching Scheme:				**Examination Scheme:**
Lecture : 03hr/week				**In-Sem : 30 Marks** **End-Sem: 70 Marks**

Course Objectives:

- To understand the need and origin of the optimization methods.
- To get a broad picture of thevarious applications of optimization methods used in engineering
- To define an optimizationproblem and its various components.

Course Outcomes:

Upon completion of the course, students will be able to:

1. Describe clearly a problem, identify its parts and analyze the individual functions.
2. Perform mathematical translation of the verbal formulation of an optimizationproblem.
3. Design algorithms, the repetitive use of which will lead reliably to finding an approximate solution
4. Discover, study and solve optimization problems.
5. Investigate, study, develop, organize and promote innovative solutions for various applications.

Unit I : Introduction to Optimization **6Hrs**

Introduction: Historical Development, Engineering Applications of Optimization, Statement of an Optimization Problem, Classification of Optimization Problems, Optimization Techniques, Engineering Optimization Literature, Mathematical Background.

Unit II :Classical Optimization Techniques **7Hrs**

Single-Variable Optimization, Multivariable Optimization with No Constraints, Multivariable Optimization with Equality Constraints, Multivariable Optimization with Inequality Constraints, Convex Programming Problem.

Unit III : Linear Programming **6 Hrs**

Introduction, Applications of Linear Programming, Standard Form of a Linear Programming Problem, Geometry of Linear Programming Problems, Definitions and Theorems, Solution of a System of Linear Simultaneous Equations, Pivotal Reduction of a General System of Equations, Motivation of the Simplex Method, Simplex Method,Revised Simplex Method, Duality in Linear Programming, Decomposition Principle, Sensitivity or Post optimality Analysis,Transportation Problem.

Unit IV : Nonlinear Programming -I **7Hrs**

Unimodal Function, Elimination Methods:Unrestricted Search, Unrestricted Search, Dichotomous Search, Interval Halving Method, Fibonacci Method

Interpolation Methods:Quadratic Interpolation Method, Cubic Interpolation Method, Direct Root Methods, Practical Considerations,

Unit V :Nonlinear Programming-II7Hrs

Introduction to Unconstrained Optimization techniques, Direct Search Methods: Random Search Methods,Grid Search Method, Univariate Method, Pattern Directions, Powell's Method, Simplex Method. Indirect Search Methods: Gradient of a Function, Steepest Descent (Cauchy) Method, Conjugate Gradient (Fletcher–Reeves) Method, Newton's Method, Davidon–Fletcher–Powell Method, Test Functions.

Unit VI : Modern Methods of Optimization6 Hrs

Genetic algorithms, Simulated annealing, Particle Swarm Optimization, Ant Colony Optimization, Optimization of Fuzzy systems, Neural Network based optimization

Text Books:

1.Singiresu S Rao, "Engineering optimization Theory and Practice", New Age International, 2009

2.Kalynamoy Deb, "Optimization for Engineering Design, Algorithms and Examples",PHI

Reference Books:

1. Hadley, G. "Linear programming", Narosa Publishing House, New Delhi.

2.Ashok D Belegundu, Tirupathi R Chandrupatla, "Optimization concepts and Application inEngineering", Pearson Education.

3. KantiSwarup, P.K.Gupta and Man Mohan, Operations Research, Sultan Chand and Sons.

4. J. S. Arora, Introduction to Optimum Design, McGraw-Hill Book Company.

5. David Lay, Steven L Lay, "Linear Algebra and its Applications", Pearson Education.

6. Papalambros& Wilde, Principles of Optimal Design, Cambridge University Press, 2008

404185 Electronics in Agriculture (Elective II)				
Credits: 03				
Teaching Scheme:			**Examination Scheme:**	
Lecture : 03 Hr/Week				**In-Sem : 30 Marks** **End-Sem: 70 Marks**

Course Objectives:

- To inculcate the ability to recognize environmental problems and to provide solutions to agricultural sector.
- An over view of technology of advanced topics like DAS, SCADA and Virtual Instrumentation.
- The ability to select the essential elements and practices needed to develop and implement the Engineering Automation for Agricultural sector.

Course Outcomes:

After successfully completing the course students will be able to

1. Understand Role of computers & virtual instrumentation.
2. Provide communication solution for interpreting environmental parameters with Electronics systems.
3. Describe Instrument technology used in agriculture.
4. Apply knowledge of Electronics in Agriculture.
5. Understand Greenhouse Technology & Role of Electronics Governance.

Unit I: Review of computers & Virtual instrumentation **6 Hrs**

Data loggers, Data acquisitions systems (DAS), Supervisory control and data acquisition (SCADA), Basics of PLC, Functional block diagram of computer control system, alarms, interrupts.Virtual Instrumentation: Historical Perspective, advantages, Block diagram and architecture of virtual instrument, data flow techniques, graphical programming in data flow, comparison with conventional programming.

Unit II:Communication Systems **6Hrs**

Use of field buses, functions, international standards, field bus advantages and disadvantages, Instrumentation network: sensor networks, Open networks-advantages and limitations, HART Network, Foundation field bus network.Profibus PA: Basics, architecture, model, network design.Foundation field bus segments: General consideration, network design.

Unit III:Instrument technology for agriculture **6Hrs**

Instrument for measurement of pH, Electrical conductivity, gas analysis, humidity, leaf area, chlorophyll content, and soil moisture & temperature.

Unit IV:Precision Farming **6Hrs**

An introduction to precision farming. GIS/GPS positioning system for precision farming, Yield monitoring and mapping, soil sampling and analysis. Computers and Geographic information systems. Precision farming- Issues and conditions. Role of electronics in farm machinery for precision farming.

Unit V:Electronics in Agriculture 6 Hrs Instrument for crop monitoring – moisture measurement – capacitive, infrared reflectance and resistance. Monitoring soil and weather – measurement of soil properties and meteorological parameters – irrigation control systems. Instruments for crop establishment monitoring. Crop spraying – selective crop spraying – flow control. Yield monitoring. Technology for precision farming. Instruments for protected cultivation – green house environment control – transducers and control system. Instruments and systems for crop handling processing and storage. ,	
Unit VI:Applications & Electronics Governance 6Hrs Greenhouse: History of modeling and control of Greenhouse, Identification of control and manipulation variables for Greenhouse. Crop Preservation : Importance of Preservation of various commodities and parts of plants, Drying process for preservation, Variable identification for drying process, Electronic control system for grape drying process.Agriculture& Electronics Governance: Governance products & services in agriculture sector, Role of Electronics Governance in Agricultural sector.	
Text Books: 1. Curtis Johnson, "Process Control Instrumentation Technology"; 8th Edition, Pearson Education 2.Stuart A. Boyer, SCADA supervisory control and data acquisition, ISA Publication	
Reference Books: 1. De Mess M. N. Fundamental of Geographic Information System. John Willy & sons, NewYork, Datta S.K.1987. 2. K. Krishna Swamy, "Process Control"; New Age International Publishers 3. Kuhar, John. E. 1977. The precision farming guide for agriculturalist. 4. Lori J. Dhabalt, USManual of Soil & Water conservation Engineering. Oxford & IBH Co. Sigma &Jagmohan, 1976.	

404186 Lab Practice I				
Credits:02				
Teaching Scheme:			**Examination Scheme:**	
Practical : 04 Hrs/week				**Oral : 50 Marks** **Term-work :50 Marks**

Computer Networks & Security

List of the Experiments(Minimum 8 experiments are to be performed).

1. Implementation of LAN using suitable multiuser Windows operating System anddemonstrating client-server and peer to peer mode of configuration.
2. Installation and configuration of Web server, FTP Server.
3. Study of DNS, SMTP & POP3 Determine the local host address, Ping to a host using its NetBIOS name Add IP addresses/host name mappings to the local host file Configure DNS service on Windows 2000 server Use Domain Name Service to resolve hostnames into IP addresses. Interact with an Email server using SMTP and POP3 protocols commands.
4. Installation and configuration of Telnet server for Telnet communication.
5. Installation and configuration of Proxy server.
6. Installation and configuration of DHCP server.
7. Study of IP Addresses subnetting and CIDR
8. Study of Network Protocol Analyzer tool/software.
9. Study of network monitoring tool/software.
10. Simulating LAN or WAN using suitable network simulator.
11. Write a program to simulate leaky bucket/token bucket.
12. Echo Client and Server Program Using TCP or UDP or both in C/Java
13. Write a program for Encryption and Decryption
14. Study of HTTPS, IPSec and SSH using Wireshark.

Radiation & Microwave Techniques

List of Experiments[Minimum 08]

Group A [Any 2]

1. To measure and compare radiation pattern, return loss, impedance, gain, beam width of dipole antenna and folded dipole antenna at microwave frequency

OR

1. To measure radiation pattern and gain of horn or parabolic antenna at microwave frequency
2. Design, simulate and compare performance of microwave dipole antennas of length 2λ, λ, $\lambda/2$ and $\lambda/4$.
3. Design, simulate and compare the performance of two element broad side and end fire uniform amplitude and uniformly spaced linear array.

Group B[Any 6]

4. To measure and plot mode characteristics of reflex klystron.
5. To measure VI characteristics of Gunn Diode and study of PIN modulator.
6. To measure and verify port characteristics of microwave tees (E, H, E-H or magic planes).
7. To measure and verify port characteristics of directional coupler and calculate coupling factor, insertion loss and directivity.
8. To measure and verify port characteristics of isolator and circulator and calculate insertion loss and isolation in dB.
9. To measure wavelength of the microwave using microwave test bench and verify with its theoretical calculations.
10. To plot standing wave pattern and measure SWR for open, short and matched termination at microwave frequency using slotted section with probe carriage.
11. Study the network analyzer and carry out the measurements of s-parameters.

404186Laboratory Practice II

Credits: 02				
Teaching Scheme:			**Examination Scheme:**	
Practical : 04 hr/week				**Practical : 50 Marks** **Termwork : 50 Marks**

VLSI Design& Technology

List of Experiments:

A. To write VHDL code, simulate with test bench, synthesis, implement on PLD. [Any 4].

1. 4 bit ALU for add, subtract, AND, NAND, XOR, XNOR, OR, & ALU pass.
2. Universal shift register with mode selection input for SISO, SIPO, PISO, & PIPO modes.
3. FIFO memory.
4. LCD interface.
5. Keypad interface.

B. To prepare CMOS layout in selected technology, simulate with and without capacitive load, comment on rise, and fall times.

1. Inverter, NAND, NOR gates, Half Adder
2. 2:1 Multiplexer using logic gates and transmission gates.
3. Single bit SRAM cell

Digital Image and Video Processing

List of Practicals

(Perform any 8 practical on appropriate software)

1. Perform basic operations on images.
2. Perform conversion between color spaces.
3. Perform histogram equalization.
4. Perform image filtering in spatial domain.
5. Perform image filtering in frequency domain.
6. Perform image restoration.
7. Perform image compression using DCT / Wavelet transform.
8. Perform edge detection using various masks.
9. Perform global and adaptive thresholding.
10. Apply morphological operators on an image.
11. Obtain boundary / regional descriptors of an image.
12. Extraction of frames from video, improve the quality and convert them back to compressed video.

Industrial Drives and Control

(Minimum 8 experiments are to be performed):

1. DC motor control using semi/full 1-Φ /3-Φ converter. (Open loop and closed loop)
2. 4-Quadrant chopper fed reversible DC drive
3. Dual converter fed DC Drive (Single phase/ Three phase)
4. Induction motor speed control using VFD
5. Speed Control of Universal Motor.
6. Stepper motor drive.
7. BLDC Motor drive.
8. Three phase brushless generator for wind energy applications.
9. Simulation of closed loop controlled DC motor drive using PSIM/Matlab/MathCad/ open source software

10 Simulation of closed loop controlled AC motor drive using PSIM / Matlab/MathCad/ open source software

Embedded Systems & RTOS

Minimum 08 experiments

Any 02 Lab exercise from Sr.No 2,3,4

Any 01 Lab exercise from Sr.No 05,06

List of Practicals:

1. Porting of ucos-II on ARM7/Cortex controller.
2. Implementation/Verification of multitasking (minimum 03 tasks) with ucos-II on ARM7/Cortex controller.
3. Implementation of semaphore with ucos –II service ARM7/Cortex controller for resource management and synchronization.
4. Implementation of interprocess communication with ucos-II mailbox and message queue service on ARM7/Cortex controller.
5. Programming with exploring onchip ADC of Cortex /MSP430 based microcontroller.
6. Programming on motor control with exploring onchip PWM of Cortex based microcontroller.
7. Exercise on Porting of Linux on ARM board (ARM9 preferably)
8. Programming for device driver with Embedded Linux.
9. Programming with Arduino development for GPIO on Arduino Uno board.

Case study of any compute/communication/control application on Arduino Uno board

Internet of Things

A Project based Learning approach will be followed for this course hence the experiments will be small projects to be built by the students.

Suggested List of the Experimental Projects(Minimum 6 are to be performed):

1. Study& Survey of various development boards for IoT.

2. Study & Survey of various IoT platforms.

3. Interfacing sensors and actuatorswithAurdino .

4. Build a cloud-ready temperature sensor with the Arduino Uno and the anyIoT Platform: This project shows the building of a temperature sensor.

5. Interfacing Sensors and actuators with Raspberry Pi 2.

6. IoT based Stepper Motor Control with Raspberry Pi: The combination of Raspberry Pi and IoT is an exciting one. Raspberry Pi has many general purpose I/O pins and has the ability to control different actuators like stepper motors. In this project, an internet control of stepper motor using

Raspberry Pi computer is developed. The connectivity is divided into server side software and client side software.

7.IoT based Web Controlled Home Automation using Raspberry Pi.

8. A Simple IoT Project with the ESP8266 WiFi module: Here is a simple project with ESP8266 wi-fimodule.This project collects the temperature and is displayed on the network.

9. Implement a RFID Based IoT Project

404188 Project Phase-I

Credits: 02

Teaching Scheme:		Examination Scheme:
Tutorial: 2 Hrs/week		OR :50Marks

Note:

1. Term work assessment is based on the project topic. It consists of Literature Survey and basic project work. The abstract of the project should be submitted before Term workassessment.
2. The report consists of the Literature Survey, basic project work and the size of the report should be maximum of 40pages.
3. The examination is conducted by two examiners (internal and external) appointed by the university. The examiners appointed must have minimum 5 years of experience with UG qualification or 2 years with PG qualification.
4. The assessment is based on Innovative Idea, Depth of understanding, Applications, Individual contributions, presentation, and the grade given by the internal guide based on the work carried out in a semester.
5. A log book of Work carried out during the semester will be maintained with monthly review remarks by the guide and HoD.
6. A certified copy of report is required to be presented to external examiner at the time of final examination.

Audit Course 5 (1):Green Energy

About the course

This course provides an introduction to energy systems and renewable energy resources, with a scientific examination of the energy field and an emphasis on alternate energy sources and their technology and application. The students will explore society's present needs and future energy demands, examine conventional energy sources and systems, including fossil fuels and nuclear energy, and then focus on alternate, renewable energy sources such as solar, biomass (conversions), wind power, geothermal, and hydro. Energy conservation methods will be emphasized

Course Objectives:

- To understand the conventional and non conventional energy sources
- To understand different renewable energy sources and their generation
- To understand the various applications & benefits of renewable energy sources
- To enable student to understand project management, energy audit and Installation

Course Outcomes:
After the successful completion of this course, the student is expected to have/be able to:
1. List and generally explain the main sources of energy and their primary applications in the India, and the world.
2. Describe the challenges and problems associated with the use of various energy sources, including fossil fuels, with regard to future supply and the environment.
3. Discuss remedies/potential solutions to the supply and environmental issues associated with fossil fuels and other energy resources.
4. List and describe the primary renewable energy resources and technologies.
5. Describe/illustrate basic electrical concepts and system components.
6. Convert units of energy—to quantify energy demands and make comparisons among energy uses, resources, and technologies.
7. Collect and organize information on renewable energy technologies as a basis for further analysis and evaluation.

Unit 1: Introduction of conventional & renewable energy sources:
Environment aspects, Energy Efficient materials, Pollution Control techniques, Energy conservation, Energy Audits

Unit II: Details of renewable energy sources & various systems
Solar, Wind, Hydro, Bio-power, Waste to Power

Unit III: Various applications & benefits
Renewable power projects for smart cities & rural electrification, Power conversion techniques, Off-grid/Stand-alone systems, Grid connected systems, Design of Grid-tied & off-grid Solar PV systems, Design of Grid-tied & off-grid Wind systems, Design of Grid-tied & off-grid Hybrid systems, Storage technologies

Unit IV: Project management
Installation & commissioning techniques & standards, Remote monitoring & control techniques, Performance optimization & control, Practical's / Hands-on exposure, Maintenance & Service of plants, Government policies

Guidelines for Conduction (Any one or more of following but not limited to)
• Guest Lectures
• Group Activities
• Assignments
• Taking up small project for short duration

Guidelines for Assessment (Any one or more of following but not limited to)
• Practical Test
• Presentation
• Paper / (Theory assessment test)
• Report

Sources/ References:

1. Boyle, Godfrey. 2004. Renewable Energy (2nd edition). Oxford University Press, 450 pages (ISBN: 0-19- 926178-4).
2. Boyle, Godfrey, Bob Everett, and Janet Ramage (eds.) 2004. Energy Systems and Sustainability: Power for a Sustainable Future. Oxford University Press, 619 pages (ISBN: 0-19-926179-2)
3. Ashok Desai V, *Non-Conventional Energy,* Wiley Eastern Ltd, 1990.
4. Mittal K.M, *Non-Conventional Energy Systems*, Wheeler Publishing Co. Ltd, 1997.
5. Ramesh R, Kurnar K.U, *Renewable Energy Technologies,* Narosa Publishing House, New Delhi, 1997.
6. Renewable Energy Resources by John Twidell and Tony Weir.

Audit Course 5 (2) :Human Behavior

About the Course:

Human behavior is the responses of individuals or groups of humans to internal and external stimuli. It refers to the array of every physical action and observable emotion associated with individuals, as well as the human race. Social behavior is a subset of human behavior and includes the study of considerable influence of social interaction and culture. Additional influences include ethics, encircling, authority, rapport, hypnosis, persuasion and coercion.

The behavior of humans falls within a range with some behavior being common, some unusual, some acceptable, and some beyond acceptable limits. The acceptability of behavior depends heavily upon social norms and is regulated by various means of social control. Human behavior is experienced throughout an individual's entire lifetime. It includes the way they act based on different factors such as genetics, social norms, core faith, and attitude. An attitude is an expression of favor or disfavor toward a person, place, thing, or event.

Course Objectives:

- To develop understanding of Behavioral Aspects.
- To identify and develop Attitude and Core Faith values
- To expose students to Family Relations, time and career management
- To enable student to understand Creative Thinking and Problem solving
- To enable students to understand Humanistic Education.

Course Outcomes:

On completion of the course, society will observe –

1. Change in awareness levels, knowledge and understanding of student
2. Change in attitudes / behavior of students with regards to their education improved teamwork, institutional leadership and other life skills
3. Improvement in social health and attitude.

Unit 1:

Why Human Relations are so important? Understanding Behavior, Human Relations, and Performance, Personality, Stress, Learning, and Perception, Attitudes, Self-Concept, Natural acceptance of human values, and Ethics, Dealing with Conflict, Leading and Trust.

Unit 2:

Time and Career Management, Interpersonal Communication, Organizational Structure and Communication, Team Dynamics and Leadership, Teams and Creative Problem Solving and Decision Making

Unit 3:

Understanding Harmony in the Family and Society, Harmony in Human Relationship, Understanding the meaning of *Vishwas*; Difference between intention and competence, Understanding the meaning of *Samman*; Difference between respect and differentiation. Understanding the harmony in the society: *Samadhan, Samridhi, Abhay, Sahasttva*as comprehensive Human Goals.

Unit 4:

Justice in Humankind, Nurturing and Exploitation, Definitiveness of Ethical Human Conduct, Basis for Humanistic Education, Humanistic Constitution and Humanistic Universal Order, Competence in professional ethics.

Reference Books:

1. “Human Relations in Organizations Applications and Skill Building” RobartLussier, eighth edition, McGraw-Hill (2014).

2. Atkinson and Hilgard’s, “Introduction to psychology” Nolen-Hoeksema, S., Fredrickson, B. L., Loftus, G. R., & Lutz, C., Cengage Learning EME.

3. “A Foundation Course in Human Values and Professional Ethics” R R Gaur, R Sangal, G P Bagaria, Excel Books, New Delhi and Teacher's Manual, R R Gaur, R Sangal, G P Bagaria, Excel Books, New Delhi

4. A Nagraj, 1998, JeevanVidyaekParichay, Divya Path Sansthan, Amarkantak.

5. A.N. Tripathy, 2003, Human Values, New Age International Publishers.

Semester-II

404189 Mobile Communication		
Credits: 03		
Teaching Scheme:		**Examination Scheme:**
Lectures: 3Hrs/ Week		**In-Sem : 30 Marks** **End-Sem : 70 Marks**

Course Objectives

- To understand switching techniques for voice and data traffic.
- To nurture students with knowledge of traffic engineering to design networks.
- To realize importance of cellular concepts and its propagation mechanism.
- To understand architecture of GSM system.
- To overview 4G LTE and 5G technologies.

Course Outcomes

On completion of the course, student will be able to

1. Apply the concepts of switching technique and traffic engineering to design multistage networks.
2. Explore the architecture of GSM.
3. Differentiate thoroughly the generations of mobile technologies.

Unit I - Switching techniques for Voice and Data **8Hrs**

Switching techniques for Voice: Manual Switching System, Electronic Switching System and Time Division Switching. Single Stage networks, Gradings, Two stage and Three stage networks. Synchronization, **Control of switching systems:** Call processing Functions, Common Control, Reliability, Availability and Security.

Switching techniques for Data: Circuit switching, Message Switching and packet Switching in perceptive with mobile communication.

Unit II - Traffic Engineering and Signalling **8Hrs**

Telecommunication Traffic: Unit of Traffic, Traffic measurement, A mathematical model, Lost- call systems: Theory, traffic performance, loss systems in tandem, traffic tables. Queuing systems: Erlang Distribution, probability of delay, Finite queue capacity, Systems with a single server, Queues in tandem, delay tables and application of delay formulae.

Signaling: Customer line signaling. FDM carrier systems, PCM signaling, Inter-register signaling, Common channel signaling, CCITT signaling system and Digital customer line signaling.

Unit III - Cellular Concept **8Hrs**

Introduction to cellular telephone system, Cellular concept : Expansion of mobile system capacity through frequency reuse, Cell geometry, Selection of cluster size, Cell splitting and sectoring, Coverage and capacity in cellular system and Handoff strategies.

Propagation Mechanism: Free space and two ray propagation model, Basic propagation mechanism. Hata outdoor propagation model. **Small Scale Fading and Multipath:** Types of Small scale fading, Small scale multipath propagation, Impulse response model of multipath channel and Small scale multipath measurements.

Unit IV - GSM Fundamentals **8Hrs**

Introduction, Architecture of GSM, characteristics of GSM standards, services, Radio transmission parameters in GSM System, Applications.

Unit V - GSM Channels and Services	**8Hrs**
Traffic and Logical Channels in GSM, GSM time hierarchy, GSM burst structure, Description of call setup procedure, Handover mechanism in GSM, Security in GSM. **Data transmission in GSM:** Data Services, SMS, HSCSD, GPRS, EDGE. **Multiple Access Techniques**-TDMA, CDMA and OFDMA.	
Unit VI - Evolution of Mobile Technologies	**6Hrs**
Evolution of Mobile Generation and its comparison(GSM & CDMA) **Overview of LTE :** LTE basics , LTE frame structure, LTE Design parameters with Standardization and Architecture of LTE. **Overview of 5 G Networks :** Comparison of 4G and 5G technology, Opportunities and requirements in 5G network, Open Wireless Architecture of 5G network and Disruptive technologies for 5G.	
Text Books	
1. Thiagarajan Vishwanathan, "Telecommunication Switching Systems and Networks"; PHIPublications 2. Theodore Rappaport, "Wireless Communications Principles and Practice" Second Edition, Pearson Education	
Reference Books	
1. Fei Hu, "Opportunities in 5G Networks : A research& development perspective", CRC Press 2. J. E. Flood , "Telecommunications Switching, Traffic and Networks", Pearson Education 3. Krzysztof Wesolowski, "Mobile Communication Systems", Wiley Student Edition 4. John C. Bellamy, "Digital Telephony", Third Edition; Wiley Publications 5. Mischa Schwartz, "Mobile Wireless Communications", Cambridge University Press 6. AdityaJagannatham,"Principles of Modern Wireless Communication Systems"	

404190 Broadband Communication Systems

Credits: 04

Teaching Scheme:				**Examination Scheme:**
Lecture : 04 hr/week				**In-Sem : 30 Marks** **End-Sem : 70 Marks**

Course Objectives:

- To comprehend the three primary components of a fiber optic communication system.
- To understand the system design issues and the role of WDM components in advanced light wave systems.
- To understand the basics of orbital mechanics and the look angles from ground stations to the satellite.
- To apply subject understanding in Link Design.

Course Outcomes:

After successfully completing the course students will be able to:

1. Perform Link power budget and Rise Time Budget by proper selection of components and check its viability.
2. Perform Satellite Link design for Up Link and Down Link.

UNIT I: Light wave System Components **8Hrs** Key Elements of optical fiber system, Optical fibers as a communication channel: Optical fiber modes and configurations, Mode theory for Circular waveguides, Single mode fibers, Graded index fiber structure, Signal degradation in optical fibers. Optical sources: Basic concepts and characteristics of LEDs and LASERs. Photo detectors: Basic concepts, Common photo detectors.
UNIT II: Light wave Systems **6 Hrs** System architectures, Point to point links: System considerations, Design guidelines: Optical power budget, Rise time budget, Long - Haul systems.
UNIT III: Multichannel Systems **6 Hrs** Overview of WDM, WDM Components: 2 x 2 Fiber coupler, Optical isolators and circulators, Multiplexers and De-multiplexers, Fiber Bragg Grating, FBG applications for multiplexing and de-multiplexing function, Diffraction gratings, Overview of optical amplifiers: SOA, EDFA and RFA in brief.
UNIT IV: Orbital Mechanics and Launchers **8 Hrs** History of Satellite communication, Orbital mechanics, Look angle determination, Orbital perturbations, Orbital determination, Launchers and launch vehicles, Orbital effects in communication system performance.
UNIT V: Satellite sub systems **6 Hrs** Satellite Subsystems, Attitude and Control Systems (AOCS), Telemetry, Tracking, Command and monitoring, Power systems, Communication subsystems, Satellite antennas, Equipment reliability and space qualification.
UNIT VI: Satellite communication link design **8Hrs** Introduction, Basic transmission theory, System noise temperature and G/T Ratio, Design of downlinks, SatelHrsite systems using small earth stations, Uplink design, Design of specified C/N: Combining C/N and C/I values in satellite links system design examples.
Text Books: 1. Gerd Keiser, “Optical fiber Communications”, Tata McGraw Hill, 4th edition. 2. Timothy Pratt, Charles Bostian, Jeremy Allnutt, “Satellite Communications”, John Wiley & Sons.
Reference Books: 1. Govind P. Agrawal, “Fiber -Optic Communication Systems”, Wiley, 3rd edition. 2. Dennis Roody, “Satellite Communications”, McGraw Hill

404191 Machine Learning (Elective III)

Credits: 03

Teaching Scheme:				**Examination Scheme:**
Lecture : 03 Hr/week				**In-Sem : 30 Marks** **End-Sem: 70 Marks**

Course Objectives:

- Explore supervised and unsupervised learning paradigms of machine learning used forregression and classification.
- To design and analyze various machine learning algorithms using neural networks
- To explore Deep learning technique and various feature extraction strategies.

Course Outcomes:

On completion of the course, student will be able to

1. To compare and contrast pros and cons of various machine learning techniques and to get an in sight of when to apply a particular machine learning approach.
2. To mathematically analyze various machine learning approaches and paradigms.
3. To implement convolution neural networks in recognition applications.

Unit I :Introduction to Machine Learning **4Hrs**

Why Machine learning. Types of machine learning, basic concepts in machine learning like parametric and non-parametricmodeling, linear and nonlinear regression, overfitting and dimensionality reduction. Decision trees, Feature reduction.

Unit II : Models for Regression and Classification **8Hrs**

Linear Models for Regression :Least SquaresandNearestNeighbors ,Linear Basis Function Models,The Bias-Variance Decomposition,Bayesian Linear Regression,Bayesian Model ComparisonLinear Models for Classification : Discriminant Functions .Probabilistic Discriminative Models Multivariate Data,ParameterEstimation,MultivariateClassification,Multivariate RegressionKernal Methods : Support Vector machines and Relevance Vector Machines

Unit III :Clustering **6Hrs**

Dimensionality Reduction : Principal Components Analysis,Factor Analysis,Multidimensional Scaling,Linear Discriminant Analysis Clustering : k-Means Clustering,Mixtures of Gaussians.

Unit IV : Artificial Neural Networks I 6Hrs

Biological neuron, Artificial neuron model, concept of bias and threshold, Activation functions, McCulloch-Pits Neuron Model, learning paradigms,concept of error energy, gradient descent algorithm and application of linear neuron for linear regression,: Learning mechanisms: Hebbian, Delta Rule, Perceptron and its limitations.

Unit V : Artificial Neural Networks II **6 Hrs**

Multilayer perceptron (MLP) and back propagation algorithm, Application of MLP for classification, Self-Organizing Feature Maps,Learning vector quantization Radial Basis Function networks.

Unit VI : Deep Learning and Convolution Neural Networks **6Hrs**

Improvement of the Deep Neural Network:Vanishing Gradient, Overfitting, Computational Load,ReLU Function, Dropout Architecture of ConvNet, Convolution Layer, Pooling Layer, Applications of CNN's.

Text Books:

1. Christopher Bishop, "Pattern Recognition and Machine Learning", Springer, 2007.
2. LaureneFausett ," Fundamentals of Neural Networks: Architectures, Algorithms And Applications, Pearson Education, Inc, 2008.

Reference Books:

1. Kevin Murphy, Machine Learning: A Probabilistic Perspective, MIT Press, 2012.
2. Trevor Hastie, Robert Tibshirani, Jerome Friedman, "The Elementsof Statistical Learning", Springer 2009.
3. Phil Kim, "MATLAB Deep Learning: With Machine Learning, Neural Networks and Artificial Intelligence",a Press 2017.
4. EthemAlpaydın "Introduction to Machine Learning" Second Edition The MIT Press 2010.
5. SimonHaykin," Neural Networks : A comprehensive foundation, Prentice Hall International Inc. 1999.

404191 PLC & Automation (Elective III)

Credits: 03

Teaching Scheme:			**Examination Scheme:**	
Lecture : 03hr/week				**In-Sem : 30 Marks** **End-Sem: 70 Marks**

Course Objectives:

- Student will get the ability to recognize industrial control problems suitable for PLC control
- The learners will get an over view of technology of advanced topics such as SCADA, DCS Systems, DigitalController, CNC Machines.
- Student will gain the ability to select the essential elements and practices needed to develop and implement the Engineering Automation using PLC approach.

Course Outcomes:

On successful completion of the course, students able to:

1. Understand PLC architecture
2. Develop PLC ladder programs for simple industrial applications
3. Design Automation systems for industrial applications
4. Implement the Engineering Automation using PLC approach.

Unit I: Process Control & Automation 6Hrs

Process control principles, Servomechanisms, Control System Evaluation, Analog control, Digital control, Types of Automation; Architecture of Industrial Automation Systems, Advantages and limitations of Automation, Effects of modern developments in automation on global competitiveness.

Unit II: Transmitters and Signal Conditioning 6Hrs

Need of transmitters, Standardization of signals, Current, Voltage and Pneumatic signal standards, 2-Wire & 3-Wire transmitters, Analog and Digital signal conditioning for RTD, Thermocouple, DPT etc , Smart and Intelligent transmitters.

Unit III: Controllers and Actuators 6Hrs

PID Controller, Cascade PID control, Microprocessor Based control, PAC (Programmable automation controller), Mechanical switches, Solid state switches,Electrical actuators: Solenoids, Relays and Contactors, AC Motor, VFD, energy conservation schemes through VFD, DC Motor, BLDC Motor, Stepper Motor, Servo Motor, Pneumatic and hydraulic actuators.

Unit – IV Introduction to PLC 6Hrs

PLC: Characteristics, Operation, function, Types of PLC, Architecture Of PLC, Applications of PLC, PC v/s PLC, PLC programming, Ladder diagram: of logic gates, multiplexer, Ladder diagram for different logical conditions or logical equations or truth table. Timers: types of timer, Characteristics, Function of timer in PLC, Classification of a PLC timer, Ladder diagram using timer, PLC counter, Ladder diagram using counter.

Unit – V Industrial Automation 6 Hrs

Basic Concept, History and Hierarchy of DCS, Functions of each level, Advantages and Disadvantages, Architecture of SCADA , MTU- functions of MTU, RTU- Functions of RTU, Working of SCADA, Comparison, suitability of PLC, DCS and SCADA, Applications: Thermal power plant, Irrigation and Cement factory.

Unit VI: Automation and CNC (Computer Numeric Control) Machines	**7 Hrs**

Introduction of CNC Machines: Basics and need of CNC machines, NC, CNC and DNC (Direct NC) systems, Structure of NC systems, Applications of CNC machines in manufacturing, Advantages of CNC machines. Industrial Communication:Devicenet, Interbus , Device network: Foundation Fieldbus -H 1, HART, CAN, PROFIBUS-PA, Control network: ControlNet, FF-HSE, PROFIBUS-DP, Ethernet, TCP/IP. Panel Engineering for Automation

Text Books:

1. Curtis Johnson, "Process Control Instrumentation Technology"; 8th Edition, Pearson Education.
2. MadhuchhandaMitra, SamarjitSen Gupta, "Programmable Logic controllers and Industrial Automation"; Penram International Publishing India Pvt. Ltd.

Reference Books:

1. Stuart A. Boyer, SCADA supervisory control and data acquisition, ISA Publication.
2. John W. Webb, Ronold A Reis, "Programmable Logic Controllers, Principles and Applications"; 5th Edition, Prentice Hall of India Pvt. Ltd.
3. Kilian, "Modern control technology: components & systems, Delmar 2nd edition.
4. Bela G Liptak, Process software and digital networks, 3rd edition, 2002.
5. Pollack. Herman, W & Robinson., T. "Computer Numerical Control", Prentice Hall. NJ. Pabla, B.S. &Adithan, M. "CNC Machines", New Age Publishers, New Delhi

404191Audio and Speech Processing (Elective III)

Credits: 03

Teaching Scheme	Examination Scheme
Lecture : 03 hr/week	**In-Sem: 30 Marks** **End-Sem: 70 Marks**

Course Objectives:

- To understand basics of speech production and perception mechanism.
- To understand classification of speech sounds based on acoustic and articulatory phonetics.
- To understand the motivation of short-term analysis of speech and audio.
- To understand various audio and speech coding techniques.
- To perform the analysis of speech signal using LPC.
- To extract the information of the speech or audio signals in terms of cepstral features.
- To provide a foundation for developing applications in the field of speech and audio processing.

Course Outcomes:

On completion of the course, student will be able to

1. Design and implement algorithms for processing speech and audio signals considering the properties of acoustic signals and human hearing.
2. Analyze speech signal to extract the characteristic of vocal tract (formants) and vocal cords (pitch).
3. Analyze speech signal for extracting LPC and MFCC Parameters of speech signal.
4. Apply the knowledge of speech and audio signal analysis to build speech processing applications like speech coding, speech recognition, speech enhancement and speaker recognition/verification.

Unit I : Fundamentals of speech production 6 Hrs
Anatomy and physiology of speech production, Human speech production mechanism, LTI model for speech production, Nature of speech signal, linear time varying model, articulators, articulatory phonetics, manner of articulation, place of articulation, acoustic phonetics, spectrogram, classification of speech sounds: vowels, semivowels, nasal diphthongs, stops, affricates, fricative, vowel triangle.

Unit II : Human auditory system and speech perception 6 Hrs
Anatomy and physiology of the ear, outer ear, middle ear and inner ear. Human auditory system, simplified model of cochlea. Sound perception, Auditory psychophysics, thresholds, just noticeable differences (JNDs), Sound pressure level and loudness. Sound intensity and Decibel sound levels. Pitch perception, masking, Concept of critical band and introduction to auditory system as a filter bank, Uniform, non-uniform filter bank, mel scale and bark scale. Speech perception: vowel perception. Coarticulation effects. Consonant perception, perception of manner of articulation feature. Perception of place of articulation.

Unit III: Time and frequency domain methods for speech and audio signal analysis. 6Hrs
Time-dependent speech processing. Short-time energy, short time average magnitude, Short time average zero crossing rate. Speech Vs. silence discrimination using energy and zero crossing rate. Short-time autocorrelation function, short-time average magnitude difference function. Pitch period estimation using autocorrelation method. Audio feature extraction, Spectral centroid, spectral spread, spectral entropy, spectral flux, spectral roll-off. Spectrogram: narrow band and wide band spectrogram.

Unit IV : Linear prediction and cepstral analysis 6Hrs
Basic principles of linear predictive analysis. Autocorrelation method, covariance method. Solution of LPC equations: Durbin's recursive solution, lattice formulations and solutions. Frequency domain interpretation of LP analysis. Applications of LPC parameters as pitch detection and formant analysis
Homomorphic processing of speech signal, application of cepstral analysis for vocal tract vocal cord parameter estimation (formants and pitch). Computation of MFCC.

Unit V : Speech and Audio coding 6Hrs
Time domain waveform coding: linear PCM, companded PCM, DPCM, DM, ADM.
Spectral coders: Filter bank analysis, sub-band coders, Adaptive transform coders (ATC), Harmonic coding. Linear predictive coders (LPC), Non-LP source voice coders: phase vocoders, channel vocoders, excitation for vocoders, Homomorphic (Cepstral) vocoders. Speech coding standards and applications.

Unit VI : Digital speech processing for man-machine communication 6Hrs
Automatic speech recognition (isolated word recognition, automatic telephone number dialing system etc. using statistical signal modeling e.g. GMM, GMM-HMM), Linear and dynamic time warping, text to speech synthesis, speaker recognition and verification, speech enhancement, Introduction to Musical instrument classification, Musical Information retrieval.

Text Books:

1. L. R. Rabiner and S.W. Schafer, "Digital processing of speech signals" Pearson Publication.
2. Douglas O'Shaughnessy, "Speech Communications: Human and Machine:, 2nd Edition Universities Press.

Reference Books:

1. Thomas F. Quateri , "Discrete-Time Speech Signal Processing: Principles and Practice" Pearson Publication.
2. ShailaApte, "Speech and audio processing", Wiley India Publication
3. Ben Gold and Nelson Morgan, "Speech and Audio Signal Processing: Processing and Perception of Speech and Music", Wiley India.
4. L. R. Rabiner , B. H. Juang and B. Yegnanarayana "Fundamentals of speech recognition". PearsonPublication

404191 Software Defined Radio (Elective III)

Credits: 03

Teaching Scheme:	Examination Scheme:
Lecture : 03Hr/Week	In-Sem: 30 Marks End-Sem: 70 Marks

Course Objectives:

- To understand "Modern Radio Communication System " that can be reconfigured
- To understand GNU Radio
- To understand how SDR platform provides easy access to wireless network system
- To understand how unlike simulation in Communication Projects, SDR allows easy
- access to both PHY and MAC layer
- To understand the concept of Cognitive Radio and Spectrum sharing

Course Outcomes:

On completion of the course, student will be able to

1. Compare SDR with traditional Hardware Radio HDR.
2. Implement modern wireless system based on OFDM, MIMO & Smart Antenna.
3. Build experiment with real wireless waveform and applications, accessing both PHY and MAC, Compare SDR versus MATLAB and Hardware Radio
4. Work on open projects and explore their capability to build their own communication System.

Unit I : Introduction to SDR and RF Implementation **6Hrs**

Introduction to SDR, Need of SDR, Principles of SDR , Basic Principle and difference in Analog radio and SDR , SDR characteristics, required hardware specifications, Software/Hardware platform, GNU radio -What is GNU radio, GNU Radio Architecture, Hardware Block of GNU,GNU software , MATLAB in SDR , Radio Frequency Implementation issues, Purpose of RF front End, Dynamic Range ,RF receiver Front End topologies, Flexibility of RF chain with software radio, Duplexer ,Diplexer ,RF filter ,LNA ,Image reject filters , IF filters , RF Mixers Local Oscillator , AGC, Transmitter Architecture and their issues, Sampling theorem in ADC, Noise and distortion in RF chain, Pre-distortion

Unit II :SDR Architecture **7Hrs**

Architecture of SDR-Open Architecture, Software Communication Architecture, Transmitter Receiver Homodyne/heterodyne architecture, RF front End, ADC, DAC, DAC/ADC Noise Budget, ADC and DAC Distortion, Role of FPGA/CPU/GPU in SDR, Applications of FPGA in SDR, Design Principles using FPGA, Trade –offs in using DSP, FPGA and ASIC, Power Management Issues in DSP, ASIC, FPGA

Unit III : Multi Rate Signal Processing	**6Hrs**
Sample timing algorithms, Frequency offset estimation and correction, Channel Estimation, Basics of Multi Rate, Multi Rate DSP, Multi Rate Algorithm, DSP techniques in SDR, OFDM in SDR	
Unit IV : Smart/MIMO Antennas using Software Radio	**6Hrs**
Smart Antenna Architecture, Vector Channel Modeling , Benefits of Smart Antenna Phased Antenna Array Theory, Adaptive Arrays, DOA Arrays, Applying Software Radio Principles to Antenna Systems, Beam forming for systems-Multiple Fixed Beam Antenna Array, Fully Adaptive Array , Relative Benefits and Trade-offs OF Switched Beam and Adaptive Array, Smart Antenna Algorithms , Hardware Implementation of Smart Antennas, MIMO -frequency, time, sample Synchronization, Space time block coding-Space Time Filtering, Space Time Trellis Coding . Case Study : Principles of MIMO-OFDM	
Unit : Cognitive Radio	**6Hrs**
Cognitive Radio Architecture, Dynamic Access Spectrum, Spectrum Efficiency, Spectrum Efficiency gain in SDR and CR ,Spectrum Usage, SDR as a platform for CR, OFDM as PHY layer ,OFDM Modulator, OFDM Demodulator, OFDM Bandwidth, Benefits of OFDM in CR, Spectrum Sensing in CR, CR Network	
Unit VI : Applications of SDR	**7Hrs**
Applicationof SDR in Advance Communication System-Case Study, Challenges and Issues, Implementation, Parameter Estimation –Environment, Location, other factors, Vertical Handoff, Network Interoperability. Case Study : 1)CR for Public Safety –PSCR , Modes of PSCR, Architecture of PSCR 2)Beagle board based SDR 3)Embedded PCSR using GNU radio	
Text Books: 1. Jeffrey. H. Reed ,Software Radio : A Modern Approach to Radio Engineering, Pearson LPE 2. Markus Dillinge, KambizMadani, Nancy Alonistioti, Software Defined Radio :Architectures , Systems and Functions ,Wiley	
Reference Books: 1. Tony .J. Rouphael, RF and DSP for SDR, Elsevier Newness Press ,2008 2. Dr.TajStruman,Evaluation of SDR –Main Document 3. SDR –Handbook, 8th Edition , PENTEK 4. Bruce a. Fette, Cognitive Radio Technology, Newness, Elsevier	

404191 Audio Video Engineering (Elective III)

Credits: 03

Teaching Scheme:			Examination Scheme:	
Lecture : 03Hr/Week			**In-Sem** **End-Sem**	**: 30 Marks** **: 70 Marks**

Course Objectives:

- After learning AVE course, students will get benefit to learn and understand the working of real life video system and the different elements of video system plus the encoding/decoding techniques.
- The learners will be groomed up to understand different channel allocations, difference between various systems present in this world, their transmission and reception techniques.
- Students will get insight on functioning of individual blocks, different standards of compression techniques and they will be acquainted with different types of analog, digital TV and HDTV systems.
- The students will get overview of fundamentals of Audio systems and basics of Acoustics

Course Outcomes:

On successful completion of the course, students able to:

1. Apply the fundamentals of Analog Television and Colour Television standards.
2. Explainthe fundamentals of Digital Television, DTV standards and parameters.
3. Study and understand various HDTV standards and Digital TV broadcasting systems and acquainted with different types of analog, digital TV and HDTV systems.
4. Understandacoustic fundamentals and various acoustic systems.

Unit I: Fundamentals of Colour Television **8Hrs**

The basic Television system and scanning principles, Composite video signal and television standards, Color TV systems, fundamentals, mixing of colours, colour perception, chromaticity diagram. NTSC, PAL, SECAM systems, colour TV transmitter, (high level, low level), colour TV receivers.

Unit II: Digital TV and Display Devices **6Hrs**

Introduction to Digital TV, Digital TV signals and parameters, Digital TV Transmitters, MAC signals, advanced MAC signal transmission, Digital TV receivers, Basic principles of Digital Video compression techniques, MPEG Standards. Digital TV recording techniques, Display devices: OLED, LCD, TFT, Plasma, Camcoder, Digicam.

Unit III: HDTV **6Hrs**

HDTV standards and systems, HDTV transmitter and receiver/encoder, Digital TV satellite Systems, video on demand, CCTV, CATV, direct to home TV, set top box with recording facility, conditional access system (CAS), 3D TV systems, HD video cameras, Digital broadcasting, case study (Cricket match, Marathon, Football match).

Unit IV: Advanced TV Systems **6Hrs**

IP Audio and Video, IPTV systems, Mobile TV, Video transmission in 3G/4G mobile System, Digital Video Recorders, Wi-Fi Audio / Video Transmitter and Receivers.

Unit V: Fundamentals of Audio-Video Recording **8Hrs**

Methods of sound recording & reproduction, optical recording, CD recording, audio standards. Digital Sound Recording, CD/ DVD player, MP3 player, Blue Ray DVD Players, MP3 Player.

Unit VI: Fundamentals of Acoustics 6Hrs Studio acoustics & reverberation, P.A. system for auditorium, acoustic chambers, Cordless microphone system, special types of speakers & microphones, Digital Radio Receiver Satellite radio reception.
Text Books 1. Television and video Engineering, A. M. Dhake, TMH Publication. 2. R. R. Gulati, "Monochrome and colour television"
Reference Books 1. Television Engineering -Audio and Video Systems, D. S. Bormane, P.B. Mane& R RItkarkar, Wiley publication. 2. S. P. Bali, "Color TV Theory and Practice". 3. Bernard Grobb, Charles E, "Basic TV and Video Systems". 4. Video Demisified, Kelth jack, Penram International Publication. 5. Audio Video Systems, R.G. Gupta, TMH Publication

404192 ROBOTICS (Elective-IV)

Credits: 03

Teaching Scheme:		**Examination Scheme:**
Lecture : 03Hr/Week		**In-Sem : 30 Marks** **End-Sem: 70 Marks**

Course Objectives:

- To understand the history, concept development and key components of robotics technologies.
- To understand basic mathematics manipulations of spatial coordinate representation and transformation.
- Able to solve basic robot forward and inverse kinematic problems
- To understand and able to solve basic robotic dynamics, path planning and control problems

Course Outcomes:

On completion of the course, student will be able to

1. Familiar with the history, concept development and key components of robotics technologies.
2. Implement basic mathematics manipulations of spatial coordinate representation and transformation.
3. Solve basic robot forward and inverse kinematic problems
4. Understand and able to solve basic robotic dynamics, path planning and control problems

Unit I :Basic concepts in robotics 6Hrs

Definition ; anatomyof robot, basic structure of robot, Specifications and Classification of robot, Safety Measures in robotics ,Industrial Applications of Robots.

Unit II :Robot drivers,Sensors and Vision 6Hrs

Drives for robots: Electric, hydraulic and pneumatic.

Sensors: Internal-External,Contact-noncontact, position, velocity,force, torque, proximity and range.

Vision: Introduction to techniques, Image acquisition and processing

Unit III : End Effectors and Actuators **6Hrs** Different types of grippers- Mechanical,Magnetics,vacuum,Adhesive, Gripper force Analysis&Gripper Design , overview of actuators, Power and torque, Acceleration and velocitySpecifications and characteristics of Stepper motors, AC motors, DC motors and servomotors.
Unit IV : Robot Kinematics and Dynamics **8Hrs** Direct and inverse kinematics for industrial robots for position and orientation, Redundancy, Manipulator, direct and inverse velocity. Lagrangian formulation , Link inertia tensor and manipulator inertia tensor, Newton –Eller formulation for RP and RP manipulators, Trajectory planning, interpolation, static force and moment transformation, solvability, stiffness
Unit V:Programming methods **6Hrs** Robot language classification, Robot language structure, elements and its functions. Simple programs on Sensing distance and direction., Line Following Algorithms, Feedback Systems Other topics on advance robotic techniques
Unit VI : Developing and building a robot **6Hrs** Models of flexible links and joints, Robotic arm – Components and structure, Types of joints and workspace, Design models for mechanic arms and lifting systems **Case Study:** 1. Robots in material handling and assembly. 2. Human Robot Interaction
Text Books: 1. Introduction to Robotics By S.K.Saha , Tata McGraw Hill **2.** Robotics Control ,Sensing ,Vision and Intelligence by K.S. Fu, R.C .Gonzalez, C.S.G.Lee , Tata McGraw Hill
Reference Books: 1. J. Hirchhorn: Kinematics and Dynamics of Machinery, McGraw Hill book co. 2. Robert J. Schilling , Fundamentals of Robotics- Analysis and Control, Prentics Hall india. 3. Robotics Technology and Flexible Automation by S.R.Deb, S. Deb, Tata McGraw Hill 4. Robot Motion and Control (Recent Developments) by M.Thoma& M. Morari

404194 Biomedical Electronics (Elective-IV)				
Credits: 03				
Teaching Scheme:			**Examination Scheme:**	
Lecture : 03 hr/week				**In-Sem : 30 Marks** **End-Sem : 70 Marks**

Course Objectives:

- To study Human Physiological Systems from Engineering Perspectives
- To understand the basic signals in the field of biomedical.
- To study origins and characteristics of some of the most commonly used biomedical signals, including ECG, EEG, PCG, Pulse.
- To understand Sources and characteristics of noise and artifacts in bio signals.
- To understand use of bio signals in diagnosis, patient monitoring and physiological investigation

Course Outcomes:

After successfully completing the course students will be able to:

1. Model a biomedical system.
2. Understand various methods of acquiring bio signals.Understand various sources of bio

3. signal distortions and its remedial techniques.
4. Get an Overview of major Devices currently used in Medical field
5. The students will have an understanding of analyzing bio-signal and classifying them

Unit I: Introduction to Biomedical System 6Hrs

Biomedical Instrumentation System, Cell structure, Bio-Cell potential , Concept of Bio-electrodes, Types of Bio-electrodes to measure Bio-signal, Transducers and Sensors to measure Bio signal EEG,ECG,EMG, Respiration, Body temperature, SPO2, and Pulse. Artifacts in Bio signal Acquisition: Noise, Power line, Baseline, Skin Impedance and Motion Artifacts, Techniques to reduce the artifacts.

Unit II: Cardiovascular System 6Hrs

Introduction to Heart**,** Physiology and anatomy of Heart, Lead Configurations to acquire ECG, ECG preamplifiers, ECG recorder, Heart Sounds and Murmurs, Phonocardiography

Unit III:Nervous System 6Hrs

Nerve Cell and nerve potential, Neural Communication, Brain structure, 10-20 electrode placement for EEG , Types of Montage configuration, Types of EEG signals and its significance, EEG machine, EEG applications for Epilepsy and Sleep apnea**.**

Unit IV: Medical Instrumentation 8Hrs

Design of Instrumentation system for ECG acquisition, Isolation Amplifier, Right Leg drive Mechanism, Noise removal techniques using Active Filters, Wiener Filters, Adaptive Filters: Basic Concept, Principle noise cancellation model, removal of periodic events, using adaptive cancellation, adaptive cancellation of maternal ECG from fetal ECG of Interest. Grounding and shielding Concepts

Unit: Analysis of Electrical Activity of Heart 6Hrs

ECG Signal Processing: Removal of Base line and Power line Interference, Muscle noise Filtering, Highlight ECG feature points, QRS detection, ECG classification for normal and abnormal state using Multilayer Perceptron. Use of Multiscale analysis for ECG parameter estimation.

Unit VI:Medical Devices 4Hrs

Introduction To Blood Pressure Measurement (noninvasive), Life saving Devices Pacemakers and Defibrillators, Bedside Monitors, Central Monitoring system, Stress Test System, X Ray, CT scan , Dental instruments

Text Books:

1. Joseph J. Carr and John M. Brown, “Introduction to Biomedical Equipment Technology”, 4th Edition, Prentice Hall, 2000.
2. R. Rangayan, “Biomedical Signal Analysis”, Wiley 2002.
3. R.S.Khandpur, “Handbook of Biomedical Instrumentation”, Tata McGraw Hill, New Delhi, 2003, Edition-II.

Reference Books:

1. John L Semmlow, “Bio-signal and Biomedical Image Processing”, Marcel Dekker
2. Joseph J. Carr and John M. Brown, “Introduction to Biomedical Equipment Technology”, 4thEdition, Prentice Hall, 2000.

404194 Wireless Sensor Networks (Elective-IV)				
Credits: 03				
Teaching Scheme:			**Examination Scheme:**	
Lecture : 03 hr/week				**In-Sem : 30 Marks** **End-Sem: 70 Marks**

Course Objectives:

- To learn basic concepts of Wireless sensor networks
- To be familiar with architecture and protocols used in Wireless sensor networks
- To provide knowledge of deployment and security issued of Wireless sensor networks

Course Outcomes:

On completion of the course, student will be able to

1. Explain various concepts and terminologies used in WSN
2. Describe importance and use of radio communication and link management in WSN
3. Explain various wireless standards and protocols associated with WSN
4. Recognize importance of localization and routing techniques used in WSN
5. Understand techniques of data aggregation and importance of security in WSN
6. Examine the issues involved in design and deployment of WSN

Unit1 : Introduction **6 Hrs**

What are Wireless Sensor Networks, Wireless Sensor Node, Anatomy of a Sensor Node, architecture of WSN , Performance metrics in WSNs, types of WSN

Unit 2: Radio Communication And Link Management **7 Hrs**

Radio Waves and Modulation/Demodulation, Properties of Wireless Communications, Medium Access Protocols, Wireless Links Introduction, Properties of Wireless Links, Error Control, Naming and Addressing, Topology Control

Unit 3: Wireless Standards And Protocol Stack **7 Hrs**

WSN Standards- IEEE802.15.4 Low rate WPAN, Zigbee, WirelessHART, ISA 100.11a, 6LoWPAN,IEEE802.15.3, Wibree,BLE, Zwave, ANT, Insteon, Wavenis, Protocol stack of WSNs, Cross Layer Protocol Stack

Unit 4: Localization And Routing **7 Hrs**

Localization : Localization Challenges and Properties, Deployment Schemes, Proximity Schemes. Ranging Schemes, Range-Based Localization, Range-Free Localization,
Routing Basics, Routing Metrics, Routing Protocols, Full-Network Broadcast, Location-Based Routing, Directed Diffusion, Collection Tree Protocol, Zigbee, Multi-Hop Communications

Unit 5: Data Aggregation And Security **7 Hrs**

Clustering Techniques, In-Network Processing and Data Aggregation, Compressive Sampling, Security Issues in Wireless Sensor Networks, Attacks, Defensive Measures, Securityrequirements and threat model,

Unit 6: Designing And Deploying WSN Applications **6 Hrs**

Designing and Deploying WSN Applications,Early WSN Deployments, General Problems, General Testing and Validation, Requirements Analysis, The Top-Down Design Process, Bottom-Up Implementation Process.

Text Books 1.Kazem Sohraby, Daniel Minoli and TaiebZnati, “ Wireless Sensor Networks Technology, Protocols, and Applications“, John Wiley & Sons, 2007. 2.Holger Karl and Andreas Willig, “Protocols and Architectures for Wireless Sensor Networks”, John Wiley & Sons, Ltd, 2005.
Reference Books 1. HossamFahmy, “Wireless Senor Networks: Concepts, Application, experimentation and analysis”, Springer Publication 2. Anna Forster, “Introduction to Wireless Sensor Networks”, IEEE Press, Wiley Publication 3.Anna Hac, “Wireless Sensor Network Designs”, John Wiley & Sons Ltd,

404194 Renewable Energy Systems (Elective-IV)

Credits: 03

Teaching Scheme:			Examination Scheme:	
Lecture : 03hr/week				**In-Sem : 30 Marks** **End-Sem : 70 Marks**

Course Objectives:

- To study energy generation, different energy sources and their utilization and impact on environment
- To gain knowledge of solar radiation and its applications
- To understand the wind energy and its nature
- To analyze the performance of solar collectors and wind turbines
- To learn fuel cell and its efficiency

Course Outcomes:

On successful completion of the course, students able to:

1. Interpret energy reserves of India and potential of different energy sources.
2. Measure the solar radiation parameters and performance of different solar collectors.
3. Calculate different parameters of wind turbine rotor.
4. Implicit the importance and applications of geothermal and ocean energy.
5. Demonstrate knowledge in field of fuel cell and potential for power generation.

Unit I : Energy Resources and Utilization: 6Hrs

Conservation and forms of energy, energy reserves in India, nuclear power, hydroelectric power potential, India's power scene, impact on environment, renewable energy sources, energy parameters, cogeneration, rational energy use of energy, energy efficiency and conservation, new technologies, distributed energy systems and dispersed generation.

Unit II :Solar Energy 8Hrs

Solar constant, spectral distribution of extraterrestrial radiation, terrestrial solar radiation, solar radiation geometry, computation of COSθ, sunrise, sunset, day length, LAT, Empirical equation, solar radiation measurement, Solar Thermal energy collectors, design parameters,laws of thermal radiation, radiation heat transfer between real bodies, radiation optics, transmitivity, heat losses and coefficient, Solar Thermal energy storage.

Unit III : Solar photovoltaic systems& Solar Applications 8Hrs

Solar photovoltaic systems: Photovoltaics, Different types of PV Cells, Mono-poly crystalline and amorphous Silicon solar cells. Design of PV array. Efficiency and cost of PV systems

Solar Applications: Solar water heating, solar distillation, solar ponds, solar pumping system, solar cooker, solar green house.

Unit IV : Wind energy 8Hrs

Classification, types of rotors, terminology, operation of wind turbines, wind energy extraction, wind characteristics, wind speed, energy estimation, power density duration curve, density function, field data analysis, direction and wind speed, variation of wind speed, wind scale, energy pattern factor in wind power studies, land for wind energy, design of wind turbine rotor, regulating system, wind power generation curve, horizontal axis wind turbine generator, modes of wind power generation, advantages and disadvantages, wind energy farms.

Unit V: Ocean and Geothermal Energy	**6Hrs**
Ocean Energy: Tidal Energy, Tidal characteristics, Tidal Energy estimation, Development of a tidal power scheme,Wave energy- characteristics-energy and power from the waves. **Geothermal energy:**Structure of earth's interior, sites, field, gradient, resources, power generation, geothermal resources in India, utilization, global status of electricity generation from geothermal resources, advantages of geothermal energy	
Unit VI : Fuel Cells	**6Hrs**
Principle of operation of an acidic Fuel Cell, Technical parameter, Fuel Processor, methanol fuel cell, fuel cell types, Advantages of fuel cell power plants, comparison between acidic and alkaline hydrogen-oxygen fuel cells, state of art fuel cells, energy output of a fuel cell, efficiency and EMF of a fuel cell, Gibbs-Helmholtz equation, operating characteristics of fuel cells.	
Text Books: 1. D.P. Kothari, K.C. Singal and RakeshRanjan, "Renewable Energy Sources and Emerging Technologies", Prentice Hall of India, New Delhi, 2009. 2. S.P. Sukhatme, "Solar Energy: Principles of Thermal Collection and Storage", TMH, New Delhi, 2008	
Reference Books: 1. Chetan Singh Solanki, "Renewable Energy Technologies", Prentice Hall of India, New Delhi, 2009 2. G. D. Rai, "Non- conventional Energy Sources", Khanna publishers, New Delhi, 2011. 3. MaltiGoel, "Energy Souces and Global Warming", allied publishers Pvt Ltd. New Delhi, 2005.	

404193 Laboratory Practice III

Credits: 02

Teaching Scheme:	Examination Scheme:
Practical : 02 Hr/week	TW : 50 Marks Oral : 50 Marks

Mobile Communication:

List of Practicals: (Any Eight)

1. Perform an experiment to explain PSTN TST switch.
2. Write a program to elaborate Lost call system/ delay system used in the analysis of voice/data traffic.
3. Write a program to measure bit error rate in presence of AWGN model.
4. Write a program to simulate speech coding and decoding technique used in mobile Communication.
5. Set up and carry out experiment on AT commands for call operation.
6. Write a program to simulate experiment on GMSK modulation.
7. Write a program to measure bit error rate in presence of Hata/ Multipath propagation model.
8. Set up and carry out experiment to explain VoIP call routing process.
9. Visit to Mobile Telephone Switching Office (MTSO).
10. Perform an experiment / Simulate to elaborate the operation of Multiple access techniques such as TDMA/CDMA/OFDMA.

Broadband Communication System:

List of the Experiments:

- **Minimum 8 experiments are to be performed excluding tutorials.**
- **Tutorials are mandatory. (Expt. 5 and 12)**

1. Estimation of Numerical aperture of fiber.
2. Plot the characteristics of various sources and detectors.
3. Measure attenuation of MMSI and SMSI fiber and comment on the result based on attenuation due to increase in length as well as loss due to bend.
4. Set up a digital link and analyze.
5. Tutorial on Power budget and time budget analysis of optical fiber system.
6. Establishing a direct communication link between Uplink Transmitter and Downlink Receiver using tone signal.
7. To set up an Active Satellite link and demonstrate Link Fail Operation.
8. To establish an AUDIO-VIDEO satellite link between Transmitter and Receiver.
9. To communicate VOICE signal through satellite link.
10. To transmit and receive three separate signals (Audio, Video, Tone) simultaneously through satellite Link.
11. To transmit and receive PC data through satellite link.
12. Tutorial on satellite link design
13. Students, as a part of their term work, should visit satellite earth station and submit a report of visit. (Optional).

404194 Laboratory Practice IV (Elective III)

Credits: 01

Teaching Scheme:				Examination Scheme:
Practical : 02 Hr/week				**Oral : 50 Marks**

Machine Learning

List of Practical's:

(Use appropriate Software available in the Institute)

1. Implement simple logic network using MP neuron model
2. Implement a simple linear regressor with a single neuron model
3. Implement and test MLP trained with back-propagation algorithm
4. Implement and test RBF network
5. Implement SOFM for character recognition.
6. Implement SVM classifier for classification of data into two classes. Student can use datasets such as flower classification etc.
7. Implement and test Multiclass SVM classifier.
8. Implement and test CNN for object recognition.

PLC & Automation

List of Experiments (Minimum 8 experiments are to be performed).

1. Control the speed of servo motor using analog voltage 0-10V.
2. Rotate the servo motor according to X, Y co-ordinates.
3. Temperature detection using RTD & control the temperature of water at desired set point.
4. Control the flow of water using analog control valve.
5. Control the speed of AC 3ϕ motor using VFD.
6. Design simulation of 3 cylinder piston pump using pneumatic kit & PLC.
7. Detect the angle of shaft using Encoder & PLC.
8. Control the speed of 3ϕ AC motor from Mobile/HMI with PLC.
9. Interfacing of RFID with PLC & show the corresponding user data on SCADA to access the control.
10. Interface PLC with RTU & SCADA at remote location.
11. Exchange the data between two PLC's using Ethernet.
12. Interfacing of PLC to VFD over profibus& exchange the data

Audio and Speech Processing

List of Experiments (Minimum 8 experiments are to be performed):
NOTE: To perform the experiments software like MATLAB, SCILAB or any appropriate open source software can be used. For analysis of speech signals tools like PRAAT, Audacity can be used. Open source software is encouraged.

1. Record speech signal (isolated words, continuous speech) and analyze the speech signal using speech analysis tool (e.g. PRAAT). Observe spectrogram, pitch, formants, intensity etc.
2. Write a program to compute short time Energy and ZCR for different frame rates and comment on the result.
3. Write a program to classify voiced, unvoiced and silence frames using frame level energy and zero crossing rate
4. Write a program to compute narrow band and wide band spectrogram. Comment on the time and frequency resolution of wide band and narrow band spectrogram.
5. Write a program for extracting pitch period for a voiced part of the speech signal using autocorrelation method and average magnitude difference function (AMDF).
6. Write a program to design a Mel filter bank and using this filter bank write a program to extract MFCC features.
7. Write a program to perform the cepstral analysis of speech signal and detect the pitch from the voiced part using cepstrum analysis.
8. Write a program to find LPC coefficients using Levinson Durbin algorithm.
9. Write a program to enhance the noisy speech signal using spectral subtraction method.
10. Write a program to extract frequency domain audio features like SC, SF and Spectral roll off.

Software Defined Radio

List of the Experiments(Minimum 8 experiments are to be performed):

1. Introduction to GNU Radio
2. Introduction to Software Defined Radio Systems
3. Implementation of AM using SDR
4. Implementation of FM using SDR with application such as transfer of files
5. Implementation of M-PSK transmitter using SDR
6. Implementation of M-PSK receiver using SDR
7. Implementation of M-QAM transmitter using SDR
8. Implementation of M-QAM receiver using SDR
9. Implementation of Transmission of files on Wireless media using SDR
10. Implementation of OFDM using SDR
11. Implementation of Cognitive radio using SDR

Audio Video Engineering

List of Experiments (Minimum 8 experiments are to be performed).

1. Voltage and waveform analysis for color TV.
2. Study of direct to home TV and set top box.
3. Study Wi-Fi TV system
4. Study of Digital TV pattern generator.
5. Study of HDTV
6. Study of Digital TV.
7. Simulation of Video, Audio and Image compressing techniques (Software Assignments)
8. Study of Audio system: CD players and MP3 player.
9. Study of PA system with chord less microphone
10. Directivity pattern of Microphones / Loud speakers
11. Visit to TV transmitter/ Digital TV Studio/ All India Radio / TV Manufacturing factory

404195 Project Phase-II		
Credits:06		
Teaching Scheme:		**Examination Scheme:**
Tutorial: 6 Hrs/Week		**TW: 150 Mark** **OR: 50 Marks**

1. GroupSize

The student will carry the project work individually or by a group of students. Optimum group size is in 3 students. However, if project complexity demands a maximum group size of 4 students, the committee should be convinced about such complexity and scope of thework.

2. Selection and approval of topic

Topic should be related to real life application in the field of Electronics and Telecommunication

OR

Investigation of the latest development in a specific field of Electronics or Communication or Signal Processing

OR

The investigation of practical problem in manufacture and / or testing of electronics or communication equipment

OR

The Microprocessor / Microcontroller based applications project ispreferable.

OR

Software development project related to VHDL, Communication, Instrumentation, Signal Processing and Agriculture Engineering with the justification for techniques used / implemented is accepted.

OR

Interdisciplinary projects should be encouraged. The examination will be conducted independently in respective departments.

3. Note:

The group should maintain a logbook of activities. It should have entries related to the work done,problems faced, solution evolved etc., duly signed by internal and external guides.

Project report must be submitted in the prescribed format only. No variation in the format will be accepted. One guide will be assigned at the most 3 project groups.

Audit Course 6 (1)
Team Building, Leadership and Fitness

About the course

Team building allows students to work together in social situations just as they would in the classroom, their daily lives, or down the road in the workplace. Team building challenges students to solve problems and execute working with others. It shows them how to be accountable. It allows team members to stay motivated and energized to work on the project together. They work on jobs and tasks cohesively, rather than working alone without interaction. By working together, members of the team can "work together, stay together, and achieve together" .Trust and communication issues can also be noticed from team building exercises. Team building is known to improve performance in teams; members will remain motivated and can easily overcome indifferences to see the strengths in all team members.

Leadership is about the art of motivating, influencing and directing people so that they work together to achieve the goals of a team or broader organization. It's important for students to experience leadership opportunities during their schooling, to learn the art of building relationships within teams, defining identities and achieving tasks effectively. It also provides an opportunity to learn to identify and display effective communication and interpersonal skills. Leadership begins with identifying and understanding our values. Our values are our fundamental beliefs – those principles we consider to be worthwhile and desirable. Fitness does not only refer to being physically fit, but also refers to a person's mental state as well. If a person is physically fit, but mentally unwell or troubled, he or she will not be able to function optimally. Mental fitness can only be achieved if your body is functioning well. You can help relax your own mind and eliminate stresses by exercising regularly and eating right. People who are physically fit are also healthier, are able to maintain their most optimum weight and are least prone to cardiac and other health problems. In order to maintain a relaxed state of mind, a person should be physically active. A person who is fit both physically and mentally strong enough to face the ups and downs of life, and is not affected by drastic changes if they take place.

Course Objectives:

- To develop understanding of team skills and dynamics
- To identify and develop personal skills to become a more effective team member
- To introduce to the students the social change model of leadership
- To expose students to the leadership skills and imbibe within them that the fact that Leadership is a process, not a characteristic associated with an individual or role.
- To enable student to understand principles of fitness training and exercise
- To enable students to understand human posture, nutritional values and mental fitness

Course Outcomes:

On completion of the course, society will observe –

1. Change in awareness levels, knowledge and understanding of today's youth
2. Change in attitudes / behavior of students with regards to their improved teamwork, institutional leadership and other life skills
3. Increase in the body's fitness levels and also reduced health problems
4. Improvement in social health and attitude.

Unit 1: Team Building

Types of Teams, Characteristics of a Team, Stages of Team Development (Forming ,Storming, Norming, Adjourning) , Systematic Approach to Team Work , High Performing Team (Characteristics , Maintenance , Causes of low performance Why Teams Fail , People,Communication , Resources , Objectives)

Unit II: Leadership Defining Leadership , Personal Leadership Profile, Leadership in the Context of Community, Leadership Theory, Leadership Concepts, Foundations of Group Behavior: The Meaning of Group, Group behavior & Group Dynamics, Types of Groups, The Five -Stage Model of Group Development Managing Organizational Change, Leadership Styles leading to Authenticity, Learning and Development, Positive Responses to Aggressive Behavior, Professionalism, Team Building
Unit III: Educational Leadership Key challenges for educational leaders, Characteristics, Capabilities of authentic leader, values and ethics in decision making, Continuous professional Development suitable for 21st century pedagogy, Emotional intelligence for educational leaders. Need of Educational research for educational leadership
Unit IV: Fitness for Engineers Fundamentals of Exercise Science: Skeletal, muscular, cardiovascular, nervous system, nutrition, flexibility, special population and injuries, Basics of fitness, Weight management and supplementation
Guidelines for Conduction (Any one or more of following but not limited to) • Guest Lectures • Group Activities • Assignment • Taking up assisted Health challenge for short duration (ex. Yoga and Pranayam, Weight management , stability in mental health) **Guidelines for Assessment** (Any one or more of following but not limited to) • Practical Test • Presentation • Paper / (Theory assessment test) •• Report
Sources/ References: 1. Organizational Behavior by Fred Luthans 2. Organizational Behavior by M N Mishra 3. Leadership Development Activities, John Adair, 2nd Edition Jaico Publication 4. Leadership Games, Stephen S Kogan, 5. Mastering Leadership, 2nd Edition, Michael Williams, Viva Books 6. Sculpt and Shape: The Pilates Way by YasminKarachiwala 7. Total Fitness: The LeenaMogre Way by LeenaMogre 8. Don’t Lose Your Mind, Lose Your Weight: RutujaDiwekar 9. Yog Its Philosophy and Practice English by Swami Ramdevji

Audit Course 6 (2)
Environmental Issues And Disaster Management

About the Course:

The importance of environmental science and environmental studies cannot be disputed. The need for sustainable development is a key to the future of mankind. Continuing problems of pollution, loss of forget, solid waste disposal, degradation of environment, issues like economic productivity and national security, Global warming, the depletion of ozone layer and loss of biodiversity have made everyone aware of environmental issues.

It is clear that no citizen of the earth can afford to be ignorant of environment issues. Environmental management has captured the attention of health care managers. Managing environmental hazards has become very important. In spite of the deteriorating status of the environment, study of environment has so far not received adequate attention in our academic programmes.

Course objective :

- To develop understanding of Environment Issues and Biodiversity
- To introduce to the students the environment, Disaster Management
- To enable students to understand ecosystem and preservation of environment
- To understand Disaster Management and handling them

Course Outcomes :

On completion of course students will be able:

1. To learn the different environmental issues and disasters.
2. To deal with problems associated with environment and effectively handle the disasters.

Unit 1: Environmental Pollution

A) Definition, Cause, effects and control measures of :-

Air pollution,Water pollution, Soil pollution, Marine pollution, Noise pollution, Thermal pollution, Nuclear hazards, Solid waste Management, urban and industrial wastes.

Role of an individual in prevention of pollution. Pollution case studies.

B) Social Issues and the Environment:

Water conservation, rain water harvesting, watershed management, Resettlement and rehabilitation of people; its problems and concerns.

Unit 2 : Ecosystems, Biodiversity and its conservation

A) Concept of an ecosystem.

Structure and function of an ecosystem, Producers, consumers and decomposers, • Energy flow in the ecosystem, Ecological succession, Food chains, food webs and ecological pyramids.

Structure and function of the following ecosystem :

a. Forest ecosystem

b. Grassland ecosystem

c. Desert ecosystem

d. Aquatic ecosystems (ponds, streams, lakes, rivers, oceans, estuaries)

Biodiversity at global, National and local levels, India as a mega-diversity nation

Hot-sports of biodiversity, Threats to biodiversity : habitat loss, poaching of wildlife, man-wildlife conflicts, Endangered and endemic species of India, Conservation of biodiversity : In-situ and Ex-situ conservation of biodiversity.

Unit 3 : Disaster Management

a) Causes – Natural disaster and Manmade disaster
b) Speed of onset – Sudden and Slow

Natural Disasters

These types of disaster naturally occur in proximity to, and pose a threat to, people, structures or economic assets.
Examples are Storm, Flood, Earthquake, Tsunamis

Manmade Disasters

Accidents: Road, Rail, Air, Sea, Building collapse.
Industrial Mishaps: Gas leak, Explosion, Safety.
Fire: Building, Coal, Oil.
Forest Fire (In tropical counters, forest fires are often manmade)
Speed of onset
1 Sudden onset: little or no warning, minimal time to prepare. For example, an earthquake, tsunami, cyclone, volcano, etc.
2 Slow onset: adverse event slow to develop; first the situation develops; the second level is an emergency; the third level is a disaster.
For example, drought, civil strife, etc.

Unit 4: Case Studies

- Environmental ethics: Awareness, Issues and possible solutions.
- Climate change, global warming, acid rain, ozone layer depletion, nuclear accidents and holocaust.
- Wasteland reclamation.
- Consumerism and waste products.
- Environment Protection Act.
- Air and Water (Prevention and Control of Pollution) Act
- Wildlife Protection Act and Forest Conservation Act
- Issues involved in enforcement of environmental legislation.
- Role of an individual in prevention of pollution and case studies.

References:

1. Disaster Management: Disaster Manager’s Handbook by W. Nick Carter, Asian Development Bank.
2. An Introduction To Disaster Management EBook By S. Vidyanathan - Publisher: IKON
3. Textbook for environmental studies ,ErachBharucha For UGC.

Savitribai Phule Pune University

Faculty of Science and Technology

Syllabus for

S.E (Electronics / Electronics & Telecommunication Engineering)

(Course 2019)

(w.e.f. June 2020)

Savitribai Phule Pune University, Pune
S.E. (Electronics / E&TC Engineering) 2019 Course
(With effect from Academic Year 2020-21)

Semester-III

Course Code	Course Name	Teaching Scheme (Hours/Week)			Examination Scheme and Marks						Credit			
		Theory	Practical	Tutorial	In-Sem	End-Sem	TW	PR	OR	Total	TH	PR	TUT	Total
207005	Engineering Mathematics III	04	-	01	30	70	25	-	-	125	04	-	01	05
204181	Electronic Circuits	03	-	-	30	70	-	-	-	100	03	-	-	03
204182	Digital Circuits	03	-	-	30	70	-	-	-	100	03	-	-	03
204183	Electrical Circuits	03	-	-	30	70	-	-	-	100	03	-	-	03
204184	Data structures	03	-	-	30	70	-	-	-	100	03	-	-	03
204185	Electronic Circuit Lab	-	02	-	-	-	-	50	-	50	-	01	-	01
204186	Digital circuits Lab		02					50		50		01		01
204187	Electrical Circuit Lab	-	02	-	-	-	25	-	-	25	-	01	-	01
204188	Data Structures Lab	-	02	-	-	-	-	-	25	25	-	01	-	01
204189	Electronic Skill Development	-	02	-	-	-	25	-	-	25	-	01	-	01
204190	Mandatory Audit Course 3 [&]	-	-	-					-	-	-	-	-	-
Total		**16**	**10**	**01**	**150**	**350**	**75**	**100**	**25**	**700**	**16**	**05**	**01**	**22**

Savitribai Phule Pune University, Pune
S.E. (Electronics / E&TC Engineering) 2019 Course
(With effect from Academic Year 2020-21)

Semester-IV

Course Code	Course Name	Teaching Scheme (Hours/Week)			Examination Scheme and Marks						Credit			
		Theory	Practical	Tutorial	In-Sem	End-Sem	TW	PR	OR	Total	TH	PR	TUT	Total
204191	Signals & Systems	03	-	01	30	70	25	-	-	125	03	-	01	04
204192	Control Systems	03	-		30	70		-	-	100	03	-	-	03
204193	Principles of Communication Systems	03	-	-	30	70	-	-	-	100	03	-	-	03
204194	Object Oriented Programming	03	-	-	30	70	-	-	-	100	03	-	-	03
204195	Signals & Control System Lab		02				50			50		01		01
204196	Principle of Communication Systems Lab	-	02	-	-	-	-	50	-	50	-	01	-	01
204197	Object Oriented Programming Lab	-	02	-	-	-	-	-	50	50	-	01	-	01
204198	Data Analytics Lab		02				-		25	25		01		01
204199	Employability Skill Development	02	02	-	-	-	50	-	-	50	02	01	-	03
204200	Project Based Learning $^{\eta}$	-	04				50		-	50		02		02
204201	Mandatory Audit Course 4$^{\&}$	-	-	-	-	-	-	-	-	-	-	-	-	-
Total		**14**	**14**	**01**	**120**	**280**	**175**	**50**	**75**	**700**	**14**	**07**	**01**	**22**

Abbreviations:

In-Sem: In semester, End-sem: End semester, TH : Theory, TW : Term Work
PR : Practical, OR : Oral, TUT : Tutorial

Note: Interested students of S.E. (Electronics/E&TC) can opt any one of the audit course from the list of audit courses prescribed by BoS (Electronics & Telecommunications Engineering)

General Instructions

- PR/Tutorial/PBL must be conducted in three batches per division.
- Minimum number of required Experiments/Assignments in PR/ Tutorial shall be carried out as mentioned in the syllabi of respective subjects.
- Assessment of tutorial work has to be carried out as term-work examination. Term-work Examination at second year of engineering course **shall be internal continuous assessment only.**
- **η:** Project based learning (PBL) requires continuous mentoring by faculty throughout the semester for successful completion of the tasks selected by the students per batch. While assigning the teaching workload of 2 Hrs. / week / batch needs to be considered for the faculty involved. The Batch needs to be divided into sub-groups of 5 to 6 students. Assignments / activities / models/ projects etc. under project-based learning is carried throughout semester and Credit for PBL has to be awarded on the basis of internal continuous assessment and evaluation at the end of semester.
- **&:** Audit course is mandatory but non-credit course. Assessment has to be conducted at the end of Sem III & IV respectively for award of grade at college level. Grade awarded for audit course shall not be calculated for grade point & CGPA.

- **Examination Scheme:** The theory examination shall be conducted in two phases for all the subjects.
    - Phase I as **In-Semester Examination** of 30 marks written theory examination based on Unit-1 and Unit-2 of course syllabus scheduled by university.
    - Phase II as **End-Semester Examination** of 70 marks written theory examination based on unit number 3, 4, 5, 6 of course syllabus scheduled by university.

- **Structure of Question Paper:**
    - Two units **(Unit1 and Unit 2)** will be covered for 30 Marks for **In-Semester Examination** Equal weightage will be given to both the units.

- Four units **(Unit 3, Unit 4, Unit 5 and Unit 6)** shall have weightage of 70 Marks for **End-Semester Examination**. Marks weightage for the various units shall be as shown in Table below:

Sr. No.	**Unit No.**	**In - Sem**	**End - Sem**
1.	I	15	--
2.	II	15	--
3.	III	--	18
4.	IV	--	17
5.	V	--	18
6.	VI	--	17

- Papers will have only one section and there will be two questions for In-sem and four questions for End-sem. For each question there will be alternate Question based on same unit and of the same marks.

- Framing of questions should be according to Anderson / Bloom's Taxonomy and disseminated through the question papers with a mention of course outcomes as well.

- **Assessment**:

A. Theory:

- In-sem assessment will be done at the centralized assessment programme (CAP) Centre of the College by the Expert who is appointed as an examiner for the courses as per 48(3) panel of Maharashtra Public University act 2016.

- End-sem assessment will be done at the CAP Centre designated by the University by the Expert who is appointed as an examiner for the subject as per 48(3) panel.

B. **Term Work:** Term Work is continuous assessment based on work done, submission of work in the form of report / journal, timely completion, attendance, and understanding. It should be assessed by subject teacher of the institute. At the end of the semester, the final grade for a Term Work shall be assigned based on the performance of the student and is to be submitted to the Savitribai Phule Pune University (SPPU). A student who fails in the Term Work on account of unsatisfactory performance shall be given F grade and on the account of inadequate attendance shall be given FX grade. Failing in a particular course Term Work shall not be the criteria for detention in the semester.

C. **Practical / Oral:** Practical / Oral is to be conducted and assessed jointly by internal and external examiners. The performance in the Practical / Oral examination shall be assessed by at least one pair of examiners appointed as examiners by the Savitribai Phule Pune University. The examiners will prepare the mark / grade sheet in the format as specified by the Savitribai Phule Pune University and authenticate it.

Guidelines for Instructor's Manual

- The instructor's manual is to be developed as a hands-on resource and reference.
- Copy of Curriculum, Conduction & Assessment guidelines, List of Experiments to be attached.

Guidelines for Laboratory Conduction

- Students are not allowed to touch any equipment or other materials in the laboratory until they are instructed by Teacher or Technician.
- All the experiments mentioned in the syllabus are compulsory.
- Use of open source software and recent version is to be encouraged.
- In addition to these, faculty member has to get it done a mini-project based on the concepts learned.

Guidelines for Student's Lab Journal

- The laboratory assignments/experiments are to be submitted by student in the form of journal.
- Journal consists of Certificate, table of contents, and handwritten write-up for each experiment.
- Each experiment should consist of:
  - ✓ Title.
  - ✓ Objectives.
  - ✓ Problem Statement, Outcomes
  - ✓ Hardware / Software (If any) requirements.
  - ✓ Concept.
  - ✓ Experimental procedure / Setup.
  - ✓ Observation table.
  - ✓ Conclusion.

Guidelines for Lab Assessment

- Continuous assessment of laboratory work is done based on overall performance.
- Each lab assignment/ experiment assessment will assign grade / marks based on parameters with appropriate weightage.
- Suggested parameters for overall assessment as well as each lab assignment / experiment assessment include:
  - ✓ Timely completion.
  - ✓ Performance.
  - ✓ Punctuality and neatness.
- The parameters for assessment are to be known to the students at the beginning of the course.

Savitribai Phule Pune University Second Year of Electronics / E & Tc Engineering (2019 Course) 207005: Engineering Mathematics - III		
Teaching Scheme:	**Credit**	**Examination Scheme:**
Theory: 04 hrs. / week **Tutorial: 01 hr. / week**	**04 + 01 = 05**	**In-Sem (Theory): 30 Marks** **End Sem (Theory): 70 Marks** **Term Work: 25 Marks**

Prerequisite Courses, if any: Differential and Integral calculus, Taylor series, Differential equations of first order and first degree, Fourier series, Vector algebra and Algebra of complex numbers.

Companion Course, if any: --

Course Objectives:

- To make the students familiarize with concepts and techniques in Ordinary differential equations, Fourier Transform, Z-Transform, Numerical methods, Vector calculus and functions of a Complex variable.
- The aim is to equip them with the techniques to understand advanced level mathematics and its applications that would enhance analytical thinking power, useful in their disciplines.

Course Outcomes: On completion of the course, learner will be able to –

CO1: Solve higher order linear differential equation using appropriate techniques for modelling, analyzing of electrical circuits and control systems.

CO2: Apply concept of Fourier transform & Z-transform and its applications to continuous & discrete systems, signal & image processing and communication systems.

CO3: Obtain Interpolating polynomials, numerically differentiate and integrate functions, numerical solutions of differential equations using single step and multi-step iterative methods used in modern scientific computing.

CO4: Perform vector differentiation & integration, analyze the vector fields and apply to electro-magnetic fields & wave theory.

CO5: Analyze Complex functions, Conformal mappings, Contour integration applicable to electrostatics, digital filters, signal and image processing.

Course Contents

Unit I	Linear Differential Equations (LDE) and Applications	(09 Hrs)

LDE of n^{th} order with constant coefficients, Complementary Function, Particular Integral, General method, Short methods, Method of variation of parameters, Cauchy's and Legendre's DE, Simultaneous and Symmetric simultaneous DE. Modeling of Electrical circuits.

Mapping of Course Outcomes for Unit I	**CO1: Solve higher order linear differential equation using appropriate techniques for modelling, analyzing of electrical circuits and control systems.**	
Unit II	**Transforms**	**(09 Hrs)**
Fourier Transform (FT): Complex exponential form of Fourier series, Fourier integral theorem, Fourier Sine & Cosine integrals, Fourier transform, Fourier Sine and Cosine transforms and their inverses. **Z - Transform (ZT):** Introduction, Definition, Standard properties, ZT of standard sequences and their inverses. Solution of difference equations.		
Mapping of Course Outcomes for Unit II	**CO2: Apply concept of Fourier transform & Z-transform and its applications to continuous & discrete systems, signal & image processing and communication systems.**	
Unit III	**Numerical Methods**	**(09 Hrs)**
Interpolation: Finite Differences, Newton's and Lagrange's Interpolation formulae, Numerical Differentiation. **Numerical Integration:** Trapezoidal and Simpson's rules, Bound of truncation error, **Solution of Ordinary differential equations:** Euler's, Modified Euler's, Runge-Kutta 4th order methods and Predictor-Corrector methods.		
Mapping of Course Outcomes for Unit III	**CO3: Obtain Interpolating polynomials, numerically differentiate and integrate functions, numerical solutions of differential equations using single step and multi-step iterative methods used in modern scientific computing.**	
Unit IV	**Vector Differential Calculus**	**(09 Hrs)**
Physical interpretation of Vector differentiation, Vector differential operator, Gradient, Divergence and Curl, Directional derivative, Solenoidal, Irrotational and Conservative fields, Scalar potential, Vector identities.		
Mapping of Course Outcomes for Unit IV	**CO4: Perform vector differentiation & integration, analyze the vector fields and apply to electro- magnetic fields & wave theory.**	
Unit V	**Vector Integral Calculus & Applications**	**(10 Hrs)**
Line, Surface and Volume integrals, Work-done, Green's Lemma, Gauss's Divergence theorem, Stoke's theorem. Applications to problems in Electro-magnetic fields.		
Mapping of Course Outcomes for Unit V	**CO4: Perform vector differentiation & integration, analyze the vector fields and apply to electro- magnetic fields & wave theory.**	
Unit VI	**Complex Variables**	**(06 Hrs)**
Functions of a Complex variable, Analytic functions, Cauchy-Riemann equations, Conformal mapping, Bilinear transformation, Cauchy's integral theorem, Cauchy's integral formula and Residue theorem.		

Mapping of Course Outcomes for Unit VI	CO5: Analyze Complex functions, Conformal mappings, Contour integration applicable to electrostatics, digital filters, signal and image processing.

Learning Resources

Text Books:

1. B.V. Ramana, "Higher Engineering Mathematics", Tata McGraw Hill.
2. B.S. Grewal, "Higher Engineering Mathematics", Khanna Publication, New Delhi.

Reference Books:

1. Erwin Kreyszig, "Advanced Engineering Mathematics", Wiley India,10th Edition.
2. M.D. Greenberg, "Advanced Engineering Mathematics", Pearson Education, 2nd Edition.
3. Peter. V and O'Neil, "Advanced Engineering Mathematics", Cengage Learning,7th Edition.
4. S.L. Ross, "Differential Equations", Wiley India, 3rd Edition.
5. S. C. Chapra and R. P. Canale, "Numerical Methods for Engineers", McGraw-Hill, 7th Edition.
6. J. W. Brown and R. V. Churchill, "Complex Variables and Applications", McGraw-Hill Inc, 8th Edition.

MOOC / NPTEL Courses:

1. NPTEL Course **"Transform Calculus And its applications in differential equations"**
   https://nptel.ac.in/courses/111/105/111105123/
2. NPTEL Course on **"Numerical Methods"**
   https://nptel.ac.in/courses/111/107/111107105/
3. NPTEL Course on **"Integral & Vector Calculus"**
   https://nptel.ac.in/courses/111/105/111105122/
4. NPTEL Course on **"Complex Analysis"**
   https://nptel.ac.in/courses/111/103/111103070/

Virtual LAB Link:

1. **Numerical Methods:**
   http://vlabs.iitb.ac.in/vlabs-dev/labs/numerical_lab/index.php

Guidelines for Tutorial and Term Work

i) Tutorial shall be engaged in three batches per division.
ii) Term work shall be based on continuous assessment of six assignments (one per each unit) and performance in internal tests.
iii) Additional tutorials (Min. 2) are to be conducted using Virtual Lab.

Savitribai Phule Pune University Second Year of Electronics / E & Tc Engineering (2019 Course) 204181: Electronic Circuits		
Teaching Scheme:	**Credit**	**Examination Scheme:**
Theory: 03 hrs. / week	**03**	**In-Sem (Theory): 30 Marks** **End Sem (Theory): 70 Marks**

Prerequisite Courses, if any: 104010 - Basic Electronics Engineering

Companion Course, if any: 204185 - Electronic Circuits Laboratory

Course Objectives: To make the students understand

- Semiconductor device MOSFET, its characteristics, parameters & applications.
- Concepts of feedbacks in amplifiers & oscillators.
- Operational amplifier, concept, parameters & applications.
- ADC, DAC as an interface between analog & digital domains.
- Voltage to current and current to voltage converters.
- Concepts, characteristics & applications of PLL.

Course Outcomes: On completion of the course, learner will be able to -

CO1: Assimilate the physics, characteristics and parameters of MOSFET towards its application as amplifier.

CO2: Design MOSFET amplifiers, with and without feedback, & MOSFET oscillators, for given specifications.

CO3: Analyze and assess the performance of linear and switching regulators, with their variants, towards applications in regulated power supplies.

CO4: Explain internal schematic of Op-Amp and define its performance parameters.

CO5: Design, Build and test Op-amp based analog signal processing and conditioning circuits towards various real time applications.

CO6: Understand and compare the principles of various data conversion techniques and PLL with their applications.

Course Contents

Unit I	MOSFET & its Analysis	(08 Hrs)

Enhancement MOSFET: Construction, Characteristics, DC Load line, AC equivalent ckt, Parameters, Parasitics.
Non ideal characteristics: Finite output resistance, Body effect, Sub-threshold conduction, breakdown effects, temperature effect, effect of W/L ratio, Common source amplifier & analysis, Source follower: circuit diagram, comparison with common source, Frequency response for amplifier

Mapping of Course Outcomes for Unit I	**CO1: Assimilate the physics, characteristics and parameters of MOSFET towards its application as amplifier.**

Unit II	MOSFET Circuits	(06 Hrs)
MOSFET as switch, CMOS inverter, resistor & diode. Current sink & source, Current mirror. Four types of feedback amplifiers, Effects of feedback, Voltage series & current series feedback amplifiers and analysis, Barkhausen criterion, Wein bridge & phase shift oscillator.		
Mapping of Course Outcomes for Unit II	**CO2: Design MOSFET amplifiers, with and without feedback, & MOSFET oscillators, for given specifications.**	
Unit III	**Voltage Regulators**	**(06 Hrs)**
Three terminal voltage regulators (317 & 337): Block diagram of linear voltage regulator, IC 317 and IC337, Features and specifications, typical circuits, current boosting, Low Dropout Regulator (LDO). **SMPS:** Block diagram, Types, features and specifications, typical circuits buck and boost converter.		
Mapping of Course Outcomes for Unit III	**CO3: Analyze and assess the performance of linear and switching regulators, with their variants, towards applications in regulated power supplies.**	
Unit IV	**Operational Amplifier**	**(08 Hrs)**
Block diagram, Differential amplifier analysis for Dual input Balanced output mode - AC analysis (using r parameters) & DC analysis, Level shifter, Op amp parameters, Current mirror, Op-amp characteristics (AC & DC). Voltage series & voltage shunt feedback amplifiers, Effect on R_i, R_o, gain & bandwidth.		
Mapping of Course Outcomes for Unit IV	**CO4: Explain internal schematic of Op-Amp and define its performance parameters.**	
Unit V	**Op-Amp Applications**	**(08 Hrs)**
Inverting amplifier, non-inverting amplifier, Voltage follower, Summing amplifier, Differential amplifier, Practical integrator, Practical differentiator, Instrumentation amplifier, Comparator, Schmitt trigger, Square & triangular wave generator.		
Mapping of Course Outcomes for Unit V	**CO5: Design, Build and test Op-amp based analog signal processing and conditioning circuits towards various real time applications.**	
Unit VI	**Converters & PLL**	**(06 Hrs)**
Voltage to Current, Current to Voltage converters. **DAC & ADC:** Resistor weighted and R-2R DAC, SAR, Flash and dual slope ADC Types / Techniques, Characteristics, block diagrams, Circuits, Specifications, Merits, Demerits, Comparisons. **PLL:** Block Diagram, Characteristics, phase detectors, Details of PLL IC 565 Applications, Typical circuits.		
Mapping of Course Outcomes for Unit VI	**CO6: Understand and compare the principles of various data conversion techniques and PLL with their applications.**	

Learning Resources

Text Books:

1. Donald Neaman, “Electronic Circuits - Analysis and Design”, Mc Graw Hill, 3rd Edition.
2. Ramakant Gaikwad, “Op Amps & Linear Integrated Circuits”, Pearson Education.

Reference Books:

1. Millman Halkias, “Integrated Electronics”.
2. Phillip E. Allen and Douglas R. Holberg, “CMOS Analog Circuit Design”, Oxford, 2nd Edition.
3. Salivahan and Kanchana Bhaskaran, “Linear Integrated Circuits”, Tata McGraw Hill.

MOOC / NPTEL Courses:

1. NPTEL Course **“Analog Electronic Circuits”**

   https://nptel.ac.in/courses/108/105/108105158/

2. NPTEL Course on **“Analog Circuits”**

   https://nptel.ac.in/courses/108/101/108101094/

Savitribai Phule Pune University Second Year of Electronics / E & Tc Engineering (2019 Course) 204182: Digital Circuits		
Teaching Scheme:	**Credit**	**Examination Scheme:**
Theory: 03 hrs. / week	**03**	**In-Sem (Theory): 30 Marks** **End Sem (Theory): 70 Marks**

Prerequisite Courses, if any: --

Companion Course, if any: 204186 - Digital Circuits Laboratory

Course Objectives: To make the students understand

- The fundamental principles of two-valued logic and various devices used to implement logical operations on variables.
- Boolean algebra, Karnaugh maps and its application to the design and characterization of digital circuits.
- To analyze logic processes and implement logical operations using combinational logic circuits.
- The principles of logic design and use of simple memory devices, flip-flops, and sequential circuits.
- Concepts of sequential circuits and to analyze sequential systems in terms of state machines.
- System design approach using programmable logic devices.

Course Outcomes: On completion of the course, learner will be able to -

CO1: Identify and prevent various hazards and timing problems in a digital design.

CO2: Use the basic logic gates and various reduction techniques of digital logic circuit.

CO3: Analyze, design and implement combinational logic circuits.

CO4: Analyze, design and implement sequential circuits.

CO5: Differentiate between Mealy and Moore machines.

CO6: Analyze digital system design using PLD.

Course Contents

Unit I	Digital Logic Families	(05 Hrs)

Classification and Characteristics of digital Logic Families: Speed, power dissipation, figure of merit, fan in, fan out, current, voltage, noise immunity, operating temperatures and power supply requirements. TTL logic. Operation of TTL NAND gate, active pull up, wired AND, open collector output, unconnected inputs. Tri-State logic. CMOS logic: CMOS inverter, NAND, NOR gates, unconnected inputs, wired logic, open drain output. Interfacing CMOS and TTL, Data sheet specifications.

Mapping of Course Outcomes for Unit I	**CO1: Identify and prevent various hazards and timing problems in a digital design.**	
Unit II	**Combinational Logic Design**	**(08 Hrs)**
Definition of combinational logic, canonical forms, Standard representations for logic functions, k-map representation of logic functions (SOP and POS forms), minimization of logical functions for min-terms and max-terms (upto 4 variables), don't care conditions, Design Examples: Arithmetic Circuits, BCD to 7 segment decoder, Code converters. Introduction to Quine- McCluskey method, Quine McCluskey using don't care terms, Reduced prime implicants Tables.		
Mapping of Course Outcomes for Unit II	**CO2: Use the basic logic gates and various reduction techniques of digital logic circuit.**	
Unit III	**Combinational Circuits**	**(06 Hrs)**
Adders and their use as subtractor, look ahead carry, ALU, Digital Comparator, Parity generators/checkers, Multiplexers and their use in combinational logic designs, multiplexer trees, De-multiplexers and their use in combinational logic designs, Decoders, Demultiplexer trees.		
Mapping of Course Outcomes for Unit III	**CO3: Analyze, design and implement combinational logic circuits.**	
Unit IV	**Sequential Logic Design**	**(08 Hrs)**
1 Bit Memory Cell, Clocked SR, JK, MS J-K flip flop, D and T flip-flops. Use of preset and clear terminals, hold and setup time and metastability. Excitation Table for flip flop, Conversion of flip flops, Typical data sheet specifications of Flip flop application of Flip flops. Registers, Shift registers, Counters (ring counters, twisted ring counters), ripple counters, Mod-n counters, up/down counters, synchronous counters, lock out, Clock Skew, Clock jitter. Effect on synchronous designs, Sequence Generators.		
Mapping of Course Outcomes for Unit IV	**CO4: Analyze, design and implement sequential circuits.**	
Unit V	**State Machines**	**(07 Hrs)**
Basic design steps- State diagram, State table, State reduction, State assignment, Mealy and Moore machines representation, Implementation, finite state machine implementation, Sequence detector. Introduction to Algorithmic state machines- construction of ASM chart and realization for sequential circuits		
Mapping of Course Outcomes for Unit V	**CO5: Differentiate between Mealy and Moore machines.**	

Unit VI	Programmable Logic Devices	(08 Hrs)
Programmable logic devices: Detail architecture, Study of PROM, PAL, PLA, General Architecture, features and typical specifications of FPGA and CPLD. Semiconductor memories: memory organization and operation, expanding memory size, Classification and characteristics of memories, RAM ROM, EPROM, EEPROM, NVRAM, SRAM, and DRAM. Designing combinational circuits using PLDs.		
Mapping of Course Outcomes for Unit VI	**CO6: Analyze digital system design using PLD.**	

Learning Resources

Text Books:

1. R.P. Jain, "Modern Digital Electronics", Tata McGraw Hill Publication, 3rd Edition.
2. Thomas Floyd, "Digital Electronics", 11th Edition.
3. M. Morris Mano, "Digital Logic and Computer Design", Prentice Hall of India, 4th Edition.
4. Taub and Schilling, "Digital Principles and Applications," TMH.

Reference Books:

1. Anand Kumar, "Fundamentals of Digital Circuits", Prentice Hall of India, 1st Edition.
2. J. F. Wakerly, "Digital Design- Principles and Practices,", Pearson, 3rd Edition.
3. M. M. Mano, "Digital Design," Prentice Hall India.

MOOC / NPTEL Courses:

1. NPTEL Course **"Digital Circuits"**
   https://nptel.ac.in/courses/108/105/ 108105113/
2. NPTEL Course **"Digital Circuits & Systems"**
   https://nptel.ac.in/courses/117/106/117106086/
3. NPTEL Course **"Digital Electronic Circuits"**
   https://nptel.ac.in/courses/108/105/108105132/

Savitribai Phule Pune University

Second Year of Electronics / E & Tc Engineering (2019 Course)

204183: Electrical Circuits

Teaching Scheme:	Credit	Examination Scheme:
Theory: 03 hrs. / week	03	In-Sem (Theory): 30 Marks End Sem (Theory): 70 Marks

Prerequisite Courses, if any: 103004 - Basic Electrical Engineering

Companion Course, if any: 204187 - Electrical Circuits Laboratory

Course Objectives:

- To analyze simple DC and AC circuits with circuit simplification techniques.
- To formulate and analyze driven and source free RL and RC circuits.
- To formulate & determine network parameters for given network.
- To understand the constructional details, characteristics, features and application areas of various types of electric motors.

Course Outcomes: On completion of the course, learner will be able to -

CO1: Analyze the simple DC and AC circuit with circuit simplification techniques.

CO2: Formulate and analyze driven and source free RL and RC circuits.

CO3: Formulate & determine network parameters for given network and analyze the given network using Laplace Transform to find the network transfer function.

CO4: Explain construction, working and applications of DC Machines / Single Phase & Three Phase AC Motors.

CO5: Explain construction, working and applications of special purpose motors & understand motors used in electrical vehicles.

CO6: Analyze and select a suitable motor for different applications.

Course Contents

Unit I	Basic Circuit analysis & Simplification Techniques	(08 Hrs)

Kirchhoff"s Current and Voltage Laws, Independent and Dependent sources and their interconnection, power calculations.

Network Analysis: Mesh, Super mesh, Node and Super Node analysis. Source transformation and source shifting.

Network Theorems: Superposition, Thevenin's, Norton's and Maximum Power Transfer. **(Analysis of simple DC circuits using all above techniques & Analysis of simple AC circuits using only Mesh analysis)**

Mapping of Course Outcomes for Unit I	CO1: Analyze the simple DC and AC circuit with circuit simplification techniques.

Unit II	Transient Analysis of Basic RL, RC and RLC Circuits	(07 Hrs)
Initial conditions, Driven RL and RC circuits, source free RL and RC circuits, properties of exponential response, Natural and Forced response of RL and RC circuits. Introduction to driven & Source free series RLC circuit. Over damped and Under damped series RLC circuit.		
Mapping of Course Outcomes for Unit II	**CO2: Formulate and analyze driven and source free RL and RC circuits.**	
Unit III	**Two Port Network Parameters and Functions**	**(07 Hrs)**
Terminal characteristics of network, Z, Y, h, ABCD Parameters; Reciprocity and Symmetry conditions, Applications of the parameters. Application of Laplace Transforms to circuit analysis, network functions for one port and two port networks, poles and zeros of network functions and network stability.		
Mapping of Course Outcomes for Unit III	**CO3: Formulate & determine network parameters for given network and analyze the given network using Laplace Transform to find the network transfer function.**	
Unit IV	**DC Machines**	**(08 Hrs)**
Construction, working principle, derivation of emf equation, types, voltage equation of DC generator. Working principle, derivation of Torque equation, types, voltage equation & speed equation of DC Motor. Basic characteristics & different methods of speed control of DC Shunt and Series motor, Power flow diagram of DC motor, Numericals on speed & torque. Need of starter, three point & four point starters for DC shunt motor, applications of DC Motors. **Permanent Magnet DC motors (PMDC):** Construction, Working and applications.		
Mapping of Course Outcomes for Unit IV	**CO4: Explain construction, working and applications of DC Machines / Single Phase & Three Phase AC Motors.** **CO6: Analyze and select a suitable motor for different applications.**	
Unit V	**AC Motors (Single phase & Three phase)**	**(08 Hrs)**
Three phase Induction motors: Construction, working principle, types, concept of slip, effect of slip on rotor parameters, derivation of torque equation, condition for maximum torque, torque ratios, Torque-slip characteristics, Power flow diagram with numerical. **Single phase Induction motor:** Construction, working principle, types and applications **Necessity of starters**: Study of DOL & Star-Delta starters, speed control using V/f method, Applications.		

Mapping of Course Outcomes for Unit V	CO4: Explain construction, working and applications of DC Machines / Single Phase & Three Phase AC Motors. CO6: Analyze and select a suitable motor for different applications.	
Unit VI	**Special Purpose Motors**	**(06 Hrs)**

BLDC Motor: Types, Construction, working principle, Bipolar control circuit, torque-speed characteristics and applications.

Stepper Motor: Types, Construction, working principle, different modes of operation, control circuit, applications.

Introduction to Electric vehicle, block diagram, case study of any one electric vehicle with respect to specifications of motor, battery and controller.

Mapping of Course Outcomes for Unit VI	CO5: Explain construction, working and applications of special purpose motors & understand motors used in electrical vehicles. CO6: Analyze and select a suitable motor for different applications.

Learning Resources

Text Books:

1. Ravish R Singh, "Network Analysis & Synthesis", McGraw-Hill Education.
2. B.L. Theraja, A.K. Theraja, "Electrical Technology", Vol II, AC & DC Machines, S. Chand

Reference Books:

1. I.J Nagarath and D.P Kothari, "Electrical Machines",Tata McGraw-Hill Publication 4th Edition.
2. William H. Hayt, Jack E. Kimmerly and Steven M. Durbin, "Electrical Circuit Analysis", Tata McGraw Hill publication, 7th Edition.
3. V K Mehta and Rohit Mehta, "Principles of Electrical Machines", S Chand Publications.
4. A K Babu, "Electric & Hybrid Vehicle", Khanna Publishing.

MOOC / NPTEL Courses:

1. NPTEL Course **"Basic Electrical Circuits"**
   https://nptel.ac.in/courses/117/106/117106108/
2. NPTEL Course **"Electrical Machines - I"**
   https://nptel.ac.in/courses/108/105/108105017/
3. NPTEL Course **"Electrical Machines - II"**
   https://nptel.ac.in/courses/108/105/108105131/

Other:

1. Application Note of Microchip AN885 on BLDC Motor Fundamentals.

Savitribai Phule Pune University Second Year of Electronics / E & Tc Engineering (2019 Course) 204184: Data Structures		
Teaching Scheme:	**Credit**	**Examination Scheme:**
Theory: 03 hrs. / week	**03**	**In-Sem (Theory): 30 Marks** **End Sem (Theory): 70 Marks**

Prerequisite Courses, if any: 110005 - Programming and Problem Solving

Companion Course, if any: 204188 - Data Structures Laboratory

Course Objectives:

To learn basic concepts of C Programming language.

- To learn different sorting and searching algorithms and their analysis.
- To learn linear data structures: Stack and Queue, Linked List and their applications.
- To learn nonlinear data structures: Tree, Graph and their applications.
- To study the systematic ways of solving problem, various methods of organizing large amount of data.
- To solve problems using data structures such as binary tree, binary search tree, and graph and writing programs.

Course Outcomes: On completion of the course, learner will be able to -

CO1: Solve mathematical problems using C programming language.

CO2: Implement sorting and searching algorithms and calculate their complexity.

CO3: Develop applications of stack and queue using array.

CO4: Demonstrate applicability of Linked List.

CO5: Demonstrate applicability of nonlinear data structures - Binary Tree with respect to its time complexity.

CO6: Apply the knowledge of graph for solving the problems of spanning tree and shortest path algorithm.

Course Contents

Unit I	Introduction to C Programming	(08 Hrs)

C Fundamentals: Constants, Variables and Keywords in C, Operators, Bitwise Operations, Decision Control and Looping Statements.

Arrays & Pointers: Arrays, Functions, Recursive Functions, Pointers, String Manipulations, Structures, Union, Enumeration, MACROS.

File Handling: File Operations- Open, Close, Read, Write and Append.

Mapping of Course Outcomes for Unit I	CO1: Solve mathematical problems using C programming language.

Unit II	Searching and Sorting Algorithms	(06 Hrs)
Algorithms: Analysis of Iterative and Recursive algorithms, Space & Time complexity, Asymptotic notation- Big-O, Theta and Omega notations. **Searching methods:** Linear, Binary and Fibonacci Search. **Sorting methods:** Bubble, Insertion, Selection, Merge, and Quick Sort.		
Mapping of Course Outcomes for Unit II	**CO2: Implement sorting and searching algorithms and calculate their complexity.**	
Unit III	**Stack and Queue**	**(06 Hrs)**
Stack: Concept, Basic Stack operations, Array representation of stack, Stack as ADT, Stack Applications: Reversing data, Arithmetic expressions conversion and evaluation. **Queue:** Concept, Queue operations, Array representation of queue, Queue as ADT, Circular queue, Priority Queue, Applications of queue: Categorizing data, Simulation of queue.		
Mapping of Course Outcomes for Unit III	**CO3: Develop applications of stack and queue using array.**	
Unit IV	**Linked List**	**(06 Hrs)**
Concept of linked organization, Singly Linked List, Stack using linked list, Queue using linked list, Doubly Linked List, Circular Linked List, Linked list as ADT. Representation and manipulations of polynomials using linked list, comparison of sequential and linked organization.		
Mapping of Course Outcomes for Unit IV	**CO4: Demonstrate applicability of Linked List.**	
Unit V	**Trees**	**(06 Hrs)**
Introduction to trees: Basic Tree Concepts. **Binary Trees:** Concept & Terminologies, Representation of Binary Tree in memory, Traversing a binary tree. **Binary Search Trees (BST):** Basic Concepts, BST operations, Concept of Threaded Binary Search Tree AVL Tree: Basic concepts and rotations of a Tree.		
Mapping of Course Outcomes for Unit V	**CO5: Demonstrate applicability of nonlinear data structures - Binary Tree with respect to its time complexity.**	

Unit VI	Graphs	(06 Hrs)
Graph: Basic Concepts & terminology. **Representation of graphs:** Adjacency matrix, Adjacency list. **Operations on graph:** Traversing a graph. **Spanning trees:** Minimum Spanning tree- Kruskal's Algorithm, Prim's Algorithm and Dijkstra's Shortest Path Algorithm.		
Mapping of Course Outcomes for Unit VI	**CO6: Apply the knowledge of graph for solving the problems of spanning tree and shortest path algorithm.**	

Learning Resources

Text Books:

1. Ellis Horowitz and Sartaj Sahni, "Fundamentals of Data Structures", Galgotia Books Source, 2nd Edition

2. Richard. F. Gilberg and Behrouz A. Forouzan, "Data Structures: A Pseudocode Approach with C," Cengage Learning, 2nd Edition.

Reference Books:

1. E Balgurusamy, "Programming in ANSI C", Tata McGraw-Hill, 3rd Edition.

2. Yedidyah Langsam, Moshe J Augenstein and Aaron M Tenenbaum "Data structures using C and C++" PHI Publications, 2nd Edition.

3. Reema Thareja, "Data Structures using C", Oxford University Press, 2nd Edition.

MOOC / NPTEL Courses:

1. NPTEL Course **"Programming & Data Structure"**

https://nptel.ac.in/courses/106/105/106105085/

2. NPTEL Course "**Data Structures & Algorithms**"

https://nptel.ac.in/courses/106/102/106102064/

Savitribai Phule Pune University Second Year of Electronics / E & Tc Engineering (2019 Course) 204185: Electronic Circuits Lab		
Teaching Scheme:	**Credit**	**Examination Scheme:**
Practical: 02 hrs. / week	**01**	**Practical: 50 Marks**
Prerequisite Courses, if any: -		
Companion Course, if any: 204181 - Electronic Circuits		

List of Laboratory Experiments	
Group A: [Any 4 to be performed]	
1.	To design, build single stage CS amplifier & verify dc operating point.
2.	To build & test single stage CS amplifier, plot frequency response. Calculate A_v, R_i, R_o & bandwidth.
3.	To implement current series feedback amplifier & measure R_{if}, R_{of}, A_{vf} & bandwidth.
4.	To implement MOSFET amplifier-based Wein bridge oscillator.
5.	To design & implement an adjustable voltage regulator using three terminal voltage regulator IC.
Group B: Compulsory	
6.	To measure following Op- amp parameters & compare with specifications given in data sheet. **[Any two Practical Op-Amp can be used for comparison. e.g. LM741, OP07, LF351, LF356, TI071, TI072]** a) Input bias current b) Input offset current c) Input offset voltage d) Slew rate e) CMRR
7.	To design, build & test integrator using Op-amp for given frequency f_a.
8.	To design, build & test 2 or 3-bit R-2R ladder DAC.
9.	To design, build & test Square and triangular waveform generator using Op-Amp (LF351/6)

Group C: [Any 2 to be performed]	
11.	To design, build & test Schmitt trigger using Op-Amp (LF356, TI071)
12.	To design, build & test three Op amp Instrumentation amplifier for typical application.
13.	To design, build & test 2-bit flash ADC.
14.	To build & test PLL ckt.

Virtual LAB Links:

1. **Integrated Circuits:**
   http://vlabs.iitb.ac.in/vlabs-dev/vlab_bootcamp/bootcamp/electronerds/index.html

2. **Basic Electronics Virtual Lab:**
   http://vlabs.iitkgp.ernet.in/be/

Note:

- One practical from each Group should be performed as simulation practical (using any available tool).
- Additional (min.2) practicals are to be performed using Virtual Lab.

Savitribai Phule Pune University Second Year of Electronics / E & Tc Engineering (2019 Course) 204186: Digital Circuits Lab		
Teaching Scheme:	**Credit**	**Examination Scheme:**
Practical: 02 hrs. / week	**01**	**Practical: 50 Marks**
Prerequisite Courses, if any: --		
Companion Course, if any: 204182 - Digital Circuits		

List of Laboratory Experiments

1.	**Study of IC-74LS153 as a Multiplexer:** (Refer Data-Sheet). a. Design and Implement 8:1 MUX using IC-74LS153 & Verify its Truth Table. b. Design & Implement the given 4 variable function using IC74LS153. Verify its Truth-Table.
2.	**Study of IC-74LS138 as a Demultiplexer / Decoder:** (Refer Data-Sheet) a. Design and Implement full adder and subtractor function using IC-74LS138. b. Design & Implement 3-bit code converter using IC-74LS138. (Gray to Binary/Binary to Gray).
3.	**Study of IC-74LS83 as a BCD adder:** (Refer Data-Sheet). a. Design and Implement 1-digit BCD adder usingIC-74LS83. b. Design and Implement 4-bit Binary sub tractor using IC-74LS83.
4.	**Study of IC-74LS85 as a magnitude comparator:** (Refer Data-Sheet) a. Design and Implement 4-bit Comparator. b. Design and Implement 8-bit Comparator.
5.	**Study of Counters:** a. Design and Implement 4-bit counter using JK- Flip flop.
6.	**Study of Counter ICs (74LS90/74LS93):** (Refer Data-Sheet) a. Design and Implement MOD-N and MOD-NN using IC-74LS90 and draw Timing diagram. b. Design and Implement MOD-N and MOD-NN using IC-74LS93 and draw Timing diagram.

7.	**Study of synchronous counter:** a. Design & Implement 4-bit Up/down Counter and MOD-N Up/down Counter using IC74HC191 / IC74HC193. Draw Timing Diagram.
8.	Verify four voltage and current parameters for TTL and CMOS (IC 74LSXX, 74HCXX), (Refer Data-Sheet).
9.	**Study of Shift Register:** Design and Implement 4-bit right shift and left shift register using D-flip flop.
10.	**Study of Shift Register (74HC194 / 74LS95):** a. Design and Implement Pulse train generator using IC-74HC194 / IC74LS95 (Use right shift/ left shift). b. Design and Implement 4-bit Ring Counter/ Twisted ring Counter using shift registers IC 74HC194 / IC74LS95.
11.	**Study of Counter ICs (74LS90 / 74LS93):** (Refer Data-Sheet) a. Design and Implement MOD-N and MOD-NN using IC-74LS90 and draw Timing diagram. b. Design and Implement MOD-N and MOD-NN using IC-74LS93 and draw Timing diagram.

Virtual LAB Links:

1. **Digital Logic Design:**
   http://vlabs.iitb.ac.in/vlabs-dev/labs/dldesignlab/index.html
2. **Digital Electronics:**
   http://vlabs.iitb.ac.in/vlabs-dev/vlab_bootcamp/bootcamp/cool_developers/index.html
3. **Digital Logic Design using Gates:**
   http://vlabs.iitb.ac.in/vlabs-dev/labs/dldgates/index.html
4. **Digital Applications:**
   http://vlabs.iitb.ac.in/vlabs-dev/labs/digital_application/index.html
5. **Digital Electronics Circuits Lab:**
   http://vlabs.iitkgp.ernet.in/dec/
6. **Digital Logic Design Lab:**
   http://cse15-iiith.vlabs.ac.in/
7. **Hybrid Electronics:**
   http://he-coep.vlabs.ac.in/

Note: Additional (min.2) practicals are to be performed using Virtual Lab.

Savitribai Phule Pune University Second Year of Electronics / E & Tc Engineering (2019 Course) 204187: Electrical Circuits Lab		
Teaching Scheme:	**Credit**	**Examination Scheme:**
Practical: 02 hrs. / week	**01**	**Term Work: 25 Marks**
Prerequisite Courses, if any: --		
Companion Course, if any: 204183 - Electrical Circuits		

List of Laboratory Experiments

Group A: Tutorial Assignment

- Tutorials must be conducted batch wise.
- Batch size should not be more than 20 students.
- The main objective of this tutorial is to focus on the outcomes defined in the theory syllabus by solving the following assignment based on paper work.

1 (a)	**Determine the following using KVL, KCL, node, loop analysis and circuit simplification techniques:** 1. Currents through various given branches. 2. Voltages across the given branches. 3. Power absorbed or delivered by a given component. **(Analysis of simple DC circuits using all above techniques & Analysis of simple AC circuits using Mesh and Nodal analysis is expected)** **Verifying the results using appropriate simulator is expected:** https://www.falstad.com/circuit/ **OR** https://www.tinkercad.com/dashboard?type=circuits&collection=designs **OR** http://vlab.amrita.edu/?sub=1&brch=75 **OR any other equivalent**
1 (b)	**Determine the following using Network Theorems. One problem statement on each theorem.** 1. Currents through various given branches. 2. Voltages across the given branches. 3. Power absorbed or delivered by a given component. **(Analysis of simple DC circuits using all theorems is expected)** **Verifying the results using appropriate simulator is expected:**

	https://www.falstad.com/circuit/ **OR** https://www.tinkercad.com/dashboard?type=circuits&collection=designs **OR** http://vlab.amrita.edu/?sub=1&brch=75 **OR any other equivalent**
2 (a)	Formulate differential equation for RL and RC circuits and solve for current and voltages by determining initial conditions for driven and source free conditions.
2(b)	Carry out the transient analysis and determine the voltage, current expressions for a given network involving RL, RC, RLC. (One problem statement on each combination, source free and driven RL, RC, series RLC network) **Verifying the results using appropriate simulator is expected:** https://www.falstad.com/circuit/ **OR** https://www.tinkercad.com/dashboard?type=circuits&collection=designs **OR** http://vlab.amrita.edu/?sub=1&brch=75 **OR any other equivalent**
3 (a)	Determine the Z, Y, h, ABCD parameters for a given network. **Verifying the results using appropriate simulator is expected:** https://www.falstad.com/circuit/ **OR** https://www.tinkercad.com/dashboard?type=circuits&collection=designs
3 (b)	Analyze the given network using Laplace Transform and find the network transfer function.
Group B: Lab Practicals	
4.	To study speed control of DC shunt motor using armature voltage and field current control method. Measure RPM and plot graph of speed versus armature voltage and field current. **Virtual Lab Link:** http://vlabs.iitb.ac.in/vlabs-dev/vlab_bootcamp/bootcamp/Sadhya/index.php
5.	To study No-load test and blocked rotor test on 3-phase induction motor. **Virtual Lab Link:** http://vem-iitg.vlabs.ac.in/
6.	Torque- speed characteristic of 3 phase induction motor
7.	To Study BLDC Motor Drive.
8.	To study operating modes of stepper motor.

Group C: Industrial Visit / Case study	
9.	Industrial visit to electric motor manufacturing company / electric vehicle company / Power generation station. **OR** Case study of any one electric vehicle with respect to specifications of motor, battery and controller.

Virtual LAB Links:

1. **Analog Signal, Network and Measurement Virtual Lab:**
   http://vlabs.iitkgp.ernet.in/asnm/
2. **Electric Circuits Lab:**
   http://vlab.amrita.edu/?sub=1&brch=75
3. **Electrical Machines Lab:**
   http://vlabs.iitb.ac.in/vlabs-dev/vlab_bootcamp/bootcamp/Sadhya/index.php
4. **Electrical Machines Lab:**
   http://em-coep.vlabs.ac.in/

Note: Additional (min.2) practicals are to be performed using Virtual Lab

Savitribai Phule Pune University Second Year of Electronics / E & Tc Engineering (2019 Course) 204188: Data Structures Lab		
Teaching Scheme:	**Credit**	**Examination Scheme:**
Practical: 02 hrs. / week	**01**	**Oral: 25 Marks**
Prerequisite Courses, if any: 110005 - Programming and Problem Solving		
Companion Course, if any: 204184 - Data Structures		

List of Laboratory Experiments	
Group A: Compulsory **Write a C program to:**	
1.	Perform following String operations with and without pointers to arrays (without using the library functions): a. substring b. palindrome c. compare d. copy e. reverse
2.	Implement Database Management using array of structures with operations Create, Display, Modify, Append, Search and Sort. (For any database like Employee or Bank database with and without pointers to structures)
3.	Implement Stack and Queue using arrays.
4.	Create a singly linked list with options: a. Insert (at front, at end, in the middle) b. Delete (at front, at end, in the middle) c. Display d. Display Reverse e. Revert the SLL
5.	Implement Binary search tree with operations Create, search, and recursive traversal.
6.	Implement Graph using adjacency Matrix with BFS & DFS traversal.
Group B: [Any 3 to be performed] **Write a C program to:**	
7.	Implement stack and queue using linked list.
8.	Implement assignment 2 using files.

9.	Add two polynomials using linked list.
10.	Reverse a doubly linked list.
11.	Evaluate postfix expression (input will be postfix expression).
12.	Reverse and Sort stack using recursion.
13.	Implement inorder tree traversal without recursion.
14.	To find inorder predecessor and successor of a given key in BST.
15.	Implement Quicksort.

Group C: [Any 1 to be performed]

Write a C program to:

16.	Implement merge sort for doubly linked list.
17.	Construct a tree from given in order and preorder traversal.
18.	Implement Dijkstra's Algorithm.
19.	Implement Circular Linked List with various operations.
20.	Represent graph using adjacency list or matrix and generate minimum spanning tree using Prim's algorithm.

Group Assignment

- Make Group of **4 students** in a batch (Batch of 20)
- Group will select any one topic as group assignment
- After completing the assignment, the respective group will present it during the practical slot.
  - Distribution of work in a group during presentation may contain:
    - Algorithm / Flowchart
    - Program Explanation
    - Applications

Virtual LAB Links:

1. **Data Structures - I:**
   https://ds1-iiith.vlabs.ac.in/data-structures-1/
2. **Data Structures - II:**
   https://ds2-iiith.vlabs.ac.in/data-structures-2/
3. **Data Structures Lab:**
   http://cse01-iiith.vlabs.ac.in/
4. **Computer Programming Lab:**
   http://cse02-iiith.vlabs.ac.in/

Note: Additional (min.2) practicals are to be performed using Virtual Lab.

Savitribai Phule Pune University Second Year of Electronics / E & Tc Engineering (2019 Course) 204189: Electronic Skill Development Lab		
Teaching Scheme:	**Credit**	**Examination Scheme:**
Practical: 02 hrs. / week	**01**	**Term Work: 25 Marks**
Prerequisite Courses, if any: Basic Electronics Engineering, Fundamentals of Programming, Open-source electronics platform based on easy-to-use hardware and software (preferably Arduino)		
Companion Course, if any: Any one of the following: 1. Jeremy Blum PCB tutorials. 2. OrCAD basic Tutorials.		

List of Assignments [Min. 10 must be completed]	
Group A: Application of Electronics Principles in Practice	
1.	Electronic Components and Connections (Bread boarding).
2.	Introduction and applications using Arduino and micro python.
3.	Using Sensors & Actuators and their interfacing with Arduino (Motor Driver with relays , Reversible motor, SSR).
4.	Wireless Connectivity to Arduino .
Group B: Hardware Design, Fault Finding, Testing, Repair and Measuring	
5.	Drawing layout of PCB using PCB design software.
6.	Single layer PCB design for a simple electronic circuit.
7.	Using test equipment for testing, fault finding & repair etc.
8.	Use of measuring equipment for measurement of signals.
9.	Using Simulation software for design & testing of electronic circuits.
Group C: Assembly, SMD Overview, Power Budgeting, Batteries (Lead Acid , LiPo), Solar	
10.	Assemble and utilize mechanical parts such as DC Motor, AC Motor, Stepper motor Solenoid, sensors etc., connect and assemble mechanical parts to form a working unit , Wire and form cables. industry standards

11.	Assemble and use various types of parts and surface mounted devise parts, Assemble parts to standard determined by IPC-A-610, Work to correct sequences and tolerances, Accurately solder components using lead free solder to comply with
12.	Calculation of Power budget for an electronic circuit.
13.	Study & Use of various types of Batteries.
14.	Study of various solar power generation systems.

Learning Resources

Reference Books:

1. R S Khandpur, "Printed Circuit Boards: Design - Fabrication and Assembly", Tata McGraw Hill

2. Simon Monk "Hacking Electronics", McGraw Hill

Web resources:

1. https://github.com/arduino/Arduino

2. https://spoken-tutorial.org/tutorialsearch/?search_foss=Arduino&search_language=English

3. https://worldskillsindia.co.in/worldskill/file/2019/Electronics.pdf

4. https://worldskills.org/what/projects/wsss/

Savitribai Phule Pune University Second Year of Electronics / E & Tc Engineering (2019 Course) 204190: Mandatory Audit Course - 3		
Teaching Scheme:	**Credit**	**Examination Scheme:**
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List of Courses to be opted (Any one) under Mandatory Audit Course 3

- Technical English For Engineers
- Ecology and Environment
- Ecology and Society
- German I
- Science, Technology and Society
- Introduction to Japanese Language and Culture

GUIDELINES FOR CONDUCTION OF AUDIT COURSE

In addition to credits courses, it is mandatory that there should be audit course (non-credit course) from second year of Engineering. The student will be awarded grade as AP on successful completion of audit course. The student may opt for two of the audit courses (One in each semester). Such audit courses can help the student to get awareness of different issues which make impact on human lives and enhance their skill sets to improve their employability. List of audit courses offered in the semester is provided in the curriculum. Student can choose one of the audit course from list of courses mentioned. Evaluation of audit course will be done at institute level.

The student registered for audit course shall be awarded the grade AP and shall be included such grade in the Semester grade report for that course, provided student has the minimum attendance as prescribed by the Savitribai Phule Pune University and satisfactory in-semester performance and secured a passing grade in that audit course. No grade points are associated with this 'AP' grade and performance in these courses is not accounted in the calculation of the performance indices SGPA and CGPA. Evaluation of audit course will be done at institute level itself.

Selecting an Audit Course:

Using NPTEL Platform:

NPTEL is an initiative by MHRD to enhance learning effectiveness in the field of technical education by developing curriculum based video courses and web based e-courses. The details of NPTEL courses are available on its official website www.nptel.ac.in

- Student can select any one of the courses mentioned above and has to register for the corresponding online course available on the NPTEL platform as an Audit course.
- Once the course is completed the student can appear for the examination as per the guidelines on the NPTEL portal.
- After clearing the examination successfully; student will be awarded with certificate.

Assessment of an Audit Course:

- The assessment of the course will be done at the institute level. The institute has to maintain the record of the various audit courses opted by the students. The audit course opted by the students could be interdisciplinary.
- During the course students will be submitting the online assignments. A copy of same students can submit as a part of term work for the corresponding Audit course.
- On the satisfactory submission of assignments, the institute can mark as “Present” and the student will be awarded the grade AP on the marksheet.

Savitribai Phule Pune University **Second Year of Electronics / E & Tc Engineering (2019 Course)** **204191: Signals & Systems**		
Teaching Scheme:	**Credit**	**Examination Scheme:**
Theory: 03 hrs. / week **Tutorial: 01 hr. / week**	**03 + 01 = 04**	**In-Sem (Theory): 30 Marks** **End Sem (Theory): 70 Marks** **Term Work: 25 Marks**

Prerequisite Courses, if any: --

Companion Course, if any: 204195 - Signal & Control Systems Lab

Course Objectives:

- To understand the mathematical representation of continuous and discrete time signals and systems.
- To classify signals and systems into different categories.
- To analyze Linear Time Invariant (LTI) systems in time and transform domains.
- To build basics for understanding of courses such as signal processing, control system and communication.
- To develop basis of probability and random variables.

Course Outcomes: On completion of the course, learner will be able to -

CO1: Identify, classify basic signals and perform operations on signals.

CO2: Identify, Classify the systems based on their properties in terms of input output relation and in terms of impulse response and will be able to determine the convolution between to signals.

CO3: Analyze and resolve the signals in frequency domain using Fourier series and Fourier Transform.

CO4: Resolve the signals in complex frequency domain using Laplace Transform, and will be able to apply and analyze the LTI systems using Laplace Transforms.

CO5: Define and Describe the probability, random variables and random signals. Compute the probability of a given event, model, compute the CDF and PDF.

CO6: Compute the mean, mean square, variance and standard deviation for given random variables using PDF.

Course Contents		
Unit I	**Introduction to Signals & Systems**	**(07 Hrs)**
Signals: Introduction, Graphical, Functional, Tabular and Sequence representation of Continuous and Discrete time signals. Basics of Elementary signals: Unit step, Unit ramp, Unit parabolic, Impulse, Sinusoidal, Real exponential, Complex exponential, Rectangular pulse, Triangular, Signum, Sinc and Gaussian function. **Operations on signals**: time shifting, time reversal, time scaling, amplitude scaling, signal addition, subtraction, signal multiplication. Communication, control system and Signal processing examples. **Classification of signals:** Deterministic, Random, periodic , Non periodic, Energy , Power, Causal , Non-Causal, Even and odd signal. **Systems**: Introduction, Classification of Systems: Lumped Parameter and Distributed Parameter System, static and dynamic systems, causal and non-causal systems, Linear and Non- linear systems, time variant and time invariant systems, stable and unstable systems, invertible and non- invertible systems.		
Mapping of Course Outcomes for Unit I	**CO1: Identify, classify basic signals and perform operations on signals.**	
Unit II	**Time domain representation of LTI System**	**(07 Hrs)**
Input-output relation, definition of impulse response, convolution sum, convolution integral, computation of convolution integral using graphical method for unit step to unit step, unit step to exponential, exponential to exponential, unit step to rectangular and rectangular to rectangular only. Computation of convolution sum. Properties of convolution. System interconnection, system properties in terms of impulse response, step response in terms of impulse response.		
Mapping of Course Outcomes for Unit II	**CO2: Identify, Classify the systems based on their properties in terms of input output relation and in terms of impulse response and will be able to determine the convolution between to signals.**	
Unit III	**Fourier Series**	**(07 Hrs)**
Fourier series (FS) representation of periodic Continuous Time (CT) signals, Dirichlet condition for existence of Fourier series, orthogonality, basis functions, Amplitude and phase response, FS representation of CT signals using trigonometric and exponential Fourier series. Applications of Fourier series, properties of Fourier series and their physical significance, Gibbs phenomenon.		
Mapping of Course Outcomes for Unit III	**CO3: Analyze and resolve the signals in frequency domain using Fourier series and Fourier Transform.**	

Unit IV	Fourier Transform	(07 Hrs)
Fourier Transform (FT) representation of aperiodic CT signals, Dirichlet condition for existence of Fourier transform, evaluation of magnitude and phase response, FT of standard CT signals, Properties and their significance, Interplay between time and frequency domain using sinc and rectangular signals, Fourier Transform for periodic signals.		
Mapping of Course Outcomes for Unit IV	**CO3: Analyze and resolve the signals in frequency domain using Fourier series and Fourier Transform.**	
Unit V	**Laplace Transform**	**(07 Hrs)**
Definition of Laplace Transform (LT), Limitations of Fourier transform and need of Laplace transform, ROC, Properties of ROC, Laplace transform of standard periodic and aperiodic functions, properties of Laplace transform and their significance, Laplace transform evaluation using properties, Inverse Laplace transform based on partial fraction expansion, stability considerations in S domain, Application of Laplace transforms to the LTI system analysis.		
Mapping of Course Outcomes for Unit V	**CO4: Resolve the signals in complex frequency domain using Laplace Transform, and will be able to apply and analyze the LTI systems using Laplace Transforms.**	
Unit VI	**Probability and Random Variables**	**(07 Hrs)**
Probability: Experiment, sample space, event, probability, conditional probability and statistical independence, Bayes theorem, Uniform and Gaussian probability models. **Random variables:** Continuous and Discrete random variables, cumulative distributive function, Probability density function, properties of CDF and PDF. Statistical averages, mean, moments and expectations, standard deviation and variance.		
Mapping of Course Outcomes for Unit VI	**CO5: Define and Describe the probability, random variables and random signals. Compute the probability of a given event, model, compute the CDF and PDF.** **CO6: Compute the mean, mean square, variance and standard deviation for given random variables using PDF.**	
Learning Resources		
Text Books: 1. Simon Haykins and Barry Van Veen, "Signals and Systems", Wiley India, 2nd Edition. 2. M.J. Roberts "Signal and Systems", Tata McGraw Hill 2007.		

Reference Books:

1. Charles Phillips, “Signals, Systems and Transforms”, Pearson Education, 3rd Edition.
2. Peyton Peebles, “Probability, Random Variable, Random Processes”, Tata Mc Graw Hill, 4th Edition.
3. A. Nagoor Kanni “Signals and Systems”, Mc Graw Hill, 2nd Edition.

MOOC / NPTEL Courses:

1. NPTEL Course **“Principles of Signals & System”**

https://nptel.ac.in/courses/108/104/108104100/

2. Lecture Series on, **“Signals & Systems”**

http://www.nptelvideos.in/2012/12/signals-and-system.html

Savitribai Phule Pune University

Second Year of Electronics / E & Tc Engineering (2019 Course)

204192: Control Systems

Teaching Scheme:	Credit	Examination Scheme:
Theory: 03 hrs. / week	03	In-Sem (Theory): 30 Marks End Sem (Theory): 70 Marks

Prerequisite Courses, if any: --

Companion Course, if any: 204195 - Signal & Control Systems Lab

Course Objectives:

- To Introduce elements of control system and their modeling using various Techniques.
- To get acquainted with the methods for analyzing the time response and Stability of System
- To Introduce and analyze the frequency response and Stability of System
- To Introduce concept of root locus, Bode plots, Nyquist plots.
- To Introduce State Variable Analysis method.
- To get acquainted with Concepts of PID controllers and IoT based Industrial Automation.

Course Outcomes: On completion of the course, learner will be able to -

CO1: Determine and use models of physical systems in forms suitable for use in the analysis and design of control systems.

CO2: Determine the (absolute) stability of a closed-loop control system.

CO3: Perform time domain analysis of control systems required for stability analysis.

CO4: Perform frequency domain analysis of control systems required for stability analysis.

CO5: Apply root-locus, Frequency Plots technique to analyze control systems.

CO6: Express and solve system equations in state variable form.

CO7: Differentiate between various digital controllers and understand the role of the controllers in Industrial automation.

Course Contents

Unit I	Introduction to Control Systems & its modelling	(06 Hrs)

Basic Elements of Control System, Open loop and Closed loop systems, Differential equations and Transfer function, Modeling of Electric systems, Translational and rotational mechanical systems, Block diagram reduction Techniques, Signal flow graph.

Mapping of Course Outcomes for Unit I	CO1: Determine and use models of physical systems in forms suitable for use in the analysis and design of control systems.

Unit II	Time domain analysis	(06 Hrs)
Time domain analysis: transient response and steady state response, standard test inputs for time domain analysis, order and type of a system, transient analysis of first and second order systems, time domain specifications of second order under damped system from its step response, Steady state error and static error constants.		
Mapping of Course Outcomes for Unit II	CO2: Determine the (absolute) stability of a closed-loop control system.	
Unit III	**Stability analysis**	**(08 Hrs)**
Characteristic equation of a system, concept of pole and zero, response of various pole locations in s-plane, concept of stability absolute stability, relative stability, stability of system from pole locations, Routh Hurwitz stability criterion, Root locus: definition, magnitude and angle conditions, construction of root locus, concept of dominant poles, effect of addition of pole and zero on root locus. Application of root locus for stability analysis.		
Mapping of Course Outcomes for Unit III	CO3: Perform time domain analysis of control systems required for stability analysis.	
Unit IV	**Frequency domain analysis**	**(08 Hrs)**
Frequency response and frequency domain specifications, correlation between time domain and frequency domain specifications, polar plot, Nyquist stability criterion and construction of Nyquist plot, Bode plot, determination of frequency domain specifications and stability analysis using Nyquist plot and Bode plot.		
Mapping of Course Outcomes for Unit IV	CO4: Perform frequency domain analysis of control systems required for stability analysis. CO5: Apply root-locus, Frequency Plots technique to analyze control systems.	
Unit V	**State space representation**	**(06 Hrs)**
State space advantages and representation, Transfer function from State space, physical variable form, phase variable forms: controllable canonical form, observable canonical form, Solution of homogeneous state equations, state transition matrix and its properties, computation of state transition matrix by Laplace transform method only.		
Mapping of Course Outcomes for Unit V	CO6: Express and solve system equations in state variable form.	

Unit VI	Controllers and Digital Control Systems	(06 Hrs)
Concept of Controller, Basic ON-OFF Controller, Concept of Dead Zone, Introduction to P, I, D, PI, PD and PID controller, OFFSET of Controller, Integral Reset, PID Characteristics. Concept of Zeigler-Nicholas method. Concept of Industrial Automation, Need of IoT based Industrial Automation.		
Mapping of Course Outcomes for Unit VI	CO7: Differentiate between various digital controllers and understand the role of the controllers in industrial automation.	

Learning Resources

Text Books:

1. N. J. Nagrath and M. Gopal, "Control System Engineering", New Age International Publishers, 5th Edition.
2. K. Ogata, "Modern Control Engineering", Prentice Hall India Learning Private Limited; 5th Edition.

Reference Books:

1. Benjamin C. Kuo, "Automatic control systems", Prentice Hall of India, 7th Edition.
2. M. Gopal, "Control System – Principles and Design", Tata McGraw Hill, 4th Edition.
3. Schaum's Outline Series, "Feedback and Control Systems" Tata McGraw-Hill.
4. John J. D'Azzo and Constantine H. Houpis, "Linear Control System Analysis and Design", Tata McGraw-Hill, Inc.
5. Richard C. Dorf and Robert H. Bishop, "Modern Control Systems", Addison – Wesley.

MOOC / NPTEL Courses:

1. NPTEL Course **"Control System"**

   https://nptel.ac.in/courses/107/106/107106081/

2. NPTEL Course **"Control System Design"**

   https://nptel.ac.in/courses/115/108/115108104/

Savitribai Phule Pune University Second Year of Electronics / E & Tc Engineering (2019 Course) 204193: Principles of Communication Systems		
Teaching Scheme:	**Credit**	**Examination Scheme:**
Theory: 03 hrs. / week	**03**	**In-Sem (Theory): 30 Marks** **End Sem (Theory): 70 Marks**

Prerequisite Courses, if any: --

Companion Course, if any: 204191 - Signals & Systems
204196 - Principles of Communication Systems Lab

Course Objectives:

- To equip/ familiarize students with basic mathematical tools for time and frequency domain analysis of communication signal and systems.
- To acquaint the students with the fundamental principles of modulation process and different amplitude and angle modulation systems.
- To introduce the students with the concept of Sampling theorem and pulse modulation techniques PAM, PWM, PPM.
- To impart pre-requisites of digital communication systems and explore digital representation techniques like PCM, DPCM, DM and ADM.
- To highlight the issues in baseband digital transmission such as data representation, synchronization, multiplexing and ISI.

Course Outcomes: On completion of the course, learner will be able to -

CO1: To compute & compare the bandwidth and transmission power requirements by analyzing time and frequency domain spectra of signal required for modulation schemes under study.

CO2: Describe and analyze the techniques of generation, transmission and reception of Amplitude Modulation Systems.

CO3: Explain generation and detection of FM systems and compare with AM systems.

CO4: Exhibit the importance of Sampling Theorem and correlate with Pulse Modulation technique (PAM, PWM, and PPM).

CO5: Characterize the quantization process and elaborate digital representation techniques (PCM, DPCM, DM and ADM).

CO6: Illustrate waveform coding, multiplexing and synchronization techniques and articulate their importance in baseband digital transmission.

Course Contents		
Unit I	**Signals & spectra**	**(08 Hrs)**
Introduction to Communication System, Analog and Digital messages, regenerative repeaters, Signal Bandwidth & Power. Size & classification of signal, exponential Fourier series, concept of negative frequencies. Fourier transform and properties, Frequency shifting, Concept of baseband and bandpass signals, Signal transmission through LTI system. Signal energy & Energy Spectral density. Signal power & Power Spectral Density, Input and output PSD, PSD of modulated signal.		
Mapping of Course Outcomes for Unit I	**CO1: To compute & compare the bandwidth and transmission power requirements by analyzing time and frequency domain spectra of signal required for modulation schemes under study.**	
Unit II	**AM transmission & reception for signal tone**	**(08 Hrs)**
Need for frequency translation, Amplitude modulation (DSB-C), Double sideband Suppressed carrier (DSB-SC) modulation, Single sideband modulation (SSB), Vestigial Sideband modulation (VSB),Spectrum and Bandwidth of AM, DSB-SC, SSB & VSB, Calculation of modulation index for AM wave, Modulation index for more than one modulating signals, Power and power efficiency, AM reception		
Mapping of Course Outcomes for Unit II	**CO2: Describe and analyze the techniques of generation, transmission and reception of Amplitude Modulation Systems.**	
Unit III	**FM transmission & reception for signal tone**	**(08 Hrs)**
Phase Modulation (PM) and Frequency Modulation (FM), Relationship between Phase and Frequency Modulation, Modulation Index, Spectrum of FM (single tone): Feature of Bessel Coefficient, Power of FM signal, Bandwidth of tone modulated FM signal, modulation index : AM vs. FM, Spectrum of constant Bandwidth' FM, Narrowband and Wideband FM. **FM Modulators and Demodulators:** FM generation by Armstrong's Indirect method, frequency multiplication and application to FM, FM demodulator.		
Mapping of Course Outcomes for Unit III	**CO3: Explain generation and detection of FM systems and compare with AM systems.**	
Unit IV	**Pulse Modulation**	**(06 Hrs)**
Need of analog to digital conversion, sampling theorem for low pass signal in time domain, and Nyquist criteria, Types of sampling- natural and flat top. Pulse amplitude modulation & concept of TDM: Channel bandwidth for PAM, equalization, Signal Recovery through holding. Pulse Width Modulation (PWM) and Pulse Position Modulation (PPM): Generation & Detection.		
Mapping of Course Outcomes for Unit IV	**CO4: Exhibit the importance of Sampling Theorem and correlate with Pulse Modulation techniques (PAM, PWM, and PPM)**	

Unit V	Digital Representation of Analog Signals	(06 Hrs)
Quantization of Signals: Quantization error, Uniform & Non-Uniform types of Quantization, Mid-rise & Mid-tread Quantizer. **Companding:** A-law & µ-law. **Pulse Code Modulation system**: Generation & Reconstruction, Differential Pulse code modulation, Delta Modulation, Adaptive Delta Modulation.		
Mapping of Course Outcomes for Unit V	**CO5: Characterize the quantization process and elaborate digital representation techniques (PCM, DPCM, DM and ADM).**	
Unit VI	**Baseband Digital Transmission**	**(06 Hrs)**
Line codes: Properties and spectrum. **Digital Multiplexing and hierarchies:** T1, AT&T, E1, CCITT, Scrambling & Unscrambling. **Synchronization:** Carrier Synchronization, Bit Synchronization and Frame Synchronization. Intersymbol Interference, Equalization.		
Mapping of Course Outcomes for Unit VI	**CO6: Illustrate waveform coding, multiplexing and synchronization techniques and articulate their importance in baseband digital transmission.**	

Learning Resources

Text Books:

1. Taub, Schilling and Saha, "Principles of Communication Systems", McGraw-Hill, 4th Edition.
2. B P Lathi, Zhi Ding, "Modern Analog and Digital Communication System", Oxford University Press, 4th Edition.

Reference Books:

1. Bernard Sklar and Prabitra Kumar Ray, "Digital Communications Fundamentals and Applications", Pearson Education 2nd Edition.
2. Wayne Tomasi, "Electronic Communications System", Pearson Education, 5th Edition.
3. A.B Carlson, P B Crully and J C Rutledge, "Communication Systems", Tata McGraw Hill Publication, 5th Edition.
4. Simon Haykin, "Communication Systems",John Wiley & Sons, 4th Edition.

MOOC / NPTEL Course:

1. NPTEL Course **"Principles of Communication Systems-I"**

https://nptel.ac.in/courses/108/104/108104091/

Savitribai Phule Pune University Second Year of Electronics / E & Tc Engineering (2019 Course) 204194: Object Oriented Programming		
Teaching Scheme:	**Credit**	**Examination Scheme:**
Theory: 03 hrs. / week	**03**	**In-Sem (Theory): 30 Marks** **End Sem (Theory): 70 Marks**

Prerequisite Courses, if any: --

Companion Course, if any: 204197 - Object Oriented Programming Lab

Course Objectives:

- Make the students familiar with basic concepts and techniques of object oriented programming in C++ To acquaint the students with the fundamental principles of modulation process and different amplitude and angle modulation systems.
- Develop an ability to write programs in C++ for problem solving.

Course Outcomes: On completion of the course, learner will be able to -

CO1: Describe the principles of object oriented programming.

CO2: Apply the concepts of data encapsulation, inheritance in C++.

CO3: Understand Operator overloading and friend functions in C++.

CO4: Apply the concepts of classes, methods inheritance and polymorphism to write programs C++.

CO5: Apply Templates, Namespaces and Exception Handling concepts to write programs in C++.

CO6: Describe and use of File handling in C++.

Course Contents

Unit I	Foundation of Object Oriented Programming	(08 Hrs)

Introduction to procedural, modular, object-oriented and generic programming techniques, Limitations of procedural programming, Need of object-oriented programming, fundamentals of object-oriented programming: objects, classes, data members, methods, messages, data encapsulation, data abstraction and information hiding, inheritance, polymorphism. Inline functions, Function overloading, call by value and call by reference, return by reference, functions with default arguments, this pointer, illustrative Simple C++ Programs. Dynamic initialization of variables, memory management operators, Member dereferencing operators, operator precedence, typecast operators, Scope resolution operators, arrays.

Mapping of Course Outcomes for Unit I	**CO1: Describe the principles of object oriented programming.**

Unit II	**Classes & Objects**	**(06 Hrs)**
Defining class, Defining member functions, static data members, static member functions, private data members, public member functions, arrays of objects, objects as function arguments. Constructors and Destructors: types of constructors, handling of multiple constructors, destructors. (**Complex Class & String Class**)		
Mapping of Course Outcomes for Unit II	**CO2: Apply the concepts of data encapsulation, inheritance in C++.**	
Unit III	**Operator Overloading**	**(06 Hrs)**
Fundamentals of Operator Overloading, Restrictions on Operators Overloading, Operator Functions as Class Members vs. as Friend Functions, Overloading Unary Operators, Overloading Binary Operators, Overloading of operators using friend functions.		
Mapping of Course Outcomes for Unit III	**CO3: Understand Operator overloading and friend functions in C++.**	
Unit IV	**Inheritance & Polymorphism**	**(06 Hrs)**
Introduction to inheritance, base and derived classes, friend classes, types of inheritance, hybrid inheritance, member access control, static class, multiple inheritance, ambiguity, virtual base class, Introduction to polymorphism, pointers to objects, virtual functions, pure virtual functions, abstract base class, Polymorphic class, virtual destructors, early and late binding, container classes, Contained classes, Singleton class.		
Mapping of Course Outcomes for Unit IV	**CO4: Apply the concepts of classes, methods inheritance and polymorphism to write programs C++.**	
Unit V	**Templates, Namespaces and Exception handling**	**(06 Hrs)**
Templates: Introduction, Function template and class template, function overloading vs. function templates **Namespaces:** Introduction, Rules of namespaces **Exception handling:** Introduction, basics of exception handling, exception handling mechanism, throwing and catching mechanism, specifying exceptions, Multiple Exceptions, Exceptions with arguments C++ streams, stream classes, unformatted I/O, formatted I/O and I/O manipulators.		
Mapping of Course Outcomes for Unit V	**CO5: Apply Templates, Namespaces and Exception Handling concepts to write programs in C++.**	

Unit VI	Working with files	(06 Hrs)
Introduction, classes for file Stream Operations, opening and closing files, detecting End_Of_File (EOF), modes f File Opening, file pointers and manipulators, updating file, error handling during file operations.		
Mapping of Course Outcomes for Unit VI	**CO6: Describe and use of File handling in C++.**	
Learning Resources		

Text Books:

1. E Balagurusamy, "Programming with C++", Tata McGraw Hill, 3rd Edition.

2. Herbert Schildt, "The Complete Reference C++", 4th Edition.

Reference Books:

1. Robert Lafore, "Object Oriented Programming in C++", Sams Publishing, 4th Edition.

2. Matt Weisfeld, "The Object-Oriented Thought Process", Pearson Education.

MOOC / NPTEL Courses:

1. NPTEL Course **"Programming in Java"**

https://nptel.ac.in/courses/106/105/106105191/

2. NPTEL Course **"Programming in C++"**

https://nptel.ac.in/courses/106/105/106105151/

Other Resources:

1. Bjarne Stroustrup, "A Tour of C++".

Savitribai Phule Pune University Second Year of Electronics / E & Tc Engineering (2019 Course) 204195: Signals & Control System Lab		
Teaching Scheme:	**Credit**	**Examination Scheme:**
Practical: 02 hrs. / week	**01**	**Term Work: 50 Marks**
Prerequisite Courses, if any: --		
Companion Course, if any: 204192 - Signals & Systems 204193 - Control systems		

SIGNALS & SYSTEMS

Group A: [Any 6 to be performed]	
1.	Generate and plot the following signals in time domain and also sketch its amplitude and phase spectrum. Verify the result: • Impulse • Unit Step • Exponential • Unit ramp • Sinc • Rectangular
2 (a)	Write the codes to plot the following signals also simulate the signals: (a) $\sin(200\pi t)$ (b) $\sin(200\pi t+\frac{\pi}{6})$ (c) $\sin(200\pi t-\frac{\pi}{6})$ (d) $\cos(200\pi t)$ (e) $\cos(200\pi t+\frac{\pi}{4})$ (f) $\cos(200\pi t-\frac{\pi}{6})$
2 (b)	Develop codes to simulate, and plot the results for an exponential signal: $x(t)=k\,e^{-at}u(t)$ for the cases: (a) $k=1$, and $a=0.35$ (b) $k=1.2$ and $a=-0.45$
3.	**Sampling & Aliasing** Consider various human voice / speech (probably your voice both male and female) or music signals. Try different sampling rates and observe the effect of aliasing.

4.	**Real time speech signal and Spectral analysis** The speech signal has frequency components in the audio frequency range 300 Hz to 3400 Hz of the electromagnetic spectrum. Record the male and female voice speech Signal. Write a program to record the speech signals and sketch it in time domain, its amplitude spectrum and phase spectrum.
5.	The music signal has frequency components in the audio frequency range 20 Hz to 20000 Hz of the electromagnetic spectrum. Record or use the recorded music samples of different instruments (at least four) and Write a program to record the music signal and sketch it in time domain, its amplitude spectrum and phase spectrum. Also comment on the result.
6.	Find the convolution integral of Unit step and exponential signals and write a program to sketch the out response of the system. Also verify the commutative property of convolution integral.
7.	Take any one periodic signal and find its Fourier series coefficients using exponential or trigonometric FS method. Write a program to find its Fourier series coefficients. Also using FS coefficients, reconstruct the signal. Observe the effect of Gibb's phenomenon.

CONTROL SYSTEMS

Group B: [Any 8 to be performed]	
1.	Numerical on Black diagram reduction technique, Signal Flow Graphs (at least 4 numericals)
2.	Computation of transfer function of Electric Circuits, Mechanical Circuits for concept understanding with their analogy Force-Voltage and Force Current.
3.	Standard input signals and time response analysis of First Order and Second order Systems for step input. Underdamped, Critically damped and Overdamped case.
4.	Stability analysis for any given system with Characteristic Equation given (Software Simulation).
5.	Computation and Software / Simulation of root locus for given G(s)H(s). Comment on time domain specifications and stability of the system.
6.	Computation and analysis of frequency response analysis u Bode Plot for given G(s) H(s). Comment on Gain Margin, Phase Margin and Stability of the system.
7.	Software implementation/Simulation frequency response analysis using Nyquist Plot for given G(s) H(s). Comment on Gain Margin, Phase Margin and Stability of the system

8.	Compute correlation time domain and frequency domain with examples (at least 4 numericals).
9.	Computation of State Model from Transfer function and Compute Transfer Function from state model solve at least 4/5 numericals.
10.	Derivation of Properties and solve numerical on state transition matrix.
11.	Observe the effect of P, PI, PD and PID controller on the step response of a feedback control system. Comment on effect of Controller mode Time domain specifications/ analysis.

Virtual LAB Link:

1. **Signals and Systems Labotratory:**
   http://ssl-iitg.vlabs.ac.in/

Note: Additional (min. 3) tutorials are to be performed using Virtual Lab.

Savitribai Phule Pune University Second Year of Electronics / E & Tc Engineering (2019 Course) 204196: Principles of Communication Systems Lab		
Teaching Scheme:	**Credit**	**Examination Scheme:**
Practical: 02 hrs. / week	**01**	**Practical: 50 Marks**
Prerequisite Courses, if any: --		
Companion Course, if any: 204193 - Principles of Communication Systems		

List of Laboratory Experiments	
Group A: Hardware Practicals	
1.	AM Generation (DSB-FC): Calculation of modulation index by graphical method, Power of AM Wave for different modulating signal and Observe Spectrum.
2.	Frequency modulator & demodulator using Varicap/Varactor Diode and NE 566 VCO, IC 565 (PLL based detection), calculation of modulation index & BW of FM.
3.	Verification of Sampling Theorem, PAM Techniques, (Flat top & Natural sampling), reconstruction of original signal, Observe Aliasing Effect in frequency domain.
4.	Generation and Detection of PWM using IC 555
5.	Study of PCM
6.	Study of Companded PCM
7.	**Study of DM:** Generation and detection
8.	**Study of ADM:** Generation and detection
9.	Study of line codes (NRZ, RZ, POLAR RZ, BIPOLAR (AMI), MANCHESTER) & their spectral analysis.
Group B: Simulation Practicals [Any 3 to be performed]	
10.	Simulation of T1/E1 system using suitable software.
11.	Simulation program to study effect of ISI and noise in baseband communication system.
12.	Simulation program to calculate Signal to noise ratio for PCM system & DM system.
13.	Verify Sampling Theorem using simulation.
14.	Demonstrate Scrambling and descrambling operation either using hardware or any simulation tool.

Savitribai Phule Pune University Second Year of Electronics / E & Tc Engineering (2019 Course) 204197: Object Oriented Programming Lab		
Teaching Scheme:	**Credit**	**Examination Scheme:**
Practical: 02 hrs. / week	**01**	**Oral: 50 Marks**
Prerequisite Courses, if any: --		
Companion Course, if any: 204194 - Object Oriented Programming		

List of Laboratory Experiments	
Group A: [Any Four to be performed]	
1.	Write a program in C++ to sort the numbers in an array using separate functions for read, display, sort and swap. The objective of this assignment is to learn the concepts of input, output, functions, call by reference in C++.
2.	Write a C++ program that illustrates the concept of Function over loading.
3.	Write a program in C++ to perform following operations on complex numbers Add, Subtract, Multiply, Divide, Complex conjugate. Design the class for complex number representation and the operations to be performed. The objective of this assignment is to learn the concepts classes and objects.
4.	Write a program in C++ to implement Stack. Design the class for stack and the operations to be performed on stack. Use Constructors and destructors. The objective of this assignment is to learn the concepts classes and objects, constructors and destructors.
5.	Write a program in C++ to overload unary operators for complex class.
Group B: [Any Seven to be performed]	
6.	Write a program in C++ to perform following operations on complex numbers Add, Subtract, Multiply, Divide. Use operator overloading for these operations. The objective of this assignment is to learn the concepts operator overloading.
7.	Write a program in C++ to implement string class. Write constructors, destructor, Accepts function and Display function.
8.	Write a program in C++ to implement string class. Write constructors, destructor, Accepts function and Display function. To overload = operator so as call copy constructor.

9.	Write a program in C++ to implement containment concept using Employee, B Date, & String Classes.
10.	Write a program in C++ to Read and Display the information of Employee Using Multiple Inheritance. Use Basic Info and Department Info as a base classes of Employee class.
11.	Write a C++ program that illustrates run time polymorphism by using virtual functions.
12.	Write a C++ program which use try and catch for exception handling.
13.	Write a C++ program which to implement class and function template.
14.	Write a C++ program which to demonstrate use of namespace in the program.
15.	Write a C++ program which copies the contents of one file to another.

Virtual LAB Links:

1. **Object Oriented Programming with C++:**
   http://vlabs.iitb.ac.in/vlabs-dev/labs/oops/index.php

2. **Problem Solving Lab:**
   http://ps-iiith.vlabs.ac.in/

Note: Additional (min.2) practicals are to be performed using Virtual Lab.

Savitribai Phule Pune University

Second Year of Electronics / E & Tc Engineering (2019 Course)

204198: Data Analytics Lab

Teaching Scheme:	Credit	Examination Scheme:
Practical: 02 hrs. / week	01	Oral: 25 Marks

Prerequisite Courses, if any: 110005 - Programming and Problem Solving

Companion Course, if any: --

Course Objectives:

- To introduce to students fundamentals of data science.
- To introduce to students various Python packages related to data science.
- To make student write Python programs related to data sequences using NumPy and Pandas.
- To make student write Python programs related to data frames using NumPy and Pandas.

Guidelines for Instructor's Manual

This course introduces student to the basics of the Python programming environment for preliminary data science applications. The course also introduces data manipulation and cleaning techniques using the popular Python Pandas and Scikit-learn library and introduces the abstraction of the Series and Data Frame as the central data structures for data analysis.

Design minimum ten lab assignments based on the syllabus. The focus shall be on to make student take tabular data, clean it, manipulate it, and run basic inferential statistical analyses. It is preferred to use some real life data (of small size) for validation of the assignments.

Guidelines for Laboratory Conduction

During each lab experiment the following activities will be carried out:

- The instructor will explain the aims & objectives of the assignments.
- The instructor will explain the topics required to carry out the experiment.
- The students will do the hands on as per the Lab manual & Web resources provided.
- The students will show the results to the instructor.

Note: If required, the teacher can conduct (additional) one lecture per week to explain theoretical aspects of data science and to demonstrate Python data science library functions.

Guidelines for Student's Lab Journal

The student's Lab Journal can be assignments submitted in the form a soft copy/hard copy. In case of soft copy submission, the print out of only first page can be kept in the Journal. It should include following as applicable:

Assignment No, Title of Assignment, Date of Performance, Date of Submission, Aims & Objectives, Theory, Description of data used, Results, Conclusion.

Guidelines for Lab /TW Assessment

The oral examination will be based on the work carried out by the student in the Lab course. Suitable rubrics can be used by the internal & external examiner for assessment.

List of Laboratory Experiments / Assignments

1.	**Introduction to data analytics and Python fundamentals:** • Understanding the Data. • Python Packages for Data Science. • Importing and Exporting Data in Python. • Getting Started Analyzing Data in Python. • Accessing Databases with Python.
2.	**Data Visualization in Python:** • **Matplotlib, Pandas, Seaborn**: Sactterplot, Barchart, Linechart, Histogram. • **Other Graphs**: Boxplot, Heatmap, Faceting, Pairplot.
3.	**Data Wrangling:** • Pre-processing Data in Python • Dealing with Missing Values in Python • Data Formatting in Python • Data Normalization in Python • Binning in Python • Turning categorical variables into quantitative variables in Python
4.	**Statistical Data Analysis:** • Probability. • Sampling & Sampling Distributions. • Hypothesis Testing.

5.	**Exploratory Data Analysis:** • Descriptive Statistics. • Group By in Python. • Correlation. • Correlation – Statistics. • Analysis of Variance ANOVA.
6.	**Model Development:** • Linear Regression and Multiple Linear Regression • Model Evaluation using Visualization • Polynomial Regression and Pipelines • Measures for In-Sample Evaluation • Prediction and Decision Making

Learning Resources

Reference Books:

1. Jake Vander Plas and O'Reilly, "Python Data Science Handbook: Essential Tools for Working with Data"
2. Wes McKinney and O'Reilly, "Python for Data Analysis", 2nd Edition.
3. Joel Grus and O'Reilly, "Data Science from Scratch: First Principles with Python".

Web resources:

1. https://swayam.gov.in/nd1_noc20_cs46/
2. https://www.coursera.org/learn/data-analysis-with-python
3. https://www.geeksforgeeks.org/python-for-data-science/
4. https://www.coursera.org/learn/python-data-analysis/home/welcome/
5. https://www.udemy.com/course/data-science-with-python-a-complete-guide-3-in-1/

Savitribai Phule Pune University

Second Year of Electronics / E & Tc Engineering (2019 Course)

204199: Employability Skills Development

Teaching Scheme:	Credit	Examination Scheme:
Theory: 02 hrs. / week Practical: 02 hrs. / week	02 + 01 = 03	Term work: 50 Marks

Prerequisite Courses, if any: --

Companion Course, if any: --

Course Objectives:

- Develop good communication skills – both oral as well as written.
- Encourage creative and critical thinking among students.
- Nurture collaborative behavior to work efficiently in groups.

Course Outcomes: On completion of the course, learner will be able to -

CO1: Define personal and career goals using introspective skills and SWOC assessment. Outline and evaluate short-term and long-term goals.

CO2: Develop effective communication skills (listening, reading, writing, and speaking), self- management attributes, problem solving abilities and team working & building capabilities in order to fetch employment opportunities and further succeed in the workplace.

CO3: Be a part of a multi-cultural professional environment and work effectively by enhancing inter-personal relationships, conflict management and leadership skills.

CO4: Comprehend the importance of professional ethics, etiquettes & morals and demonstrate sensitivity towards it throughout certified career.

CO5: Develop practically deployable skill set involving critical thinking, effective presentations and leadership qualities to hone the opportunities of employability and excel in the professional environment.

Course Contents

Unit I	Understanding Self and Soft Skills	(04 Hrs)

Introduction to introspective methods, SWOC Analysis, Understanding the importance of soft skills, soft skill vs hard skill, interdisciplinary relevance, emotional quotient and emotional intelligence, personal and career goal setting, aligning aspirations with individual's skill sets, understanding self-esteem and critically evaluating oneself.

Mapping of Course Outcomes for Unit I	**CO1: Define personal and career goals using introspective skills and SWOC assessment. Outline and Evaluate short-term and long-term goals.**	
Unit II	**Communication Skills**	**(04 Hrs)**
Essentiality of good communication skills, Importance of feedback, Different types of communication, Barriers in communication and how to overcome these barriers, Significance of non-verbal messages as augmentation to verbal communication, Group Discussion, Listening Vs Hearing, Reading to comprehend, Learning to skim and scan to extract relevant information, Effective digital communication.		
Mapping of Course Outcomes for Unit II	**CO2: Develop effective communication skills (listening, reading, writing, and speaking), self - management attributes, problem solving abilities and team working & building capabilities in order to fetch employment opportunities and further succeed in the workplace.**	
Unit III	**Language & Writing Skills**	**(04 Hrs)**
Fundamentals of English Grammar, improve Lexical resource, essential steps to improve spoken and written English, Business vocabulary, Writing - Email, Resume, Formal letter, Official Communication, Essay, Presentation – Planning, Organizing, Preparing and Delivering Professional presentation, Resume writing: Resume content, identification of carrier objective, characteristics of good resume, different formats of resume-chronological, Functional , Hybrid Effective letter and cover letter writing, Application writing, Report writing.		
Mapping of Course Outcomes for Unit III	**CO2: Develop effective communication skills (listening, reading, writing, and speaking), self - management attributes, problem solving abilities and team working & building capabilities in order to fetch employment opportunities and further succeed in the workplace.**	
Unit IV	**Leadership Skills and Group Dynamics**	**(04 Hrs)**
Understanding Corporate Culture and Leadership skills, difference between a leader and a manager, Importance of resilience in a professional surrounding, Developing empathy and emotional intelligence, being assertive and confident, 4-Ds of decision making, Creative and solution-centric thinking, Resolving conflicts, Working cohesively as a team to achieve success, 5 Qualities of an Effective team - Positivity, respect for others, trust, goal-focused, supportiveness.		
Mapping of Course Outcomes for Unit IV	**CO3: Be a part of a multi-cultural professional environment and work effectively by enhancing inter- personal relationships, conflict management and leadership skills.**	

Unit V	Professionalism & Ethics	(04 Hrs)
Understanding ethics and morals, Importance of Professional Ethics, hindrances due to absence of Work ethics, Professional etiquette – Introductions, with colleagues, attire, events, dinning, telephone, travelling, netiquette, social media, writing. Stress as integral part of life, Identifying signs and sources of stress, Steps to cope with stress – open communication, positive thinking, Belief in oneself, ability to handle failure, Retrospective thinking for future learning, Organizing skills to enhance time management, Focusing on goals, smart work vs hard work, Prioritizing activities, Perils of procrastination, Daily evaluation of "to-do" list.		
Mapping of Course Outcomes for Unit V	**CO4: Comprehend the importance of professional ethics, etiquettes & morals and demonstrate sensitivity towards it throughout certified career.** **CO5: Develop practically deployable skill set involving critical thinking, effective presentations and leadership qualities to hone the opportunities of employability and excel in the professional environment.**	
Unit VI	**Quantitative Ability & Logical Reasoning**	**(04 Hrs)**
Numbers, HCF and LCM, Time and distance, Time and work, Clock, Simple interest and compound interest, Boats and steams, Number series, Ratio and proportion, probability, profit and loss, odd man out series, permutations, height and distance, square and cube rootmatching, selection, verbal reasoning, logical games, logical deductions, logical problems, cause and effect.		
Mapping of Course Outcomes for Unit VI	**CO2: Develop effective communication skills (listening, reading, writing, and speaking), self - management attributes, problem solving abilities and team working & building capabilities in order to fetch employment opportunities and further succeed in the workplace.**	

Learning Resources

Text Books:

1. R. S. Agarwal "Quantitative Aptitude for Competitive Examinations" S. Chand Publications.
2. R.Gajendra Singh Chauhan and Sangeeta Sharma, "Soft Skills-An integrated approach to maximize personality", Wiley Publication, ISBN: 987-81-265-5639-7

Reference Books:

1. Indrajit Bhattacharya, "An Approach to Communication Skills", Dhanpat Rai.
2. Simon Sweeney, "English for Business Communication", Cambridge University Press.
3. Sanjay Kumar and Pushpa Lata, "Communication Skills", Oxford University Press.
4. Atkinson and Hilgard's, "Introduction to Psychology", 14th Edition.
5. Kenneth G. Mcgee, "Heads Up: How to Anticipate Business Surprises & Seize Opportunities First", Harvard Business School Press, Boston, Massachusetts.
6. Krishnaswami, N. and Sriraman, "Creative English for Communication", Macmillan.

MOOC / NPTEL Courses:

1. NPTEL Course **"Developing Soft skills & Personality"**

   https://nptel.ac.in/courses/109/104/109104107/

2. NPTEL Course **"Communication Skills"**

   https://nptel.ac.in/courses/109/104/109104030/

3. NPTEL Course **"Effective Writing"**

   https://nptel.ac.in/courses/109/107/109107172/

4. NPTEL Course **"Interpersonal Skills"**

   https://nptel.ac.in/courses/109/107/109107155/

THEORY SESSIONS		
Sr. No.	**Topic to be covered**	**No. of Hours**
1.	Soft Skills Vs Hard Skills	1
2.	Planning Career Goals – Short Term & Long Term	1
3.	Understanding SWOC Analysis	1
4.	Resume Writing	1
5.	Presentation Skills	1
6.	Interview Skills	1
7.	Writing Skills	1
8.	Corporate Business Etiquette	2
9.	Time & Stress Management	1
10.	Attitude	1
11.	Leadership Skills	1
12.	Creative & Lateral Thinking	1
13.	Problem Solving	1
14.	Team Dynamics	1
15.	Mental Arithmetic	2
16.	Number Sequence	2
17.	Speed Calculation	2
18.	Fundamentals of English Grammar	2
19.	Verbal Reasoning / Verbal Ability	1
	TOTAL HOURS	**24**

Guidelines for Conduction of Employability Skills Development Lab

- The teacher may design specific assignments that can highlight the learning outcomes of each unit.
- Each activity conducted in the lab should begin with a brief introduction of the topic, purpose of the activity from a professional point of view and end with the learning outcomes as feedback from students.
- Most of the lab sessions can be designed to be inclusive; allowing students to learn skills experientially; which will benefit them in the professional environment.
- Every student must be given sufficient opportunity to participate in each activity and constructive feedback from the instructor / facilitator at the end of the activity should learn towards encouraging students to work on improving their skills.
- Activities should be designed to respect cultural, emotional and social standing of students. Some of the activities can be designed to cater to enhancement of multiple skills – For eg – Team Building Activity can highlight 'open communication', 'group discussion', 'respecting perspectives', 'leadership skills', 'focus on goals' which can help students improve their inherent interpersonal skills.

Guidelines for Student's Lab Journal and TW Assessment

- Each student should have a Lab Workbook (sample can be provided if required) which outlines each lab activity conducted.
- The student must respond by writing out their learning outcomes and elaborating the activities performed in the lab.
- Continuous assessment of laboratory work is to be done based on overall performance and lab assignments and performance of student.
- Each lab assignment assessment will be assigned grade/marks based on parameters with appropriate weightage.
- Suggested parameters for overall assessment as well as each lab assignment assessment include- timely completion, performance, punctuality, neatness, enthusiasm, participation and contribution in various activities-SWOC analysis, presentations, team activity, event management, group discussion, group exercises and interpersonal skills and similar other activities/assignments

<table>
<tr><th colspan="2">List of Laboratory Sessions</th></tr>
<tr><td>1.</td><td>Introduction of Self / SWOC Analysis:
a. Explain how to introduce oneself in a professional manner and presenting oneself positively.
Name | Academic Profile | Achievements | Career Aspirations | Personal Information (hobbies, family, social)
b. Focus on introspection and become aware of one’s Strengths, Weakness, Opportunities and Challenges.
Students can write down their SWOC in a matrix and the teacher can discuss the gist personally.</td></tr>
<tr><td>2.</td><td>Career Goals and Planning:
• Make students understand the difference between a job and a career. Elaborate steps on how to plan a career.
➢ Students can choose a career and they should write down what skills, knowledge, steps are need to be successful in that particular career and how they can get the right opportunity.
• Explain to students how to plan short term and long term goals.
➢ Think and write down their short term goals and long terms goals. Teacher can read and discuss (provide basic counselling) about the choices written.</td></tr>
<tr><td>3.</td><td>Group Discussion:
• The class can be divided into groups of 8 - 10 students in each group for a discussion lasting 10 minutes:
➢ Topics can be topical and non-controversial. After each group finishes its discussion, the teacher can give critical feedback including areas of improvement. The teacher should act as a moderator / observer only.</td></tr>
<tr><td>4.</td><td>Team Building Activities:
• The class can be divided into groups of 4-5 students in each group and an activity can be given to each group:
➢ The activities chosen for each team should be competitive and should involve every student in the team. The activities can be conducted indoors or outdoors depending on infrastructure.</td></tr>
</table>

5.	**Public Speaking - (Choose any 2):** • **Prepared Speech:** ➢ Topics are shared with students and they will be given 10 minutes to prepare and 3 minutes to deliver followed by Q&A from audience. Teacher can evaluate each student based on content, communication skills, logical and cohesive presentation of topic, perspective of student, ability to handle questions and respond positively. • **Extempore Speech:** ➢ Various topics are laid out in front of the audience and each student is to pick one topic and speak about the topic for 5 minutes followed by Q&A from audience. Teacher can evaluate each student based on ability to think on his/her feet, content, communication skills, logical and cohesive presentation of topic, perspective of student, ability to handle questions and respond positively. • **Reviewing an Editorial article:** ➢ Either using e-paper / printed copy, students have to select a recent editorial (that is non-controversial), read it and explain to the audience what the editor's perspective is and what the student's perspective is. • **Book Review:** ➢ Each student will orally present to the audience his/her review of a book that he/she has recently read.
6.	**Mock Interviews:** • Every student has to undergo this session and the teacher should seek the assistance of another faculty member / TPO Officer to act as interview panel. Students will be informed beforehand about the job profile that they are appearing the interview for and they have to come prepared with a printed copy of their resume, formally dressed. Questions will include technical as well as HR. Faculty can choose to give problems that students have to solve using their technical skills. Students will be graded on the basis of their technical knowledge, ability to answer questions well, presentation of self, body language and verbal skills.
7.	**Listening and Reading Skills:** • Listening Worksheets to be distributed among students ➢ Each student can be given specifically designed worksheets that contain blanks / matching / MCQs that are designed to an audio (chosen by the faculty). Students must listen to the audio (only once) and complete the

	worksheet as the audio plays. This will help reiterate active listening as well as deriving information (listening to information between the lines). ➢ Reading Comprehension Worksheets to be distributed among students. • Teacher can choose reading passages from non-technical domains, design worksheets with questions for students to answer. This will enhance students' reading skills by learning how to skim and scan for information.
8.	**Writing Skills (Choose any 2):** • **Letter / Email Writing:** ➢ After explaining to the students the highlights of effective writing, students can be asked to write (using digital platforms / paper-based) letter to an organization with the following subject matter: i. Requesting opportunity to present his/her product. ii. Complaining about a faulty product / service. iii. Apologizing on behalf of one's team for the error that occurred. iv. Providing explanation for a false accusation by a client . • **Report Writing** ➢ After describing various formats to write report and explaining how to write a report, each student should be asked to write a report (digital / paper-based) on any of the following topics: ▪ Industrial visit. ▪ Project participated in. ▪ Business / Research Proposal. • **Resume Writing** ➢ The teacher should conduct a brief session outlining the importance of a CV / Resume and students can write / type out their own resumes: ▪ Share various professional formats. ▪ Focus on highlighting individual strengths. ▪ Develop personalized professional goals / statement at the beginning of the resume.
9.	**Lateral and Creative Thinking:** • Every student needs to step out of the linear thinking and develop lateral and creative thinking. Teacher can develop creative activities in the classroom / lab that will help students enhance their creative thinking. Some of the suggested activities: ➢ Each group (3-4 students) can be given random unrelated items and they will be given 20 mins to come up with creative ideas on how the objects can be used for activities / purposes other than its intended one.

	➢ Each student is given a random line and he/she has to spin a fictional story and tell it to the class (3 minutes). Each story should have a beginning, middle and end. ➢ Each group (3-4 students) can be given a fictional / hypothetical dangerous situation and they have to find a solution to that problem. They can present it to the other teams who will then get the opportunity to pick flaws in the ideas.
10.	**Presentation Skills:** Every student will have to choose a topic of his/her choice and make a 5-minute presentation using audio-video aids / PPT. The topic can either be technical or non-technical. Focus and evaluation of each presentation should be the depth of knowledge about the topic, originality of perspective on the topic, well-researched or not, verbal and non-verbal skills and ability to answer questions effectively. Plagiarism should be discredit and students should be warned about it.
11.	**Expert Lecture:** Highlighting the need to manage stress and time, experts from the fields of health and fitness, counselling, training, medical or corporate HR can be invited to deliver a participatory session that focus on helping students to cope with parental, social, peer and career pressures.

Virtual LAB Link:

1. **Virtual English Communication Lab:**
   https://ve-iitg.vlabs.ac.in/

Note: Additional (min.3) tutorials are to be performed using Virtual Lab.

Savitribai Phule Pune University Second Year of Electronics / E & Tc Engineering (2019 Course) 204200: Project Based Learning		
Teaching Scheme:	**Credit**	**Examination Scheme:**
Practical: 04 hrs. / week	**02**	**Term Work: 50 Marks**

Preamble:

The main stream engineering education follows traditional classroom teaching, in which the major focus is mainly on the lecturer and the student has very little (if any) choice on the learning process. However rapid development in engineering and technology requires adopting a teaching approach that would assist students not only in developing a core set of industry relevant skills, but also enable them to adapt to changes in their professional career.

PBL is an approach to design Electronic Systems Curricula for making electronics more appealing to students. Since electronics is an important grounding for other disciplines (computer science, signal processing, and communications), this approach proposes the development of multidisciplinary projects using the PBL strategy for increasing the attractiveness of the curriculum. Promoting electronics as grounding for other disciplines can be done by defining a new curriculum that includes practical courses (laboratories) in which the students develop whole systems involving multidisciplinary knowledge.

Course Objectives: On completion of the course, learner will be able to -

- To emphasize project based learning activities that are long-term, interdisciplinary and student-centric.
- To inculcate independent and group learning by solving real world problem with the help of available resources.
- To be able to develop application based on the fundamentals of electronics and communication engineering by possibly the integration of previously acquired knowledge.
- To get practical experience in all steps in the life cycle of the development of electronic systems: specification, design, implementation, and testing.
- To be able to select and utilize appropriate hardware and software tools to design and analyze the proposed system.
- To provide every student the opportunity to get involved either individually or as a group so as to develop team skills and learn professionalism.

Course Outcomes: On completion of the course, learner will be able to -

CO1: Identify the real-world problem (possibly of interdisciplinary nature) through a rigorous literature survey and formulate / set relevant aim and objectives.

CO2: Contribute to society through proposed solution by strictly following professional ethics and safety measures.

CO3: Propose a suitable solution based on the fundamentals of electronics and communication engineering by possibly the integration of previously acquired knowledge.

CO4: Analyze the results and arrive at valid conclusion.

CO5: Use of technology in proposed work and demonstrate learning in oral and written form.

CO6: Develop ability to work as an individual and as a team member.

Group Structure:

Working in supervisor/mentor –monitored groups. The students plan, manage and complete a task/project/activity which addresses the stated problem.

1. Create groups of 5 (five) to 6 (six) students in each class

Project Selection:

Survey through journals, patents or field visit (A problem can be theoretical, practical, social, technical, symbolic, cultural and/or scientific), check the physibility of solution, analyze the problem, design and find the values of components.

There are no commonly shared criteria for what constitutes an acceptable project. Projects vary greatly in the depth of the questions explored, the clarity of the learning goals, the content and structure of the activity.

The problem-based project oriented model for learning is recommended. The model begins with the identifying of a problem, often growing out of a question or "wondering". This formulated problem then stands as the starting point for learning. A problem can be theoretical, practical, social, technical, symbolic, cultural and/or scientific and grows out of students' wondering within different disciplines and professional environments. As stated in the preamble as electronics is an important grounding for other disciplines (computer science, signal processing, and communications), the project topic can be Interdisciplinary in nature. However the chosen problem must involve the application of electronics and communication engineering fundamentals. Out of the total developed system setup, the project must involve minimum 40% electronic components. Although in a genuine case 100% software based project topic may be allowed.

Ethical Practices, team work and project management:

Use IEEE standards for project manufacturing, respect the time of others, attend the reviews, poster presentation and model exhibitions, strictly follow the deadline of project completion, comply with all legislation requirements that govern workplace health and safety practices.

Effective Documentation:

In order to make our engineering graduates capable to prepare effective documentation, it is required for the students to learn the effective writing skills. The PBL final report is expected to consist of the Literature Survey, Problem Statement, Aim and Objectives, System Block Diagram, System Implementation Details, Discussion and Analysis of Results, Conclusion, System Limitations and Future Scope. Many freely available software tools (for instance Medley (Elsevier), Grammerly) are expected to be used during the preparation of PBL synopsis and final report. It is expected that the PBL guides/mentors shall teach students about utilizing valid sources of information (such as reference papers, books, magazines, etc) related to their PBL topic.

Evaluation & Continuous Assessment:

The institution/head/mentor is committed to assessing and evaluating both student performance and program effectiveness. Progress of PBL is monitored regularly on weekly basis. Weekly review of the work is necessary. During process of monitoring and continuous assessment and evaluation the individual and team performance is to be measured. PBL is monitored and continuous assessment is done by supervisor /mentor and authorities. Students must maintain an institutional culture of authentic collaboration, self-motivation, peer-learning and personal responsibility. The institution/department should support students in this regard through guidance/orientation programs and the provision of appropriate resources and services. Supervisor/mentor and Students must actively participate in assessment and evaluation processes.

It is recommended that the all activities are required to be recorded and regularly. A regular assessment of PBL work is required to be maintained at the department in PBL log book by students. It is expected that the PBL log book must include following:

1. Weekly monitoring by the PBL guide,
2. Assessment sheet for PBL work review by PBL guide and PBL Evaluation Committee (PEC).

The PEC structure shall consist of Head of the department, 1/2 senior faculties of the department and one industry expert (optional). Continuous Assessment Sheet (CAS) is to be maintained by the department.

Recommended parameters for assessment, evaluation and weightage:

1. Idea Inception (kind of survey). (10%)
2. Outcome (Participation/ publication, copyright, patent, product in market). (50%)
3. Documentation (Gathering requirements, design & modeling, implementation/execution, use of technology and final report, other documents). (15%)
4. Attended reviews, poster presentation and model exhibition. (10%)
5. Demonstration (Poster Presentation, Model Exhibition etc). (10%).
6. Awareness /Consideration of - Environment/ Social /Ethics/ Safety measures/Legal aspects. (5%)

Learning Resources

Reference Books / Research Articles:

1. John Larmer, John R. Mergendoller, and Suzie Boss, "Setting the Standard for Project Based Learning".

2. John Larmer and Suzie Boss, "Project Based Teaching: How to Create Rigorous and Engaging Learning Experiences".

3. Erin M. Murphy and Ross Cooper, "Hacking Project Based Learning: 10 Easy Steps to PBL and Inquiry". M. Krašna, "Project based learning (PBL) in the teachers' education,"39th International Convention on Information and Communication Technology, Electronics and Microelectronics (MIPRO), Opatija, 2016, pp. 852-856, doi: 10.1109/MIPRO.2016.7522258.

4. J. Macias- Guarasa, J.M. Montero, R. San-Segundo, A. Araujo and O. Nieto-Taladriz, "A project based learning approach to design electronic systems curricula", IEEE transactions on Education, vol.49, no. 3, pp. 389-397, Aug. 2006, doi: 10.1109/TE.2006.879784

Web resources:

- Project-Based Learning, Edutopia, March 14, 2016.
- What is PBL? Buck Institute for Education.
- www.howstuffworks.com
- www.wikipedia.org

Savitribai Phule Pune University Second Year of Electronics/E & Tc Engineering (2019 Course) 204201: Mandatory Audit Course - 4		
Teaching Scheme:	**Credit**	**Examination Scheme:**
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List of Courses to be opted (Any one) under Mandatory Audit Course 4

- Enhancing Soft Skills and Personality
- Language & Mind
- Emotional Intelligence
- German II
- Human Behaviour
- Speaking Effectively

GUIDELINES FOR CONDUCTION OF AUDIT COURSE

In addition to credits courses, it is mandatory that there should be audit course (non-credit course) from second year of Engineering. The student will be awarded grade as AP on successful completion of audit course. The student may opt for two of the audit courses (One in each semester). Such audit courses can help the student to get awareness of different issues which make impact on human lives and enhance their skill sets to improve their employability. List of audit courses offered in the semester is provided in the curriculum. Student can choose one of the audit course from list of courses mentioned. Evaluation of audit course will be done at institute level.

The student registered for audit course shall be awarded the grade AP and shall be included such grade in the Semester grade report for that course, provided student has the minimum attendance as prescribed by the Savitribai Phule Pune University and satisfactory in-semester performance and secured a passing grade in that audit course. No grade points are associated with this 'AP' grade and performance in these courses is not accounted in the calculation of the performance indices SGPA and CGPA. Evaluation of audit course will be done at institute level itself.

Selecting an Audit Course:

Using NPTEL Platform:

NPTEL is an initiative by MHRD to enhance learning effectiveness in the field of technical education by developing curriculum based video courses and web based e-courses. The details of NPTEL courses are available on its official website www.nptel.ac.in

- Student can select any one of the courses mentioned above and has to register for the corresponding online course available on the NPTEL platform as an Audit course.
- Once the course is completed the student can appear for the examination as per the guidelines on the NPTEL portal.
- After clearing the examination successfully; student will be awarded with certificate.

Assessment of an Audit Course:

- The assessment of the course will be done at the institute level. The institute has to maintain the record of the various audit courses opted by the students. The audit course opted by the students could be interdisciplinary.
- During the course students will be submitting the online assignments. A copy of same students can submit as a part of term work for the corresponding Audit course.
- On the satisfactory submission of assignments, the institute can mark as "Present" and the student will be awarded the grade AP on the marksheet.

Savitribai Phule Pune University
Faculty of Science & Technology

Curriculum

For

First Year
Bachelor of Engineering
(Choice Based Credit System)

(2019 Course)

(With Effect from Academic Year 2019-20)

TABLE -1 First Engineering _Structure for Semester-I

Course Code	Course Name	Teaching Scheme (Hours/Week)			Examination Scheme and Marks						Credits			
		Theory	Practical	Tutorial	ISE	ESE	TW	PR	OR	Total	TH	PR	TUT	Total
107001	Engineering Mathematics-I	03	--	01	30	70	25	--	--	125	03	--	01	04
107002/ 107009	Engineering Physics / Engineering Chemistry	04	02	--	30	70	--	25	--	125	04	01	--	05
102003	Systems in Mechanical Engineering	03	02	--	30	70	--	25	--	125	03	01	--	04
103004 / 104010	Basic Electrical Engineering / Basic Electronics Engineering	03	02	--	30	70	--	25	--	125	03	01	--	04
110005/ 101011	Programming and Problem Solving / Engineering Mechanics	03	02	--	30	70	--	25	--	125	03	01	--	04
111006	Workshop[@]	--	02	--	--	--	--	25	--	25	--	01	--	01
	Total	16	10	01	150	350	25	125	--	650	16	05	01	22
101007	Audit Course 1[&]	02	Environmental Studies-I											

Induction Program : 2 weeks at the beginning of semester-I and 1 week at the beginning of semester-II

TABLE -2 First Engineering_ Structure for Semester-II

Course Code	Course Name	Teaching Scheme (Hours/Week)			Examination Scheme and Marks						Credits			
		Theory	Practical	Tutorial	ISE	ESE	TW	PR	OR	Total	TH	PR	TUT	Total
107008	Engineering Mathematics-II	04	--	01	30	70	25	--	--	125	04	--	01	05
107002/ 107009	Engineering Physics/ Engineering Chemistry	04	02	--	30	70	--	25	--	125	04	01	--	05
103004 / 104010	Basic Electrical Engineering / Basic Electronics Engineering	03	02	--	30	70	--	25	--	125	03	01	--	04
110005/ 101011	Programming and Problem Solving / Engineering Mechanics	03	02	--	30	70	--	25	--	125	03	01	--	04
102012	Engineering Graphics [Ω]	01	02	01	--	50	25		--	75	01	01		02
110013	Project Based Learning[§]	--	04	--	--	--	25	50	--	75	--	02	--	02
	Total	15	12	02	120	330	75	125	--	650	15	05	02	22
101014	Audit Course 2[&]	02	Environmental Studies-II											
107015		--	Physical Education-Exercise and Field Activities											

Instructions:

- PR/Tutorial must be conducted in three batches per division.
- Minimum number of required Experiments/Assignments in PR/ Tutorial shall be carried out as mentioned in the syllabi of respective subjects.
- Every Student should appear for Engineering Physics, Engineering Chemistry, Engineering Mechanics, Basic Electrical Engineering, Basic Electronics Engineering, Programming and Problem solving during the year.
- College is allowed to distribute Teaching workload of subjects Engineering Physics, Engineering Chemistry, Basic Electrical Engineering, Basic Electronics Engineering, Engineering Mechanics, Programming and Problem solving in semester I and II dividing number of FE divisions into two appropriate groups.
- Assessment of tutorial work has to be carried out as term-work examination. Term-work Examination and Practical Examination at first year of engineering course **shall be internal continuous assessment only.**

Ω 1 Credit for Engineering Graphics theory has to be awarded on the basis of End semester examination of 50 marks while 1 credit of tutorial and practical **shall be awarded on internal continuous assessment only**.

@ Credit for the course of workshop practical is to be awarded on the basis of continuous assessment / submission of job work.

§ Project based learning (PBL) requires continuous mentoring by faculty throughout the semester for successful completion of the tasks selected by the students per batch. While assigning the teaching workload a load of 2 Hrs/week/batch needs to be considered for the faculty involved. The Batch needs to be divided into sub-groups of 5 to 6 students. Assignments / activities / models/ projects etc. under project based learning is carried throughout semester and Credit for PBL has to be awarded on the basis of internal continuous assessment and evaluation at the end of semester.

& Audit course for Environmental Studies and II (As per D.O.No.F.13-1/2000 (EA/ENV/COS-I) dated 14 May, 2019) is mandatory but non-credit course. Examination has to be conducted at the end of Sem I & II respectively for award of grade at college level. Grade awarded for audit course shall not be calculated for grade point &CGPA.

Audit course for Physical education is mandatory non-credit course. Examination has to be conducted at the end of Semester for award of grade at college level. Grade awarded for audit course shall not be calculated for grade point &CGPA.

Guidelines for Induction Program

Induction programme for first year students is introduced to familiarize them to the new environment and encourage them to look beyond classrooms. Objective is to help new students adjust and feel comfort-able in the new environment, inculcate in them the ethos and culture of the institution, help them build bonds with other students and faculty members, and expose them to a sense of larger purpose and self exploration. Induction Program should be preferably of 3 weeks (**2 weeks at the beginning of semester-I and 1 week at the beginning of semester-II)**.

In order to implement the (SIP) in the College the following activities can be taken at College.

- Physical Activity-This would involve a daily routine of physical activity with games and sports.
- Creative Arts: - Every students would chose one skill related to the arts whether visual arts or performing arts.
- Mentoring and Universal Human values:-Mentoring and connecting the students with faculty members and other students is the most important part of student induction. This can be effectively done by forming a group of 20-22 students with a faculty mentor each. This can be implemented through group discussion and real life activities rather than lecturing.
- Familiarization with College, Department, Branch :-The incoming student should be told about the credit, grading system and scheme of the examination. They should be explained how the study in College differs from the study in school. They should be taken on College tour and shown important points such as library, canteen, gymkhana etc. They should be shown their department.
- Literary Activity :-Literary Activity would compass reading book, writing a summery, debating, checking play etc.
- Proficiency modules :- The modules can be designed to overcome some critical lacunas that students might have like English Speaking, Computer familiarity etc.
- Lectures by Eminent People:- The lectures of Eminent people to be organized to expose the student to social activity public life.
- Visit to local Area:-A couple of visits to the landmark of the city or a hospital are orphanage could be organized.
- Extracurricular activities in College:-The new students should be introduced to the extracurricular activities at the College.
- Feedback and Report on the program:-Students should be asked to give their mid program Feedback and a each group of 20-22 students should be asked to prepare a single report on their experience of the program.

To Summarize the above activity the sequence of activities can be planned as given below :

- Address by Principal, HOD's and other functionaries and welcome the new students along with their parents.
- The branch wise allocation of students to be done and a group of 20-22 students is to farmed along with one faculty as mentor.
- A detail time table of various activities is to be prepared and displayed for all students. The timetable should give details of location and details of faculty in charge of the activity.
- The visit to local areas can be arranged on Saturdays.

The various activities to be carried out can be divided into three phases :-

1. Initial phase:- Which may induce Address by Principal, HOD's and other functionaries College and Dept Visit, interaction with parents Forming of students group and assigning of mentor mentee.
2. Regular Phase:- This phase may include the activities such as creative arts / universal

Human values Games & Sports in the morning session and in the afternoon session. Literary activities, Proficiency module, Lectures & workshop, Extra curricular Activities can be scheduled.

3. Closing Phase:- This phase may include taking feed back of students, preparation of Report by each group, Test of creative Arts, Human Values can be taken.

These are summarized guidelines given to the student inducing induction programme (SIP) Please refer SIP Manual published by AICTE for detail guidelines [2].

Savitribai Phule Pune University		
First Year Engineering (2019 Course)		
107001 – Engineering Mathematics – I		
Teaching Scheme: **TH : 3 Hrs./Week** **TUT : 1 Hr/Week**	**Credits** **04**	**Examination Scheme:** **In-Semester Exam :30 Marks** **End-Semester Exam :70 Marks** **TW :25 Marks**

Prerequisites:
Differentiation, Integration, Maxima and Minima, Determinants and Matrices.

Course Objectives:
To make the students familiarize with concepts and techniques in Calculus, Fourier series and Matrices. The aim is to equip them with the techniques to understand advanced level mathematics and its applications that would enhance analytical thinking power, useful in their disciplines.

Course Outcomes (COs): The students will be able to learn

CO1: Mean value theorems and its generalizations leading to Taylors and Maclaurin’s series useful in the analysis of engineering problems.

CO2: the Fourier series representation and harmonic analysis for design and analysis of periodic continuous and discrete systems.

CO3: to deal withderivative of functions of several variables that are essential in various branches of Engineering.

CO4: to apply the concept of Jacobian to find partial derivative of implicit function and functional dependence. Use of partial derivatives in estimating error and approximation and finding extreme values of the function.

CO5: the essential tool of matrices and linear algebra in a comprehensive manner for analysis of system of linear equations, finding linear and orthogonal transformations, Eigen values and Eigen vectors applicable to engineering problems

Course Contents

Unit I: Differential Calculus: (08 Hrs.)
Rolle’s Theorem, Mean Value Theorems, Taylor's Series and Maclaurin's Series, Expansion of functions using standard expansions, Indeterminate Forms, L' Hospital's Rule, Evaluation of Limits and Applications.

Unit II: Fourier Series (08 Hrs.)
Definition, Dirichlet’s conditions, Full range Fourier series, Half range Fourier series, Harmonic analysis, Parseval’s identity and Applications to problems in Engineering.

Unit III: Partial Differentiation (08Hrs.)
Introduction to functions of several variables, Partial Derivatives, Euler's Theorem on Homogeneous functions, Partial derivative of Composite Function, Total Derivative, Change of Independent variables

Unit IV: Applications of Partial Differentiation (08 Hrs.)
Jacobian and its applications, Errors and Approximations, Maxima and Minima of functions of two variables, Lagrange's method of undetermined multipliers.

Unit V: Linear Algebra-Matrices, System of Linear Equations (08 Hrs.)
Rank of a Matrix, System of Linear Equations, Linear Dependence and Independence, Linear and Orthogonal Transformations, Application to problems in Engineering.

Unit VI: Linear Algebra-Eigen Values and Eigen Vectors, Diagonaliztion (08 Hrs.)
Eigen Values and Eigen Vectors, Cayley Hamilton theorem, Diagonaliztion of a matrix, Reduction of Quadratic forms to Canonical form by Linear and Orthogonal transformations.

Text Books:

1. Higher Engineering Mathematics by B. V. Ramana (Tata McGraw Hill)
2. Higher Engineering Mathematics by B. S. Grewal (Khanna Publication, Delhi)

Reference Books:

1. Advanced Engineering Mathematics by Erwin Kreyszig (Wiley Eastern Ltd.)
2. Advanced Engineering Mathematics by M. D. Greenberg (Pearson Education)
3. Advanced Engineering Mathematics by Peter V. O'Neil (Thomson Learning)
4. Thomas' Calculus by George B. Thomas, (Addison-Wesley, Pearson)
5. Applied Mathematics (Vol. I & Vol. II) by P.N.Wartikar and J.N.Wartikar Vidyarthi Griha Prakashan, Pune.
6. Linear Algebra –An Introduction, Ron Larson, David C. Falvo (Cenage Learning, Indian edition)

Tutorial and Term Work:

i) Tutorial for the subject shall be engaged in minimum three batches (batch size of 22 students maximum) per division.

ii) Term work shall consist of six assignments on each unit-I to unit-VI and is based on performance and continuous internal assessment.

107002: Engineering Physics

Teaching Scheme:	Credits	Examination Scheme:
TH: 04 Hr/week	05	In-Semester :30 Marks
PR: 02 Hr/Week		End-Semester :70 Marks
		PR :25 Marks

Prerequisite Courses, if any:
Fundamentals of: optics, interference, diffraction polarization, wave-particle duality, semiconductors and magnetism

Companion Course, if any: Laboratory Practical

Course Objectives:
To teach students basic concepts and principles of physics, relate them to laboratory experiments and their applications

Course Outcomes:
On completion of the course, learner will be able to–

CO1: Develop understanding of interference, diffraction and polarization; connect it to few engineering applications.

CO2: Learn basics of lasers and optical fibers and their use in some applications.

CO3: Understand concepts and principles in quantum mechanics. Relate them to some applications.

CO4: Understand theory of semiconductors and their applications in some semiconductor devices.

CO5: Summarize basics of magnetism and superconductivity. Explore few of their technological applications.

CO6: Comprehend use of concepts of physics for Non Destructive Testing. Learn some properties of nanomaterials and their application.

Course Contents

Unit I — Wave Optics — (08 Hrs)

Interference

- Introduction to electromagnetic waves and electromagnetic spectrum
- Interference in thin film of uniform thickness (with derivation)
- Interference in thin film wedge shape (qualitative)
- Applications of interference: testing optical flatness, anti-reflection coating

Diffraction

- Diffraction of light
- Diffraction at a single slit, conditions for principal maxima and minima, diffraction pattern
- Diffraction grating, conditions for principal maxima and minima starting from resultant amplitude equations, diffraction pattern
- Rayleigh's criterion for resolution, resolving power of telescope and grating

Polarization

- Polarization of light, Malus law
- Double refraction, Huygen's theory of double refraction
  Applications of polarization: LCD

Unit II **Laser and Optic Fibre** **(08 Hrs)**

Laser

- Basics of laser and its mechanism, characteristics of laser
- Semiconductor laser: Single Hetro-junction laser
- Gas laser: CO_2 laser
- Applications of lasers: Holography, IT, industrial, medical

Optic Fiber

- Introduction, parameters: Acceptance Angle, Acceptance Cone, Numerical Aperture
- Types of optical fiber- step index and graded index
- Attenuation and reasons for losses in optic fibers (qualitative)
- Communication system: basic building blocks

Advantages of optical fiber communication over conventional methods.

Unit III **Quantum Mechanics** **(08 Hrs)**

- De-Broglie hypothesis
- Concept of phase velocity and group velocity (qualitative)
- Heisenberg Uncertainty Principle
- Wave-function and its physical significance
- Schrodinger's equations: time independent and time dependent
- Application of Schrodinger's time independent wave equation - Particle enclosed in infinitely deep potential well (Particle in RigidBox)
- Particle in Finite potential well (Particle in Non Rigid box) (qualitative)
- Tunneling effect, Tunneling effect examples (principle only): Alpha Decay, Scanning Tunneling Microscope, Tunnel diode
- Introduction to quantum computing

Unit IV **Semiconductor Physics** **(08 Hrs)**

- Free electron theory (Qualitative)
- Opening of band gap due to internal electron diffraction due to lattice Band theory of solids
- Effective mass of electron Density of states
- Fermi Dirac distribution function
- Conductivity of conductors and semiconductors
- Position of Fermi level in intrinsic and extrinsic semiconductors (with derivations based on carrier concentration)
- Working of PN junction on the basis of band diagram
- Expression for barrier potential (derivation)
- Ideal diode equation
- Applications of PN junction diode: Solar cell (basic principle with band diagram) IV Characteristics and Parameters, ways of improving efficiency of solar cell
- Hall effect: Derivation for Hall voltage, Hall coefficient, applications of Hall effect

Unit V **Magnetism and Superconductivity** **(8Hrs.)**

Magnetism

- Origin of magnetism
- Classification of magnetism on the basis of permeability (qualitative)
- Applications of magnetic devices: transformer cores, magnetic storage, magneto-optical recording

Superconductivity

- Introduction to superconductivity; Properties of superconductors: zero electrical
- resistance, critical magnetic field, persistent current, Meissner effect
- Type I and Type II superconductors
- Low and high temperature superconductors (introduction and qualitative)
- AC/DC Josephson effect; SQUID: basic construction and principle of working; Applications of SQUID
- Applications of superconductors

Unit VI **Non Destructive Testing and Nanotechnology** **(8 Hrs.)**

Non Destructive Testing

- Classification of Non-destructive testing methods
- Principles of physics in Non-destructive Testing
- Advantages of Non-destructive testing methods
- Acoustic Emission Testing
- Ultrasonic (thickness measurement, flaw detection)
- Radiography testing

Nanotechnology

- Introduction to nanotechnology
- Quantum confinement and surface to volume ratio
- Properties of nanoparticles: optical, electrical, mechanical

Applications of nanoparticles: Medical (targeted drug delivery), electronics, space and defense, automobile

Books & Other Resources:

Text Books:

1. Engineering Physics, Avadhanulu, Kshirsagar, S. Chand Publications
2. A textbook of optics – N Subrahmanyam and BriLal , S. Chand Publications
3. Engineering Physics, Gaur, Gupta, Dhanpat Rai and Sons Publications

Reference Books:

1. Fundamentals of Physics, Resnick and Halliday (John Wiley and Sons)
2. Optics, Jenkins and White (Tata Mcgraw Hill)
3. Principles of Physics, Serway and Jewett (Saunders college publishing)
4. Introduction to Solid State Physics, C. Kittel (Wiley and Sons)
5. Principles of Solid State Physics, H. V. Keer, New Age International
6. Laser and Non-Linear Optics, B. B. Laud (Oscar publication)
7. Nanotechnology: Principles and Practices, Dr. S. K. Kulkarni (Capital Publishing Company

Guidelines for Instructor's Manual

Lab manual is expected to cover following points:

1. Engineering Program Outcome (Graduate Attribute) and which attributes will be covered during practical
2. List of experiments to be performed with mention of objectives and outcome of the experiment

Guidelines for Student's Lab Journal

Student’s lab journal is expected to cover:

1. List of experiments to be performed with mention of objectives and outcome of the experiment.
2. Instructions to students for performing the experiments
3. Precautions for each experiment
4. Write up of experiment (Preferably mentioning significance of experiment).

Guidelines for Lab /TW Assessment

1. The distribution of weightage of term work marks should be informed to students before start of the semester.
2. Term work assessment should be on continuous basis. At frequent intervals students are expected to inform about their progress/lagging.

Guidelines for Laboratory Conduction

1. DO’s and DONT’S, along with precautions, are need to be displayed at prominent location in laboratory
2. Students should be informed about DO’S and DON’T and precautions before performing the experiment

Suggested List of Laboratory Experiments (<u>Any eight</u>)

Sr.	Experiment
1	Experiment based on Newton’s rings (determination of wavelength of monochromatic light, determine radius of curvature of plano-convex lens)
2	To determine position of diffraction minima by studying diffraction at a single slit
3	To determine unknown wavelength by using plane diffraction grating
4	To find out Resolving power of Diffraction Grating/Telescope
5	To verify Malus Law
6	Any experiment based on Double Refraction (Determination of refractive indices, identification of types of crystal)
7	Any Experiment based on Laser (Thickness of wire, determination of number of lines on grating surface)
8	An experiment based on optic fibers
9	To study IV characteristics of Solar Cell and determine parameters (fill factor and efficiency)
10	To determine band gap of given semiconductor
11	To determine Hall coefficient and charge carrier density
12	Temperature dependence characteristics of semiconductor laser
13	To find out Magnetic susceptibility of given material
14	Ultrasonic Interferometer: Determination of velocity of ultrasonic waves in given liquid and find its compressibility
	Suggested Demonstration Experiments
1	Michelson interferometer
2	Half shade Polarimeter
3	Determination of absorption coefficient of sound of given material
4	Temperature dependence
5	Brewster’s law
6	Measurement of sound pressure level

102003 - Systems in Mechanical Engineering

Teaching Scheme:	**Credits**	**Examination Scheme:**
TH : 3 Hrs./week **PR : 2 Hrs./Week**	**04**	**In-Semester :30 Marks** **End-Semester :70 Marks** **PR :25 Marks**

Course Objectives:

1. To identify the sources of energy and their conversions
2. To explain the basic concept of engineering thermodynamics and its application
3. To understanding the specifications of vehicles
4. To get acquainted with vehicle systems
5. To introduce manufacturing processes applying proper method to produce components
6. To be able to select and compare domestic appliances

Course Outcomes

On completion of the course, learner will be able to

CO1: Describe and compare the conversion of energy from renewable and non-renewable energy sources

CO2: Explain basic laws of thermodynamics, heat transfer and their applications

CO3: List down the types of road vehicles and their specifications

CO4: Illustrate various basic parts and transmission system of a road vehicle

CO5: Discuss several manufacturing processes and identify the suitable process

CO6: Explain various types of mechanism and its application

Course Contents

Unit I — Introduction of energy sources & its conversion — (06 Hrs)

Energy sources: Thermal energy, Hydropower energy, Nuclear energy, Solar energy, Geothermal energy, Wind energy, Hydrogen energy, Biomass energy and Tidal energy. Grades of Energy. (*Numerical on efficiency calculation of thermal power plant*)

Energy conversion devices: Introduction of pump, compressor, turbines, wind mills etc (*Simple numerical on power and efficiency calculations)*

Unit II — Introduction to Thermal Engineering — (06Hrs)

Laws of thermodynamics, heat engine, heat pump, refrigerator *(simple numerical)*

Modes of heat transfer: conduction, convection and radiation, Fourier's law, Newton's law of cooling, Stefan Boltzmann's law. *(Simple numerical)*

Two stroke and Four stroke engines (Petrol, Diesel and CNG engines). Steam generators.

Unit III — Vehicles and their Specifications — (04 Hrs)

Classification of automobile. Vehicle specifications of two/three wheeler, light motor vehicles, trucks, buses and multi-axle vehicles. Engine components (Introduction). Study of engine specifications, comparison of specifications of vehicles. Introduction of Electric and Hybrid Vehicles. Cost analysis of the Vehicle.

Unit IV — Vehicle systems — (08 Hrs)

Introduction of chassis layouts, steering system, suspension system, braking system, cooling system and fuel injection system and fuel supply system. Study of Electric and Hybrid Vehicle systems. Study of power transmission system, clutch, gear box (Simple Numerical), propeller shaft, universal joint, differential gearbox and axles. Vehicle active and passive safety arrangements: seat, seat belts, airbags and antilock brake system.

Unit V **Introduction to Manufacturing** **(06 Hrs)**

Conventional Manufacturing Processes: Casting, Forging, Metal forming (Drawing, Extrusion, etc.), Sheet metal working, Metal joining, etc. Metal cutting processes and machining operations- Turning, Milling and Drilling, etc.

Micromachining. Additive manufacturing and 3D Printing. Reconfigurable manufacturing system and IOT, Basic CNC programming**:** Concept of Computer Numerical Controlled machines.

Unit VI Engineering Mechanisms and their application in Domestic Appliances (6Hrs.)

Introduction to Basic mechanisms and equipment: Pumps, blowers, compressors, springs, gears, Belt-Pulley, Chain-Sprocket, valves, levers, etc. Introduction to terms: Specifications, Input, output, efficiency, etc.

Applications of: Compressors - Refrigerator, Water cooler, Split AC unit; Pumps - Water pump for overhead tanks, Water filter/Purifier units; Blower - Vacuum cleaner, Kitchen Chimney; Motor - Fans, Exhaust fans, Washing machines; Springs - Door closure, door locks, etc.; Gears - Wall clocks, watches, Printers, etc.; Application of Belt-Pulley/Chain-Sprocket - Photocopier, bicycle, etc.; Valves - Water tap, etc.; Application of levers - Door latch, Brake pedals, etc.; Electric/Solar energy - Geyser, Water heater, Electric iron, etc. (simple numerical on efficiency calculation)

Books & Other Resources

Text Books

1. Nag, P. K., “Engineering Thermodynamics," Tata McGraw-Hill Publisher Co. Ltd.
2. Chaudhari and Hajra, “Elements of Workshop Technology”, Volume I and II, Media Promoters and Publishers, Mumbai
3. Agrawal,Basant and Agrawal, C. M., (2008), “Basics of Mechanical Engineering”, John Wiley and Sons, USA
4. Rajput, R.K., (2007), “Basic Mechanical Engineering”, Laxmi Publications Pvt. Ltd.
5. Pravin Kumar, (2018), “ Basic Mechanical Engineering, 2nd Ed.”, Pearson (India) Ltd.
6. Moran, M. J., Shapiro, H. N., Boettner, D. D., and Bailey, M. “Fundamentals of Engineering Thermodynamics”, Wiley
7. Surinder Kumar, (2011), “Basic of Mechanical Engineering”, Ane Books Pvt. Ltd. New Delhi

Reference Books

1. Khan, B. H., “Non Conventional Energy Sources, Tata McGraw-Hill Publisher Co. Ltd.
2. Boyle, Godfrey, “Renewable Energy”,2nd Ed., Oxford University Press
3. Khurmi, R.S. ,and Gupta, J. K.,“A Textbook of Thermal Engineering”, S. Chand & Sons
4. Incropera, F. P. and Dewitt, D.P., (2007), “Fundamentals of Heat and Mass Transfer, 6th Ed., John Wiley and Sons, USA
5. Groover,Mikell P., (1996), “Fundamentals of Modern Manufacturing: Materials, Processes, and Systems”, Prentice Hall, USA
6. Norton, Robert L., (2009), “Kinematics and Dynamics of Machinery”, Tata McGrawHill
7. Cleghorn, W. L., (2005), “Mechanisms of Machines”, Oxford University Press
8. Juvinal, R. C., (1994), “Fundamentals of Machine Component Design”, John Wiley and Sons, USA
9. Ganeshan, V., (2018), “Internal Combustion Engines”, McGraw Hill
10. Anderson, Curtis Darrel and Anderson,Judy, (2010), “Electric and Hybrid Cars: A History”, 2nd Ed., McFarland

Guidelines for Instructor's Manual

The Instructor’s Manual should contain following related to every experiment:

- Brief theory related to the experiment.
- Apparatus with their detailed specifications.

- Schematic, Layout /diagram.
- Observation table/ simulation plots/graphs.
- Sample calculations for one/two reading.
- Result table.
- Graph and Conclusions.
- Few questions related to the experiment.
- Relevance of practical in real life /industry

Guidelines for Student's Lab Journal

The Student's Lab Journal should contain following related to every experiment:

- Theory related to the experiment.
- Apparatus with their detailed specifications.
- Schematic, Layout /diagram.
- Observation table/ simulation plots/graphs.
- Sample calculations for one/two reading.
- Result table.
- Graph and Conclusions.
- Few short questions related to the experiment.

Guidelines for Lab /TW Assessment

- There should be continuous assessment for the TW.
- Assessment must be based on understanding of theory, attentiveness during practical, and understanding.
- Session, how efficiently the student is able to do connections and get the results.
- Timely submission of journal.

The student shall complete the following activity as a term work.

Sr. No.	Activity
1.	**Group A: Industry / Workshop / Showroom Visit:** The visit of students is mandatory, to provide awareness and understanding of the course.
2.	**Group B: Assignments:** The student shall complete the following assignments on: i. Energy sources (Minimum one assignment on Conventional and one on Non-conventional sources) ii. Vehicle specifications and systems in passenger car iii. Electric vehicle specifications and its systems iv. Domestic appliances viz. refrigerator, air-conditioner, washing machine, cold storage
3.	**Group C: Experiments:** The student shall complete the following (**any four**) experiments: i. Demonstration of power train system in the vehicle ii. Demonstration of vehicle systems (automobile chassis, steering system, suspension system, braking system - Any Two) iii. Demonstration of energy conversion devices iv. Demonstration of additive manufacturing / rapid prototyping techniques v. Demonstration of CNC

103004: Basic Electrical Engineering		
Teaching Scheme: **TH : 03 Hr/week** **PR : 02 Hr/Week**	**Credits** **04**	**Examination Scheme:** **In-Semester : 30 Marks** **End-Semester : 70 Marks** **PR : 25 Marks**

Prerequisite Courses, if any: Engineering physics**,** electron theory, electricity, potential and kinetic energy

Course Overview: This course aims at enabling students of all Engineering Branches to understand the basic concepts of electrical engineering. This course is designed to provide knowledge of fundamentals and various laws in electromagnetic and magnetic circuits, electrostatics. The steady state analysis of AC and DC circuits, and its applications transformer, batteries and different energy conversion techniques are also included in this course.

Course Objectives:

1. To introduce fundamental concepts, various laws-principles and theorems associated with electrical systems.
2. To impart basic knowledge of all electrical quantities such as current, voltage, power, energy, frequency along with different types of fields.
3. To provide knowledge about fundamental parameters such as resistance, inductance and capacitance and magnetic circuits, AC and DC circuits.
4. To provide knowledge of the concepts of transformer, different energy conversions techniques.

Course Outcomes:

At the end of course students will be able to

CO1: Differentiate between electrical and magnetic circuits and derive mathematical relation for self and mutual inductance along with coupling effect.

CO2: Calculate series, parallel and composite capacitor as well as characteristics parameters of alternating quantity and phasor arithmetic

CO3: Derive expression for impedance, current, power in series and parallel RLC circuit with AC supply along with phasor diagram.

CO4: Relate phase and line electrical quantities in polyphase networks, demonstrate the operation of single phase transformer and calculate efficiency and regulation at different loading conditions

CO5: Apply and analyze the resistive circuits using star-delta conversion KVL, KCL and different network theorems under DC supply.

CO6: Evaluate work, power, energy relations and suggest various batteries for different applications, concept of charging and discharging and depth of charge.

Course Contents

Unit I **Electromagnetism**: (**6Hrs**)

Review: resistance, emf, current, potential, potential difference and Ohm's law

Electromagnetism: Magnetic effect of an electric current, cross and dot conventions, right hand thumb rule, nature of magnetic field of long straight conductor, solenoid and toroid. Concept of mmf, flux, flux density, reluctance, permeability and field strength, their units and relationships. Simple series magnetic circuit, Introduction to parallel magnetic circuit(Only theoretical treatment), comparison of electric and magnetic circuit, force on current carrying conductor placed in magnetic field, Fleming's left hand rule. Faradays laws of electromagnetic induction, Fleming's right hand rule, statically and dynamically induced e.m.f., self and mutual inductance, coefficient of couplings. Energy stored in magnetic field.

Unit II **Electrostatics and AC Fundamentals** **(6 Hrs)**

A) **Electrostatics:** Electrostatic field, electric flux density, electric field strength, absolute permittivity, relative permittivity and capacitance. Capacitor, capacitors in series and parallel, energy stored in capacitors, charging and discharging of capacitors (no derivation) and time constant. **(2Hrs)**

B) **AC Fundamentals:** Sinusoidal voltages and currents, their mathematical and graphical representation, Concept of cycle, Period, frequency, instantaneous, peak(maximum), average and r.m.s. values, peak factor and form factor. Phase difference, lagging, leading and in phase quantities and phasor representation. Rectangular and polar representation of phasor. **(4Hrs)**

Unit III **Single Phase AC Circuits** **(06 Hrs)**

Study of AC circuits consisting of pure resistance, pure inductance, pure capacitance, series R-L, R-C and R-L-C circuits, phasor diagrams, voltage, current and power waveforms, resonance in series RLC circuits, concept of impedance, concept of active, reactive, apparent, complex power and power factor, Parallel AC circuits (No numericals), concept of admittance

Unit IV **Polyphase A.C. Circuits and Single phase Transformers** **(06 Hrs)**

A) **Polyphase A.C. Circuits:** Concept of three-phase supply and phase sequence. Balanced and unbalanced load, Voltages, currents and power relations in three phase balanced star-connected loads and delta-connected loads along with phasor diagrams. **(3Hrs)**

B) **Single phase transformers:** principle of working, construction and types, emf equation, voltage and current ratios. Losses, definition of regulation and efficiency, determination of these by direct loading method. Descriptive treatment of autotransformers. **(3Hrs)**

Unit V **DC Circuits:** **(06 Hrs)**

Classification of electrical networks, Energy sources – ideal and practical voltage and current sources, Simplifications of networks using series and parallel combinations and star-delta conversions, Kirchhoff's laws and their applications for network solutions using loop analysis, Superposition theorem, Thevenin's theorem.

Unit VI **Work, Power, Energy and Batteries** **(06 Hrs)**

A) **Work, Power, Energy:** Effect of temperature on resistance, resistance temperature coefficient, insulation resistance, conversion of energy from one form to another in electrical, mechanical and thermal systems. (**4Hrs**)

B) **Batteries :**Different types of batteries (Lead Acid and Lithium Ion), construction, working principle, applications, ratings, charging and discharging, concept of depth of charging, maintenance of batteries, series -parallel connection of batteries **(2Hrs)**

Books & Other Resources:

Text Books:

1. V.D. Toro, Principles of Electrical Engineering, Prentice Hall India, 1989
2. D. P. Kothari, I.J. Nagrath, Theory and Problems of Basic Electrical Engineering, PHI Publication
3. V.K. Mehta, RohitMehata Basic Electrical Engineering, S Chand Publications
4. B.L. Theraja, A text book on electrical technology Vol-I

Reference Books:

1. H Cotton, Electrical technology, CBS Publications
2. L. S. Bobrow, ―Fundamentals of Electrical Engineering‖, Oxford University Press, 2011.
3. E. Hughes, ―Electrical and Electronics Technology‖, Pearson, 2010.
4. D. C. Kulshreshtha, ―Basic Electrical Engineering‖, McGraw Hill, 2009.

Guidelines for Instructor's Manual

The Instructor's Manual should contain following related to every experiment –

- Brief theory related to the experiment.
- Apparatus with their detailed specifications.

- Connection diagram /circuit diagram.
- Observation table/ simulation waveforms.
- Sample calculations for one/two reading.
- Result table.
- Graph and Conclusions.
- Few questions related to the experiment.
- Relevance of practical in real life /industry

Guidelines for Student's Lab Journal

The Student's Lab Journal should contain following related to every experiment –

- Theory related to the experiment.
- Apparatus with their detailed specifications.
- Connection diagram /circuit diagram.
- Observation table/ simulation waveforms.
- Sample calculations for one/two reading.
- Result table.
- Graph and Conclusions.
- Few short questions related to the experiment.

Guidelines for Lab /TW Assessment

- There should be continuous assessment for the TW.
- Assessment must be based on understanding of theory, attentiveness during practical, understanding .
- Session, how efficiently the student is able to do connections and get the results.
- Timely submission of journal.

Suggested List of Laboratory Experiments/Assignments

Group A

Following **eight** practical are compulsory

1. To study safety precautions while working on electrical systems, handling of various equipment's such as multimeter, ammeters, voltmeters, wattmeter's, real life resistors, inductors and capacitors
2. To calculate and measure of charging and discharging of capacitor and observe the response on storage oscilloscope.
3. To measure steady state response of series RL and RC circuits on AC supply and observations of voltage and current waveforms on storage oscilloscope.
4. To derive resonance frequency and analyze resonance in series RLC circuit.
5. To verify the relation between phase and line quantities in three phase balanced star delta connections of load.
6. To determine efficiency and regulation of transformer by direct loading test of a single phase transformer.
7. To verify KVL and Superposition theorem.
8. To verify Thevenin's theorem in a DC network

Group B

From following **minimum two** practical are compulsory

1. To measure insulation resistance of electrical equipment's/cable using Megger
2. To demonstrate different types of electrical protection equipments such as fuses, MCB, MCCB, ELCB.
3. To measure of earth resistance at substation earthing using fall of potential method with IS 3043 standard.
4. To study of LT and HT electricity bills.

110005: Programming and Problem Solving

Teaching Scheme:	Credits	Examination Scheme:
TH: 03 Hrs/Week	**04**	**In-Semester : 30 Marks**
PR : 02 Hrs/Week		**End-Semester : 70 Marks**
		PR : 25 Marks

Prerequisite Courses, if any: students are expected to have a good understanding of basic computer principles.

Companion Course, if any: Programming and Problem Solving Laboratory (110005)

Course Objectives:

Prime objective is to give students a basic introduction to programming and problem solving with computer language Python. And to introduce students not merely to the coding of computer programs, but to computational thinking, the methodology of computer programming, and the principles of good program design including modularity and encapsulation.

1. To understand problem solving, problem solving aspects, programming and to know about various program design tools.
2. To learn problem solving with computers
3. To learn basics, features and future of Python programming.
4. To acquaint with data types, input output statements, decision making, looping and functions in Python
5. To learn features of Object Oriented Programming using Python
6. To acquaint with the use and benefits of files handling in Python

Following Fields are applicable for courses with companion Laboratory course

Course Outcomes: On completion of the course, learner will be able to–

CO1: Inculcate and apply various skills in problem solving.

CO2: Choose most appropriate programming constructs and features to solve the problems in diversified domains.

CO3: Exhibit the programming skills for the problems those require the writing of well-documented programs including use of the logical constructs of language, Python.

CO4: Demonstrate significant experience with the Python program development environment.

Course Contents

Unit I Problem Solving, Programming and Python Programming (07 Hrs)

General Problem Solving Concepts- Problem solving in everyday life, types of problems, problem solving with computers, difficulties with problem solving, problem solving aspects, top down design. Problem Solving Strategies,

Program Design Tools: Algorithms, Flowcharts and Pseudo-codes, implementation of algorithms.

Basics of Python Programming: Features of Python, History and Future of Python, Writing and executing Python program, Literal constants, variables and identifiers, Data Types, Input operation, Comments, Reserved words, Indentation, Operators and expressions, Expressions in Python.

Unit II Decision Control Statements (08 Hrs)

Decision Control Statements: Decision control statements, **Selection/conditional** branching Statements: if, if-else, nested if, if-elif-else statements. **Basic loop** Structures/Iterative statements: while loop, for loop, selecting appropriate loop. Nested loops, The *break, continue, pass, else* statement used with loops. Other data types- Tuples, Lists and Dictionary.

Unit III	Functions and Modules	(08 Hrs)

Need for functions, **Function**: definition, call, variable scope and lifetime, the return statement. Defining functions, Lambda or anonymous function, documentation string, good programming practices. Introduction to modules, Introduction to packages in Python, Introduction to standard library modules.

Unit IV	Strings	(07 Hrs)

Strings and Operations- concatenation, appending, multiplication and slicing. Strings are immutable, strings formatting operator, built in string methods and functions. Slice operation, ord() and chr() functions, in and not in operators, comparing strings, Iterating strings, the string module.

Unit V	Object Oriented Programming	(08 Hrs)

Programming Paradigms-monolithic, procedural, structured and object oriented, **Features of Object oriented programming-**classes, objects, methods and message passing, inheritance, polymorphism, containership, reusability, delegation, data abstraction and encapsulation.

Classes and Objects: classes and objects, class method and self object, class variables and object variables, public and private members, class methods.

Unit VI	File Handling and Dictionaries	(07 Hrs)

Files: Introduction, File path, Types of files, Opening and Closing files, Reading and Writing files. Dictionary method. **Dictionaries-** creating, assessing, adding and updating values.

Case Study: Study design, features, and use of any recent, popular and efficient system developed using Python. (This topic is to be excluded for theory examination).

Text Books:

1. Reema Thareja, "Python Programming Using Problem Solving Approach", Oxford University Press, ISBN 13: 978-0-19-948017-6
2. R. Nageswara Rao, "Core Python Programming", Dreamtech Press; Second edition ISBN-10: 938605230X, ISBN-13: 978-9386052308 ASIN: B07BFSR3LL

Reference Books:

1. R. G. Dromey, "How to Solve it by Computer", Pearson Education India; 1st edition, ISBN-10: 8131705625, ISBN-13: 978-8131705629 Maureen Spankle, "Problem Solving and Programming Concepts", Pearson; 9th edition, ISBN-10: 9780132492645, ISBN-13: 978-0132492645
2. Romano Fabrizio, "Learning Python", Packt Publishing Limited, ISBN: 9781783551712, 1783551712
3. Paul Barry, "Head First Python- A Brain Friendly Guide", SPD O'Reilly, 2nd Edition, ISBN:978-93-5213-482-3
4. Martin C. Brown, "Python: The Complete Reference", McGraw Hill Education, ISBN-10: 9789387572942, ISBN-13: 978-9387572942, ASIN: 9387572943
5. Jeeva Jose, P. Sojan Lal, "Introduction to Computing & Problem Solving with Python", Khanna Computer Book Store; First edition, ISBN-10: 9789382609810, ISBN-13: 978-9382609810

Programming and Problem Solving Laboratory

Guidelines for Instructor's Manual

The instructor's manual is to be developed as a hands-on resource and reference. The instructor's manual need to include prologue (about University/program/ institute/ department/foreword/ preface etc), copy of curriculum, conduction & Assessment guidelines, topics under consideration-concept, objectives, outcomes, set of typical applications/assignments/ guidelines, and references.

Guidelines for Student's Lab Journal

The laboratory assignments are to be submitted by student in the form of journal. Journal consists of prologue, Certificate, table of contents, and handwritten write-up of each assignment (Title, Objectives, Problem Statement, Outcomes, software & Hardware requirements, Date of Completion, Assessment grade/marks and assessor's sign, Theory-Concept in brief, features of tool/framework/language used, Design, test cases, conclusion. Program codes with sample output of all performed assignments are to be submitted as softcopy.

As a conscious effort and little contribution towards Green IT and environment awareness, attaching printed papers as part of write-ups and program listing to journal may be avoided. Use of DVD containing students programs maintained by lab In-charge is highly encouraged. For reference one or two journals may be maintained with program prints at Laboratory.

Guidelines for Lab /TW Assessment

Continuous assessment of laboratory work is done based on overall performance and lab assignments performance of student. Each lab assignment assessment will assign grade/marks based on parameters with appropriate weightage. Suggested parameters for overall assessment as well as each lab assignment assessment include- timely completion, performance, innovation, efficient codes, punctuality and neatness.

Guidelines for Laboratory Conduction

List of laboratory assignments is provided below for reference. The instructor is expected to frame the assignments by understanding the prerequisites, technological aspects, utility and recent trends related to the topic. The assignment framing policy need to address the average students and inclusive of an element to attract and promote the intelligent students. The instructor may set multiple sets of assignments and distribute among batches of students. It is appreciated if the assignments are based on real world problems/applications. Encourage students for appropriate use of coding style, proper indentation and comments.

Use of open source software and recent version is to be encouraged.

In addition to these, instructor may assign one real life application in the form of a mini-project based on the concepts learned. Instructor may also set one assignment or mini-project that is suitable to respective branch beyond the scope of syllabus.

Suggested List of Laboratory Experiments/Assignments

(Any 6 to 8 laboratory assignments)

Sr. No.	**Problem Statement** **Write Program in Python (with function/class/file, as applicable)**
1.	To calculate salary of an employee given his basic pay (take as input from user). Calculate gross salary of employee. Let HRA be 10 % of basic pay and TA be 5% of basic pay. Let employee pay professional tax as 2% of total salary. Calculate net salary payable after deductions.
2.	To accept an object mass in kilograms and velocity in meters per second and display its momentum. Momentum is calculated as $e=mc^2$ where m is the mass of the object and c is its velocity.
3.	To accept N numbers from user. Compute and display maximum in list, minimum in list, sum and average of numbers.
4.	To accept student's five courses marks and compute his/her result. Student is passing if he/she scores marks equal to and above 40 in each course. If student scores aggregate greater than 75%, then the grade is distinction. If aggregate is 60>= and <75 then the grade if first division. If aggregate is 50>= and <60, then the grade is second division. If aggregate is 40>= and <50, then the grade is third division.
5.	To check whether input number is Armstrong number or not. An Armstrong number is an integer with three digits such that the sum of the cubes of its digits is equal to the number itself. Ex. 371.
6.	To simulate simple calculator that performs basic tasks such as addition, subtraction, multiplication and division with special operations like computing x^y and x!.

7.	To accept the number and Compute a) square root of number, b) Square of number, c) Cube of number d) check for prime, d) factorial of number e) prime factors
8.	To accept two numbers from user and compute smallest divisor and Greatest Common Divisor of these two numbers.
9.	To accept a number from user and print digits of number in a reverse order.
10.	To input binary number from user and convert it into decimal number.
11.	To generate pseudo random numbers.
12.	To accept list of N integers and partition list into two sub lists even and odd numbers.
13.	To accept the number of terms a finds the sum of *sine* series.
14.	To accept from user the number of Fibonacci numbers to be generated and print the Fibonacci series.
15.	Write a python program that accepts a string from user and perform following string operations- i. Calculate length of string ii. String reversal iii. Equality check of two strings iii. Check palindrome ii. Check substring
16.	To copy contents of one file to other. While copying a) all full stops are to be replaced with commas b) lower case are to be replaced with upper case c) upper case are to be replaced with lower case.
17.	To count total characters in file, total words in file, total lines in file and frequency of given word in file.
18.	Create class EMPLOYEE for storing details (Name, Designation, gender, Date of Joining and Salary). Define function members to compute a)total number of employees in an organization b) count of male and female employee c) Employee with salary more than 10,000 d) Employee with designation “Asst Manager”
19.	Create class STORE to keep track of Products (Product Code, Name and price). Display menu of all products to user. Generate bill as per order.
Mini-Projects	
20.	Calculator with basic functions. Add more functionality such as graphic user interface and complex calculations.
21.	Program that simulates rolling dice. When the program runs, it will randomly choose a number between 1 and 6 (Or other integer you prefer). Print that number. Request user to roll again. Set the min and max number that dice can show. For the average die, that means a minimum of 1 and a maximum of 6.
22.	Use raspberry pi/or similar kit and python for- • Room Temperature Monitoring System • Motion Detection System • Soil Moisture Sensor • Home Automation System • A robot • Smart mirror or a smart clock. • Smile Detection using Raspberry Pi Camera
23.	Guess Number: Randomly generate a number unknown to the user. The user needs to guess what that number is. If the user’s guess is wrong, the program should return some sort of indication as to how wrong (e.g. the number is too high or too low). If the user guesses correctly, a positive indication should appear. Write functions to check if the user input is an actual number, to see the difference between the inputted number and the randomly generated numbers, and to then compare the numbers.

111006 -Workshop Practice

Teaching Scheme:	Credits	Examination Scheme:
PR : 2 Hrs/Week	**01**	**PR : 25 Marks**

Course Objectives:

1. To understand the construction and working of machine tools and functions of its parts.
2. To develop the skill through hands-on practices using hand tools, power tools, machine tools in manufacturing and assembly shop leading to understanding of a production processes.
3. To understand workshop layout and safety norms.

Course Outcomes:

CO1: Familiar with safety norms to prevent any mishap in workshop.
CO2: Able to handle appropriate hand tool, cutting tool and machine tools to manufacture a job.
CO3: Able to understand the construction, working and functions of machine tools and their parts.
CO4: Able to know simple operations (Turning and Facing) on a centre lathe.

Note

1. The demonstration of machine tools to be conducted by **teaching** faculty.
2. Minimum eight experiments to be conducted out of 10.

Guidelines for Instructor's Manual

Instructor manual shall contain:

- The production drawing of a job with all linear and geometric dimensions, Raw material, size and shape, allowances provided.
- List of tooling required.
- Process plan to complete the job.
- General safety instructions.

Guidelines for Student's Lab Journal

i. Student has to maintain a workshop diary consisting of drawing / sketches of the jobs and a brief description of tools, equipment, and procedure used for doing the job and time schedule.
ii. Student has to maintain one file for write ups based on demonstration of machine tools and safety norms

Guidelines for LAB/TW Assessment

Term work assessment shall be based on the timely completion of jobs, quality of job, skill acquired, and maintain of workshop diary and brief write-ups on illustrations/sketches of demonstrated parts/mechanisms/machine tools etc.

Guidelines for Laboratory Conduction

i. 1^{st} on importance of workshop practical and shop floor safety norms
ii. 2^{nd} to 6^{th} Sessions are about demonstration of machine tools (Any 4)
iii. 7^{th} to 9^{th} on making utility job (Any 2)
iv. 10^{th}& 11^{th} session on preparation of workshop layout and safety norms.

Suggested List of Laboratory Experiments/Assignments

Sr. No.	List of Experiments
1.	Mandatory briefing on shop-floor safety
2.	**Demonstration and working of centre lathe** Demonstration on various functions of lathe parts: Headstock, Tailstock, Carriage, Lead screw, All geared Mechanism, Apron mechanism etc.
3.	**Demonstration of Lathe operations:** Step turning and facing, drilling operation on a Mild Steel cylindrical job on centre lathe. Understanding the concept of speed, feed and depth of cut.

4.	**Demonstration of Drilling machine** Demonstration on construction of Radial drilling machine, Tool holding devices, Concept of speed, feed and depth of cut.
5.	**Demonstration on Milling machine** Demonstration on construction, table movements, indexing and tooling of milling machine.
6.	**Demonstration of Shaper/Grinding machine (Any one)** Shaper: Crank and slotted link mechanism, Work feed mechanism Grinding: Surface grinder/Cylindrical grinding machine, Mounting of grinding wheel
7.	**Term work includes one job of Carpentry** Introduction to wood working, kinds of woods, hand tools & machines, Types of joints, wood turning. Pattern making, types of patterns and its allowances.
8.	**Term work to include one job involving fitting** to size, male-female fitting with drilling and tapping operation on Mild Steel plate; Introduction to marking, cutting and sawing, sizing of metal, shearing, Concept of fits and interchangeability, selection of datum and measurements.
9.	**Term work to include one utility job preferably using sheet metal** (e.g. Tray, Funnel etc.) with riveting/welding/brazing/soldering (at least one temporary and one Permanent joint either using resistance welding/Arc welding); Introduction to sheet metal operations: punching, blanking, bending, drawing.
10.	**Prepare a Layout of Workshop** To prepare a work shop layout.
11.	**Collection of information about safety norms** in any one of the following type of industry:Metalworking/Chemical/Cement/Pharmaceuticals/Defense/Atomic energy/Aerospace /Marine/Construction/Railway etc.

Reference/Text Books

1. John, K. C., (2010),"Mechanical Workshop Practice, Prentice Hall Publication, New Delhi
2. Hazra and Chaudhary, Workshop Technology-I & II, Media promoters & Publisher Pvt. Ltd.

101007: Environmental Studies-I

TH:02 Hrs./week **(Mandatory Non-Credit Course)**

Course Objectives:

1. To explain the concepts and strategies related to sustainable development and various components of environment.
2. To examine biotic and abiotic factors within an ecosystem, to identify food chains, webs, as well as energy flow and relationships.
3. To identify and analyze various conservation methods and their effectiveness in relation to renewable and nonrenewable natural resources.
4. To gain an understanding of the value of biodiversity and current efforts to conserve biodiversity on national and local scale.

Course Outcomes: On completion of the course, learner will be able to–

CO1:Demonstrate an integrative approach to environmental issues with a focus on sustainability.

CO2: Explain and identify the role of the organism in energy transfers in different ecosystems.

CO3: Distinguish between and provide examples of renewable and nonrenewable resources & analyze personal consumption of resources.

CO4: Identify key threats to biodiversity and develop appropriate policy options for conserving biodiversity in different settings.

Course Contents

Unit I	**Introduction to environmental studies**	**(02 Hrs)**

Multidisciplinary nature of environmental studies; components of environment – atmosphere, hydrosphere, lithosphere and biosphere. Scope and importance; Concept of sustainability and sustainable development.

Unit II	**Ecosystems**	**(06 Hrs)**

What is an ecosystem? Structure and function of ecosystem; Energy flow in an ecosystem: food chain, food web and ecological succession. Case studies of the following ecosystems:

a) Forest ecosystem
b) Grassland ecosystem
c) Desert ecosystem
d) Aquatic ecosystems (ponds, streams, lakes, rivers, oceans, estuaries)

Unit III	**Natural Resources: Renewable and Non-renewable Resources**	**(08 Hrs)**

Land Resources and land use change; Land degradation, soil erosion and desertification.
Deforestation: Causes and impacts due to mining, dam building on environment, forests, biodiversity and tribal populations.
Water: Use and over-exploitation of surface and ground water, floods droughts, conflicts over water (international & inter-state).
Heating of earth and circulation of air; air mass formation and precipitation.
Energy resources: Renewable and non-renewable energy sources, use of alternate energy sources, growing energy needs, case studies.

Unit IV	**Biodiversity and Conservation**	**(08 Hrs)**

Levels of biological diversity: genetic, species and ecosystem diversity; Biogeography zones of India; Biodiversity patterns and global biodiversity hot spots. India as a mega-biodiversity nation; Endangered and endemic species of India. Threats to biodiversity: habitat loss, poaching of wildlife, man-wildlife conflicts, biological invasions; Conservation of biodiversity; In-situ and Ex-situ conservation of biodiversity. Ecosystem and biodiversity services: Ecological, economic, social, ethical, aesthetic and Informational value.

Suggested Readings:

1. Carson, R. 2002. Silent spring. Houghton Mifflin Harcourt.
2. Gadgil, M., & Guha, R.1993. This Fissured Land: An Ecological History of India. Univ. of California Press.
3. Gleeson,B. and Low, N. (eds.) 1999. Global Ethics and Environment, London, Routledge.
4. Gleick, P.H. 1993. Water in Crisis. Pacific Institute for Studies in Dev., Environment & Security. Stockholm Env. Institute, Oxford Univ. Press.
5. Groom, Martha J. Gary K. Meffe, and Carl Ronald carroll. Principals of Conservation Biology.
   Sunderland: Sinauer Associates, 2006.
6. Grumbine, R. Edward, and Pandit, M.K. 2013. Threats from India's Himalaya dams. Science, 339:36-37.
7. McCully, P.1996. Rivers no more: the environmental effects of dams (pp.29-64). Zed Books.
8. McNeil, John R. 2000. Something New Under the Sun: An Environmental History of the Twentieth Century.

107008 – Engineering Mathematics – II

Teaching Scheme:	Credits	Examination Scheme:
TH : 4 Hrs./Week	**05**	**In-Semester : 30 Marks**
TUT : 1 Hr./Week		**End-Semester : 70 Marks**
		TW : 25 Marks

Prerequisites:
Integration, Differential Equation, Three-dimensional coordinate systems

Course Objectives:
To make the students familiarize with Mathematical Modeling of physical systems using differential equations advanced techniques of integration, tracing of curve, multiple integrals and their applications. The aim is to equip them with the techniques to understand advanced level mathematics and its applications that would enhance thinking power, useful in their disciplines.

Course Outcomes (COs): The students will be able to learn

CO1: the effective mathematical tools for solutions of first order differential equations that model physical processes such as Newton's law of cooling, electrical circuit, rectilinear motion, mass spring systems, heat transfer etc.

CO2: advanced integration techniques such as Reduction formulae, Beta functions, Gamma functions, Differentiation under integral sign and Error functions needed in evaluating multiple integrals and their applications.

CO3: to trace the curve for a given equation and measure arc length of various curves.

CO4: the concepts of solid geometry using equations of sphere, cone and cylinder in a comprehensive manner.

CO5: evaluation of multiple integrals and its application to find area bounded by curves, volume bounded by surfaces, Centre of gravity and Moment of inertia.

Course Contents

Unit I: First Order Ordinary differential Equations (09 Hrs.)
Exact differential equations, Equations reducible to exact form. Linear differential equations, Equations reducible to linear form, Bernoulli's equation.

Unit II: Applications of Differential Equations (09 Hrs.)
Applications of Differential Equations to Orthogonal Trajectories, Newton's Law of Cooling, Kirchhoff's Law of Electrical Circuits, Rectilinear Motion, Simple Harmonic Motion, One dimensional Conduction of Heat.

Unit III: Integral Calculus (09 Hrs.)
Reduction Formulae, Beta and Gamma functions, Differentiation Under Integral Sign and Error functions.

Unit IV: Curve Tracing (09 Hrs.)
Tracing of Curves – Cartesian, Polar and Parametric curves, Rectification of curves.

Unit V: Solid Geometry (09 Hrs.)
Cartesian, Spherical polar and Cylindrical coordinate systems, Sphere, Cone and Cylinder.

Unit VI: Multiple Integrals and their Applications (09 Hrs.)
Double and Triple integrations, Change of order of integration, Applications to find Area, Volume, Mass, Centre of Gravity and Moment of Inertia.

Text Books:
1. Higher Engineering Mathematics by B. V. Ramana (Tata McGraw Hill)
2. Higher Engineering Mathematics by B. S. Grewal (Khanna Publication, Delhi)

Reference Books:
1. Advanced Engineering Mathematics by Erwin Kreyszig (Wiley Eastern Ltd.)
2. Advanced Engineering Mathematics by M. D. Greenberg (Pearson Education)
3. Advanced Engineering Mathematics by Peter V. O'Neil (Thomson Learning)
4. Thomas' Calculus by George B. Thomas, (Addison-Wesley, Pearson)
5. Applied Mathematics (Vol. I and II) by P.N. Wartikar and J.N.Wartikar Vidyarthi Griha Prakashan, Pune.
6. Differential Equations by S. L. Ross (John Wiley and Sons)

Tutorial and Term Work:
i) Tutorial for the subject shall be engaged in minimum three batches (batch size of 22 students) per division.
ii) Term work shall consist of six assignments on each unit-I to unit-VI and is based on

performance and continuous internal assessment.

107009: Engineering Chemistry

Teaching Scheme:	Credits	Examination Scheme:
TH : 04 Hrs/week	**05**	**In Semester : 30 Marks**
PR : 02 Hrs/Week		**End Semester: 70 Marks**
		PR : 25 Marks

Prerequisite Courses, if any:
Types of titrations, volumetric analysis, structure property relationship, types of crystals, periodic table, classification and properties of polymers, electromagnetic radiation, electrochemical series

Companion Course, if any: Laboratory Practical

Course Objectives:

1. To understand technology involved in analysis and improving quality of water as commodity.
2. To acquire the knowledge of electro-analytical techniques that facilitates rapid and precise understanding of materials.
3. To understand structure, properties and applications of speciality polymers and nano material.
4. To study conventional and alternative fuels with respect to their properties and applications.
5. To study spectroscopic techniques for chemical analysis.
6. To understand corrosion mechanisms and preventive methods for corrosion control.

Course Outcomes:
On completion of the course, learner will be able to–
CO1: Apply the different methodologies for analysis of water and techniques involved in softening of water as commodity.
CO2: Select appropriate electro-technique and method of material analysis.
CO3: Demonstrate the knowledge of advanced engineering materials for various engineering applications.
CO4: Analyze fuel and suggest use of alternative fuels.
CO5: Identify chemical compounds based on their structure.
CO6: Explain causes of corrosion and methods for minimizing corrosion.

Course Contents

Unit I — Water Technology — (08Hrs)

Impurities in water, hardness of water: Types, Units and Numericals. Determination of hardness (by EDTA method using molarity concept) and alkalinity, numericals. Ill effects of hard water in boiler - priming and foaming, boiler corrosion, caustic embrittlement, scale and sludge.
Water treatment: i) Zeolite method and numericalsii) Demineralization method. Purification of water: Reverse osmosis and Electrodialysis.

Unit II — Instrumental Methods of Analysis — (08Hrs)

Introduction: Types of reference electrode (calomel electrode), indicator electrode (glass electrode), ion selective electrode: ion selective membranes such as solid membrane, enzyme based membrane and gas sensing membrane.
[A] Conductometry: Introduction, conductivity cell, conductometric titrations of acid versus base with titration curve.
[B] pHmetry: Introduction, standardization of pH meter, pH metric titration of strong acid versus strong base with titration curve.

Unit III	**Engineering Materials**	**(08Hrs)**

A] Speciality polymers: Introduction, preparation, properties and applications of the following polymers:
1. Engineering Thermoplastic: Polycarbonate,
2. Bio-degradable polymers: Poly (hydroxybutyrate-hydroxyvalanate),
3. Conducting Polymer: Polyacetylene,
4. Electroluminescent polymer: Polyphenylenevinylene,
5. Polymer composites: Fiber reinforced plastic (FRP)- Glass reinforced and Carbon reinforced polymer composite

[B] Nanomaterials: Introduction, classification of nanomaterials based on dimensions (zero dimensional, one-dimensional, two-dimensional and three-dimensional), structure, properties and applications of graphene and carbon nanotubes, quantum dots (semiconductor nanoparticles).

Unit IV	**Fuels**	**(08Hrs)**

Introduction (definition, classification of fuel based on chemical reactions and characteristics of an ideal fuel),
Calorific value (CV): Higher calorific value (HCV) and Lower calorific value (LCV), Determination of Calorific value: Principle, construction and working of Bomb calorimeter and Boy's gas calorimeter and numericals,
Solid fuel: Coal: Analysis of Coal-Proximate and Ultimate analysis, numericals,
Liquid fuel: Petroleum: Refining of petroleum /crude oil and composition, boiling range and uses of various fractions,
Gaseous fuel: Composition, properties and applications of CNG. Hydrogen gas as a future fuel
Alternative fuels: Power alcohol and biodiesel.

Unit V	**Spectroscopic Techniques**	**(08Hrs)**

[A]UV-Visible Spectroscopy:
Introduction, interaction of electromagnetic radiation with matter, statement of Beer's law and Lambert's law, absorption of UV radiation by organic molecule leading to different electronic transitions, terms involved in UV-visible Spectroscopy- chromophore, auxochrome, bathochromic shift, hypsochromic shift, hyperchromic shift and hypochromic shift, Instrumentation and basic principle of single beam spectrophotometer, applications of UV-visible spectroscopy.

[B] Infra red Spectroscopy:
Introduction, Principle of IR Spectroscopy, types of vibrations: Stretching (symmetric and asymmetric) and bending (scissoring, rocking, wagging and twisting), conditions of absorption of IR radiations, vibration of diatomic and polyatomic molecules. Instrumentation with block diagram. Parts of IR spectrum, fundamental group region, fingerprint region, applications of IR spectroscopy.

Unit VI	**Corrosion Science**	**(08Hrs)**

Introduction, Types of corrosion – Dry and Wet corrosion, mechanism of dry corrosion, nature of oxide films and Pilling-Bedworth's rule, wet corrosion – mechanism: hydrogen evolution and oxygen absorption, galvanic cell corrosion, concentration cell corrosion, Factors influencing rate of corrosion. Methods of corrosion control and prevention: cathodic and anodic protection, metallic coatings and its types, surface preparation, methods to apply metallic coatings-hot dipping, cladding, electroplating, cementation.

Books & Other Resources:

Text Books:

1. Engineering Chemistry by O .G. Palanna, Tata Magraw Hill Education Pvt. Ltd.
2. Textbook of Engineering Chemistry by Dr. S. S. Dara, Dr. S. S. Umare, S. Chand & Company Ltd.
3. Textbook of Engineering Chemistry by Dr. Sunita Rattan, S. K. Kataria& Sons Publisher

Reference Books:

1. Engineering Chemistry, Wiley India Pvt. Ltd.
2. Inorganic Chemistry, 5 ed by Shriver and Atkins, Oxford University Press
3. Basic Concept of Analytical Chemistry, 2ed , S. M. Khopkar, New Age-International Publisher
4. Instrumental Methods of Chemical Analysis, G. R. Chatwal& S. K. Anand, Himalaya Publishing House
5. Spectroscopy of organic compounds, 2 ed, P. S. Kalsi, New Age-International Ltd., Publisher
6. Polymer Science, V. R. Gowarikar, N. V. Viswanathan, jayadevSreedhar, Wiley Eastern Limited

1. To determine hardness of water by EDTA method
2. To determine alkalinity of water
3. To determine strength of strong acid using pH meter
4. To determine maximum wavelength of absorption of $CuSO_4$/$FeSO_4$/ $KMnO_4$, verify Beer's law and find unknown concentration of given sample.
5. Titration of a mixture of weak acid and strong acid with strong base using conductometer
6. Preparation of polystyrene/phenol-formaldehyde/urea-formaldehyde resin
7. To determine molecular weight/radius of macromolecule polystyrene/ polyvinyl alcohol by viscosity measurement.
8. Proximate analysis of coal.
9. To coat copper and zinc on iron plate using electroplating.
10. Preparation of biodiesel from oil.
11. Colloidal synthesis of 2-6 or 3-5 semiconductor quantum dots nanoparticles

104010:Basic Electronics Engineering

Teaching Scheme:	Credits	Examination Scheme
TH : 03 Hrs./week	**04**	**In - Semester : 30 Marks**
PR : 02 Hrs./week		**End - Semester : 70 Marks**
		PR : 25 Marks

Course Objectives:

1. The principle of electronics and working principle of PN junction diode and special purpose diodes.
2. The functioning of transistors like BJT, MOSFETs and OPAMP.
3. Basics of various logic gates, digital circuits and their applications.
4. Working and functions of various electronic instruments.
5. The operating principles and applications of various active and passive sensors.
6. Basic principles of communication systems.

Course Outcomes: On completion of the course, learner will be able to–

CO1: Explain the working of P-N junction diode and its circuits.

CO2: Identify types of diodes and plot their characteristics and also can compare BJT with MOSFET.

CO3: Build and test analog circuits using OPAMP and digital circuits using universal/basic gates and flip flops.

CO4: Use different electronics measuring instruments to measure various electrical parameters.

CO5: Select sensors for specific applications.

CO6: Describe basic principles of communication systems.

Course Contents

Unit I — Introduction to Electronics — (08Hrs)

Evolution of Electronics, Impact of Electronics in industry and in society.
Introduction to active and passive components, P-type Semiconductor, N-type Semiconductor. Current in semiconductors(Diffusion and Drift Current)
P-N Junction Diode: P-N Junction diode construction and its working in forward and reverse bias condition, V-I characteristics of P-N junction Diode, Diode as a switch, Half Wave Rectifier, Full wave and Bridge Rectifier.
Special purpose diodes: Zener diode, Light Emitting Diode (LED) and photo diode along with V-I characteristics and their applications.

Unit II — Transistor and OPAMP — (07Hrs)

Bipolar Junction Transistor : Construction, type, Operation, V-I Characteristics, region of operation, BJT as switch and CE amplifier
Metal Oxide Semiconductor Field Effect Transistors (MOSFET): Construction, Types, Operation, V-I characteristics, Regions of operation, MOSFET as switch & amplifier.
Operational amplifier: Functional block diagram of operational amplifier, ideal operational amplifier, Op-amp as Inverting and Non inverting amplifier

Unit III — Number System and Logic Gates — (07Hrs)

Number System:- Binary, BCD, Octal, Decimal, Hexadecimal their conversion and arithmetic, De-Morgan's theorem.
Basic Gates:- AND, OR, NOT, Universal Gate- XOR, XNOR, Half adder, Full adder
Flip Flop's SR, JK, T and D
Introduction to Microprocessor and Microcontroller (Only block diagram and explanation)

Unit IV — Electronic Instrumentation — (06Hrs)

Electronic Instruments: Principles and block diagram of digital multimeter, Function Generator, Digital Storage Oscilloscope (DSO) Power scope, AC/DC power supply, Auto transformer, Analog ammeter and voltmeter.

Unit V — Sensors — (07Hrs)

Classification of a sensors, Active /Passive Sensors, Analog/Digital Sensors, Motion Sensors (LVDT, Accelerometer), Temperature Sensors (Thermocouple, Thermistor, RTD), Semiconductor Sensors(Gas Sensors), Optical Sensors (LDR), Mechanical Sensors (Strain Guage, Load Cell, Pressure sensors), Biosensors. (Working Principle and one application).

Unit VI — Communication Systems — (07Hrs)

Basic Communication System: Block Diagram, Modes of Transmission, Communication Media: Wired and Wireless, Electromagnetic Spectrum, Allotment of frequency band for different applications, Block Diagram of AM and FM Transmitter and receiver,
Mobile Communication System: Cellular concept, Simple block diagram of GSM system.

Books & Other Resources:

Text Books:

1. "Electronics Devices" by Thomas. L. Floyd, 9th Edition, Pearson (Unit I, II)
2. "Modern Digital Electronics" by R.P. Jain, 4th Edition, Tata McGraw Hill (Unit III)
3. "Electronic Instrumentation" by H.S. Kalsi, 3rd Edition, Tata McGraw Hill (Unit IV)
4. "Sensors and Transducers" by D. Patrnabis, 2nd Edition, PHI (Unit V)
5. "Electronic Communication Systems" by Kennedy & Davis, 4th Edition, Tata McGraw Hill (Unit VI)
6. "Mobile Wireless communication" by M. Schwartz, Cambridge University Press (Unit VI)

Reference Books:

1. "Digital Fundamentals" by Thomas. L. Floyd, 11th Edition, Pearson

2. "Mobile Communication" by J. Schiller, 2nd Edition, Pearson 3. "Sensors Handbook", by S. Soloman, 2nd Edition.	
List of Laboratory Experiments/Assignments	
1.	**Electronic Components:** Study of Active and Passive components a) Resistors (Fixed & Variable), Calculation of resistor value using color code. b) Capacitors (Fixed & Variable) c) Inductors, Calculation of inductor value using color code. d) Devices such Diode, BJT, MOSFETs, various IC packages e) Switches & Relays
2.	**Measurements using various measuring equipments:** a) Set up CRO and function generator for measurement of voltage, frequency b) Obtain the phase shift between to signals using CRO with the help of Lissagous pattern. c) Measure voltage, resistance using digital multimeter. Also use multimeter to check diode, BJT
3.	**V-I characteristics of:** a) P-N Junction Diode **(Study the datasheet of typical PN junction diode 1N 400X)** b) Zener Diode **(Study the datasheet of typical Zener diode 1N 4148)**
4.	**Rectifier circuits:** a) Implement half wave, full wave and bridge rectifier using diodes b) Observe the effect of capacitor filter on rectifier output
5.	**Frequency response of MOSFET:** a) To plot frequency response of BJT amplifier.**(Simulation)** b) To plot frequency response of MOSFET amplifier.**(Simulation)**
6.	**Linear applications of Op-amp:** Build inverting and non-inverting amplifier using op-amp **(Study the datasheet of typical Op-Amp 741)**
7.	**Test and verify the truth tables of:** a) Basic and Universal Gates **(Study the data sheet of respective IC's)** b) Half / Full Adder c) RS/JK/T/D flip flop
8.	**Study of transducers : (Any 3)**
9.	Build and test any circuit using BJT/MOSFET/Op-Amp/Logic Gates using any one sensor.
10.	Case Study of any one electronics appliances with block diagram, specification etc.

Guidelines for Instructor's Manual

- The instructor's manual is to be developed as a hands-on resource and reference.
- Copy of Curriculum, Conduction & Assessment guidelines, List of Experiments to be attached.

Guidelines for Student's Lab Journal

- The laboratory assignments/experiments are to be submitted by student in the form of journal.
- Journal consists of Certificate, table of contents, and handwritten write-up for each experiment.
- Each experiment should consist of :
  - ✓ Title.
  - ✓ Objectives.
  - ✓ Problem Statement, Outcomes
  - ✓ Hardware / Software (If any) requirements.
  - ✓ Concept.
  - ✓ Experimental procedure / Setup.

- ✓ Observation table
- ✓ Conclusion.

Guidelines for Laboratory Conduction

- All the experiments mentioned in the syllabus are compulsory.
- Use of open source software and recent version is to be encouraged.

Guidelines for Lab /TW Assessment

- Continuous assessment of laboratory work is done based on overall performance.
- Each lab assignment/ experiment assessment will assign grade / marks based on parameters with appropriate weightage.
- Suggested parameters for overall assessment as well as each lab assignment / experiment assessment include:
  - ✓ Timely completion.
  - ✓ Performance.
  - ✓ Punctuality and neatness.
- The parameters for assessment is to be known to the students at the beginning of the course.

101011: Engineering Mechanics

Teaching Scheme:	Credits	Examination Scheme:
TH : 3 Hrs./week **PR : 2 Hrs./Week**	**04**	**In-Semester : 30 Marks** **End-Semester : 70 Marks** **PR : 25 Marks**

Prerequisite Courses, if any: 12th Physics, Maths

Course Objectives:

1. To impart knowledge about force systems and methods to determine resultant centroid and moment of inertia
2. To teach methods to calculate force of friction
3. To impart knowledge to determine reaction of beams, calculate member forces in trusses, cables and frames using principles of equilibrium
4. To teach space force systems
5. To train students to solve problems related to particle mechanics using principles of kinematics, kinetics and work power energy

Course Outcomes:

On completion of the course, learner will be able to–

CO1: Determine resultant of various force systems

CO2: Determine centroid, moment of inertia and solve problems related to friction

CO3: Determine reactions of beams, calculate forces in cables using principles of equilibrium

CO4: Solve trusses, frames for finding member forces and apply principles of equilibrium to forces in space

CO5: Calculate position, velocity and acceleration of particle using principles of kinematics

CO6: Calculate position, velocity and acceleration of particle using principles of kinetics and Work, Power, Energy

Course Contents

Unit I — Resolution and Composition of Forces (07Hrs)

Principle of statics, Force system, Resolution and composition of forces, Resultant of concurrent forces. Moment of a force, Varignon's theorem, resultant of parallel force system, Couple, Equivalent force couple system, Resultant of parallel general force system

Unit II — Distributed Forces and Friction (06Hrs)

Moment of area, Centroid of plane lamina and wire bends, Moment of Inertia.

Friction- Laws of friction, application of friction on inclined planes Wedges and ladders friction Application to flat belt

Unit III **Equilibrium** **(06Hrs)**

Free body diagram Equilibrium of concurrent, parallel forces in a plane Equilibrium of general forces in a plane Equilibrium of three forces in a plane, Types of beams, simple and compound beams, Type of supports and reaction,

Forces in space, Resultant of concurrent and parallel forces in a space, Equilibrium of concurrent and parallel forces in a space.

Unit IV **Analysis of Structures** **(06 Hrs)**

Two force member, Analysis of plane trusses by Method of joints Analysis of plane trusses by method of section, Analysis of plane frames, Cables subjected to point load multi force member.

Unit V **Kinematics of Particle** **(06 Hrs)**

Kinematics of linear motion- Basic concepts Equation of motion for constant acceleration Motion under gravity, Variable acceleration motion curves.

Kinematics of curvilinear motion- Basic Concepts Equation of motion in Cartesian coordinates Equation of motion in path coordinates Equation of motion in polar coordinates Motion of projectile.

Unit VI **Kinetics of Particle** **(06Hrs)**

Kinetics- Newton's Second Law of motion Application of Newton's Second Law.

Work, power, energy, conservative and non-conservative forces Conservation of energy for motion of particle, Impulse, Momentum, Direct central impact. Coefficient of restitution, Impulse Momentum principle of particle.

Books & Other Resources:

Text Books:

1. Vector Mechanics for Engineers, by F. P. Beer and E. R. Johnson, McGraw-Hill Publication
2. Engineering Mechanics by R. C. Hibbeler, Pearson Education

Reference Books:

1. Engineering Mechanics by S. P. Timoshenko and D. H. Young, McGraw- Hill publication
2. Engineering Mechanics by J. L. Meriam and Craige, John Willey
3. Engineering Mechanics by F L Singer, Harper and Rowe publication
4. Engineering Mechanics by A. P. Boresi and R. J. Schmidt, Brooks/Cole Publication

Laboratory Course

Guidelines for Instructor's Manual

An instruction manual with aim, objective, apparatus, procedure and calculations to be performed for each experiment to be provided for students called as Lab Manual. Every year problems for assignment should be changed. It is advisable to give different data to different batches

Guidelines for Student's Lab Journal

Journal should be hand written

Guidelines for Lab /TW Assessment

Each and every experiment should be assessed and given mark out of 10. Finally the marks can be converted as per given in the structure.

Guidelines for Laboratory Conduction

Divide the students of a batch in groups of not more than 4 students and ask each group to take readings separately followed by calculations for each experiment. After every experiment faculty should sign the lab manual of readings of every student in the batch

Suggested List of Laboratory Experiments/Assignments

Sr. No.	Group A
	1. Verification of law of parallelogram of forces/polygon of forces. 2. To determine support reaction of simple/compound beams. 3. Determination of coefficient friction of belt/inclined plane. 4. To determine forces in the members of space force system. 5. To study the curvilinear motion. 6. Determination of coefficient of restitution.
	Group B
	Assignment of five problems on every unit to be solved during practical
	Group C
	Any two assignments of the following by graphical method using any drawing software. a) To determine the resultant of general force system. b) To determine unknown forces of concurrent force system c) To determine the forces in the member of the plane truss d) To determine velocity and acceleration of particle from given s-t diagram.

102012: Engineering Graphics

Teaching Scheme:	Credits	Examination Scheme:
TH : 01 Hr/week **PR : 02 Hrs/Week** **TUT : 01 Hr/Week**	**02**	**End-Semester : 50 Marks** **TW : 25 Marks**

Course Objectives

1. To acquire basic knowledge about engineering drawing language, line types, dimension methods, and simple geometrical construction.
2. To draw conic sections by various methods, involutes, cycloid and spiral.
3. To acquire basic knowledge about physical realization of engineering objects and shall be able to draw its different views.
4. To visualize three dimensional engineering objects and shall be able to draw their isometric views.
5. To imagine visualization of lateral development of solids.
6. To acquire basic knowledge about the various CAD drafting software's and its basic commands required to construct the simple engineering objects.

Course Outcomes
On completion of the course, learner will be able to
CO1: Draw the fundamental engineering objects using basic rules and able to construct the simple geometries.
CO2: Construct the various engineering curves using the drawing instruments.
CO3: Apply the concept of orthographic projection of an object to draw several 2D views and its sectional views for visualizing the physical state of the object.
CO4: Apply the visualization skill to draw a simple isometric projection from given orthographic views precisely using drawing equipment.
CO5: Draw the development of lateral surfaces for cut section of geometrical solids.
CO6: Draw fully-dimensioned 2D, 3D drawings using computer aided drafting tools.

Course Contents

Unit I **Fundamentals of Engineering Drawing** **(01 Hrs)**
Need of Engineering Drawing and design, Sheet layout, Line types and dimensioning and simple geometrical constructions

Unit II **Introduction to 2D and 3D computer aided drafting packages** **(02 Hrs)**
Evolution of CAD, Importance of CAD, Basic Commands - Edit, View, Insert, Modify, Dimensioning Commands, setting and tools etc. and its applications to construct the 2D and 3D drawings

Unit III **Engineering Curves** **(01 Hr)**
Introduction to conic sections and its significance, various methods to construct the conic sections. Helix for cone and cylinder , rolling curves (Involutes , Cycloid) and Spiral

Unit IV **Orthographic Projection** **(02 Hrs)**
Principle of projections, Introduction to First and Third angle Projection methods, Orthographic projection of point, line, plane, solid and machine elements/parts

Unit V **Isometric Projection** **(03 Hrs)**
Introduction to isometric projection, oblique projection and perspective projection. Draw the isometric projection from the given orthographic views

Unit VI **Development of Lateral Surfaces** **(03 Hrs)**
Introduction to development of lateral surfaces and its industrial applications. Draw the development of lateral surfaces for cut section of cone, pyramid, prism etc.

Books & Other Resources

Text Books

1. Bhatt, N. D. and Panchal, V. M., (2016), “Engineering Drawing”, Charotar Publication, Anand, India
2. K. Venugopal, K, (2015), “Engineering and Graphics”, New Age International, New Delhi
3. Jolhe, D. A., (2015), “Engineering Drawing with introduction to AutoCAD”, Tata McGraw Hill, New Delhi
4. Rathnam, K., (2018), “ A First Course in Engineering Drawing”, Springer Nature Singapore Pte. Ltd., Singapore

Reference Books

1. Madsen, D. P. and Madsen, D. A., (2016), “Engineering Drawing and design”, Delmar Publishers Inc., USA
2. Bhatt, N. D., (2018), “Machine Drawing”, Chartor Publishing house, Anand, India
3. Dhawan, R. K., (2000), “A Textbook Of Engineering Drawing”, S. Chand, New Delhi
4. Luzadder, W. J. and Duff, J. M., (1992), “The Fundamentals of Engineering Drawing: With an Introduction to Interactive Computer Graphics for Design and Production”, Peachpit Press, USA
5. Giesecke, F. E., Mitchell, A., Spencer, H. C., Hill, I. L., Loving, R. O., Dygon, J. T., (1990), “Principles of engineering graphics”, McMillan Publishing, USA

6. Jensen, C., Helsel, J. D., Short, D. R., (2008), “Engineering Drawing and Design”, McGraw-Hill International, Singapore

Guidelines for Laboratory Conduction

Tutorial Session

Can be utilized to teach the basic commands of any drafting package, by using this knowledge students shall be able to complete the five assignments on the CAD software. (Minimum 2 problems in each assignment)

Assignment 1: Construct any Engineering Curve using any method

Assignment 2: Orthographic view of any machine element along with sectional view.

Assignment 3: Draw Isometric view for given orthographic views.

Assignment4 :Draw the isometric or Orthographic view of a product/object (For example Workshop Job prepared during the workshop practice or any product developed during the first year session).

Assignment 5: Draw the development of lateral surface of a solid/ truncated solid.

Practical Session

Draw minimum two problems on each assignment on the A3 size drawing sheet.

Suggested List of Laboratory Experiments/Assignments

Assignment 1: Construct any Engineering Curve by any method

Assignment 2: Orthographic view of any machine element along with sectional view.

Assignment 3: Draw Isometric view for given orthographic views.

Assignment 4: Draw the development of lateral surface of a solid/ truncated solid

Assignment 5: Draw the isometric or Orthographic view of a product/object (For example Workshop Job prepared during the workshop practice or any product developed during the first year session.)

110013: Project Based Learning

Teaching Scheme:	**Credits**	**Examination Scheme:**
PR: 04 Hrs/Week	**02**	**PR : 50 Marks**

Preamble:

For better learning experience, along with traditional classroom teaching and laboratory learning; project based learning has been introduced with an objective to motivate students to learn by working in group cooperatively to solve a problem.

Project-based learning (PBL) is a student-centric pedagogy that involves a dynamic classroom approach in which it is believed that students acquire a deeper knowledge through active exploration of real-world challenges and problems. Students learn about a subject by working for an extended period of time to investigate and respond to a complex question, challenge, or problem. It is a style of active learning and inquiry-based learning. (Reference: Wikipedia). Problem based learning will also redefine the role of teacher as mentor in learning process. Along with communicating knowledge to students, often in a lecture setting, the teacher will also to act as an initiator and facilitator in the collaborative process of knowledge transfer and development.

Course Objectives:

1. To emphasizes learning activities that are long-term, interdisciplinary and student-centric.
2. To inculcate independent learning by problem solving with social context.
3. To engages students in rich and authentic learning experiences.
4. To provide every student the opportunity to get involved either individually or as a group so as to develop team skills and learn professionalism.

Course Outcomes:
CO1: Project based learning will increase their capacity and learning through shared cognition.
CO2: Students able to draw on lessons from several disciplines and apply them in practical way.
CO3: Learning by doing approach in PBL will promote long-term retention of material and replicable skill, as well as improve teachers' and students' attitudes towards learning.

Group Structure:
Working in supervisor/mentor –monitored groups. The students plan, manage and complete a task/project/activity which addresses the stated problem.

- There should be team/group of 5 -6 students
- A supervisor/mentor teacher assigned to individual groups

Selection of Project/Problem:
The problem-based project oriented model for learning is recommended. The model begins with the identifying of a problem, often growing out of a question or "wondering". This formulated problem then stands as the starting point for learning. Students design and analyze the problem within an articulated interdisciplinary or subject frame.
A problem can be theoretical, practical, social, technical, symbolic, cultural and/or scientific and grows out of students' wondering within different disciplines and professional environments. A chosen problem has to be **exemplary**. The problem may involve an interdisciplinary approach in both the analysis and solving phases.
By exemplarity, a problem needs to refer back to a particular practical, scientific, social and/or technical domain. The problem should stand as one specific example or manifestation of more general learning outcomes related to knowledge and/or modes of inquiry.
There are no commonly shared criteria for what constitutes an acceptable project. Projects vary greatly in the depth of the questions explored, the clarity of the learning goals, the content and structure of the activity.

- A few hands-on activities that may or may not be multidisciplinary
- Use of technology in meaningful ways to help them investigate, collaborate, analyze, synthesize and present their learning.
- Activities may include- Solving real life problem, investigation /study and Writing reports of in depth study, field work.

Assessment:
The institution/head/mentor is committed to assessing and evaluating both student performance and program effectiveness.
Progress of PBL is monitored regularly on weekly basis. Weekly review of the work is necessary. During process of monitoring and continuous assessment AND evaluation the individual and team performance is to be measured. PBL is monitored and continuous assessment is done by supervisor /mentor and authorities.
Students must maintain an institutional culture of authentic collaboration, self-motivation, peer-learning and personal responsibility. The institution/department should support students in this regard through guidance/orientation programs and the provision of appropriate resources and services. Supervisor/mentor and Students must actively participate in assessment and evaluation processes.
Group may demonstrate their knowledge and skills by developing a public product and/or report and/or presentation.

- Individual assessment for each student (Understanding individual capacity, role and involvement in the project)
- Group assessment (roles defined, distribution of work, intra-team communication and togetherness)
- Documentation and presentation

Evaluation and Continuous Assessment:

It is recommended that the all activities are to be record and regularly, regular assessment of work to be done and proper documents are to be maintained at college end by both students as well as mentor (you may call it PBL work book).

Continuous Assessment Sheet (CAS) is to be maintained by all mentors/department and institutes.

Recommended parameters for assessment, evaluation and weightage:

- Idea Inception **(5%)**
- Outcomes of PBL/ Problem Solving Skills/ Solution provided/ Final product **(50%)** (Individual assessment and team assessment)
- Documentation (Gathering requirements, design & modeling, implementation/execution, use of technology and final report, other documents) **(25%)**
- Demonstration (Presentation, User Interface, Usability etc) **(10%)**
- Contest Participation/ publication **(5%)**
- Awareness /Consideration of -Environment/ Social /Ethics/ Safety measures/Legal aspects **(5%)**

PBL workbook will serve the purpose and facilitate the job of students, mentorand project coordinator. This workbook will reflect accountability, punctuality, technical writing ability and work flow of the work undertaken.

References:

- Project-Based Learning, Edutopia, March 14, 2016.
- What is PBL? Buck Institute for Education.
- www.schoology.com
- www.wikipedia.org
- www.howstuffworks.com

101014: Environmental Studies-II

TH: 02 Hr/week **Mandatory Non-Credit Course**

Course Objectives:

1. To provide a comprehensive overview of environmental pollution and the science and technology associated with the monitoring and control.
2. To understand the evolution of environmental policies and laws.
3. To explain the concepts behind the interrelations between environment and the development.
4. To examine a range of environmental issues in the field, and relate these to scientific theory.

Course Outcomes: On completion of the course, learner will be able to–

CO1: Have an understanding of environmental pollution and the science behind those problems and potential solutions.

CO2: Have knowledge of various acts and laws and will be able to identify the industries that are violating these rules.

CO3: Assess the impact of ever increasing human population on the biosphere: social, economic issues and role of humans in conservation of natural resources.

CO4: Learn skills required to research and analyze environmental issues scientifically and learn how to use those skills in applied situations such as careers that may involve environmental problems and/or issues.

Course Contents

Unit V **Environmental Pollution** **(08 Hrs)**

Environmental pollution : types, causes, effects and controls; Air, water, soil, chemical and noise pollution

Nuclear hazards and human health risks

Solid waste management: Control measures of urban and industrial waste

Pollution case studies.
Unit VI **Environmental Pollution** **(07 Hrs)** Climate change, global warming, ozone layer depletion, acid rain and impacts on human communities& agriculture.Environment Laws : Environment Protection Act; Air (Prevention & Control of Pollution) Act; Water (Prevention and control of Pollution) Act; Wildlife protection Act; Forest Conservation Act; International agreements; Montreal and Kyoto Protocols and conservation on Biological Diversity (CBD). The Chemical Weapons Convention (CWC).Nature reserves, tribal population and rights, and human, wildlife conflicts in Indian context
Unit VII **Human Communities and the Environment** **(06 Hrs)** Human population and growth; Impacts on environment, human health and welfares. Carbon foot-print. Resettlement and rehabilitation of project affected persons; case studies. Disaster management: floods earthquakes, cyclones and landslides. Environmental movements: Chipko, Silent valley, Bishnios of Rajasthan. Environmental ethics: Role of Indian and other religions and cultures in environmental conservation. Environmental communication and public awareness, case studies (e.g., CNG vehicles in Delhi).
Unit VIII **Field work** **(05 Hrs)** • Visit to an area to document environmental assets; river/forest/flora/fauna, etc. • Visit to a local polluted site – Urban/Rural/Industrial/Agricultural. • Study of common plants, insects, birds and basic principles of identification. • Study of simple ecosystems-pond, river Delhi Ridge, etc
Suggested Readings: 1. Carson, R. 2002. Silent spring. Houghton Mifflin Harcourt. 2. Gadgil, M., & Guha, R.1993. This Fissured Land: An Ecological History of India. Univ. of California Press. 3. Gleeson,B. and Low, N. (eds.) 1999. Global Ethics and Environment, London, Routledge. 4. Gleick, P.H. 1993. Water in Crisis. Pacific Institute for Studies in Dev., Environment & Security. Stockholm Env. Institute, Oxford Univ. Press. 5. Groom, Martha J. Gary K. Meffe, and Carl Ronald carroll. Principals of Conservation Biology, Sunderland: Sinauer Associates, 2006 6. Grumbine, R. Edward, and Pandit, M.K. 2013. Threats from India's Himalaya dams. Science, 339:36-37. 7. McCully, P.1996. Rivers no more: the environmental effects of dams (pp.29-64). Zed Books. 8. McNeil, John R. 2000. Something New Under the Sun: An Environmental History of the Twentieth Century.

FACULTY OF ENGINEERING

Syllabus

B.E. (Information Technology) 2015 Course

(With effect from Academic Year 2018-2019)

SAVITRIBAI PHULE PUNE UNIVERSITY

The syllabus is prepared by

B.O.S. in Information Technology, Savitribai Phule Pune University

I N D E X

PROGRAM EDUCATIONAL OBJECTIVES

The students of Information Technology course after passing out will

1. Graduates of the program will possess strong fundamental concepts in mathematics, science, engineering and Technology to address technological challenges with emerging trends.
2. Possess knowledge and skills in the field of Computer Science & Engineering and Information Technology for analyzing, designing and implementing multifaceted engineering problems of any domain with innovative and efficient approaches.
3. Acquire an attitude and aptitude for research, entrepreneurship and higher studies in the field of Computer Science & Engineering and Information Technology.
4. Learn commitment to ethical practices, societal contributions through communities and life-long intellect.
5. Attain better communication, presentation, time management and team work skills leading to responsible & competent professionals and will be able to address challenges in the field of IT at global level.

PROGRAM OUTCOMES

The students in the Information Technology course will attain:

1. An ability to apply knowledge of computing, mathematics including discrete mathematics as well as probability and statistics, science, engineering and technology.
2. An ability to define a problem and provide a systematic solution with the help of conducting experiments, as well as analyzing and interpreting the data.
3. An ability to design, implement, and evaluate a software or a software/hardware co-system, component, or process to meet desired needs within realistic constraints.
4. An ability to identify, formulate, and provide systematic solutions to complex engineering problems.
5. An ability to use the techniques, skills, and modern engineering technologies tools, standard processes necessary for practice as a IT professional.
6. An ability to apply mathematical foundations, algorithmic principles, and Information Technology theory in the modeling and design of computer-based systems with necessary constraints and assumptions.
7. An ability to analyze the local and global impact of computing on individuals, organizations and society.
8. An ability to understand professional, ethical, legal, security and social issues and responsibilities.
9. An ability to function effectively as an individual or as a team member to accomplish a desired goal(s).
10. An ability to engage in life-long learning and continuing professional development to cope up with fast changes in the technologies/tools with the help of electives, professional organizations and extra-curricular activities.
11. An ability to communicate effectively in engineering community at large by means of effective presentations, report writing, paper publications, demonstrations.
12. An ability to understand engineering, management, financial aspects, performance, optimizations and time complexity necessary for professional practice.
13. An ability to apply design and development principles in the construction of software systems of varying complexity.

B.E. (Information Technology) 2015 Course to be implemented from Academic Year 2018-19

SEMESTER-I

Subject Code	Subject	Teaching Scheme			Examination Scheme					Total Marks	Credits
		Lecture	Practical	Tutorial	In-Sem	TW	PR	OR	End-Sem		
414453	Information and Cyber Security	3	--	--	30	--	--	--	70	100	3
414454	Machine Learning and Applications	4	--	--	30	--	--	--	70	100	4
414455	Software Design and Modeling	3	--	--	30	--	--	--	70	100	3
414456	Elective-I	3	--	--	30	--	--	--	70	100	3
414457	Elective -II	3	--	--	30	--	--	--	70	100	3
414458	Computer Laboratory-VII	--	4	--	--	50	50	--	--	100	2
414459	Computer Laboratory-VIII	--	4	--	--	50	--	50	--	100	2
414460	Project Phase-I	--	--	2	--	--	--	50	--	50	2
414461	Audit Course-V	--	--	--	--	--	--	--	--	Grade	
Total		16	8	2	150	100	50	100	350	750	22
Total of Part-I		26				750					

Abbreviations: TW: Term Work **TH:** Theory **OR:** Oral **PR**: Practical **Sem**: Semester
Computer Laboratory-VII (Information and Cyber Security+ Machine Learning and Application)
Computer Laboratory-VIII (Software Design and Modeling)

Elective I		Elective II	
414456 A	1. Wireless Communications	414457A	1. Software Defined Networks
414456B	2. Natural Language Processing	414457B	2. Soft Computing
414456C	3. Usability Engineering	414457C	3. Software Testing and Quality Assurance
414456D	4. Multicore and Concurrent Systems	414457D	4. Compiler Construction
414456E	5. Business Analytics and Intelligence	414457E	5. Gamification

Audit Course-V	
414461A	1. Emotional Intelligence
414461B	2. Green Computing
414461C	3. Critical Thinking
414461D	4. Statistical Learning model using R.

SEMESTER –II

Subject Code	Subject	Teaching Scheme			Examination Scheme					Total Marks	Credits
		Lecture	Practical	Tutorial	In-Sem	TW	PR	OR	End-Sem		
414462	Distributed Computing System	3	--	--	30	--	--	--	70	100	3
414463	Ubiquitous Computing	3	--	--	30	--	--	--	70	100	3
414464	Elective-III	3	2	--	30	25	--	25	70	150	4
414465	Elective-IV	3	--	--	30	--	--	--	70	100	3
414466	Computer Laboratory-IX	--	4	--	--	50	50	--	--	100	2
414467	Computer Laboratory-X	--	2	--	--	25	--	25	--	50	1
414468	Project Work	--	--	6	--	50	--	100	--	150	6
414469	Audit Course-VI	--	--	--	--	--	--	--	--	Grade	
Total		12	8	6	120	150	50	150	280	750	22
Total of Part-II		26				750					

Abbreviations: TW: Term Work **TH:** Theory **OR:** Oral **PR**: Practical **Sem**: Semester
Computer Laboratory-IX (Distributed Computing System)
Computer Laboratory-X (Ubiquitous Computing)

Elective III		Elective IV	
414464A	1. Internet of Things (IoT)	414465A	1. Rural Technologies and Community Development
414464B	2. Information storage and retrieval	414465B	2. Parallel Computing
414464C	3. Multimedia Techniques	414465C	3. Computer Vision
414464D	4. Internet and Web Programming	414464D	4. Social Media Analytics
414464E	5. Computational Optimization	414465E	5. Open Elective

Audit Course-VI	
414469A	1. IoT – Application in Engineering field
414469B	2. Entrepreneurship
414469C	3. Cognitive Computing
414469D	4. AI and Robotics

SEMESTER-I

Savitribai Phule Pune University Fourth Year of Information Technology (2015 Course) 414453: Information and Cyber Security		
Teaching Scheme: **TH:03 Hours/Week**	**Credits: 03**	**Examination Scheme:** **In-Sem (Paper): 30 Marks** **End-Sem (paper): 70 Marks**

Prerequisites:

1. Data Communication.
2. Computer Network.

Course Objectives:

1. Understand computer, network and information security.
2. To study operating system security and malwares.
3. To study security issues in internet protocols.
4. To study network defence tools.
5. To learn forensics and investigation techniques.

Course Outcomes:

By the end of the course, students should be able to

1. Use basic cryptographic techniques in application development.
2. Apply methods for authentication, access control, intrusion detection and prevention.
3. To apply the scientific method to digital forensics and perform forensic investigations.
4. To develop computer forensics awareness.
5. Ability to use computer forensics tools.

Unit I	SECURITY BASICS	7 Hrs
Information Security Concepts, Security Threats and Vulnerabilities, Security Architectures and Operational Models, Types of Security attacks, Goals of Security, Malicious code, Intrusion detection system (IDS): Need, Types, Limitations and Challenges, security and privacy.		
Unit II	**SYMMETRIC AND ASYMMETRIC KEY CRYPTOGRAPHY**	**7Hrs**
Introduction, Classical Encryption Techniques, Block Ciphers and Data Encryption standards, Advanced Encryption standard, Public Key Cryptography and RSA, Chinese Remainder Theorem, Diffie-Hellman, Elgamal Curve Arithmetic, Elliptic Curve Arithmetic, Elliptic Curve Cryptography.		
Unit III	**DATA INTEGRITY ALGORITHMS AND SECURITY REQUIREMENTS**	**7 Hrs**
Cryptographic Hash Functions, requirements and security, SHA-1, SHA-3, Digital Signatures, X.509 Certificate, Kerberos, IP Security: Architecture Protocols IPv4, IPv6, AH, EPS, ISAKMP, Web Security: SSL, HTTPS, Mail Security: PGP, S/MIME		
Unit IV	**LEGAL, ETHICAL, AND PROFESSIONAL ISSUES IN INFORMATION SECURITY, RISK MANAGEMENT**	**7 Hrs**

Overview, Risk identification, Risk Assessment, Risk Control Strategies, Quantitative vs. Qualitative Risk Control Practices. Risk Management. Laws and Ethics in Information Security, Codes of Ethics, Protecting programs and data.

Unit V	INTRODUCTION TO CYBER LAWS	7 Hrs

Introduction, Definition and origin, Cybercrime and Information security, Classification of Cybercrimes, The legal perspectives- Indian perspective, Global perspective, Categories of Cybercrime, Types of Attacks, a Social Engineering, Cyber stalking, Cloud Computing and Cybercrime.

Unit VI	TOOLS AND METHODS USED IN CYBERCRIME	7 Hrs

Introduction, Proxy servers and Anonymizers, Phishing, Password Cracking, Key-loggers and Spywares, Types of Virus, Worms, Dos and DDoS, SQL injection, Cybercrime and Legal perspectives, Cyber laws- Indian context, The Indian IT Act-Challenges, Amendments, Challenges to Indian Law and cybercrime Scenario in India, Indian IT Act and Digital Signatures. study of any two network security scanners: Nmap, Metasploit, OpenVAS, Aircrack, Snort, Wireshark, Nikito, Samurai, Safe 3 etc.

Text Books

1. William Stallings, Computer Security : Principles and Practices, Pearson 6th Ed, ISBN: 978-0-13-335469-0
2. Nina Godbole, Sunit Belapure , Cyber Security- Understanding Cyber Crimes, Computer Forensics and Legal Perspectives, Wiely India Pvt.Ltd, ISBN- 978-81-265-2179-1
3. Bernard Menezes, Network Security and Cryptography, Cengage Learning , ISBN-978-81-315-1349-1
4. Dr. V.K. Pachghare, Cryptography and Information security, PHI, Second edition, ISBN- 978-81-203-5082-3

Reference Books

1. Bruice Schneier , Applied Cryptography- Protocols, Algorithms and Source code in C, Algorithms, Wiely India Pvt Ltd, 2nd Edition, ISBN 978-81-265-1368-0.
2. Nina Godbole , Information Systems Security , Wiley India Pvt. Ltd, ISBN -978-81-265-1692-6
3. CK Shyamala et el., Cryptography and Security, Wiley India Pvt. Ltd, ISBN-978-81-265-2285-9.
4. Berouz Forouzan, Cryptography and Network Security, TMH, 2 edition, ISBN -978-00-707-0208-0.
5. Mark Merkow, Information Security-Principles and Practices, Pearson Ed., ISBN- 978-81-317-1288-7.

Savitribai Phule Pune University
Fourth Year of Information Technology (2015 Course)
414454: Machine Learning and Applications

Teaching Scheme:	Credits: 04	Examination Scheme:
TH:04 Hours/Week		In-Sem (Paper): 30 Marks End-Sem (paper): 70 Marks

Prerequisites:

Linear Algebra and Calculus, Probability Basics

Course Objectives:

1. Understanding Human learning aspects.
2. Understanding primitives and methods in learning process by computer.
3. Understanding nature of problems solved with Machine Learning.

Course Outcomes:

By the end of the course, students should be able to

1. Model the learning primitives.
2. Build the learning model.
3. Tackle real world problems in the domain of Data Mining and Big Data Analytics, Information Retrieval, Computer vision, Linguistics and Bioinformatics.

Unit I	INTRODUCTION TO MACHINE LEARNING	8 Hrs

Introduction: What is Machine Learning, Examples of Machine Learning applications, Training versus Testing, Positive and Negative Class, Cross-validation.
Types of Learning: Supervised, Unsupervised and Semi-Supervised Learning.
Dimensionality Reduction: Introduction to Dimensionality Reduction, Subset Selection, Introduction to Principal Component Analysis.

Unit II	CLASSIFICATION	8 Hrs

Binary and Multiclass Classification: Assessing Classification Performance, Handling more than two classes, Multiclass Classification-One vs One, One vs Rest Linear Models: Perceptron, Support Vector Machines (SVM), Soft Margin SVM, Kernel methods for non-linearity

Unit III	REGRESSION AND GENERALIZATION	8 Hrs

Regression: Assessing performance of Regression – Error measures, Overfitting and Underfitting, Catalysts for Overfitting, VC Dimensions
Linear Models: Least Square method, Univariate Regression, Multivariate Linear Regression, Regularized Regression - Ridge Regression and Lasso
Theory of Generalization: Bias and Variance Dilemma, Training and Testing Curves Case Study of Polynomial Curve Fitting.

Unit IV	LOGIC BASED AND ALGEBRAIC MODELS	8 Hrs

Distance Based Models: Neighbors and Examples, Nearest Neighbor Classification, Distance based clustering algorithms - K-means and K-medoids, Hierarchical clustering. Rule Based Models: Rule learning for subgroup discovery, Association rules mining – Apriori Algorithm, Confidence and Support parameters. Tree Based Models: Decision Trees, Minority Class, Impurity Measures – Gini Index and Entropy, Best Split.		
Unit V	**PROBABILISTIC MODELS**	**8 Hrs**
Conditional Probability, Joint Probability, Probability Density Function, Normal Distribution and its Geometric Interpretation, Naïve Bayes Classifier, Discriminative Learning with Maximum Likelihood. Probabilistic Models with Hidden variables: Expectation-Maximization methods, Gaussian Mixtures		
Unit VI	**TRENDS IN MACHINE LEARNING**	**8 Hrs**
Ensemble Learning: Combining Multiple Models, Bagging, Randomization, Boosting, Stacking Reinforcement Learning: Exploration, Exploitation, Rewards, Penalties Deep Learning: The Neuron, Expressing Linear Perceptron as Neurons, Feed Forward Neural Networks, Linear Neurons and their Limitations, Sigmoid, Tanh and ReLU Neurons		

Text Books

1. Ethem Alpaydin: Introduction to Machine Learning, PHI 2nd Edition-2013.
2. Peter Flach: Machine Learning: The Art and Science of Algorithms that Make Sense of Data, Cambridge University Press, Edition 2012.

Reference Books

1. C. M. Bishop: Pattern Recognition and Machine Learning, Springer 1st Edition-2013.
2. Ian H Witten, Eibe Frank, Mark A Hall: Data Mining, Practical Machine Learning Tools and Techniques, Elsevier, 3rd Edition.
3. Parag Kulkarni: Reinforcement Learning and Systemic Machine Learning for Decision Making, IEEE Press, Reprint 2015.
4. Nikhil Buduma: Fundamentals of Deep Learning, O'Reilly Media, June 2017.
5. Hastie, Tibshirani, Friedman: Introduction to Statistical Machine Learning with Applications in R, Springer, 2nd Edition 2012.
6. Kevin P Murphy: Machine Learning – A Probabilistic Perspective, MIT Press, August 2012.

Savitribai Phule Pune University Fourth Year of Information Technology (2015 Course) 414455: Software Design and Modeling		
Teaching Scheme: **TH:03 Hours/Week**	**Credits: 03**	**Examination Scheme:** **In-Sem (Paper): 30 Marks** **End-Sem (paper): 70 Marks**

Prerequisites:

1. Problem Solving & Object-Oriented Programming.
2. Software Engineering and Project Management.
3. Database Management System.

Course Objectives:

1. To teach the student the fundamental aspects of different object oriented methodologies and unified approach along with Unified Modeling Language (UML), in terms of "how to use" it for the purpose of specifying and developing software.
2. Explore and analyze use case modeling, domain/ class modeling.
3. To teach the student Interaction and behaviour modeling.
4. Aware students with design process in software development.
5. Orient students with the software design principles and patterns.
6. Enable students to learn the architectural design guidelines in various type of application development.

Course Outcomes:

By the end of the course, students should be able to

1. Understand object oriented methodologies, basics of Unified Modeling Language (UML).
2. Understand analysis process, use case modeling, domain/class modeling
3. Understand interaction and behavior modeling.
4. Understand design process and business, access and view layer class design
5. Get started on study of GRASP principles and GoF design patterns.
6. Get started on study of architectural design principles and guidelines in the various type of application development.

Unit I	**OBJECT ORIENTED METHODOLOGIES, UML**	**7 Hrs**

Views of Software Developments: Traditional System Development Methodology and Object Oriented Analysis and Design, Importance Object –Orientation

Some of the object Oriented Methodology:- Object Oriented Design –Booch, Object Modeling Techniques – Rumbaugh, Object – Oriented Analysis - Cood Yourdon, Object – Oriented Software Engineering – Ivar Jacobson

Unified Approach: Object Oriented Analysis, Object Oriented Design, Iterative Development & Continuous Testing, Modeling Based on UML, Layered Approach,

Unified Modeling Language: Introduction to Modeling & UML, MDA, UML Structure, UML Building Blocks, UML Common Mechanisms, Introduction to all UML Diagram Notational Techniques, 4+1 View.

Unit II	OBJECT ORIENTED ANALYSIS	7 Hrs
Object Oriented Analysis Process, Use Case Modeling: Actor Identification, Actor Classification, Actor Generalization, Use Cases Identification, Communication, Uses/Include and Extend Associations, Writing a Formal Use Cases, Use Case realizations. Domain / Class Modeling: Approaches For Identifying Classes (Noun-Phase Approach, Common Class Pattern Approach, Class Responsibilities Collaboration Approach, Naming Classes, Class Associations and Identification of Associations, Generalization/Specialization Relationship, Aggregation and Composition Relationships, Attributes and Methods Identification.		
Unit III	**INTERACTION AND BEHAVIOR MODELING**	**7 Hrs**
Activity Diagram : Activity and Actions, Initial and Final Activity, Activity Edge, Decision and Merge Points, Fork and Join, Input and Output Pins, Activity Group, Activity Partitions, Constraints on Action, Swim Lanes. Sequence Diagram: Context, Objects and Roles, Links, Object Life Line, Message or stimulus, Activation/Focus of Control, Modeling Interactions. Collaboration Diagram: Objects and Links, Messages and stimuli, Active Objects, Communication Diagram, Iteration Expression, Parallel Execution, Guard Expression, Timing Diagram. State Diagram: State Machine, Triggers and Ports, Transitions, Initial and Final State, Composite States, Submachine States.		
Unit IV	**OBJECT ORIENTED DESIGN**	**7 Hrs**
Object Oriented Design Process Designing Business Layer : Object Oriented Constraints Language (OCL), Designing Business Classes : The Process, Designing Well Defined Class Visibility, Attribute Refinement, Method Design Using UML Activity Diagram, Packaging and Managing Classes. Designing Access Layer: Object Relational Systems, Object Relation Mapping, Table Class Mapping, Table – Inherited Classes Mapping, Designing the Access Layer Classes: The Process, Designing View Layer: View Layer Classes Design, Identifying View Classes by Analyzing Use Cases, Macro-Level Design Process, and Prototyping the User Interface. Component and Deployment Design using Component and Deployment Diagram.		
Unit V	**DESIGN PRINCIPLES AND PATTERNS**	**7 Hrs**
Introduction to Patterns General Responsibility Assignment Software Patterns (GRASP) : Introduction, Creator , Information Expert, Low coupling, Controller, High Cohesion, Polymorphism , Pure fabrication, Indirection, Protected Variations. Gang of Four (GoF): Introduction, Categories of Patterns (Creational, Structural and Behavioral Patterns), Singleton, Adapter, State, and Strategy.		
Unit VI	**ARCHITECTURAL DESIGN**	**7 Hrs**
Overview of software Architecture, Designing Client / Server Software Architectures, Designing Service Oriented Software Architectures, Designing Component Based Software Architectures, Designing Concurrent and Real-Time Software Architectures, Designing Product Line Architectures, Related Case Studies.		
Text Books		

1. Ali Bahrami, Object Oriented System Development: Using Unified Modeling Language, McGraw-Hill, International Editions 1999,ISBN:0-07-116090-6.
2. Craig Larman, Applying UML and Patterns, Pearson Education, Second Edition,ISBN:978-0130925695.
3. Erich Gamma et al, Design Patterns: Elements of Reusable Object, Pearson, First Edition,ISBN:9789332555402, 9332555400.

Reference Books

1. Martin Fowler, UML Distilled, Pearson, Third Edition, ISBN:978-81-317-1565-9
2. Dan Pilone, Neil Pitman, UML in Nutshell, O'reilly Pub.,ISBN:8184040024, 9788184040029.
3. Roger S. Pressman, Software Engineering: A Practitioner's Approach, McGraw Hill, Seventh Edition,ISBN: 9339212088, 9789339212087.
4. Hassan Gomaa, Software Modeling And Design UML, Use Cases, Pattern, & Software Architectures, Cambridge University Press, ISBN: 978-0-521-76414-8.
5. JIM Arlow, Ila Neustadt, UML 2 and the Unified Process, Pearson, Second Edition, ISBN: 9788131700549 Tom Pender, UML 2 Bible, Wiley India, ISBN: 9788126504527.

Savitribai Phule Pune University
Fourth Year of Information Technology (2015 Course)
414456A: Elective-I
Wireless Communications

Teaching Scheme:	Credits: 03	Examination Scheme:
TH:03 Hours/Week		In-Sem (Paper): 30 Marks End-Sem (paper): 70 Marks

Prerequisites:

1. Foundations of Communication and Computer network.
2. Computer Network Technology.

Course Objectives:

1. To provide fundamental knowledge that forms the basis for wireless communication systems and Networks.
2. For creating foundation of cellular concepts which will be useful for understanding the fundamentals of cellular mobile communication systems design.
3. To provide knowledge about the Mobile Radio Propagation models and various wireless channel effects.
4. To Study various Multiple Access techniques.
5. Give Students the exposure to recent emerging trends in wireless communication like Software Defined Radio as well.
6. To Provide overview of recent trends like wireless communication like Wi-Fi, Wi-MAX, bee, UWB Radio and Wireless Adhoc Networks.

Course Outcomes:

By the end of the course, students should be able to

1. Understand the basics of propagation of radio signals.
2. Understand the basic concepts of basic Cellular System and the design requirements.
3. Have an understanding of the basic principles behind radio resource management techniques such as power control, channel allocation and handoffs.
4. Gain insights into various mobile radio propagation models and how the diversity can be exploited to improve performance.
5. Gain knowledge and awareness of the technologies for how to effectively share spectrum through multiple access techniques i.e. TDMA, CDMA, FDMA etc.
6. Have in-depth understanding of the design consideration and architecture for different Wireless Systems like GSM, CDMA, GPRS etc.
7. Understanding of the emerging trends in Wireless communication like WiFi, WiMAX, Software Defined Radio (SDR) and related issues and challenges.

Unit I	INTRODUCTION TO WIRELESS COMMUNICATION SYSTEM	7 Hrs

Evolution of mobile communications, Mobile Radio System around the world, Types of Wireless Communication System, Comparison of Common wireless system, Trend in Cellular radio and personal communication. Second generation Cellular Networks, Third Generation (3G) Wireless Networks, Wireless Local Loop(WLL),Wireless Local Area network(WLAN), Bluetooth and

Personal Area Networks		
Unit II	**THE CELLULAR CONCEPT- SYSTEM DESIGN FUNDAMENTALS**	**7 Hrs**
Cellular system, Hexagonal geometry cell and concept of frequency reuse, Channel Assignment Strategies Distance to frequency reuse ratio, Channel & co-channel interference reduction factor, S/I ratio consideration and calculation for Minimum Co-channel and adjacent interference, Handoff Strategies, Umbrella Cell Concept, Trunking and Grade of Service, Improving Coverage & Capacity in Cellular System-cell splitting, Cell sectorization, Repeaters, Micro cell zone concept, Channel antenna system design considerations.		
Unit III	**MOBILE RADIO PROPAGATION MODEL, SMALL SCALE FADING AND DIVERSITY**	**7 Hrs**
Large scale path loss: Free Space Propagation loss equation, Path-loss of NLOS and LOS systems, Reflection, Ray ground reflection model, Diffraction, Scattering, Link budget design, Max. Distance Coverage formula, Empirical formula for path loss, Indoor and outdoor propagation models, Small scale multipath propagation, Impulse model for multipath channel, Delay spread, Feher's delay spread, upper bound Small scale, Multipath Measurement parameters of multipath channels, Types of small scale Fading, Rayleigh and rician distribution, Statistical for models multipath fading channels and diversity techniques.		
Unit IV	**MULTIPLE ACCESS TECHNIQUES**	**7 Hrs**
Access Methods: TDMA (TDD and FDMA); Spread-Spectrum Frequency-Hopping; Direct-Sequence CDMA and CSMA. Comparison of Linearly Amplified BPSK, DQPS and DQPSK and Nonlinearly Amplified (NLA) GMSK, GFSK, 4-FM, and FQPSK Radio Equipment (Coherent and Noncoherent). Radio Link Design of Digital Wireless Cellular Systems. Spectrum Utilization in Digital Wireless Mobile Systems. Capacity and Throughput (Message Delay) Study and Comparison of GMSK, GFSK, and FQPSK Modulated Wireless Systems. Time Division Multiple Access Wireless Cellular Systems. Code Division Multiple Access Spread-Spectrum Digital Cellular IS-95 System.		
Unit V	**WIRELESS SYSTEMS**	**7 Hrs**
GSM system architecture, Radio interface, Protocols, Localization and calling, Handover, Authentication and security in GSM, GSM speech coding, Concept of spread spectrum, Architecture of IS-95 CDMA system, Air interface, CDMA forward channels, CDMA reverse channels, Soft handoff, CDMA features, Power control in CDMA, Performance of CDMA System, RAKE Receiver, CDMA2000 cellular technology, GPRS system architecture.		
Unit VI	**RECENT TRENDS**	**7 Hrs**
Introduction to Wi-Fi, WiMAX, ZigBee Networks, Software Defined Radio, UWB Radio, Wireless Adhoc Network and Mobile Portability, Security issues and challenges in a Wireless network.		
Text Books		
1. Rappaport, T.S., "Wireless communications", Second Edition, Pearson Education, 2010. 2. Wireless Communications and Networking, Vijay Garg, Elsevier. 3. Wireless digital communication, KamiloFeher, PHI. 4. Andreas.F. Molisch, "Wireless Communications", John Wiley – India, 20063.		

Reference Books

1. David Tse and PramodViswanath, “Fundamentals of Wireless Communication”, Cambridge University Press, 2005.
2. UpenaDalal, “ Wireless Communication”, Oxford University Press, 2009.
3. Van Nee, R. and Ramji Prasad, “OFDM for wireless multimedia communications”, Artech House, 2000.
4. Mobile Communications Engineering, William C. Y. Lee, McGraw Hill Publications.
5. Mobile and personal Communication system and services by Rajpandya, IEEE press (PHI).
6. Wireless Communications-T.L.Singh-TMH.
7. Adhoc Mobile Wireless network, C.K.Toh Pearson.

Savitribai Phule Pune University
Fourth Year of Information Technology (2015 Course)
414456B: Elective-I
Natural Language Processing

Teaching Scheme:	Credits: 03	Examination Scheme:
TH:03 Hours/Week		In-Sem (Paper): 30 Marks End-Sem (paper): 70 Marks

Prerequisites:

1. Basic understanding of probability theory.
2. Basic knowledge of finite automata.

Course Objectives:

1. To understand the core concepts of Natural language processing and levels of language analysis.
2. To understand the computational properties of natural languages and the commonly used algorithms for processing linguistic information.

Course Outcomes:

By the end of the course, students should be able to

1. Understand automatic processing of human languages using computers.
2. Understand various applications of natural language processing.

Unit I	**INTRODUCTION**	**7 Hrs**

Applications of Natural Language Understanding, Evaluating Language Understanding Systems, The Elements of Simple Noun Phrases, Verb Phrases and Simple Sentences, Noun Phrases, Adjective Phrases, Adverbial Phrases.

Unit II	**GRAMMARS**	**7 Hrs**

Grammars and Sentence Structure, Top-Down Parser, Bottom-Up Chart Parser, Top-Down Chart Parsing, Finite State Models and Morphological Processing, Feature Systems and Augmented Grammars, Morphological Analysis and the Lexicon, Parsing with Features.

Unit III	**EFFICIENT PARSING**	**7 Hrs**

Auxiliary Verbs and Verb Phrases, Noun Phrases and Relative Clauses, Human Preferences in Parsing, Encoding Uncertainty: Shift-Reduce Parsers, A Deterministic Parser, Techniques for Efficient Encoding of Ambiguity, Partial Parsing.

Unit IV	**AMBIGUITY RESOLUTION**	**7 Hrs**

Part-of-Speech Tagging, Obtaining Lexical Probabilities, Probabilistic Context-Free Grammars, Best-First Parsing, Semantics and Logical Form, Word Senses and Ambiguity, Encoding Ambiguity in Logical Form, Verbs and States in Logical Form.

Unit V	LINKING SYNTAX AND SEMANTICS	7 Hrs
Semantic Interpretation and Compositionality, Prepositional Phrases and Verb Phrases, Lexicalized Semantic Interpretation and Semantic Roles, Handling Simple Questions, Semantic Interpretation Using Feature Unification, Semantic Filtering Using Selectional Restrictions, Semantic Networks, Statistical Word Sense Disambiguation		
Unit VI	**KNOWLEDGE REPRESENTATION**	**7 Hrs**
Handling Natural Language Quantification, Time and Aspectual Classes of Verbs, Automating Deduction in Logic-Based Representations, Procedural Semantics and Question Answering, Hybrid Knowledge Representations, Using World Knowledge, Establishing Coherence, Matching Against Expectations, Reference and Matching Expectations, Using Knowledge About Action and Casualty.		

Text Books

1. Allen James, Natural Language Understanding, Pearson India, 2nd Edition, ISBN: 9788131708958, 8131708950.
2. James H. Martin, Daniel Jurafsky, Speech and Language Processing,Pearson,1st Edition,ISBN: 9789332518414, 8131716724.

Reference Books

1. M. Christopher, H. Schutze , Foundations of Statistical Natural Language Processing, MIT Press,1st Edition, ISBN:9780262133609.
2. C. Eugene,Statistical Language Learning, MIT Press,1st Edition, ISBN:9780262032162.
3. S. Bird, E. Klein &E. Loper,Natural Language Processing with Python, O' Reilly(Shroff Publishers), 1st Edition,ISBN:9788184047486.

Savitribai Phule Pune University
Fourth Year of Information Technology (2015 Course)
414456C: Elective-I
Usability Engineering

Teaching Scheme:	Credits: 03	Examination Scheme:
TH:03 Hours/Week		In-Sem (Paper): 30 Marks End-Sem (paper): 70 Marks

Prerequisites:

1. Human Computer Interaction.

Course Objectives:

1. To explain usability engineering lifecycle for designing a user-friendly software.
2. Discuss usability design guidelines, their foundations, assumptions, advantages, and weaknesses.
3. To develop usability evaluation skills for software testing.
4. To explain industry standards for designing and evaluating use-interfaces.
5. To make aware of the current trends in usability engineering.

Course Outcomes:

By the end of the course, students should be able to

1. Justify the theory and practice of usability evaluation approaches, methods and techniques.
2. Compare and evaluate strengths and weaknesses of various approaches, methods and techniques for evaluating usability.
3. Design and implement a usability test plan, based on modelling or requirements specification.
4. Choose appropriate approaches, methods and techniques to evaluate the usability of a specified interactive system.

Unit I	INTRODUCTION	7 Hrs

What is Usability: Usability and Other Considerations, Definition of Usability, Example: Measuring the Usability of Icons, Usability Trade-Offs, Categories of Users and Individual User Differences.
Generations of User Interfaces: Batch Systems, Line-Oriented Interfaces, Full-Screen Interfaces, Graphical User Interfaces, Next-Generation Interfaces, Long-Term Trends in Usability.

Unit II	THE USABILITY ENGINEERING LIFECYCLE	7 Hrs

The Usability Engineering Lifecycle: Know the User, Competitive Analysis, Goal Setting, Parallel Design, Participatory Design, Coordinating the Total Interface, Guidelines and Heuristic Evaluation, Prototyping, Interface Evaluation, Iterative Design, Follow-Up Studies of Installed Systems, Meta-Methods, Prioritizing Usability Activities, Be Prepared.

Unit III	USABILITY HEURISTICS	7 Hrs

Usability Heuristics: Simple and Natural Dialogue, Speak the Users' Language, Minimize User Memory Load, Consistency, Feedback, Clearly Marked Exits, Shortcuts, Good Error Messages, Prevent Errors, Help and Documentation, Heuristic Evaluation.

Unit IV	USABILITY TESTING	7 Hrs
Usability Testing: Test Goals and Test Plans, Getting Test Users, Choosing Experimenters, Ethical Aspects of Tests with Human, Subjects, Test Tasks, Stages of a Test, Performance Measurement, Thinking Aloud, Usability Laboratories. Usability Assessment Methods beyond Testing: Observation, Questionnaires and Interviews, Focus Groups, Logging Actual Use, User Feedback, Choosing Usability Methods.		
Unit V	**INTERFACE STANDARDS**	**7 Hrs**
Interface Standards: National, International and Vendor Standards, Producing Usable In-House Standards. International User Interfaces: International Graphical Interfaces, International Usability Engineering Guidelines for Internationalization Resource Separation, Multi-locale Interfaces.		
Unit VI	**FUTURE DEVELOPMENTS**	**7 Hrs**
Future Developments: Theoretical Solutions, Technological Solutions, CAUSE Tools: Computer-Aided Usability Engineering, Technology Transfer, Ubiquitous Computing, Intelligent User-interfaces, Simulation and Virtual Reality. Case Study: Usability Issues in Organizations, Organizational Roles and Structures, Ethics of Usability, Web Analytics.		

Text Books

1. Jakob Nielsen, "Usability Engineering", Morgan Kaufmann, An Imprint of Academic Press, Harcourt Science and Technology Company

Reference Books

1. Rosson, M. B., & Carroll, J. M. (2001), "Usability Engineering: Scenario-Based development of human-computer interaction", Elsevier.
2. Mayhew, D. (1999), "The Usability Engineering Lifecycle: A Practitioner's Handbook for user interface design", Morgan Kaufmann.

Savitribai Phule Pune University
Fourth Year of Information Technology (2015 Course)
414456D: Elective-I
Multicore and Concurrent Systems

Teaching Scheme:	Credits: 03	Examination Scheme:
TH:03 Hours/Week		In-Sem (Paper): 30 Marks End-Sem (paper): 70 Marks

Prerequisites:

1. Computer Architecture and Organization.
2. Processor Architecture and Interfacing.
3. Operating System.
4. Programming Language and Problem Solving.

Course Objectives:

1. To understand the multicore and concurrent systems.
2. To understand the multicore and concurrent programming aspects.
3. To understand concept of distributed and shared memory programming.
4. To recognize differences in between different concurrent processing approaches and identifying correct one according to architectural and application needs.
5. To know the applications of multicore and concurrent systems and use its programming concepts for new application development.
6. To explore recent trends in multicore and concurrent system programming.

Course Outcomes:

By the end of the course, students should be able to

1. Know types of parallel machine and to know multicore and concurrent systems in detail.
2. Know the ways to measure the performance of multicore systems.
3. Understand need of multicore and concurrent system programming.
4. Know the different approaches for multicore and concurrent programming.
5. Use and apply the approaches learned, for application development.
6. Understand and explore recent trends in multicore and concurrent system programming.

Unit I	INTRODUCTION	7 Hrs

Information Security Concepts, Security Threats and Vulnerabilities, Security Architectures and Operational Models, Types of Security attacks, Goals of Security, Malicious code, Intrusion detection system (IDS): Need, Types, Limitations and Challenges, security and privacy.

Unit II	MULTICORE AND CONCURRENT PROGRAM DESIGN	7 Hrs

The PCAM methodology, Decomposition patterns: Task parallelism, Divide-and-conquer decomposition.
Geometric decomposition, Recursive data decomposition, Pipeline decomposition, Event-based coordination decomposition, Program structure patterns: Single-program, multiple-data, Multiple-program, multiple-data, Master-worker, Map-reduce, Fork/join, Loop parallelism, Matching decomposition patterns with program structure patterns.

Unit III	SHARED-MEMORY PROGRAMMING: THREADS	7 Hrs
Threads, Design concerns, Semaphores, Applying semaphores in classical problems, Monitors, Applying monitors in classical problems, Dynamic vs. static thread management, Debugging multithreaded applications, Higher-level constructs: multithreaded programming without threads: Concurrent Map, Map-Reduce, Concurrent filter, Filter-reduce.		
Unit IV	**SHARED-MEMORY PROGRAMMING: OPENMP**	**7 Hrs**
Introduction, OpenMP integration V.0: manual partitioning, OpenMP integration V.1: manual partitioning without a race condition, OpenMP integration V.2: implicit partitioning with locking, OpenMP integration V.3: implicit partitioning with reduction, Loop-level parallelism, Task parallelism, Synchronization constructs, Correctness and optimization issues.		
Unit V	**DISTRIBUTED MEMORY PROGRAMMING**	**7 Hrs**
Communicating processes, MPI, Core Concepts, Program architecture, Point-to-Point communication, Buffered communications, Non-blocking communications, Error reporting and handling, Collective communications, Communicating objects, Node management: communicators and groups, One-sided communications, I/O considerations, Combining MPI processes with threads, Timing and performance measurements, Debugging and proiling MPI programs, The Boost MPI library.		
Unit VI	**GPU PROGRAMMING**	**7 Hrs**
CUDA's programming model: threads, blocks, and grids, CUDA's execution model: streaming multiprocessors and warps, CUDA compilation process, Memory hierarchy, Optimization techniques, Dynamic parallelism, Debugging CUDA programs, Proiling CUDA programs, CUDA and MPI.		

Text Books

1. Gerassimos Barlas, "Multicore and GPU Programming An Integrated Approach", Morgan Kaufmann, 2015.
2. Max Domeika, "Software Development for Embedded Multi-core Systems: A Practical Guide Using Embedded Intel® Architecture", Elsevier Inc., 2008.
3. Jean Bacon, Janet Van Der Linden, "Concurrent Systems: An Integrated Approach to Operating Systems, Distributed Systems and Database", Addison-Wesley, Edition 2000

Reference Books

1. John L. Hennessey and David A. Patterson, " Computer Architecture – A quantitative approach", Morgan Kaufmann / Elsevier, 4th. Edition.
2. David E. Culler, Jaswinder Pal Singh, "Parallel Computing Architecture : A hardware/ software approach", Morgan Kaufmann / Elsevier. 3. Darryl Gove, "Multicore Application Programming for Windows, Linux, and Oracle Solaris", Pearson, 2011.
3. William Stallings, "Computer Organization and Architecture – Designing for Performance", Pearson Education, Seventh Edition.
4. Dezso Sima, Terence Fountain, Peter Kacsuk "Advanced Computer Architectures" A Design space approach, Pearson Education.
5. Advanced Computer Architecture Parallelism, Scalability – Kai Hwang, Programmability, Tata McGrawhill.
6. 4. Michael J Quinn, "Parallel programming in C with MPI and OpenMP", Tata McGraw

Hill, 2003.
7. Shameem Akhter and Jason Roberts, “Multi-core Programming”, Intel Press, 2006.
8. Roscoe A.W., “Understanding Concurrent Systems”, Springer-Verlag, 2010.

Savitribai Phule Pune University
Fourth Year of Information Technology Engineering (2015 Course)
414456E: Elective-I
Business Analytics and Intelligence

Teaching Scheme:	Credits: 03	Examination Scheme:
TH:03 Hours/Week		In-Sem (Paper): 30 Marks End-Sem (paper): 70 Marks

Prerequisites:

1. Fundamentals of Database Management System.
2. Fundamentals of Discrete mathematics.

Course Objectives:

1. Apply conceptual knowledge on how business intelligence is used within organizations.
2. Evaluate organization's abilities to create and mobilize corporate knowledge.
3. Select software tools for knowledge management systems in business organizations
4. Suggest design systems to provide business intelligence.

Course Outcomes:

By the end of the course, students should be able to

1. Comprehend the Information Systems and development approaches of Intelligent Systems.
2. Evaluate and rethink business processes using information systems.
3. Propose the Framework for business intelligence.
4. Get acquainted with the Theories, techniques, and considerations for capturing organizational intelligence.
5. Align business intelligence with business strategy.
6. Apply the techniques for implementing business intelligence systems.

Unit I	Decision Making and Decision Support Systems	7 Hrs

The role of computerized support for decision making and its importance. Types of decisions managers face, and the process through which they make decisions. Decision making styles, the four stages of Simon's decision making process, and common strategies and approaches of decision makers. The role of Decision Support Systems (DSS), its main components, the various DSS types and classification, and how DSS have changed over time. How DSS supports each phase of decision making and summarize the evolution of DSS applications, and on how they have changed over time.

Unit II	Business Intelligence Concepts and Platform Capabilities	7 Hrs

Definition of business intelligence (BI), BI architecture, and its components, and relation with DSS. The main components of BI platforms, their capabilities, and the competitive landscape of BI platforms. The building blocks of business reports, the types of business reports, and the components and structure of business reporting systems. Role of Mathematical model in BI, Factors Responsible for successful BI Project, Obstacle to Business Intelligence in an Organization Different types of OLAP and their applications, and the differences between OLAP and OLTP.

Unit III	Data Visualization and Dashboard Design	7 Hrs

The top job responsibilities of BI analysts by focusing on creating data visualizations and dashboards. The importance of data visualization and different types of data that can be visually represented. The types of basic and composite charts. This will help you to determine which visualization is most effective to display data for a given data set, and to identify best practices for designing data visualizations. Common characteristics of dashboard, the types of dashboards, and the list attributes of metrics usually included in dashboards. The guidelines for designing dashboard and the common pitfalls of dashboard design.

Unit IV	Business Performance Management Systems	7 Hrs

This module focuses on how BI is used for Business Performance Management (BPM). The main components of BPM as well as the four phases of BPM cycle and how organizations typically deploy BPM. The purpose of Performance Measurement System and how organizations need to define the key performance indicators (KPIs) for their performance management system. Four balanced scorecards perspectives and the differences between dashboards and scorecards. The benefits of using balanced scorecard versus using Six Sigma in a performance measurement system.

Unit V	Role of Business Intelligence and Analytics in Business	7 Hrs

The role of visual and business analytics (BA) in BI and how various forms of BA are supported in practice. ERP and Business Intelligence, BI Applications in CRM, BI Applications in Marketing, BI Applications in Logistics and Production, Role of BI in Finance, BI Applications in Banking, BI Applications in Telecommunications, BI Applications in Fraud Detection, BI Applications in Retail Industry

Unit VI	BI Maturity, Strategy and Modern Trends in BI	7 Hrs

BI maturity and strategy. Different levels of BI maturity, the factors that impact BI maturity within an organization, and the main challenges and the potential solutions for a pervasive BI maturity within an organization. The critical success factors for implementing a BI strategy, BI framework, and BI implementation targets. Open Source BI. Big Data systems. Social BI systems, Geographic BI systems. Customer Experience based BI.

Text Books

1. Sabherwal, R. and Becerra-Fernandez, I.(2011). Business Intelligence: Practices, Technologies and Management. John Wiley.
2. Turban,E. and Volonino, L.(2011). Information Technology for Managment: Improving Strategic and Operational Performance. 8th edn.Wiley.

Reference Books

1. Avison, D. and Fitzgerald, G. (2006). Information Systems development: Methodologies, techniques and tools. 4th ed. McGraw-Hill.
2. Anderson-Lehman, R., Watson, H.J., Wixom, B.H., & Hoffer, J.A., 2004, Continental Airlines Flies High with Real-Time Business Intelligence, MIS Quarterly Executive, 3, 4, pp 163-176
3. Gangadharan, G.R., & Swami, N., 2004, Business Intelligence Systems: Design and Implementation Strategies, Proceedings of the 2nd International conference on Technology Interfaces, June 7-10, Cavtat, Croatia, pp 139-144

Savitribai Phule Pune University Fourth Year of Information Technology (2015 Course) 414457A: Elective-II Software Defined Networks		
Teaching Scheme: **TH:03 Hours/Week**	**Credits: 03**	**Examination Scheme:** **In-Sem (Paper): 30 Marks** **End-Sem (paper): 70 Marks**

Prerequisites:

1. Prior knowledge of fundamentals of computer network.

Course Objectives:

1. To understand the limitations of the current technology and need and evolution of SDN.
2. To comprehend role of data, control, and management planes and their separation.
3. To recognize how SDN is coupled with the Open Flow protocol and how green ICT can help improve environmental Sustainability.
4. To understand network virtualization and network function virtualization.
5. To know in detail data and control plane in SDN.
6. To study use-cases of SDN.

Course Outcomes:

By the end of the course, students should be able to

1. Acquire fundamental knowledge of SDN exploring the need, characteristics, and architecture of SDN.
2. Recognize OpenFlow protocols and its forwarding, pipeline model.
3. Understand different methodologies for sustainable SDN.
4. Comprehend IT Infrastructure for SDN.
5. Acquiring knowledge of OpenFlow protocols, visualization.

Unit I	**INTRODUCTION TO SDN: AN OVERVIEW**	**7 Hrs**

Introduction: The Modern Data Center, Roles and Separation of data, control and management Planes, Advantages and Disadvantages. Need of SDN, Genesis of SDN.
Working of SDN: Fundamental characteristics, SDN Devices, SDN controllers, Applications.

Unit II	**OPEN FLOW PROTOCOLS**	**7 Hrs**

Introduction: Definition, OpenFlow architecture, Flow & Group Tables, types,Hybrid Approaches, The OpenFlow forwarding and pipeline model. OpenFlow Advantages and Limitations, OpenFlow Protocol. Use Case:FloodLight, Mininet,

Unit III	**NETWORK VIRTUALIZATION (NV)**	**7 Hrs**

Definition, Concepts, Benefits of Network Virtualization, Components of a Virtual Network, Applications, Existing Network Virtualization Framework (VMWare and others), Network as a Service (NaaS).

Unit IV	CONTROL PLANE	7 Hrs
Control Plane: Overview, Existing SDN Controllers including Floodlight and Open Daylight projects. Customization of Control Plane: Switching and Firewall Implementation using SDN Concepts.		
Unit V	**DATA PLANE**	**7 Hrs**
Data Plane: Software-based and Hardware-based; Programmable Network, Hardware. Programming SDNs: Northbound Application Programming Interface, Current Languages and Tools, Composition of SDNs.		
Unit VI	**NETWORK FUNCTIONS VIRTUALIZATION (NFV)**	**7 Hrs**
Introduction: Concepts, Comparison of NFV and NV, Implementation and Applications. Data Center Networks: Packet, Optical and Wireless Architectures, Network Topologies.		

Text Books

1. Thomas D. Nadeau, Ken Gray, SDN: Software Defined Networks, An Authoritative Review of Network Programmability Technologies, O'Reilly Media, ISBN:10:1-4493-4230-2, 978-1-4493-4230-2.
2. Paul Goransson and Chuck Black, Software Defined Networks: A Comprehensive Approach, Morgan Kaufmann, ISBN: 9780124166752, 9780124166844.

Reference Books

1. Vivek Tiwari, SDN and OpenFlow for Beginners ,Digital Services,10: 1-940686-00-8 13: 978-1-940686-00-4
2. Fei Hu, Network Innovation through OpenFlow and SDN: Principles and Design,CRC Press,ISBN:10: 1466572094
3. Open Networking Foundation (ONF)Documents, https://www.opennetworking.org
4. OpenFlow standards, http://www.openflow.or
5. Online Reading, http://www.nec-labs.com/~lume/sdn-reading-list.html,

Savitribai Phule Pune University
Fourth Year of Information Technology (2015 Course)
414457B: Elective-II
Soft Computing

Teaching Scheme:	Credits: 03	Examination Scheme:
TH:03 Hours/Week		In-Sem (Paper): 30 Marks End-Sem (paper): 70 Marks

Prerequisites:

1. Linear Algebra and Calculus.
2. Probability Theory.

Course Objectives:

1. Identifying Soft computing techniques and their roles in problem solving.
2. Generate an ability to build neural networks for solving real life problems.
3. Conceptualize fuzzy logic and its implementation for various real world applications.
4. Apply evolutionary algorithms and Fuzzy logic to solve the problems.
5. Design soft computing systems by hybridizing various other techniques.

Course Outcomes:

By the end of the course, students should be able to

1. Tackle problems of interdisciplinary nature.
2. Find an alternate solution, which may offer more adaptability, resilience and optimization.
3. Gain knowledge of soft computing domain which opens up a whole new career option.
4. Tackle real world research problems.

Unit I	INTRODUCTION	7 Hrs

Basic concepts of Soft Computing, Historical Developments and Definitions, Soft Computing Characteristics and Problem Solving– Strengths and Weaknesses, Constitutes of Soft Computing : Neural Computing, Fuzzy Logic and Computing, Evolutionary Computing and Genetic Algorithms, Probabilistic Reasoning.

Unit II	NEURAL NETWORKS OVERVIEW	7 Hrs

Fundamentals: Biological Neurons and Model of Artificial Neuron. Neural Network Architectures: Single Layer Network, Multi-Layer Feed Forward Neural Networks, and Feedback Networks. Perceptron Model and Learning in Perceptron, Limitation of Learning in Perceptron, Error Back Propagation learning in Multilayer FFNN. Performance Issues of EBP algorithm for MLFFNN.

Unit III	NEURAL NETWORK ARCHITECTURES	7 Hrs

Complex Architectures Learning: Competitive Learning-Self Organizing Maps, Hebbian Learning-Hopfield Networks, Boltzmann Machines, Adaptive Resonance Theory (ART) Networks, Bayesian Neural Networks, Deep Learning Architecture of Neural Networks, Applications of Neural Networks.

Unit IV	FUZZY LOGIC AND FUZZY SYSTEMS	7 Hrs

Fuzzy Logic, Fuzzy Sets and Operations, Fuzzy Relations, Fuzzy Arithmetic and Fuzzy Measures. Fuzzy to Crisp Conversions: Lambda Cuts for fuzzy sets, Fuzzy Relations, Defuzzification Methods. Fuzzy Rules and Reasoning, Fuzzy Inference Systems, Mamdani Fuzzy Models – Sugeno Fuzzy Models, Applications of Fuzzy Modeling for Decision Making.

Unit V	GENETIC ALGORITHMS	7 Hrs

Introduction, Encoding, Operators of Genetic Algorithm, Basic Genetic Algorithm, Simple GA, Crossover and Mutation, Multi-objective Genetic Algorithm (MOGA). Genetic algorithms in search and optimization, Ant colony optimization (ACO), Particle Swarm Optimization (PSO). Applications of GA for Clustering.

Unit VI	ADVANCES IN SOFT COMPUTING	7 Hrs

Soft Computing Paradigms and Hybrid Approaches. Neuro-Fuzzy modeling, Genetic Algorithm Based Backpropagation Network, Fuzzy logic based Backpropagation, Fuzzy Logic Controlled Genetic Algorithms, Simplified Fuzzy ARTMAP.

Text Books

1. S. N. Sivanandam, S. N. Deepa,Principles of Soft Computing,Wiley publications,2nd Edition, ISBN: 9788126527410.
2. J. S. R. Jang, C. T. Sun, E. Mizutani, Neuro-Fuzzy and Soft Computing- A computational approach to Learning and Machine Intelligence, PHI,1st Edition, ISBN:978-8131792469.

Reference Books

1. David E. Goldberg, Genetic Algorithms, Pearson Education, 2nd Edition, ISBN: 9788120322431, ISBN: 9780201157673.
2. Satish Kumar, Neural Networks - A Classroom Approach, Tata McGraw Hill,2nd Edition, ISBN:1259006166.
3. Timothy J. Ross, Fuzzy Logic with Engineering Applications, Wiley India, 3rd Edition, ISBN: 9788126531264.
4. Samir Roy, Udit Chakroborthy,Introduction to soft computing - neuro-fuzzy and genetic algorithm ,Person Education, 1st Edition.

Savitribai Phule Pune University
Fourth Year of Information Technology (2015 Course)
414457C: Elective-II
Software Testing and Quality Assurance

Teaching Scheme:	Credits: 03	Examination Scheme:
TH:03 Hours/Week		In-Sem (Paper): 30 Marks End-Sem (paper): 70 Marks

Prerequisites:

1. Software Engineering.

Course Objectives:

1. Learn to apply the testing strategies and methodologies in projects.
2. To understand test management strategies and tools for testing.
3. A keen awareness on the open problems in software testing and maintenance.
4. To explain quality assurance and various tools used in quality management.
5. To learn in detail about various quality assurance models.
6. To understand the audit and assessment procedures to achieve quality.

Course Outcomes:

By the end of the course, students should be able to

1. Test the software by applying testing techniques to deliver a product free from bugs.
2. Investigate the scenario and to select the proper testing technique.
3. Explore the test automation concepts and tools and estimation of cost, schedule based on standard metrics.
4. Understand how to detect, classify, prevent and remove defects.
5. Choose appropriate quality assurance models and develop quality.
6. Ability to conduct formal inspections, record and evaluate results of inspections.

Unit I	SOFTWARE TESTING BASICS	7 Hrs

Testing as an engineering activity, Role of process in software quality, Testing as a process, Basic definitions, Software testing principles, The tester's role in a software development organization, Origins of defects, Defect classes, The defect repository and test design, Defect examples, Developer / Tester support for developing a defect repository.

Unit II	TESTING TECHNIQUES AND LEVELS OF TESTING	7 Hrs

Using White Box Approach to Test design - Static Testing Vs. Structural Testing, Code Functional Testing, Coverage and Control Flow Graphs, Using Black Box Approaches to Test Case Design, Random Testing, Requirements based testing, Decision tables, State-based testing, Cause-effect graphing, Error guessing, Compatibility testing, Levels of Testing -Unit Testing, Integration Testing, Defect Bash Elimination. System Testing - Usability and Accessibility Testing, Configuration Testing, Compatibility Testing.

Unit II	TESTING TECHNIQUES AND LEVELS OF TESTING	7 Hrs

Using White Box Approach to Test design - Static Testing Vs. Structural Testing, Code Functional Testing, Coverage and Control Flow Graphs, Using Black Box Approaches to Test Case Design,

Random Testing, Requirements based testing, Decision tables, State-based testing, Cause-effect graphing, Error guessing, Compatibility testing, Levels of Testing -Unit Testing, Integration Testing, Defect Bash Elimination. System Testing - Usability and Accessibility Testing, Configuration Testing, Compatibility Testing.

Unit III	**SOFTWARE TEST AUTOMATION AND QUALITY METRICS**	

Software Test Automation, Skills needed for Automation, Scope of Automation, Design and Architecture for Automation, Requirements for a Test Tool, Challenges in Automation Tracking the Bug, Debugging. Testing Software System Security - Six-Sigma, TQM - Complexity Metrics and Models, Quality Management Metrics, Availability Metrics, Defect Removal Effectiveness, FMEA, Quality Function Deployment, Taguchi Quality Loss Function, Cost of Quality.

Unit IV	**FUNDAMENTALS OF SOFTWARE QUALITY ASSURANCE**	**7 Hrs**

SQA basics, Components of the Software Quality Assurance System, software quality in business context, planning for software quality assurance, product quality and process quality, software process models, 7 QC Tools and Modern Tools.

Unit V	**QUALITY ASSURANCE MODELS**	**7 Hrs**

Models for Quality Assurance, ISO-9000 series, CMM, CMMI, Test Maturity Models, SPICE, Malcolm Baldrige Model- P-CMM.

Unit VI	**SOFTWARE QUALITY ASSURANCE TRENDS**	**7 Hrs**

Software Process- PSP and TSP, OO Methodology, Clean-room software engineering, Defect Injection and prevention, Internal Auditing and Assessments, Inspections & Walkthroughs, Case Tools and their Affect on Software Quality.

Text Books

1. Srinivasan Desikan, Gopalaswamy Ramesh,Software Testing: Principles and Practices Pearson.
2. Daniel Galin, Software Quality Assurance: From Theory to Implementation, Pearson Addison Wesley.

Reference Books

1. Aditya P. Mathur, Foundations of Software Testing, Pearson.
2. Paul Ammann, Jeff Offutt, Introduction to Software Testing, Cambridge University Press.
3. Paul C. Jorgensen, Software Testing: A Craftsman's Approach, Auerbach Publications.
4. William Perry, Effective Methods of Software Testing, Wiley Publishing, Third Edition.
5. Renu Rajani, Pradeep Oak, Software Testing – Effective Methods, Tools and Techniques, Tata McGraw Hill.
6. Stephen Kan, Metrics and Models in Software Quality, Addison – Wesley, Second Edition.
7. S.A.Kelkar, Software quality and Testing, PHI Learing, Pvt, Ltd.
8. Watts S Humphrey, Managing the Software Process ,Pearson Education Inc.

Savitribai Phule Pune University Fourth Year of Information Technology (2015 Course) 414457D: Elective-II Compiler Construction		
Teaching Scheme: **TH:03 Hours/Week**	**Credits: 03**	**Examination Scheme:** **In-Sem (Paper): 30 Marks** **End-Sem (paper): 70 Marks**

Prerequisites:

1. Fundamentals of System Programming.
2. Computer Organization and architecture.
3. Processor Architecture and Interfacing.
4. Fundamentals of Data Structures, Data Structures and Files.
5. Theory of Computation: DFA, NFA, Regular expressions, Grammars

Course Objectives:

1. The aim of this module is to show how to apply the theory of language translation introduced in the prerequisite courses to build compilers and interpreters.
2. It covers the building of translators both from scratch and using compiler generators. In the process, the module also identifies and explores the main and advanced issues of the design of translators.
3. The construction of a compiler/interpreter for a small language is a necessary component of this module, so students can obtain the necessary skills

Course Outcomes:

By the end of the course, students should be able to

1. Understand the structure of compilers.
2. Understand the basic and advanced techniques used in compiler construction.
3. Understand the basic data structures used in compiler construction such as abstract syntax.
4. Cognitive skills (thinking and analysis)- Design and implement a compiler using a software engineering approach.
5. Communication skills (personal and academic).
6. Practical and subject specific skills (Transferable Skills) - Use generators (e.g. Lex and Yacc).

Unit I	FUNDAMENTALS OF COMPILATION	7 Hrs

Lexical Analysis: Input buffering, Regular Expression, Automata; Parsing: [Limited to] Context free grammar, Predictive parser, LR parsing, Parser generator, error recovery; Syntax and semantics analysis: [Limited to] S and L attributes, dependency graph, DAG and Activation records.

Unit II	MEMORY UTILIZATION	7 Hrs

Intermediate representations, translation into trees, canonical trees, taming conditional branches, algorithms for instruction selection; Register allocation: coloring by simplification, coalescing, precolored nodes, graph coloring implementation, register allocation for trees;

Garbage collection: Mark-and-sweep collection, copying, generational collection, incremental collection, Baker's algorithm, Interface to the compiler.		
Unit III	**OBJECT ORIENTED AND FUNCTIONAL PROGRAMMING LANGUAGE**	**7 Hrs**
Classes, single inheritance of data field, multiple inheritance, testing class membership, private fields and methods, classless languages, optimizing object oriented programs; Functional Language: closure, Immutable variables, Inline expansion, closure conversion, efficient tail recursion, lazy evaluation.		
Unit IV	**POLYMORPHIC TYPES AND DATA FLOW ANALYSIS**	**7 Hrs**
Representation of polymorphic variables, parametric polymorphism, type inference, resolution of static overloading, Data flow analysis: Intermediate representation for flow analysis, various data flow analysis, transformations using data flow analysis, methods/mechanisms for speeding up data flow analysis, alias analysis.		
Unit V	**STATIC SINGLE ASSIGNMENT FORM**	**7 Hrs**
Loop Optimization: Dominators, loop invariant computations, induction variables, array-bounds check, loop unrolling; SSA: Definition of SSA, Informal Semantics of SSA, Comparison with Classical Data-flow Analysis, SSA in Context, Benefits of SSA, Fallacies about SSA, Properties: Preliminaries, Def-Use and Use-Def Chains, Minimality, Optimization algorithms using SSA, converting to and back from SSA form, control dependency.		
Unit VI	**PIPELINING AND SCHEDULING**	**7 Hrs**
Loop scheduling without resource bound, resource bounded loop pipelining, branch prediction, cache organization and block alignment, loop interchange, blocking and garbage collection. Modern Compiler in ML: ML-Lex, ML-YACC,Tiger Compiler.		

Text Books

1. Andrew W Appel, Modern compiler implementation in C, Cambridge University, Press,4TH, ISBN:0 521 58390 X.

Reference Books

2. J. Singer,Static Single Assignment Book, Springer,1st Edition.
3. Russell Jesse **,** Static Single Assignment Form, Springer, ISBN: 10: 5508387455.
4. B. Alpern, M. N. Wegman, and F. K. Zadeck, Detecting Equality of Variables in Programs. Proceedings of the Fifteenth Annual ACM Symposium on Principles of Programming Languages, ACM.
5. Alfred V. Aho, Ravi Sethi, Jeffrey D. Ullman, Compilers Principles, Techniques and Tools, Addison Wesley, Low Price Edition, ISBN: 981–235–885 – 4.

Savitribai Phule Pune University
Fourth Year of Information Technology (2015 Course)
414457E: Elective-II
Gamification

Teaching Scheme:	Credits: 03	Examination Scheme:
TH:03 Hours/Week		In-Sem (Paper): 30 Marks End-Sem (paper): 70 Marks

Prerequisites:

1. Discrete Structures.

Course Objectives:

1. To develop problem solving abilities using gamification.
2. Students will understand gamification paradigm.

Course Outcomes:

By the end of the course, students should be able to

1. Write programs to solve problems using gamification and open source tools.
2. Apply gamification for Mobile and Web Applications.
3. Solve problems for multi-core or distributed, concurrent/Parallel environments.

Unit I	Gaming Foundations	7 Hrs

Introduction: Definition of Gamification, Why Gamify, Examples and Categories, Gamification in Context, Resetting Behavior, Replaying History, Gaming foundations: Fun Quotient, Evolution by loyalty, status at the wheel, the House always wins.

Unit II	Developing Thinking	7 Hrs

Re-framing Context: Communicology, Apparatus, and Post-history, Concepts Applied to Video games and Gamification, Rethinking 'playing the game' with Jacques Henriot, To Play Against: Describing Competition in Gamification, Player Motivation: Powerful Human Motivators, Why People Play, Player types, Social Games, Intrinsic verses Extrinsic Motivation, Progression to Mastery. Case studies for Thinking: Tower of Hanoi.

Unit III	Opponent Moves in Gamification	7 Hrs

Reclaiming Opposition: Counter gamification, Gamed Agencies: Affectively Modulating Our Screen-and App-Based Digital Futures, Remodeling design, Game Mechanics, Designing for Engagement, Case study of Maze Problem.

Unit IV	Game Design	7 Hrs

Game Mechanics and Dynamics: Feedback and Re-enforcement, Designing for engagement Game Mechanics in depth, Putting it together, Case study of 8 queen’s problem.

Unit V	Advanced tools, techniques	7 Hrs

Gamification case Studies, Coding basic game Mechanics

Unit VI	Applications	7 Hrs

Instant Gamification Platforms, Mambo.io (Ref:http://mambi.io), Installation and use of BigDoor (OpenSourcehttp://bigdoor.com),ngageoint/gamification-server(ref:https://github.com/ ngageoint/ gamification-server).

Text Books

1. Mathias Fuchs, Sonia Fizek, Paolo Ruffino, Niklas Schrape, Rethinking Gamification.
2. http://meson.press/books/rethinking-gamification, Meson Press, First Edition,ISBN:978-3-95796-001-6.
3. Gabe Zechermann, Christopher Cunningham Gamification by Design, Oreilly media, First, ISBN: 978-1-449-39767-8.

Reference Books

1. Susan Jacobs, Getting Gamification Right, The eLearning Guild, First.

Savitribai Phule Pune University Fourth Year of Information Technology (2015 Course) 414458: Computer Laboratory VII		
Teaching Scheme: **Practical:04 Hours/Week**	**Credits:02**	**Examination Scheme:** **TW:50 Marks** **PR: 50 Marks**

Prerequisites:

Knowledge of Programming Languages

1. Java.
2. R.
3. Python.
4. C++.

Course Objectives:

1. To Understand the Security issues in networks and Applications software.
2. To understand the machine learning principles and analytics of learning algorithms.

Course Outcomes:

By the end of the course, students should be able to

1. The students will be able to implement and port controlled and secured access to software systems and networks.
2. The students will be able to build learning software in various domains.

List of Laboratory Assignments

PART –A (ICS) – (All Mandatory)

Assignment 1

Write a program in C++ or Java to implement RSA algorithm for key generation and cipher verification.

Assignment 2

Develop and program in C++ or Java based on number theory such as Chinese remainder.

Assignment 3

Write a program in C++ or java to implement SHA1 algorithm using libraries (API)

Assignment 4

Configure and demonstrate use of vulnerability assessment tool such as Snort tool for intrusion or SSL Web security.

PART –B (MLA) (Any Six)

Assignment 1

Study of platform for Implementation of Assignments

Download the open source software of your interest. Document the distinct features and functionality of the software platform. You may choose WEKA and R and Python

Assignment 2

Supervised Learning - Regression (Using R) Generate a proper 2-D data set of N points. Split the data set into Training Data set and Test Data set. i) Perform linear regression analysis with Least Squares Method. ii) Plot the graphs for Training MSE and Test MSE and comment on Curve Fitting and Generalization Error. iii) Verify the Effect of Data Set Size and Bias-Variance Tradeoff. iv) Apply Cross Validation and plot the graphs for errors. v) Apply Subset Selection Method and plot the graphs for errors. vi) Describe your findings in each case
Assignment 3
Create Association Rules for the Market Basket Analysis for the given Threshold. (Using R)
Assignment 4
Implement K-Means algorithm for clustering to create a Cluster on the given data.(Using Python)
Assignment 5
Implement SVM for performing classification and find its accuracy on the given data. (Using Python)
Assignment 6
Creating & Visualizing Neural Network for the given data. (Using Python)
Assignment 7
On the given data perform the performance measurements using Simple Naïve Bayes algorithm such as Accuracy, Error rate, precision, Recall, TPR,FPR,TNR,FPR etc. (Using Weka API through JAVA)
Assignment 8
Principal Component Analysis-Finding Principal Components, Variance and Standard Deviation calculations of principal components.(Using R)
Reference Books
1. Open source software-WEKA and R and Python. 2. JAVA 6.1 or more (for RJava Package). 3. Dr. Mark Gardener, Beginning R The Statistical Programming Language, ISBN: 978-81-2654120-1, Wiley India Pvt. Ltd. 4. Jason Bell, “Machine Learning for Big Data Hands-On for Developers and Technical Professionals”, ISBN: 978-81-265-5337-2-1, Wiley India Pvt. Ltd.

Savitribai Phule Pune University
Fourth Year of Information Technology (2015 Course)
414459: Computer Laboratory VIII

Teaching Scheme:	Credits:02	Examination Scheme:
Practical:04 Hours/Week		TW:50 Marks OR: 50 Marks

Prerequisites:

1. Problem Solving & Object-Oriented Programming.
2. Software Engineering and Project Management.

Course Objectives:

1. To teach the student Unified Modeling Language (UML 2.0), in terms of "how to use" it for the purpose of specifying and developing software.
2. To teach the student how to identify different software artifacts at analysis and design phase.
3. To explore and analyze use case modeling.
4. To explore and analyze domain/ class modeling.
5. To teach the student Interaction and Behavior Modeling.
6. To Orient students with the software design principles and patterns.

Course Outcomes:

By the end of the course, students should be able to

1. Draw, discuss different UML 2.0 diagrams, their concepts, notation, advanced notation, forward and reverse engineering aspects.
2. Identify different software artifacts used to develop analysis and design model from requirements.
3. Develop use case model.
4. Develop, implement analysis model and design model.
5. Develop, implement Interaction and behavior Model.
6. Implement an appropriate design pattern to solve a design problem.

List of Laboratory Assignments

Assignment 1: Write Problem Statement for System / Project

Identify Project of enough complexity, which has at least 4-5 major functionalities.
Identify stakeholders, actors and write detail problem statement for your system.

Assignment 2: Prepare Use Case Model

Identify Major Use Cases, Identify actors.
Write Use Case specification for all major Use Cases.
Draw detail Use Case Diagram using UML2.0 notations.

Assignment 3: Prepare Activity Model

Identify Activity states and Action states.
Draw Activity diagram with Swim lanes using UML2.0 Notations for major Use Cases

Assignment 4: Prepare Analysis Model-Class Model

Identify Analysis Classes and assign responsibilities.
Prepare Data Dictionary.

Draw Analysis class Model using UML2.0 Notations. Implement Analysis class Model-class diagram with a suitable object oriented language
Assignment 5: Prepare a Design Model from Analysis Model
Study in detail working of system/Project. Identify Design classes/ Evolve Analysis Model. Use advanced relationships. Draw Design class Model using OCL and UML2.0 Notations. Implement the design model with a suitable object-oriented language.
Assignment 6: Prepare Sequence Model.
Identify at least 5 major scenarios (sequence flow) for your system. Draw Sequence Diagram for every scenario by using advanced notations using UML2.0 Implement these scenarios by taking reference of design model implementation using suitable object-oriented language.
Assignment 7: Prepare a State Model
Identify States and events for your system. Study state transitions and identify Guard conditions. Draw State chart diagram with advanced UML 2 notations. Implement the state model with a suitable object-oriented language
Assignment 8: Identification and Implementation of GRASP pattern
Apply any two GRASP pattern to refine the Design Model for a given problem description Using effective UML 2 diagrams and implement them with a suitable object oriented language
Assignment 9: Identification and Implementation of GOF pattern
Apply any two GOF pattern to refine Design Model for a given problem description Using effective UML 2 diagrams and implement them with a suitable object oriented language
Reference Books
1. UML2 Bible by Tom Pender, Wiley India Pvt. Limited 2011 2. Applying UML and Patterns Second Edition by Craig Larman, Pearson Education 3. UML 2 and the Unified Process, Second Edition, JIM Arlow, Ila Neustadt, Pearson 4. Design Patterns: Elements of Reusable Object Oriented Software, Erich Gamma, Pearson 5. Design Patterns in Java Second Edition by Steven John Metsker, Pearson All the assignments should be conducted on Latest version of Open Source Operating Systems, tools and Multi-core CPU supporting Virtualization and Multi-Threading.

Savitribai Phule Pune University
Fourth Year of Information Technology (2015 Course)
414460: Project Phase-I

Teaching Scheme:	Credits:02	Examination Scheme:
TUT:02 Hours/Week		OR:50 Marks

Prerequisites:

1. Project Based Seminar.

Course Objectives:

1. Student should be able implement their ideas/real time industrial problem/ current applications from their engineering domain.
2. Students should be able to develop plans with help of team members to achieve the project's goals.
3. Student should be able to break work down into tasks and determine appropriate procedures.
4. Student should be able to estimate and cost the human and physical resources required, and make plans to obtain the necessary resources.
5. Student should be able allocate roles with clear lines of responsibility and accountability and learn team work ethics.
6. Student should be able to apply communication skills to effectively promote ideas, goals or products.

Course Outcomes:

By the end of the course, students should be able to

1. To show preparedness to study independently in chosen domain of Information Technology and programming languages and apply their acquired knowledge to variety of real time problem scenarios.
2. To function effectively as a team to accomplish a desired goal.
3. An understanding of professional, ethical, legal, security and social issues and responsibilities related to Information Technology Project.

Contents

Project Based Seminar (PBS) helped students to gather, organize, summarize and interpret technical literature with the purpose of formulating a project proposal in third year. Students had also submitted a technical report summarizing state-of-the-art on an identified domain and topic in third year. B.E. Projects can be application oriented and/or will be based on some innovative/ theoretical work. In Project Phase-I the student will undertake project over the academic year, which will involve the analysis, design of a system or sub system in the area identified earlier in the field of Information Technology and Computer Science and Engineering. In some cases; if earlier identified project is not feasible; a new topic must be formulated in consultation with the guide and project coordinator. The project will be undertaken preferably by a group of 3-4 students who will jointly work and Implement the project. The group will select a project which is based on seminar delivered in relevant domain in Project based Seminar activity with approval from a committee formed by the department of senior faculty to check the feasibility and approve the topic.

Guidelines for Students and Faculty

- The Head of the department/Project coordinator shall constitute a review committee for project group; project guide would be one member of that committee by default.
- There shall be two reviews in Project phase –I in semester-I by the review committee.
- The Project Review committee will be responsible for evaluating the timely progress of the projects.
- As far as possible Students should finalize the same project title taken for Project Based Seminar (PBS).
- Student should Identify Project of enough complexity, which has at least 4-5 major functionalities
- Student should identify stakeholders, actors and write detail problem statement for system
- Review committee should revisit "Feasibility Review" conducted by Examiners during Oral examination in Third year in first week after commencement of the term.
- Review committee should finalize the scope of the project.
- If change in project topic is unavoidable then the students should complete the process of
- Project approval by submitting synopsis along with the review of important papers. This new
- Project topic should be approved by review committee.
- The students or project group shall make presentation on the progress made by them before the committee.
- The record of the remarks/suggestions of the review committee should be properly maintained and should be made available at the time of examination.
- Each student/group is required to give presentation as part of review for 10 to 15 minutes followed by a detailed discussion.
- Students should Revisit and Reassess the problem statement mentioned in the project-based seminar activity.

Review 1: Synopsis –

Deliverables:

1. The precise problem statement/title based on literature survey and feasibility study.
2. Purpose, objectives and scope of the project.
3. List of required hardware, software or other equipment for executing the project, test Environment/tools, cost and human efforts in hours.
4. System overview- proposed system and proposed outcomes.
5. Architecture and initial phase of design (DFD).
6. Project plan 1.0.

Review 2: SRS –

Deliverables:

1. SRS and High level design
2. Detail architecture/System design/algorithms/techniques
3. At least 30-40% coding documentation with at least 3 to 4 working modules
4. Test Results
5. Project plan 2.0

One paper should be published in reputed International conference/International journal based on project work done.

Project report contains the details as Follows:

Contents
List of Abbreviations
List of Figures
List of Graphs
List of Tables

1. Introduction and aims/motivation and objectives
2. Literature Survey
3. Problem Statement/definition
4. Project Requirement specification
5. Systems Proposed Architecture
6. High level design of the project(DFD/UML)
7. System implementation-code documentation-algorithm, methodologies, protocols used.
8. GUI/Working modules/Experimental Results
9. Project Plan
10. Conclusions
11. Bibliography in IEEE format

Appendices

A. Plagiarism Report of Paper and Project report from any open source tool
B. Base Paper(s)
C. Tools used
D. Papers Published/Certificates

- Use appropriate plagiarism tools, reference managers, Latex Lyx/latest Word for efficient and effective project writing.

Term Work:

- The term work will consist of a report and presentation prepared by the student on the project allotted to them.

Reference Books

1. UML2 Bible by Tom Pender, Wiley India Pvt. Limited 2011
2. Applying UML and Patterns Second Edition by Craig Larman, Pearson Education
3. UML 2 and the Unified Process, Second Edition, JIM Arlow, Ila Neustadt, Pearson
4. Design Patterns: Elements of Reusable Object Oriented Software, Erich Gamma, Pearson
5. Design Patterns in Java Second Edition by Steven John Metsker, Pearson

All the assignments should be conducted on Latest version of Open Source Operating Systems, tools and Multi-core CPU supporting Virtualization and Multi-Threading

Savitribai Phule Pune University
Fourth Year of Information Technology (2015 Course)
414461: Audit Course-V

In addition to credits, it is recommended that there should be audit course in preferably in each semester from second year to supplement their knowledge and skills. Student will be awarded the bachelor‘s degree if he/she earns credits and clears all the audit courses specified in the syllabus. The student may opt for one of the audit courses per semester, starting in second year first semester. Though not mandatory, such a selection of the audit courses helps the learner to explore the subject of interest in greater detail resulting in achieving the very objective of audit course's inclusion. List of options offered is provided. Each student has to choose one audit course from the list per semester. Evaluation of audit course will be done at institute level itself. Method of conduction and method of assessment for audit courses are suggested.

Criteria

The student registered for audit course shall be awarded the grade PP and shall be included such grade in the Semester grade report for that course, provided student has the minimum attendance as prescribed by the Savitribai Phule Pune University and satisfactory in-semester performance and secured a passing grade in that audit course. No grade points are associated with this 'PP' grade and performance in these courses is not accounted in the calculation of the performance indices SGPA and CGPA.

Guidelines for Conduction and Assessment (Any one or more of following but not limited to)

1. Lectures/ Guest Lectures
2. Visits (Social/Field) and reports
3. Demonstrations
4. Surveys
5. Mini Project
6. Hands on experience on Specific focused topic

Guidelines for Assessment (Any one or more of following but not limited to)

1. Written Test
2. Demonstrations/ Practical Test
3. Presentations
4. IPR/Publication
5. Report

Audit Course V Options

Course Code	Audit Course Title
414461A	1. Emotional Intelligence
414461B	2. Green Computing
414461C	3. Critical Thinking
414461D	4. Statistical Learning model using R.

Savitribai Phule Pune University
Fourth Year of Information Technology (2015 Course)
414461A: Audit Course-V
Emotional Intelligence

This Emotional Intelligence (EI) training course will focus on the five core competencies of emotional intelligence: self-awareness, self-regulation, motivation, empathy and interpersonal skills. Participants will learn to develop and implement these to enhance their relationships in work and life by increasing their understanding of social and emotional behaviors, and learning how to adapt and manage their responses to particular situations. Various models of emotional intelligence will be covered.

Course Objectives:

1) To develop an awareness of EI models.
2) To recognize the benefits of EI.
3) To understand how you use emotion to facilitate thought and behaviour.
4) To know and utilize the difference between reaction and considered response.

Course Outcomes:

By the end of the course, students should be able to,

1) Expand your knowledge of emotional patterns in yourself and others.
2) Discover how you can manage your emotions, and positively influence yourself and others.
3) Build more effective relationships with people at work and at home.
4) Positively influence and motivate colleagues, team members, and managers.
5) Increase your leadership effectiveness by creating an atmosphere that engages others.
6) Apply EI behaviours and supports high performance.

Unit I	Introduction to Emotional Intelligence (EI)

Emotional Intelligence and various EI models, The EQ competencies of self-awareness, self-regulation, motivation, empathy, and interpersonal skills, Understand EQ and its importance in life and the workplace

Unit II	Know and manage your emotions

Emotions, The different levels of emotional awareness, Increase your emotional knowledge of yourself, Recognize ‘negative’ and ‘positive’ emotions. The relationship between emotions, thought and behavior, Discover the importance of values, The impact of not managing and processing ‘negative’ emotions, Techniques to manage your emotions in challenging situations.

Unit III	Recognize Emotions in others

The universality of emotional expression, Learn tools to enhance your ability to recognize and appropriately respond to others' emotions, Perceiving emotions accurately in others to build empathy 4

Unit IV	Relate to others

Applying EI in the workplace, the role of empathy and trust in relationships, Increase your ability to create effective working relationships with others (peers, subordinates, managers, clients, Find out how to deal with conflict, Tools to lead, motivate others and create a high performing team.

Books

1) Daniel Goleman,” Emotional Intelligence – Why It Matters More Than IQ,” Bantam Books.

2) ISBN-10: 055338371X13: 978-0553383713 2. Steven Stein, “The EQ Edge”, Jossey-Bass, ISBN: 978-0-470-68161-9.
3) Drew Bird, “The Leader’s Guide to Emotional Intelligence”, ISBN: 9781535176002.

Savitribai Phule Pune University
Fourth Year of Information Technology (2015 Course)
414461B: Audit Course-V
Green Computing

Green computing is the study and practice of using computing resources efficiently. Green computing or green IT, refers to environmentally sustainable computing or IT. The goals of green computing are similar to green chemistry; reduce the use of hazardous materials, Maximize energy efficiency during the product's lifetime, and promote the recyclability or biodegradability of defunct products and factory waste.

Course Objectives:

1) To acquire knowledge to adopt green computing practices to minimize negative impacts on the environment.
2) To examine technology tools that can reduce paper waste and carbon footprint by user.
3) To understand how to minimize equipment disposal requirements.
4) To gain skill in energy saving practices in their use of hardware.

Course Outcomes:

By the end of the course, students should be able to,

1) Understand the concept of green IT and relate it to sustainable development.
2) Apply the green computing practices to save energy.
3) Discuss how the choice of hardware and software can facilitate a more sustainable operation.
4) Use methods and tools to measure energy consumption.

Unit I	Fundamentals of Green IT

Green IT Fundamentals: Business, IT, and the Environment – Green computing: carbon foot Print - Measuring, Details, reasons to bother, Plan for the Future, Cost Savings: Hardware, Power.

Unit II	Green Assets and Power Problems

Green Assets: Buildings, Data Centers, Networks, and Devices, Green Information Systems : Design and Development Models, Monitoring Power Usage, Servers, Low-Cost Options, Reducing Power Use, Data De-Duplication, Low-Power Computers and peripheral devices.

Unit III	Green Information Systems

Initial Improvement Calculations, Selecting Metrics, Tracking Progress, Change Business Processes, Customer Interaction, Paper Reduction, Green Supply Chain, Improve Technology Infrastructure, Reduce PCs and Servers, Shared Services, Hardware Costs, Cooling.

Unit IV	Green Grid Framework

Virtualizing of IT systems, Role of electric utilities, Telecommuting, teleconferencing and teleporting, Materials recycling, Best ways for Green PC, Green Data center Case Studies, Applying Green IT Strategies and Applications to a Home Hospital, Packaging Industry and Telecom Sector.

Reference Books

1. Woody Leonhard, Katherrine Murray, “Green Home computing for dummies”, August2009, ISBN: 978-0-470-46745-9
2. Alvin Galea, Michael Schaefer, Mike Ebbers, “Green Data Center: steps for the Journey”,

Shoff/IBM rebook, 2011. ISBN: 10: 1-933742-05-4; 13: 978-1-933742-05-2
3. John Lamb, “The Greening of IT”, Pearson Education, 2009, ISBN 10: 0137150830
4. Jason Harris, “Green Computing and Green IT- Best Practices on regulations & industry”,Lulu.com, 2008, ISBN: 1558604898.
5. Bud E. Smith, “Green Computing Tools and Techniques for Saving Energy, Money and Resources”, CRC Press, 2014, 9781466503403

Savitribai Phule Pune University
Fourth Year of Information Technology (2015 Course)
414461C: Audit Course-V
Critical Thinking

Thinking about one's thinking in a manner designed to organize and clarify, raise the efficiency of, and recognize errors and biases in one's own thinking. Critical thinking is not 'hard' thinking nor is it directed at solving problems (other than 'improving' one's own thinking). Critical thinking is inward-directed with the intent of maximizing the rationality of the thinker. One does not use critical thinking to solve problems—one uses critical thinking to improve one's process of thinking.

Course Objectives:

1) Critical thinking is considered among the most important "higher order cognitive skills" expected from students graduating with professional degrees (e.g. engineering, management, etc.)
2) This course will make you a better thinker; it will sharpen your mind, clarify your thoughts, and help you make smarter decisions (especially about your career). It will help you argue assertively and hence make you a forceful communicator – both in public speaking and in one-on-one situations.
3) Most employers complain that fresh graduates need too much of direction and they are incapable of "independent decision making". We intend to overcome this shortcoming

Course Outcomes:

By the end of the course, students should be able to,

1) If students whole-heartedly participate in the course, they can expect to be smarter, stronger and more confident thinkers.
2) They can embark on a life-long journey of "self-directed learning".

Unit I	Introduction to Critical Thinking

What is Critical Thinking o It's role in problem solving o The difference between a critical thinker and one who is not, Barriers that prevent us from thinking critically

Unit II	Importance of being logical

Key concepts of "Thinking fast and slow" - Logical fallacies & Mistakes we make when do not think "statistically"

Unit III	Pattern in deductive logic

Hypothetical syllogism - Categorical syllogism(Set theory concepts), Argument by elimination, based on maths, based on definition, Evaluating deductive arguments validity & soundness

Unit IV	Argumentation – Foundation of Critical Thinking

Recognizing arguments and their structural components & indicator words Analysis of arguments, Categorical logic - VENN Diagrams to test logical "validity", Propositional logic - Complex statements & arguments, Truth Tables – to test validity of complex statements

Reference Books

1) "Thinking Fast and Slow"- Daniel Kahneman – Penguin Books.
2) "Critical Thinking – Students Introduction" - Bassham, Irwin, Nardone, Wallace – McGraw Hill.

Savitribai Phule Pune University
Fourth Year of Information Technology (2015 Course)
414461D: Audit Course-V
Statistical Learning Model using R

Statistical learning theory is a framework for machine learning drawing from the fields of statistics and functional analysis Statistical learning theory deals with the problem of finding a predictive function based on data. Statistical learning theory has led to successful applications in fields such as computer vision, speech recognition, bioinformatics and baseball.

Course Objectives:

1) To get familiar with the explosion of "Big Data" problems, statistical learning /machine learning has become a very hot field.
2) To learn statistical learning and modelling skills which are in high demand also cover basic concepts of statistical learning / modelling methods that have widespread use in business and scientific research.
3) To get hands on the applications and the underlying statistical / mathematical concepts that are relevant to modelling techniques. The course are designed to familiarize students in implementing the statistical learning methods using the highly popular statistical software package R.

Course Outcomes:

By the end of the course, students should be able to,

1) Students will be familiar with concepts related to "data science", "analytics", "machine learning", etc. These are important topics, and will enable students to embark on highly rewarding careers.
2) Students will capable of learning "big data" concepts on their own

Unit I	Introduction to Statistical Learning
What is Statistical Learning, Various issues to consider while "modeling"	
Unit II	**Getting started with R programming**
Introduction to the R-Studio, user-interface, Basic commands, Data Structures in R, Graphics, Reading data into R.	
Unit III	**Linear Regression models including Lab**
Instructor should select a problem statement and design the assignment for Linear Regression.	
Unit IV	**Classification models (Logistic Regression and LDA) with Lab**
Instructor should select a problem statement and design the assignment for Logistic Regression and LDA.	
Unit VI	**Tree based methods (regression trees, classification tree) with Lab**
Instructor should select a problem statement and design the assignment for Tree based methods (regression trees, classification tree) with lab.	

Reference Books

1) An Introduction to Statistical Learning with Applications in R Gareth James, Daniela Witten, Trevor Hastie and Robert Tibshirani – 6th edition- Springer Publications.

SEMESTER-II

Savitribai Phule Pune University
Fourth Year of Information Technology (2015 Course)
414462: Distributed Computing System

Teaching Scheme:	Credits: 03	Examination Scheme:
TH:03 Hours/Week		In-Sem (Paper): 30 Marks End-Sem (paper): 70 Marks

Prerequisites:

1. Web Technology.
2. Computer Network Technology.
3. Operating System.

Course Objectives :

1. To understand the fundamentals and knowledge of the architectures of distributed systems.
2. To gain knowledge of working components and fault tolerance of distributed systems
3. To make students aware about security issues and protection mechanism for distributed environment.

Course Outcomes :

By the end of the course, students should be able to

1. Understand the principles and desired properties of distributed systems based on different application areas.
2. Understand and apply the basic theoretical concepts and algorithms of distributed systems in problem solving.
3. Recognize the inherent difficulties that arise due to distributed-ness of computing resources.
4. Identify the challenges in developing distributed applications

UNIT I	FUNDAMENTALS AND ARCHITECTURES	7 Hrs

Introduction: Characteristics and examples of distributed systems, Design goals, Types of distributed systems, Trends in distributed systems, Focus on Resource Sharing, Challenges. Architectures: Architectural styles, middleware and middleware organization, system architectures, Example architectures.

Case Study: The World Wide Web

UNIT II	COMMUNICATION AND COORDINATION	7 Hrs

Communication: Introduction, Layered protocols , Types of communication, Inter-process Communication, Remote Procedure Call (RPC), Message oriented communication, Multicast Communication, Network Virtualization: Overlay Network Coordination: Clock Synchronization, Logical Clocks, Mutual Exclusion, Election algorithms, Distributed event matching, Gossip Based coordination

Case Study: IBM's Websphere Message-Queuing System

UNIT III	REPLICATION AND FAULT TOLERANCE	7 Hrs

Replication: Reasons for replication, Replica management, Failure masking and replication, Consistency protocols, Catching and replication in web,Fault Tolerance: Introduction, Failure models, Fault systems with arbitrary failures, Reliable client server communication, Reliable group communication, Distributed commit, Recovery, Checkpoints.

Case Study: Catching and Replication in Web

UNIT IV	DISTRIBUTED FILES AND MULTIMEDIA SYSTEMS	7 Hrs

Distributed File Systems: Introduction, File System Architecture, Sun Network File System, and HDFS. Name Services: Introduction, Name Services and the Domain Name System, Directory Services.

Case Study- 1: The Global Name Service, 2. The X.500 Directory Service.

Distributed Multimedia Systems: Characteristics of Multimedia Data, Quality of Service Management, Resource management, Stream Adaptation.

Case Study: BitTorrent and End System Multicast.

UNIT V	DISTRIBUTED WEB BASED SYSTEM	7 Hrs

Architecture of Traditional Web-Based Systems, Apache Web Server, Web Server Clusters, Communication by Hypertext Transfer Protocol, Synchronization, Web Proxy Caching, Replication for Web Hosting Systems, Replication of Web Applications, Fault Tolerance in distributed web based systems, Security Concerns.

Case Study: HyperText Transfer Protocol (HTTP)

UNIT VI	SECURITY IN DISTRIBUTED SYSTEMS	7 Hrs

Introduction to Security: Security Threats, Policies, and Mechanisms, Design Issues, Cryptography.

Secure Channels: Authentication, Message Integrity and Confidentiality, Secure Group Communication,

Access Control: General Issues in Access Control, Firewalls, Secure Mobile Code, Denial of Service (DOS).

Security Management: Key Management, Secure Group Management, Authorization Management.

Emerging Trends In Distributed Systems: Grid Computing, Service Oriented Architectures (SOA).

Case Study: Kerberos.

Text Books

1. Maarten van Steen, Andrew S. Tanenbaum, Distributed Systems , PHI, 3rd Edition Version 3.01, ISBN: 978-15-430573-8-6(Printed).
2. Andrew S. Tanenbaum, Maarten van Steen, Distributed Systems – Principles and Paradigms, PHI, 2nd Edition, ISBN: 978-0130888938.

Reference Books

1. George Coulouris, Distributed Systems: Concepts and Design,Pearson, 5th edition, Jean Dollimore, Tim Kindberg, Gordon Blair, ISBN:13: 978-0132143011, ISBN:10: 0132143011.
2. Abhijit Belapurkar, Anirban Chakrabarti, Harigopal Ponnapalli, Niranjan Varadarajan, Srinivas Padmanabhuni, Srikanth Sunderrajan, Distributed System Security: Issues, Processes and solutions, Willey online Library, ISBN: 978-0-470-51988-2.
3. Sunita Mahajan, Seema Shah, Distributed Computing, Oxford University Press, 2nd Edition, ISBN-13: 978-0198093480.

Savitribai Phule Pune University Fourth Year of Information Technology (2015 Course) 414463: Ubiquitous Computing		
Teaching Scheme: **TH:03 Hours/Week**	**Credits:03**	**Examination Scheme:** **In-Sem (Paper): 30 Marks** **End-Sem (paper): 70 Marks**

Prerequisites:

1. Human Computer Interaction.
2. Computer Network Technology.

Course Objectives :

1. To describe ubiquitous computing, its properties applications and architectural design.
2. To explain various smart devices and services used in ubiquitous computing.
3. To teach the role of sensors and actuators in designing real time applications using Ubicomp.
4. To explore the concept of human computer interaction in the context of Ubicomp.
5. To explain Ubicomp privacy and challenges to privacy.
6. To describe Ubicomp network with design issues and Ubicomp management.

Course Outcomes:

By the end of the course, students should be able to

1. Demonstrate the knowledge of design of Ubicomp and its applications.
2. Explain smart devices and services used Ubicomp.
3. Describe the significance of actuators and controllers in real time application design.
4. Use the concept of HCI to understand the design of automation applications.
5. Classify Ubicomp privacy and explain the challenges associated with Ubicomp privacy.
6. Get the knowledge of ubiquitous and service oriented networks along with Ubicomp management.

UNIT I	**INTRODUCTION TO UBIQUITOUS COMPUTING**	**7 Hrs**

Concept of Ubiquitous Computing and Advantages, Ubiquitous Computing Applications and Scope, Properties of Ubiquitous Computing, Modelling the Key Ubiquitous Computing Properties. Ubiquitous System Environment Interaction. Architectural Design for UbiCom Systems: Smart DEI Model.

UNIT II	**UBIQUITOUS COMPUTING SMART DEVICES AND SERVICES**	**7 Hrs**

Smart Devices and Service properties, Smart mobile devices and Users, Mobile code, Smart Card Devices and Networks, Service Architecture Models. Service Provision Life-Cycle. Virtual Machines and Operating Systems, OS for Mobile Computers and Communicator Devices.

UNIT III	**ACTUATION AND CONTROL**	**7 Hrs**

Tagging the Physical World, Sensors and Networks, Micro- Electro-Mechanical Systems (MEMS), Embedded Systems and Real-Time Systems. Programmable and PID type control system, Robots.

UNIT IV	**HUMAN COMPUTER INTERACTION**	**7 Hrs**

User Interfaces and Interaction for devices, Abstract user interface through Basic Smart Wearable and Implanted Devices. Human- Centered Design (HCD).

User Models: Direct and indirect user input and modelling, modelling users' planned tasks and multiple tasks-based computing.

UNIT V	UBIQUITOUS COMPUTING PRIVACY	7 Hrs

Ubiquitous computing privacy definition, Solove's taxonomy of privacy, legal background, Interpersonal privacy, Ubicomp challenges to privacy: Collection scale, manner and motivation, data types, data accessibility; Case study of privacy solution such as Protecting RFID tags, ways of addressing privacy in Ubicomp.

UNIT VI	UBIQUITOUS COMMUNICATION AND MANAGEMENT	7 Hrs

Data Networks, Audio Networks, Wireless Data Networks, Ubiquitous Networks, Service oriented networks, network design issues; Configuration and Security management, Service oriented computer and information management, Context awareness.

Text Books

1. Stefan Poslad, Ubiquitous Computing, Wiley, Student Edition, ISBN:9788126527335
   John Krumm, Ubiquitous Computing Fundamentals.

Reference Books

1. Yin-Leng Theng and Henry B. L. Duh, Ubiquitous Computing, IGI, 2nd Edition, ISBN: 9781599046938.
2. Adam Greenfield, Everyware the Drawing age of Ubiquitous Computing, AIGA, 1st Edition, ISBN: 9780321384010.
3. Laurence T. Yeng, Evi Syukur and Seng W. Loke, Handbook on Mobile and Ubiquitous Computing, CRC, 2nd Edition, ISBN: 9781439848111.

Savitribai Phule Pune University
Fourth Year of Information Technology (2015 Course)
414464A: Elective III
Internet of Things (IoT)

Teaching Scheme:	Credits:04	Examination Scheme:
TH:03 Hours/Week		In-Sem (Paper): 30 Marks End-Sem (paper): 70 Marks

Prerequisites:

1. Fundamentals of Communication and Computer Network.
2. Computer Network Technology.

Course Objectives :

1. To understand what is Internet of things.
2. Describe architecture, Design, underlying technologies, platforms and cloud interface.

Course Outcomes:

By the end of the course, students should be able to

1. Explain what is internet of things.
2. Explain architecture and design of IoT.
3. Describe the objects connected in IoT.
4. Understand the underlying Technologies.
5. Understand the platforms in IoT.
6. Understand cloud interface to IoT.

UNIT I	INTRODUCTION TO INTERNET OF THINGS	8 Hrs

What is the Internet of Things? Internet of Things Definitions and Frameworks : IoT Definitions, IoT Architecture, General Observations, ITU-T Views, Working Definition, IoT Frameworks, Basic Nodal Capabilities, Physical Design of IoT: IoT Protocols, Logical Design of IoT: Functional block, communication Model, Communication API's, IoT Enabling Technologies: WSN, cloud computing, Big data Analytics, communication Protocols, Embedded systems, IoT levels and Deployment templates: Level 1 to Level 5.

UNIT II	IoT NETWORK ARCHITECTURE AND DESIGN	8 Hrs

The one M2M IoT Standardized Architecture, The IoT World Forum (IoTWF) Standardized Architecture, A Simplified IoT Architecture, IoT protocol stack, The Core IoT Functional Stack, IoT Data Management and Compute Stack: Fog Computing, Edge Computing, The Hierarchy of Edge, Fog, and Cloud IoT and M2M: Introduction to M2M, Difference between IoT and M2M, SDN and NFV for IoT.

UNIT III	SMART OBJECTS: THE "THINGS" IN IoT	8 Hrs

Sensors, Actuators, and Smart Objects, Sensor Networks, Connecting Smart Objects: Communications Criteria, IoT Access Technologies: IEEE 802.15.4, IEEE 802.15.4g and 802.15.4e, IEEE 1901.2a, LoRaWAN.

UNIT IV	ADDRESSING TECHNIQUES FOR THE IoT	8 Hrs

Address Capabilities, IPv6 Protocol Overview, IPv6 Tunneling, IPsec in IPv6, Header Compression Schemes, Quality of Service in IPv6, Migration Strategies to IPv6, Mobile IPV6 technologies for the IoT: Protocol Details, IPv6 over low-power WPAN (6LoWPAN).		
UNIT V	**IoT PLATFORMS**	**8 Hrs**
What is an IoT Device, Exemplary Devices: Raspberry Pi, Raspberry Pi Interfaces, Other IoT Devices: pcDuino, Beagle Bone Black, CubieBoard, ARDUINO.		
UNIT VI	**IoT PHYSICAL SERVERS AND CLOUD OFFEREINGS**	**8 Hrs**
Introduction to cloud storage models and communication API's, WAMP-AutoBahn for IoT, Python web application framework, Designing a RESTful web API, AMAZON web services for IoT, SkyNet IoT messaging platform, IoT case studies: Home Automation, Cities, Environment.		

Text Books

1. Internet of Things: A Hands-On Approach Arshdeep Bahga, Vijay Madisetti VPT – Paperback 2015 978- 0996025515 628/- 2.
2. IoT Fundamentals: Networking Technologies, Protocols, and Use Cases for the Internet of Things David Hanes, Gonzalo Salgueiro, Patrick Grossetete Cisco Press – Paperback – 16 Aug 2017 978-1- 58714-456- 1 599.
3. Building the Internet of Things with IPv6 and MIPv6: The Evolving World of M2M Communications Daniel Minoli Willy Publication s - 2013 978-1-118- 47347-4, 466.

Reference Books

1. Smart Internet of things projects Agus Kurniawan Packt - Sep 2016 978-1- 78646- 651-8 2 The Internet of Things Key Olivier Willy Publication 2nd Edition 978
2. Applications and protocols Hersent s 119- 99435-0, 3 The Internet of Things Connecting Objects to the Web Hakima Chaouchi, Willy Publications 978-1- 84821- 140-7.

Savitribai Phule Pune University
Fourth Year of Information Technology (2015 Course)
414464A: Elective III
Internet of Things Laboratory

Teaching Scheme:	Credits:04	Examination Scheme:
Practical:02 Hours/Week		TW:25 Marks OR: 25 Marks

Prerequisites:
1. Computer Network Technology.
2. Processor Architecture and Interfacing.

Course Objectives:
1. To study IoT platforms such as Raspberry-Pi/Beagle board/Arduino.
2. To study operating systems for platforms such as Raspberry-Pi/Beagle board/Arduino.
3. To get knowledge for communicating with objects.
4. To explore cloud environment for IoT.
5. To provide knowledge for IoT related protocols such as MQTT / CoAP etc.
6. To design the web interface for IoT.

Course Outcomes:
By the end of the course, students should be able to
1. To understand IoT platforms such as Raspberry-Pi/Beagle board/Arduino.
2. To understand operating systems for platforms such as Raspberry-Pi/Beagle board/Arduino.
3. To communicate with objects using IoT platforms such as Raspberry-Pi/Beagle board/Arduino.
4. To interface cloud environment for IoT application.
5. To implement IoT related protocols such as MQTT / CoAP etc.
6. To implement the web interface for IoT

Guidelines for Instructor
1. The faculty member should choose a suitable IoT platform from Raspberry-Pi, Beagle board, Arduino for study and implementation.
2. The faculty member should prepare the laboratory manual for all the experiments and it should be made available to students and laboratory instructor/Assistant

List of Assignments

Assignment 1
Study of Raspberry-Pi, Beagle board, Arduino.

Assignment 2
Study of different operating systems for Raspberry-Pi/Beagle board/Arduino. Understanding the process of OS installation on Raspberry-Pi/Beagle board/Arduino.

Assignment 3

Open source prototype platform- Raspberry-Pi/Beagle board/Arduino -Simple program digital read/write using LED and Switch -Analog read/write using sensor and actuators.
Assignment 4
Upload data from environmental sensor to cloud server (You can use any public cloud IBM Watson IoT cloud or Google or AWS etc.).
Assignment 5
Introduction to MQTT/ CoAP and sending sensor data to cloud using Raspberry-Pi/Beagle board/Arduino.
Assignment 6
Design a web interface to control connected LEDs remotely using Raspberry-Pi/Beagle board/Arduino.
Assignment 7
Install, configure XMPP server and deployed an application on Raspberry Pi/Beagle board/Arduino. Write client applications to get services from the server application.
Assignment 8
Install, configure APACHE server and deployed an application on Raspberry Pi/Beagle board/Arduino. Write client applications to get services from the server application.
Reference Books
1. The Internet of Things Key applications and protocols Olivier Hersent Willy Publications 2nd Edition 978-1-119- 99435-0. 2. The Internet of Things Connecting Objects to the Web Hakima Chaouchi, Willy Publications 978-1-84821- 140-7. 3. The Internet of Things Donald Norris TAB 4 Smart Internet of Things Projects Agus Kurniawan PACKT. 4. Getting Started with the Internet of Things Cuno Pfister SPD O'REILL Y IOT.

Savitribai Phule Pune University Fourth Year of Information Technology (2015 Course) 414464B: Elective III Information Storage and Retrieval		
Teaching Scheme: **TH:03 Hours/Week**	**Credits:04**	**Examination Scheme:** **In-Sem (Paper): 30 Marks** **End-Sem (paper): 70 Marks**

Prerequisites:

1. Data Structures and Files.
2. Database management systems.

Course Objectives :

1. To understand information retrieval process.
2. To understand concepts of clustering and how it is related to Information retrieval.
3. To deal Storage, Organization & Access to Information Items.
4. To evaluate the performance of IR system and understand user interfaces for searching.
5. To understand information sharing on semantic web.
6. To understand the various applications of Information Retrieval giving emphasis to multimedia and distributed IR, web Search.

Course Outcomes :

By the end of the course, students should be able to

1. Understand the concept of Information retrieval.
2. Deal with storage and retrieval process of text and multimedia data.
3. Evaluate performance of any information retrieval system.
4. Design user interfaces.
5. Understand importance of recommender system.
6. Understand concept of multimedia and distributed information retrieval.

UNIT I	INTRODUCTION	8 Hrs

Basic Concepts of IR, Data Retrieval & Information Retrieval, text mining and IR relation, IR system block diagram.

Automatic Text Analysis: Luhn's ideas, Conflation Algorithm, Indexing and Index Term Weighing, Probabilistic Indexing

Inverted file, Suffix trees & suffix arrays, Signature Files, Scatter storage or hash addressing, Clustered files, Hypertext and XML data structures.

UNIT II	CLASSIFICATOIN AND RETRIEVAL SEARCH STRATEGIES	8 Hrs

Retrieval strategies: Vector Space model, Probabilistic retrieval strategies, Language models, Inference networks, Extended Boolean retrieval, Latent semantic indexing, neural networks, Fuzzy set retrieval.

Retrieval utilities: Relevance feedback, Cluster Hypothesis, Clustering Algorithms: Single Pass Algorithm, Single Link Algorithm.

UNIT III	RETRIEVAL PERFORMANCE EVALUATION AND VISUALISATION	8 Hrs

Performance evaluation: Precision and recall, MRR, F-Score, NDCG, user oriented measures, cross fold evaluation.
Visualisation in Information System: Starting points, document context, User relevance judgement, Interface support for search process.

UNIT IV	DISTRIBUTED AND MULTIMEDIA IR	8 Hrs

Distributed IR: Introduction, Collection Partitioning, Source Selection, Query Processing, web issues.
MULTIMEDIA IR: Introduction, Data Modeling, Query languages, Generic multimedia indexing approach, One dimensional time series, two dimensional color images, Automatic feature extraction.

UNIT – V	WEB SEARCHING	8 Hrs

Searching the Web: Challenges, Characterizing the Web, Search Engines, Browsing, Mata-searchers, Web crawlers, Meta-crawler, Web data mining, Finding needle in the Haystack, Searching using Hyperlinks, Page ranking algorithms: Pagerank, Rank SVM.

UNIT VI	ADVANCED INFORMATION RETRIEVAL	8 Hrs

Semantic Search systems: G Semantic Web Google knowledge graphs, Ontology, Searching across ontologies, semantic web search.
Recommendation system: Collaborative Filtering and Content Based Recommendation of Documents and Products.
Information Extraction and Integration: Extracting Data from Text. Collecting and Integrating Specialized Information on the web.

Text Books

1. Yates & Neto, Modern Information Retrieval, Pearson Education, ISBN:81-297-0274-6
2. C.J. Rijsbergen, Information Retrieval, (www.dcs.gla.ac.uk)., 2ndISBN:978- 408709293.
3. David Grossman, Ophir Frieder, Information Retrieval - Algorithms and Heuristics, Springer International Edition, ISBN: 978-1-4020-3004-8.
4. Grigoris Antoniou and Frank van Harmelen, A semantic Web Primer, Massachusetts Institute of Technology, ISBN: 978-0-262-01242-3.
5. Pascal Hitzler, Markus Krötzsch, Sebastian Rudolph, Foundations of Semantic Web Technologies, Chapman & Hall/CRC, ISBN: 9781420090505.
6. Hang Li, Learning to Rank forInformation Retrievaland Natural Language.
7. Processing, Morgan & Claypool, ISBN: 9781608457076.

Reference Books

1. Christopher D. Manning, Prabhakar Raghavan and HinrichSchutzen, Introduction to Information Retrieval, Cambridge University Press, Online book, ISBN:978-0-521-86571-5
2. Robert Korfhage, Information Storage and Retrieval, John Wiley & Sons,1 Edition, ISBN:9788126507702.
3. Kowalski, Gerald, Maybury, Mark, Information Storage and Retrieval Systems :Theory and Implementation, Springer US, 2nd Edition,ISBN:978-0-7923-7924-9.
4. Zhang, Jin, Visualization for Information Retrieval, Springer-Verlag Berlin Heidelberg,1st Edition,ISBN:978-3-642-09442-2Mark leven, Introduction to search engines and web navigation, John Wiley and sons Inc, 2nd Edition,ISBN 9780-170-52684-2.
5. V. S. Subrahamanian, Satish K. Tripathi , Multimedia information System,Kulwer Academic Publisher.
6. ChabaneDjeraba, Multimedia mining A highway to intelligent multimedia documents, Kulwer Academic Publisher, ISBN:1-4020-7247-3.

7. Ricci, F, Rokach, L. Shapira, B.Kantor, Recommender Systems Handbook.
8. Stefan Buttcher, Charles L. A. Clarke, Gordon V. Cormack, Information Retrieval Implementing and Evaluating Search Engines, The MIT Press, Cambridge.

Savitribai Phule Pune University
Fourth Year of Information Technology (2015 Course)
414464B:
Information Storage and Retrieval Laboratory

Teaching Scheme:	Credits:04	Examination Scheme:
Practical:02 Hours/Week		TW:25 Marks OR: 25 Marks

Prerequisites:

1. Data Structures and Files.
2. Database management systems.

Course Objectives:

1. To understand information retrieval process.
2. To understand concepts of clustering and how it is related to Information retrieval.
3. To deal with Storage, Organization & Access to Information Items.
4. To evaluate the performance of IR system and understand user interfaces for searching.
5. To understand information sharing on semantic web.
6. To understand the various applications of Information Retrieval giving emphasis to multimedia and distributed IR, web Search.
7. To apply the gained knowledge in recent fields of advancements in the subject.

Course Outcomes:

By the end of the course, students should be able to,

1. Understand the concept, data structure and preprocessing algorithms of Information retrieval.
2. Deal with storage and retrieval process of text and multimedia data.
3. Evaluate performance of any information retrieval system.
4. Design user interfaces.
5. Understand importance of recommender system (Take decision on design parameters of recommender system).
6. Understand concept of multimedia and distributed information retrieval.
7. Map the concepts of the subject on recent developments in the Information retrieval field.

Guidelines for Instructor

Faculty member should frame Practical Assignments based on below given list of assignments. Students will submit term work in the form of journal containing handwritten write-ups/ source code and output. Staff incharge should maintain a record of continuous assessment and produced at the time of oral examination.

List of Assignments

Assignment 1

To implement Conflation Algorithm using File Handling.

Assignment 2

To implement single pass algorithm for clustering.

Assignment 3

To implement a program Retrieval of documents using inverted files.
Assignment 4
To implement a program for feature extraction in 2D colour images (any features like colour, texture etc
Assignment 5
To implement a simple Web Crawler in Java.
Assignment 6
Extract features from input image and plot histogram for the features.
Assignment 7
Write a program to recommend a product / learning course based on person preferences / education details.
Assignment 8
Consider set of 25 to 30 documents on 5 to 7 distinct topics. Define 5 queries and map the document that will be retrieved for every query. Write a program using any algorithm to retrieve documents. Evaluate the algorithm using all evaluation methods.
Assignment 9
Case study on Image retrieval for ADAS (Advanced Driver Assistance System) (Here students are expected to research the topics like Lane Change Assist (LCA), Driver Drowsiness and inattentiveness, Lane Change Assist, Automatic Parking, ACC etc.)
Reference Books
1. Yates & Neto, "Modern Information Retrieval", Pearson Education. 2. C.J. Rijsbergen, "Information Retrieval", (www.dcs.gla.ac.uk). 3. R. C. Gonzalez, R. E. Woods, “Digital Image Processing”, Pearson Education. 4. Zhang, Jin, “Visualization for Information Retrieval”, Springer-Verlag Berlin Heidelberg. 5. V. S. Subrahamanian, Satish K. Tripathi, “Multimedia information System”, Kulwer Academic Publisher. 6. Ricci, F, Rokach, L. Shapira, B.Kantor, “Recommender Systems Handbook”.

Savitribai Phule Pune University Fourth Year of Information Technology (2015 Course) 414464C: Elective III Multimedia Techniques		
Teaching Scheme: **TH:03 Hours/Week**	**Credits:04**	**Examination Scheme:** **In-Sem (Paper): 30 Marks** **End-Sem (paper): 70 Marks**

Prerequisites:

1. Data Structures and Files.
2. Basics of computer graphics and animation.

Course Objectives :

1. To learn basic components of multimedia (text, image, audio, video and animation).
2. To learn compression techniques for various multimedia components.
3. To learn rendering.
4. To learn animation and gaming.
5. Become acquainted with some advanced topics in multimedia.

Course Outcomes :

By the end of the course, students should be able to

1. To create own file formats for specific application.
2. To do some projects based on current trends in multimedia.
3. To use open sources for authoring tool for animation and presentations.
4. Understand some research areas of current multimedia techniques.

UNIT I	INTRODUCTION TO MULTIMEDIA	8 Hrs

Goals, objectives, and characteristics of multimedia, Multimedia building blocks, Multimedia architecture, Multimedia Applications Media Entertainment, Media consumption, web-based applications, e-learning and education

UNIT II	TEXT AND IMAGE PROCESSING	8 Hrs

Text: Text file formats: TXT, DOC; RTF, PDF, PS
Text compression: Huffman coding, LZ & LZW
Image: Basic Image fundamentals, Image File formats - (BMP, TIFF, JPEG, GIF)
Image processing cycle- Image acquisition, storage, Communication, and display, Image Enhancement, Image Compression: **Types of Compression**: Lossless & Lossy
Lossless: RLE, Shannon - Fano algorithm, Arithmetic coding.
Lossy: Vector quantization, Fractal Compression Technique, Transform coding and Hybrid: JPEG-DCT

UNIT III	AUDIO AND VIDEO PROCESSING	8 Hrs

AUDIO: Nature of sound waves, characteristics of sound waves, psycho-acoustic, MIDI, digital audio, CD formats.
Audio file formats: WAV, AIFF, VOC, AVI, MPEG Audio File formats, RMF, WMA
Audio compression techniques: DM, ADPCM and MPEG
Video: Video signal formats, Video transmission standards: EDTV, CCIR, CIF, SIF, HDTV,

digitization of video,

Video file formats: MOV, Real Video, H-261, H-263, Cinepack, Nerodigtal,Video editing, DVD formats, MPEG.

UNIT IV	ANIMATION AND VIRTUAL REALITY	8 Hrs

Animation: Basics of animation, types of animation, principles of animation, Methods of controlling animation, frame-by-frame animation techniques, real-time animation techniques, Programming aspects in creating simple animation,

OpenGL: Open GL over windows/Linux, Extension.

Virtual Reality: Concept, Forms of VR, VR applications, VR devices: Hand Gloves, Head mounted tracking system, VR chair, CCD, VCR, 3D Sound system, Head mounted display

UNIT – V	RENDERING	8 Hrs

Introduction, Basics of illumination and shading models, Transparency, Shadows and textures, Ray tracing from the light source, cone, beam and pencil tracing. Point based rendering, Mesh Simplification, Spatial partitioning, Solid Modeling

UNIT – VI	ADVANCES IN MULTIMEDIA	8 Hrs

Multimedia Communication and applications, Study of Multimedia networking, Quality of data transmission, Multimedia over IP, Media on Demand.

Multimedia in Android: Android Multimedia Framework Architecture

Gaming: Facial Recognition, Voice Recognition, Gesture Control, High-Def Displays, Augmented Reality, Mobile Gaming, Cloud Gaming, On-Demand Gaming.

Text Books

1. Ralf Steinmetz and Klara Nahrstedt "Multimedia Computing, Communication and Applications", Pearson Education.
2. K.R. Rao, "Multimedia Communication Systems: Techniques, Standards, and Networks", TMH.
3. Ranjan Parekh, "Principles of Multimedia", 2/E, Tata McGraw-Hill, ISBN: 1259006506
4. David F. Rogers, "Procedural Elements for Computer Graphics", 2nd Ed - Tata McGraw Hill Edition.
5. "OpenGL Programming Guide: The Official Guide to Learning OpenGL", Mason Woo, Jackie, Tom Davis, Version 2.1, 6th Edition, Pearson Education, ISBN 978-81-317-2184-1.

Reference Books

1. Ashok Banerji, AnandaGhosh, "Multimedia Technologies", ISBN: 9780070669239.
2. Gonzalez, Woods, "Digital Image Processing" Addison Wesley.
3. Ze-Nian Li, Marks S. Drew, "Fundamentals of Multimedia", Pearson Education.
4. Edward Angel, "OpenGL: A Primer", Addison-Wesley.
5. Parag Havaldar, Gerard Medioni, "Multimedia Systems", Cengage Learning.
6. Hill, Kelly, "Computer Graphics using OpenGL", 3rd Ed, Eastern Economy Edition.
7. Alan H. Watt and Mark Watt,"Advanced Animation and Rendering Techniques: Theory and Practice", Addison-Wesley, ACM Press, ISBN: 0201544121.
8. Foley, Dam, Feiner, Hughes,"Computer Graphics Principles & Practice", 2nd Ed, Pearson Education.
9. Introduction to Game Development Using Processing, by J. R. Parker , Mercury Learning & Information; Pap/Com edition.

Savitribai Phule Pune University
Fourth Year of Information Technology (2015 Course)
414464C: Multimedia Techniques Laboratory

Teaching Scheme:	Credits:04	Examination Scheme:
Practical:02 Hours/Week		TW:25 Marks OR: 25 Marks

Prerequisites:

1. Data Structures and Files.
2. Basics of computer graphics and animation.

Course Objectives:

1. To learn basic components of multimedia (text, image, audio, video and animation).
2. To learn compression techniques for various multimedia components.
3. To learn rendering.
4. To learn animation and gaming.
5. Become acquainted with some advanced topics in multimedia.

Course Outcomes:

By the end of the course, students should be able to

1. To create own file formats for specific application.
2. To do some projects based on current trends in multimedia.
3. To use open sources for authoring tool for animation and presentations.

List of Assignments

Assignment 1

Write a program to open and display Images in Python or Java using OpenCV tool.

Assignment 2

Write a program for generating Huffman codes for a gray scale 8-bit image

Assignment 3

Write a program for implementation of ray-tracing algorithm in Java.

Assignment 4

Create a simple animation using OpenGL

Assignment 5

Study of any virtual reality tool/software. (3DS MAX, BLENDER, GOOGLE VR)

Assignment 6

Write a Program to compress image using Python

Assignment 7

Create a short movie clip using open source tool

Assignment 8

Build a Virtual Reality web application using open source tool

Assignment 9

Write a Program to implement basic game in Python

Reference Books

1. Ralf Steinmetz and Klara Nahrstedt "Multimedia Computing, Communication and Applications", Pearson Education.
2. K.R. Rao, “Multimedia Communication Systems: Techniques, Standards, and Networks”, TMH.
3. Ranjan Parekh, "Principles of Multimedia", 2/E, Tata McGraw-Hill, ISBN: 1259006506.
4. David F. Rogers, "Procedural Elements for Computer Graphics", 2nd Ed - Tata McGraw Hill Edition.
5. "OpenGL Programming Guide: The Official Guide to Learning OpenGL", Mason Woo, Jackie, Tom Davis, Version 2.1, 6th Edition, Pearson Education, ISBN 978-81-317.

Savitribai Phule Pune University
Fourth Year of Information Technology (2015 Course)
414464D: Elective III
Internet and Web Programming

Teaching Scheme:	Credits:04	Examination Scheme:
TH:03 Hours/Week		In-Sem (Paper): 30 Marks End-Sem (paper): 70 Marks

Prerequisites Courses :

1. Internet and Web Programming.

Course Objectives :

1. To understand Internet and Web Programming basic concepts.
2. To develop client side web programming skills.
3. To develop server side web programming skills.
4. To understand Web Services and Content Management System.
5. To understand mobile web development and develop mobile web development skills.
6. To understand web security and cyber ethics.

Course Outcomes :

By the end of the course, students should be able to

1. Demonstrate static website using basic tools.
2. Develop client side programming skills.
3. Develop server side programming skills.
4. Understand web services and handle content management tools.
5. Develop mobile website using mobile web development tools.
6. Understand aspects of web security and cyber ethics.

UNIT I	INTERNET AND WEB PROGRAMMING ESSENTIALS	8 Hrs

The Internet, Introduction Basic Internet Protocol, The World Wide Web, Introduction to Web Programming, Web Clients, Web Servers, Browser and Search Engines.

Markup Languages : Introduction to HTML, Static and dynamic HTML, Structure of HTML documents, HTML Elements, Linking in HTML, Anchor Attributes, Image Maps, Meta Information, Image Preliminaries, Layouts, Backgrounds, Colors and Text, Fonts, Tables, Frames and layers, Audio and Video Support with HTML Database integration, , Forms Control, Form Elements, Applying Styles, values, selectors, class, ids, inheritance, layout, backgrounds, borders, margin, padding, lists, fonts, text formatting, positioning. HTML5. Introduction to Style Sheet, Inserting CSS in an HTML page, CSS selectors, Introduction to XML, XML key component, Transforming XML into XSLT, DTD: Schema, elements, attributes, Introduction to JSON.

UNIT II	CLIENT SIDE PROGRAMMING	8 Hrs

JavaScript: Overview of JavaScript, using JS in an HTML (Embedded, External), Data types, Control Structures, Arrays, Functions and Scopes, Objects in JS, DOM: DOM levels, DOM Objects and their properties and methods, Manipulating DOM, JQuery: Introduction to JQuery, Introduction to AJAX, Working of AJAX, AJAX processing steps, coding AJAX script. Introduction to Angular JS.

UNIT III	SERVER SIDE PROGRAMMING	8 Hrs

Introduction to Server Side technology and TOMCAT, Servlet: Introduction to Servlet, need and advantages, Servlet Lifecycle, Creating and testing of sample Servlet, session management. JSP: Introduction to JSP, advantages of JSP over Servlet, elements of JSP page: directives, comments, scripting elements, actions and templates, JDBC Connectivity with JSP. PHP: Introduction to PHP, Features, PHP script, PHP syntax, conditions & Loops, Functions, String manipulation, Arrays & Functions, Form handling, Cookies & Sessions, using MySQL with PHP.

UNIT IV	**WEB SERVICES AND CONTENT MANAGEMENT SYSTEMS**	**8 Hrs**

Introduction to Web Services, Web Services Architecture, XML Messaging, SOAP, WSDL, UDDI, REST, Java Web Services, Amazon Web Services, DevOps, Introduction to Content Management System (CMS), Wordpress / Joomla, Advanced Technology: Bootstrap, JSF, Spring.

UNIT V	**MOBILE WEB DEVELOPMENT**	**8 Hrs**

What is Mobile Web? Understanding Mobile Devices, Mobile Data Usage, Mobiles and Desktops, Building an HTML page, Getting jQuery Mobile, Implementing jQuery Mobile, Working with data attributes, Working with jQuery Mobile Pages, Enhancing Pages with Headers, Footers, and Toolbars; Working with Lists, Building a Simple Mobile Website, Working with Forms and jQuery Mobile, Creating Modal Dialogs and Widgets, Creating Grids, Panels, and Other Widgets; jQuery Mobile Configuration, Utilities, and JavaScript Methods; Working with Events.

UNIT VI	**WEB SECURITY AND CYBER ETHICS**	**8 Hrs**

Overview of Web Security: Need of Web Security, Breach of Web Security, What need to be Secure on Web? Can Web be secure? Aspects of Web Security, Purpose of Web Security, A Security Equation, Defining Security Equation, Common Threats on Web, User level Security, Server Level Security, Cyber ethics, Issues in Cyber ethics.

Text Books

1. Kogent Learning Solutions Inc,Web Technologies: HTML, JAVASCRIPT, PHP, JAVA, JSP, XML and AJAX, Blackbook, Dreamtech Press, Second Edition ,ISBN:9788177228496.
2. Raymond Camden, Andy Matthews, jQuery Mobile Web Development Essentials, Packt Publishing, Second Edition, 9781782167891.
3. Ethan Cerami, Web Services Essentials, O'Reilly Media, First Edition, 0-596-00224-6.
4. Shweta Bhasin, Web Security Basics, Premier Press, First Edition, ISBN: l978-1592000067.

Reference Books

1. Dr.Hiren Joshi, Web Technology and Application Development, DreamTech, First,ISBN:978-93- 5004-088-1.
2. Santosh Kumar K., DT Editorial Services,Black Book, JDBC 4.2, Servlet 3.1 & JSP 2.3,Dreamtech Press, Second Edition, ISBN:978-8177228700.
3. Steven M. Schafer, “HTML, XHTML and CSS”, Wiley India Edition, Fourth Edition, 978-81-265-1635-3.
4. B. V. Kumar, S. Sangeetha, S.V. Subrahmanya, J2EE Architecture, an illustrative gateway to enterprise solutions, Tata McGraw Hill Publishing Company, Second Edition, ISBN:978-0-070-621-633.
5. Ivan Bayross,”Web Enabled Commercial Application Development Using HTML, JavaScript, DHTML and PHP,BPB Publications,4th Edition,ISBN:978-8183330084.
6. Brain Fling, Mobile Design and Development, O'REILLY, First Edition, ISBN: 13:978-81-8404-817-9.

7. Jason Hunter, Java Servlet Programming, O'reilly Publications, 2nd Edition, ISBN: 978-0-596-00040-0.
8. Adam Bretz & Colin J Ihrig, Full Stack Javascript Development with MEAN, SPD, First Edition, ISBN:978-0992461256.

Savitribai Phule Pune University
Fourth Year of Information Technology (2015 Course)
414464D: Internet and Web Programming Laboratory

Teaching Scheme:	Credits:04	Examination Scheme:
Practical:02 Hours/Week		TW:25 Marks OR: 25 Marks

Prerequisites:

1. Basic Programming Skills.

Course Objectives:

1. Making Student familiar with client server architecture.
2. To develop ability for making web application using JavaScript.
3. To develop web applications using Angular JS.
4. To design and implement web services with content management.
5. To understand use of Content Management Tolls in Website Development.

Course Outcomes:

By the end of the course, students should be able to

1. Use fundamental skills to develop and maintain website and web application.
2. Apply scripting skills for Server side and Client-side Programming.
3. Develop web services to transfer data and add interactive components to website.
4. Combine multiple web technologies to create advanced web components.

Guidelines for Instructor's Manual

The instructor's manual is to be developed as hands - on resource and reference. The instructor's manual need to include prologue (about University/program/ institute/ department/foreword/ preface etc), University syllabus, conduction & Assessment guidelines, topics under consideration - concept, objectives, outcomes, set of typical applications/assignments/ guidelines, and references

Guidelines for Student Journal

The laboratory assignments are to be submitted by student in the form of journal. Journal consists of prologue, Certificate, table of contents, and handwritten write-up of each assignment (Title, Objectives, Problem Statement, Outcomes, software & Hardware requirements, Date of Completion, Assessment grade/marks and assessor's sign, Theory-Concept/technology/tool in brief, design, test cases, conclusion/analysis. Program codes with sample output of all performed assignments are to be submitted as softcopy. As a conscious effort and little contribution towards Green IT and environment awareness, attaching printed papers as part of write-ups and program listing to journal may be avoided. Use of DVD containing students programs maintained by lab In-charge is highly encouraged. For reference one or two journals may be maintained with program prints at Laboratory

Guidelines for Assessment

Continuous assessment of laboratory work is done based on overall performance and laboratory assignments performance of student. Each laboratory assignment assessment will assign grade/marks based on parameters with appropriate weightage. Suggested parameters for overall assessment as well as each lab assignment assessment include- timely completion, performance, innovation, efficient codes, punctuality and neatness

Guidelines for Practical Examination

Both internal and external examiners should jointly set problem statements. During practical assessment, the expert evaluator should give the maximum weightage to the satisfactory implementation of the problem statement. The supplementary and relevant questions may be asked at the time of evaluation to test the student's for advanced learning, understanding of the fundamentals, effective and efficient implementation. So encouraging efforts, transparent evaluation and fair approach of the evaluator will not create any uncertainty or doubt in the minds of the students. So adhering to these principles will consummate our team efforts to the promising start of the student's academics.

Guidelines for Laboratory Conduction

The instructor is expected to frame the assignments by understanding the prerequisites, technological aspects, utility and recent trends related to the topic. The assignment framing policy need to address the average students and inclusive of an element to attract and promote the intelligent students. The instructor may set multiple sets of assignments and distribute among batches of students. It is appreciated if the assignments are based on real world problems/applications. Encourage students for appropriate use of Hungarian notation, proper indentation and comments. Use of open source software is to be encouraged. In addition to these, instructor may assign one real life application in the form of a mini-project based on the concepts learned. Instructor may also set one assignment or mini-project that is suitable to respective branch beyond the scope of syllabus.

List of Assignments

Assignment 1

1.1 Using HTML5 layout tags develop informative page with sections which include various images, links to other pages for navigation, make use of all possible formatting (for example font, color etc.).

1.2 Apply CSS properties Border, margins, Padding, Navigation, dropdown list to page created in first assignment.

Assignment 2

Design an online registration form for any application and validate it using JQuery.

Assignment 3

Design Login Application using PHP and add essence of Ajax in it.

Assignment 4

Create any Java Web Service and integrate it with any suitable application.

Assignment 5

Create JSP login page and validate it. Make use of Servlets.

Assignment 6

Create an application for bill payment using Angular JS.

Assignment 7

Develop website using any CMS tool which falls into one of the categories blog, social networking, News updates, Wikipedia, E-commerce store. Website must include home page, and at least 3.

Assignment 8

Develop Mini Project using any front end tool with database connectivity.
Reference Books

1. Aleksa Vukotic and James Goodwill, "Apache Tomcat 7", Apress, 2011, ISBN: 10: 1430237236.
2. Bryan Basham, Kathy Sierra, Bert Bates, "JSP: Passing the Sun Certified Web Component Developer Exam", O'Reilly Media ISBN: 978-0-596-51668-0.
3. Chirag Rathod, Jonathan Wetherbee, Peter Zadrozny, and Raghu R. Kodali, "Beginning EJB 3: Java EE 7 Edition", Apress, 2013, ISBN: 9781430246923.
4. Richard Monson-Haefel, "J2EE Web Services", Addison-Wesley Professional, First Edition, 2004, ISBN: 10: 0321146182.
5. Chuck Cavaness, "Programming Jakarta Struts", O'relly Media, second edition 2004, ISBN: 978- 0-596-00651-8.
6. Michael Morrison, Lynn Beighley, "Head First PHP & MySQL: A Brain-Friendly Guide", O'relly Media, second edition 2008, ISBN: 13: 9788184046588.
7. Dan Rahmel, "Advanced Joomla!" Apress, First Edition, 2013, ISBN: 13: 9781430216285.
8. Iwein Fuld, Marius Bogoevici, Mark Fisher, Jonas Partner", Spring Integration in Action", Manning, 2012, ISBN: 13: 9781935182436.

Savitribai Phule Pune University
Fourth Year of Information Technology (2015 Course)
414464E: Elective III
Computational Optimization

Teaching Scheme:	Credits :04	Examination Scheme:
TH:03 Hours/Week		In-Sem (Paper): 30 Marks End-Sem (paper): 70 Marks

Prerequisites Courses :

1. Mathematical preliminaries like Linear algebra, matrices, Elements of probability theory & Elementary multivariable calculus.
2. Design and Analysis of Algorithms.
3. Genetic Algorithms.

Course Objectives :

1. To enable the student to learn and acquire mathematical methods in engineering disciplines.
2. To introduce the methods of optimization to solve a linear programming problem by various methods.
3. To introduce few advanced optimization techniques.

Course Outcomes :

By the end of the course, students should be able to

1. Learn and implement various optimization techniques.
2. Learn model real-world problems in optimization framework.
3. Apply various optimization models to solve optimization problems in computer-science & IT Engineering.

UNIT I	INTRODUCTION	8 Hrs

Overview, Operation Research Modeling Approach and Various Real Life Situations, Linear Programming Problems (LPP): Basic LPP and Applications; Various Components of LP Problem Formulation, Solving Linear Programming Problems: Using Simultaneous Equations and Graphical Method; Simplex Method; Duality Theory; Charnes' Big – M Method. Transportation Problems and Assignment Problems, 0/1 knapsack problem using brute force and dynamic approach.

UNIT II	NETWORK ANALYSIS	8 Hrs

Shortest Path: Dijkstra Algorithm; Floyd Algorithm; Maximal Flow Problem (Ford-Fulkerson); PERT-CPM, network design algorithms.

UNIT III	INVENTORY CONTROL	8 Hrs

Introduction; Economic Order Quantity (EOQ) models, Deterministic and probabilistic Models, Safety Stock, Buffer Stock, Inventory Model of Central Warehouse.

UNIT IV	GAME THEORY	8 Hrs

Introduction ; 2- person Zero – sum Game; Saddle Point ; Mini-Max and Maxi-Min Theorems, Games without saddle point ; Graphical Method ; Principle of Dominance.

UNIT V	QUEUING THEORY	8 Hrs

Introduction; Basic Definitions and Notations; Axiomatic Derivation of the Arrival & Departure (Poisson Queue). Pure Birth and Death Models; Poisson Queue Models: M/M/1: ∞ /FIFO and M/M/1: N/ FIFO.		
UNIT VI	**ADVANCED OPTIMIZATION TECHNIQUES**	**8 Hrs**
Direct and indirect search methods, Evolutionary algorithms for optimization and search, Concepts of multi-objective optimization, genetic algorithms and simulated annealing, optimization of machine learning algorithms, ant colony optimization, Applications of IT Engineering: Search Engine Optimization, Smart Grid Optimization.		

Text Books

1. H.A. Taha, "Operations Research", Fifth Edn. Macmillan Publishing Company, 1992.
2. K. Deb, "Optimization for Engineering Design- Algorithms and Examples", Prentice-Hall Of India Pvt. Ltd., New Delhi, 1995.
3. Hadley G., "Linear Programming" Narosa Publishers, 1987.
4. Mital : Optimization Methods, New Age International.
5. Kalyanmoy Deb, Mulitobjective Optimization –An evolutionary Algorithmic Approcach, John Wiley & Sons, New York.

Reference Books

1. V.K.Kapoor – "Operations Research".
2. Kanti Swaroop – "Operations Research".
3. Hillier F.& Liebermann G.J., "Operations Research", Holder Day Inc, 1974.
4. Mustafi : Operations Research, New Age International.
5. Shenoy : Operations Research for Management , New Age International.
6. Mahapatra : Introduction to System Dynamics Modelling, Universities Press.
7. Rao : Engineering Optimization , New Age International.
8. Schaum Outline Series – "Operations Research", TMH.
9. Introduction to Optimization – Edwin K P Chong, Stainslaw H Zak.
10. Nonlinear programming – Dimitry Bertsekas.
11. J.C.Pant, Introduction to Optimization, Jain Brothers, New Delhi, 1983.
12. kershenbaum A., " Telecommunication network design algorithms", TMH

Savitribai Phule Pune University
Fourth Year of Information Technology (2015 Course)
414464E: Computational Optimization Laboratory

Teaching Scheme:	Credits:04	Examination Scheme:
Practical:02 Hours/Week		TW:25 Marks OR: 25 Marks

Prerequisites:

1. Optimization Algorithms.
2. Basics of Problem Solving.
3. Fundamentals of Design and Analysis of Algorithms.

Course Objectives:

1. To understand how to solve knapsack problem by brute force method.
2. Understand different problem-solving algorithms.

Course Outcomes:

By the end of the course, students should be able to

1. Understand Transportation problem.
2. Learn different measures in shortest path algorithms.
3. Understand and learn Queuing Model.

Guidelines for Instructor

Instructor should design and implement at least 08 assignments and 2 study assignments on Computational Optimization

List of Assignments

Assignment 1

Write a program to solve Transportation problem.

Assignment 2

Write a program to solve Assignment problem.

Assignment 3

Write a program to solve 0/1 knapsack problem using brute force method.

Assignment 4

Write a program to solve 0/1 knapsack problem using dynamic programming.

Assignment 5

Write a program to solve Duality problem.

Assignment 6

Write a program to solve optimization problem using Simplex method.

Assignment 7

Write a program to solve Dijkstra's and Floyd shortest path algorithm.

Assignment 8

Design and implement Maximal flow problem.

Assignment 9

Write a program to solve PERT/CPM problem.

Assignment 10

Design and implement Mini-Max and Maxi-Min theorem.
Study Assignments
Assignment 1
EOQ Models
Assignment 2
Safety stock and buffer stock
Assignment 3
M/M/1:∞/FIFO
Assignment 4
M/M/1:N/FIFO

Savitribai Phule Pune University
Fourth Year of Information Technology (2015 Course)
414465A: Elective IV
Rural Technologies and Community Development

Teaching Scheme:	Credits:03	Examination Scheme:
TH:03 Hours/Week		In-Sem (Paper): 30 Marks End-Sem (paper): 70 Marks

Course Objectives :

1. Understand theories and practices in the rural development model.
2. Learn and analyse rural life and rural economy.
3. Understand different measures in rural development.
4. Learn different technologies used in upliftment of rural life.
5. To participate in visits and case studies for better understanding for rural development and its impact on overall economy.

Course Outcomes :

By the end of the course, students should be able to

1. Understand rural development model.
2. Learn different measures in rural development and its impact on overall economy.
3. Understand and learn importance of technologies in rural and community development.
4. Understand challenges and opportunities in rural development.

UNIT I	INTRODUCTION	7 Hrs

RURAL DEVELOPMENT - Concepts and connotations, Basic Elements, Growth Vs. Development, Why rural development, Rising expectations and development, Development and Change, Human beings as cause and consequences of development.

RURAL ECONOMY OF INDIA - Introduction, size and structure, The characteristics of rural sector, The role of agricultural sub-sector, The role of non-agricultural sub-sector, Challenges and opportunities.

UNIT II	RURAL DEVELOPMENT - MEASURES AND PARADIGMS	7 Hrs

MEASURES OF DEVELOPMENT - Introduction, Measures of level of rural development, Measures of income distribution, Measures of development simplified, Concepts and measures of rural poverty.

PARADIGMS OF RURAL DEVELOPMENT - Introduction, The modernization theory, The dependency theory of Marxist School, Rosenstein- Rodan's theory of 'Big Push', Lewis' model of economic development, The human capital model of development, The Gandhian Concept of Rural Development theories from other social sciences.

UNIT III	TECHNOLOGIES FOR RURAL DEVELOPMENT	7 Hrs

Using Water Resources - The water cycle, Drinking Water, Water quality testing, Water filtering ,Extraction from Groundwater ,Pumps Rope and washer pump ,Manuel pumps, Treadle pump, Irrigation for agriculture, Channel systems, Sprinkler systems, Drip systems Water diversion ,Water storage

Building Infrastructures and Creating Energy - Basic energy uses , Energy Sources - Firewood, Solar Energy, Hydroelectricity, Hydromechanical, Wind Energy, Energy Storage,Connecting to the Electrical Network, Environmental Considerations

Use of ICT in Rural and agricultural development - Education, Healthcare, Agriculture, Business, Resource Mapping, Digital and Social Media Marketing Decision Support Systems for soil conservation and farm management Waste Management and Sanitation.		
UNIT IV	**COMMUNITY DEVELOPMENT**	**7 Hrs**
DEVELOPING COMMUNITIES - Introduction, Service Learning and community development, Theory and practice of community development, Community development issues. The diverse meaning of community development, The knowledge base of community development, International community development.		
UNIT V	**COMMUNITY DEVELOPMENT - RURAL ENTREPRENEURSHIP**	**7 Hrs**
Different forms of Rural Entrepreneurship, Significance , Business planning for a new venture: the concept of planning paradigm, Forms of business enterprises-Sole proprietorship, partnership and corporations, Product and Process development, Marketing analysis and competitive analysis, strategies; Financial resources; debt financing, banks and financial institutions and other non-bank financial sources; Government programmes : direct loan assistance and subsidies; Industrial and legal issues for rural enterprises.		
UNIT VI	**CASE STUDIES AND FIELD VISIT**	**7 Hrs**
Role of Micro-Finance institutions in rural development, Use of ICT in Rural development, Watershed Management - Water-Cup Competition by Paani Foundation, Community Safe Water Solutions, Visit to a 'Woman Self help group' nearby and study of its functioning and its role in development. Visit to model villages in nearby region - Ralegan-Siddhi, Dist - Ahemadnagar, Hiware Bazar Dist - Ahemadnagar, Tikekarwadi - Dist. - Pune, Buchekarwadi Dist- Pune etc.		
Text Books		
1. "Rural Development: Principles, Policies and Management" - Katar Singh , Sage Publications. 2. "Introduction to Community Development - Theory, Practice and Service Learning", Edited by J W Robinson, Sage Publications. 3. G. N. Tiwari, Solar Energy: Fundamentals, Design, Modeling and Applications, Narosa, 2002. 4. "Fundamentals of Entrepreneurship", H. Nandan, Third Edition, PHL Learning Pvt. Ltd., 5. "Monetary Economics-Institutions, Theory and Policy" , First Edition, S B Gupta, S Chand Publications, ISBN – 9788121904346.		
Reference Books		
1. "KURUKSHETRA" - A Journal on Rural Development. 2. "Energy conversion", R. Y. Goswami, Frank Kreith, CRC Press, 2007. 3. "Solar Energy: Fundamental and Application" , H. P. Garg and S. Prakash,Tata McGraw Hill, 1997. 4. "Technologies for Sustainable Rural Development: Having Potential of Socio Economic. Upliftment" , TSRD 2014 , edited by Jai Prakash Shukla, Allied Publishers Pvt. Ltd.		

Savitribai Phule Pune University
Fourth Year of Information Technology (2015 Course)
414465B: Elective IV
Parallel Computing

Teaching Scheme:	Credits:03	Examination Scheme:
TH:03 Hours/Week		In-Sem (Paper): 30 Marks End-Sem (paper): 70 Marks

Prerequisites Courses :

1. System Programming.
2. Operating System.

Course Objectives :

1. Understand theories and practices in parallel computing.
2. Learning hardware concepts and various languages used in parallel computing.
3. Understand different challenges in parallel computing.

Course Outcomes :

By the end of the course, students should be able to

1. Understand fundamentals in parallel computing.
2. Understand and learn importance of technologies including different hardware structures used in parallel computing.
3. Understand challenges and opportunities in parallel computing.

UNIT I	FUNDAMENTALS OF PARALLEL COMPUTING	7 Hrs

Need for Parallel Computing, Different Parallel Computer Models, ILP, TLP and Data Parallelism, Parallel Programming Overview, Shared Memory Programming, Message Passing Paradigm, Interaction and Communication, Interconnection Networks.

UNIT II	PARALLEL HARDWARE AND LANGUAGES	7 Hrs

Introduction to parallel hardware: Multi-cores and multiprocessors; shared memory and message passing architectures; cache hierarchy and coherence; sequential consistency, Parallel languages and compilers: Language features for parallelism, parallel language constructs, optimizing compilers for parallelism, dependency analysis, code optimization and scheduling, loop parallelization and pipelining

UNIT III	CHALLENGES OF PARALLEL PROGRAMMING	7 Hrs

Identifying Potential Parallelism, Techniques for Parallelizing Programs, Issues, Cache Coherence issues, Memory Consistency Models, Maintaining Memory Consistency, Synchronization Issues, Performance Considerations.

UNIT IV	OPENMP PROGRAMMING	7 Hrs

OpenMP Execution Model, Memory Model and Consistency, Open MP Directives, Run Time Library Routines, Handling Data and Functional Parallelism.

UNIT V	MPI PROGRAMMING AND PROGRAMMING HETEROGENEOUS PROCESSORS	7 Hrs

The MPI Programming Model, Global Operations, Asynchronous Communication , Collective Communication , Other MPI Features ,Performance Issues , Combining OpenMP and MPI, GPU Architecture.

UNIT VI	GPU PROGRAMMING	7 Hrs

Introduction to GPU programming: GPU architecture; Introduction to CUDA programming, CUDA Threads and Memories, Concept of SIMD and SIMT computation; Thread blocks; Warps; Global memory; Shared memory; Thread divergence in control transfer; Example case studies, CUDA Threads and Memories , Application Development. Introduction to OpenCL.

Text Books

1. John L. Hennessey and David A. Patterson, “Computer Architecture, A quantitative approach”, Morgan Kaufmann / Elsevier Publishers, 5th. Edition, 2012.
2. Peter S. Pacheco, “An Introduction to Parallel Programming”, Morgan Kaufmann, 2011.
3. Michael J Quinn, “Parallel programming in C with MPI and OpenMP”, Tata McGraw Hill, 2003.
4. David B. Kirk and Wen,mei W. Hwu, “Programming Massively Parallel Processors”, Morgan Kaufmann, 2010.
5. David Culler: Parallel Computer Architecture: A Hardware/Software Approach, Morgan Kaufmann.
6. Jack Dongarra et al., Sourcebook of Parallel Computing, Morgan Kaufman Publishers, San Francisco, CA, 2003.

Reference Books

1. Ananth Grama, George Karypis, Vipin Kumar and Anshul Gupta, “Introduction to Parallel Computing”, Second Edition, Pearson Education Limited, 2003.
2. Shameem Akhter and Jason Roberts, “Multi,core Programming”, Intel Press, 2006.
3. Ian Foster, “Designing and Building Parallel Programs: Concepts and Tools for Parallel Software Engineering”, Addison Wesley Longman Publishing Co., USA, 1995.
4. David E. Culler, Jaswinder Pal Singh, “Parallel Computing Architecture: A hardware Software approach”, Morgan Kaufmann / Elsevier Publishers, 1999.

Savitribai Phule Pune University
Fourth Year of Information Technology (2015 Course)
414464C: Elective IV
Computer Vision

Teaching Scheme:	Credits:03	Examination Scheme:
TH:03 Hours/Week		In-Sem (Paper): 30 Marks End-Sem (paper): 70 Marks

Prerequisites Courses :

1. Students should know vectors, linear algebra (i.e., matrix operations, solution of linear equations).
2. Programming language (e.g., Matlab and/or C).

Course Objectives :

1. To review image processing techniques for computer vision.
2. To understand shape and region analysis.
3. To understand three-dimensional image analysis techniques.
4. To understand Object detection and tracking.
5. To study some applications of computer vision algorithms.

Course Outcomes :

By the end of the course, students should be able to

1. Implement fundamental image processing techniques required for computer vision.
2. Implement boundary tracking techniques.
3. Apply Hough Transform for line, circle, and ellipse detections.
4. Implement motion related techniques.
5. Develop skills to develop applications using computer vision techniques.

UNIT I	FUNDAMENTALS OF DIGITAL IMAGE PROCESSING	7 Hrs

Review of image processing techniques, classical filtering operations, Thresholding techniques, edge detection techniques, corner and interest point detection, mathematical morphology and textures.

UNIT II	SHAPES AND REGIONS	7 Hrs

Binary shape analysis – connectedness – object labeling and counting – size filtering – distance functions – skeletons and thinning – deformable shape analysis – boundary tracking procedures – active contours – shape models and shape recognition – centroidal profiles – handling occlusion – boundary length measures – boundary descriptors – chain codes – Fourier descriptors – region descriptors – moments.

UNIT III	HOUGH TRANSFORM	7 Hrs

Line detection – Hough Transform (HT) for line detection – foot-of-normal method – line localization – line fitting – RANSAC for straight line detection – HT based circular object detection – accurate center location – speed problem – ellipse detection –
Applications and case study: Human Iris location – hole detection – generalized Hough Transform – spatial matched filtering – GHT for ellipse detection – object location – GHT for feature collation.

UNIT IV	3D VISION AND MOTION	7 Hrs

Methods for 3D vision – projection schemes – shape from shading – photometric stereo – shape from texture – shape from focus – active range finding – surface representations –

point-based representation – volumetric representations – 3D object recognition – 3D reconstruction – introduction to motion – triangulation – bundle adjustment – translational alignment – parametric motion – spline based motion – optical flow – layered motion.

UNIT V	OBJECT DETECTION AND TRACKING	7 Hrs

Introduction to Motion Detection , Applications of Motion Detection and Tracking, Background Subtraction (BGS), Basic BGS Algorithms, Mixture of Gaussians (MoG), Block matching for object tracking. Single object and multi-object tracking.

UNIT VI	COMPUTER VISION APPLICATIONS	7 Hrs

Application: Photo album – Face detection – Face recognition – Eigen faces – Active appearance and 3D shape models of faces Application: Surveillance – foreground-background separation – particle filters – Chamfer matching, and occlusion – combining views from multiple cameras – human gait analysis Application: In-vehicle vision system: locating roadway – road markings – identifying road signs – locating pedestrians.

Text Books

1. Simon J. D. Prince, "Computer Vision: Models, Learning, and Inference", Cambridge University Press, 2012.

Reference Books

1. R. Davies, "Computer & Machine Vision", Fourth Edition, Academic Press, 2012.
2. R. Szeliski, "Computer Vision: Algorithms and Applications", Springer 2011.
3. Mark Nixon and Alberto S. Aquado, "Feature Extraction & Image Processing for Computer Vision", Third Edition, Academic Press, 2012.
4. D. L. Baggio et al., "Mastering OpenCV with Practical Computer Vision Projects", Packt Publishing, 2012.
5. Jan Erik Solem, "Programming Computer Vision with Python: Tools and algorithms for analyzing images", O'Reilly Media, 2012.
6. Sudha Challa, "Fundamentals of Object Tracking", Cambridge University Press, 2011.

ONLINE REFERENCES

1. http://kercd.free.fr/linksKCD.html
2. http://www.cs.ubc.ca/spider/lowe/vision.html
3. http://www.teiath.gr/seyp/optics/Vision.htm
4. http://www.visionscience.com/

Savitribai Phule Pune University
Fourth Year of Information Technology (2015 Course)
414464D: Elective IV
Social Media Analytics

Teaching Scheme:	Credits:03	Examination Scheme:
TH:03 Hours/Week		In-Sem (Paper): 30 Marks End-Sem (paper): 70 Marks

Prerequisites Courses :

1. Basic knowledge of Graphs.
2. Data mining.
3. Data Analysis.

Course Objectives :

1. To understand foundations of Social Media Analytics.
2. To Visualize and understand the data mining aspects in social networks.
3. To solve mining problems by different algorithms.
4. To understand network measures for social data.
5. To understand behavioral part of web applications for Analysis.
6. To analyze the data available on any social media applications.

Course Outcomes :

By the end of the course, students should be able to

1. Understand the basics of Social Media Analytics.
2. Explain the significance of Data mining in Social media.
3. Demonstrate the algorithms used for text mining.
4. Apply network measures for social media data.
5. Explain Behavior Analytics techniques used for social media data.
6. Apply social media analytics for Face book and Twitter kind of applications.

UNIT I	ANALYTICS IN SOCIAL MEDIA AND TYPES OF ANALYTICS TOOLS	7 Hrs

The foundation for analytics, Social media data sources, Defining social media data, data sources in social media channels, Estimated Data sources and Factual Data Sources, Public and Private data, data gathering in social media analytics.

UNIT II	VISUALIZING SOCIAL NETWORKS	7 Hrs

Introduction, A Taxonomy of Visualization, The convergence of Visualization, Interaction and Analytics. Data mining in Social Media: Introduction, Motivations for Data mining in Social Media, Data mining methods for Social Media, Related Efforts.

UNIT III	TEXT MINING IN SOCIAL NETWORKS	7 Hrs

Introduction, Keyword search, Classification Algorithms, Clustering Algorithms-Greedy Clustering, Hierarchical clustering, k-means clustering, Transfer Learning in heterogeneous Networks, Sampling of online social networks, Comparison of different algorithms used for mining, tools for text mining.

UNIT IV	NETWORK MEASURES	7 Hrs

Centrality: Degree Centrality , Eigenvector Centrality, Katz Centrality , PageRank, Betweenness Centrality, Closeness Centrality ,Group Centrality ,Transitivity and Reciprocity, Balance and Status, Similarity: Structural Equivalence, Regular Equivalence

UNIT V	BEHAVIOR ANALYTICS	7 Hrs

Individual Behavior: Individual Behavior Analysis, Individual Behavior Modeling, Individual Behavior **Prediction Collective Behavior**: Collective Behavior Analysis, Collective Behavior Modeling, Collective Behavior Prediction

UNIT VI	CASE STUDY	7 Hrs

Mining Twitter: Overview, Exploring Twitter's API, Analyzing 140 Characters

Mining Facebook: Overview, Exploring Facebook's Social Graph API's, Analyzing Social Graph Connections.

Text Books

1. Reza Zafarani Mohammad Ali Abbasi Huan Liu, Social Media Mining, Cambridge University Press, ISBN: 10: 1107018854.
2. Charu C. Aggarwal, Social Network Data Analytics, Springer, ISBN: 978-1-4419-8461-6.

Reference Books

1. Marshall Sponder, Social Media Analytics: Effective Tools for Building, Interpreting, and Using Metrics, McGraw Hill Education, 978-0-07-176829-0.
2. Matthew A. Russell, Mining the Social Web, O'Reilly, 2nd Edition, ISBN:10: 1449367615.
3. Jiawei Han University of Illinois at Urbana-Champaign Micheline Kamber, Data Mining: Concepts and Techniques, Morgan Kaufmann, 2nd Edition, ISBN: 13: 978-1-55860-901-3 ISBN: 10: 1-55860-901-6.
4. Bing Liu, Web Data Mining : Exploring Hyperlinks, Contents and Usage Data, Springer, 2nd Edition, ISBN: 978-3-642-19459-7.

Savitribai Phule Pune University Fourth Year of Information Technology(2015 Course) 414465E: Elective IV Open Elective		
Teaching Scheme: **TH:03 Hours/Week**	**Credits:03**	**Examination Scheme:** **In-Sem (Paper): 30 Marks** **End-Sem (paper): 70 Marks**

In this subject, a student can opt from other branch of engineering (preferably *Computer Engineering* and *Electronics & Telecommunication*). An institution may design the syllabus of a subject in consultation with a reputed software company/industry. This syllabus should be approved by the University board of Studies (Information Technology) and academic council of SPPU authorities and then students can opt for the same as an open elective.

Savitribai Phule Pune University
Fourth Year of Information Technology (2015 Course)
414466: COMPUTER LABORATORY-IX

Teaching Scheme:	Credits:02	Examination Scheme:
Practical:04 Hours/Week		TW:50Marks PR: 50Marks

Prerequisites:

1. Operating Systems.
2. Computer Network Technology.

Course Objectives :

1. The course aims to provide an understanding of the principles on which the distributed systems are based; their architecture, algorithms and how they meet the demands of Distributed applications.
2. The course covers the building blocks for a study related to the design and the implementation of distributed systems and applications.

Course Outcomes :

Upon successful completion of this course student will be able to

1. Demonstrate knowledge of the core concepts and techniques in distributed systems.
2. Learn how to apply principles of state-of-the-Art Distributed systems in practical application.
3. Design, build and test application programs on distributed systems.

Guidelines:

This Computer Laboratory-IX course has Distributed Systems as a core subject. The problem statements should be framed based on first six assignments mentioned in the syllabus. The teachers will frame the problem statements with due consideration that students have three hours to complete that. The practical examination will comprise of implementation and related theory. All assignments to be performed in Java 9.

Assignment 1

To develop any distributed application through implementing client-server communication programs based on Java Sockets and RMI techniques.

Assignment 2

To develop any distributed application using Message Passing Interface (MPI).

Assignment 3

To develop any distributed application with CORBA program using JAVA IDL.

Assignment 4

To develop any distributed algorithm for leader election.

Assignment 5

To create a simple web service and write any distributed application to consume the web service.

Assignment 6

To develop any distributed application using Messaging System in Publish-Subscribe paradigm.

Assignment 7

To develop Microservices framework based distributed application.

Term work:

Staff in-charge will suitably frame the above assignments and flexibility may be incorporated. Students will submit term work in the form of journal. Each assignment has to be well documented with problem definition, code documented with comments. Staff in-charge will assess the assignments continuously and grade or mark each assignment on completion date. All the assignments should be conducted on Latest version of Open Source Operating Systems, tools and Multi-core CPU supporting Virtualization and Multi-Threading.

Reference books:

1. George Coulouris, Jean Dollimore, Tim Kindberg & Gordon Blair,Distributed Systems – Concept and Design,Pearson,5th Edition ,ISBN:978-13-214301-1.
2. Nancy Ann Lynch, Distributed Algorithms, Morgan Kaufmann Publishers, illustrated, reprint, ISBN: 9781558603486.

Savitribai Phule Pune University
Fourth Year of Information Technology (2015 Course)
414467: COMPUTER LABORATORY-X

Teaching Scheme:	Credits:01	Examination Scheme:
Practical:02 Hours/Week		TW:25Marks OR: 25Marks

Prerequisites:

1. Computer Network Technology.
2. Human Computer Interface.

Course Objectives :

1. To design and implement user interfaces for performing database operations.
2. To design applications for accessing smart devices and data generated through sensors and services.
3. To implement authentication protocols for providing security.

Course Outcomes :

Upon successful completion of this course student will be able to

1. Set up the Android environment and explain the Evolution of cellular networks.
2. Develop the User Interfaces using pre-built Android UI components.
3. Create applications for performing CURD SQLite database operations using Android.
4. Create the smart android applications using the data captured through sensors.
5. Implement the authentication protocols between two mobile devices for providing. Security.
6. Analyze the data collected through android sensors using any machine learning algorithm.

Guidelines:

This Computer Laboratory-X course has ubiquitous computing as a core subject. The problem statements should be framed based on first six assignments mentioned in the syllabus. The teachers will frame the problem statements with due consideration that students have three hours to complete that. The practical examination will comprise of implementation and related theory. All assignments to be performed in Java 9.

Tools Required: Android SDK / Android Studio, SQL Lite, Sensors, Ardunio kit.

Assignment 1

Android development environment. Installing and setting up the environment. Hello world application. Running the emulator. Inserting debug messages.

Assignment 2

Android UI Design: Design a User Interface using pre-built UI components such as structured layout objects, UI controls and special interfaces such as dialogs, notifications, and menus. Also make this UI attractive using Android graphics platform OpenGL.

Assignment 3

Android-database Connectivity: Create a SQLite Database for an Android Application and perform CRUD (Create, Read, Update and Delete) database operations.

Assignment 4

Sensors for building Smart Applications: Use any sensors on the device to add rich location and motion capabilities to your app, from GPS or network location to accelerometer, gyroscope, temperature, barometer, and more.
Assignment 5
Develop a Smart Light System (Light that automatically switched on in evening and gets off in morning) using open source Hardware platform like Arduino and some sensors (Light dependent resistor) and actuator (An LED).
Assignment 6
Design and Develop a GUI for FAN regulator that uses Android platform.
Assignment 7
Develop an Android based FAN regulator using open source Hardware platform like NodeMcu and actuator (a SERVO Motor).
Assignment 8
Android and Machine Learning: Mobile multimodal sensing- Draw inferences over the data coming from phone's sensing hardware (e.g. accelerometer, GPS, microphone), and processing these samples with the help of machine learning. (Any Application: Healthcare, Smart City, Agriculture, etc).
Assignment 9
Android API: Implement an application that uses Android APIs like Google Map, recording and playing audio and video, using the built-in camera as an input device.
Assignment 10
Wireless Network: Develop an app for a rolling display program of news on computer display. The input strings are supplied by the mobile phone/ by another computer connected through wireless networks.
Assignment 11
Android Security: Authentication of two mobile devices.
Assignment 12
Case Study: Evolution of cellular networks all the way up to 7G.

Savitribai Phule Pune University
Fourth Year of Information Technology (2015 Course)
414468: Project Work

Teaching Scheme:	Credits:06	Examination Scheme:
TUT:06 Hours/Week		TW:50 Marks OR:100 Marks

Prerequisites:

1. BE-Project Phase I – Semester I.
2. Project Based Seminar.

Course Objectives:

1. The object of Project Work II & Dissertation is to enable the student to extend further the investigative study taken up under Project stage 1, either fully theoretical/practical or involving both theoretical and practical work, under the guidance of a Supervisor from the Department alone or jointly with a Supervisor drawn from R&D laboratory/Industry.
2. To expose students to product development cycle using industrial experience, use of state of art technologies.
3. To encourage and expose students for participation in National/International paper presentation activities and funding agency for sponsored projects.
4. Exposure to Learning and knowledge access techniques using Conferences, Journal papers and anticipation in research activities.
5. Evaluate the various validation and verification methods.
6. Analyzing professional issues, including ethical, legal and security issues, related to computing projects.

Course Outcomes:

By the end of the course, Students will be able to

1. Learn teamwork.
2. Be well aware about Implementation phase.
3. Get exposure of various types of testing methods and tools.
4. Understand the importance of documentation.

Contents

Review 3:
Based on Implementation (50% implementation expected)
Review 4:
Complete Project and Testing
All the groups should try to overcome all the lacunas identified by the external examiner during Project Phase I exam
The group will submit following at the end of semester II.

1. The Workable project.
2. Project report (in Latex/Lyx/latest Word) in the form of bound journal complete in all respect – 1 copy for the Institute, 1 copy for guide and 1 copy of each student in the group for certification.

The project report contains the details.

1. Problem definition
2. Requirement specification
3. System design details (UML diagrams)
4. System implementation – code documentation – dataflow diagrams/ algorithm, protocols used.
5. Test result and procedure – test report as per ATP.
6. Conclusions.
7. Appendix
    a. Tools used
    b. References
    c. Papers published/certificates
    d. Plagiarism Report of paper and project report from any open source tool

One paper should be published in reputed International conference/International.

Savitribai Phule Pune University
Fourth Year of Information Technology (2015 Course)
414461: Audit Course-VI

In addition to credits, it is recommended that there should be audit course in preferably in each semester from second year to supplement their knowledge and skills. Student will be awarded the bachelor‘s degree if he/she earns credits and clears all the audit courses specified in the syllabus. The student may opt for one of the audit courses per semester, starting in second year first semester. Though not mandatory, such a selection of the audit courses helps the learner to explore the subject of interest in greater detail resulting in achieving the very objective of audit course's inclusion. List of options offered is provided. Each student has to choose one audit course from the list per semester. Evaluation of audit course will be done at institute level itself. Method of conduction and method of assessment for audit courses are suggested.

Criteria

The student registered for audit course shall be awarded the grade PP and shall be included such grade in the Semester grade report for that course, provided student has the minimum attendance as prescribed by the Savitribai Phule Pune University and satisfactory in-semester performance and secured a passing grade in that audit course. No grade points are associated with this 'PP' grade and performance in these courses is not accounted in the calculation of the performance indices SGPA and CGPA.

Guidelines for Conduction and Assessment (Any one or more of following but not limited to)

1. Lectures/ Guest Lectures
2. Visits (Social/Field) and reports
3. Demonstrations
4. Surveys
5. Mini Project
6. Hands on experience on Specific focused topic

Guidelines for Assessment (Any one or more of following but not limited to)

1. Written Test
2. Demonstrations/ Practical Test
3. Presentations
4. IPR/Publication
5. Report

Audit Course VI Options

Course Code	Audit Course Title
414469A	1. IoT – Application in Engineering Field
414469B	2. Entrepreneurship
414469C	3. Cognitive Computing
414469D	4. AI and Robotics

Savitribai Phule Pune University Fourth Year of Information Technology (2015 Course) 414469A: Audit Course-VI IoT Applications in Engineering Field.
IOT as a game changer in several fields of applications and poised for phenomenal growth. This course introduces Students to IOT applications in various Engineering disciplines: Civil, Chemical, Electrical, E&TC, Mechanical and Metallurgical Engineering This 20 hour course is aimed at covering various components involved in IOT, concepts, definitions and mainly Engineering Applications associated with IOT/IIOT.
Course Objectives: 1. To get the detailed insight of Internet of Things. 2. To learn the IoT terms in Engineering. 3. To understand how IoT concepts can be implement. 4. To know the protocols, Sensors and other elements for IoT implementation.
Course Outcomes: By the end of the course, students should be able to 1. Expand your knowledge of Internet of Things. 2. Discover how you can use IoT in your Engineering applications. 3. Build more effective hands on with IoT elements. 4. Expand the practical knowledge of using IoT components like sensors, processors. 5. Expand the understanding of using different protocols.

Unit I	Basics of IOT – Difference between IOT and IIoT
Overview of System Components of IOT.	
Unit II	**Architecture**
Importance, Advantages & Disadvantages.	
Unit III	**Sensors, Transducers, Special requirements for IIOT sensors, Actuators, Types of Sensors, Actuators**
Sensors, Transducers, Special requirements for IIOT sensors, Actuators, Types of Sensors, Actuators.	
Unit IV	**Protocols - HART, MODBUS-Serial & Parallel, Ethernet, BACNet**
Protocols - HART, MODBUS-Serial & Parallel, Ethernet, BACNet.	
Unit V	**Introduction to IIOT Cloud Platform and Security Aspects Importance and likely Risk Elements**
Introduction to IIOT Cloud Platform and Security Aspects Importance and likely Risk Elements.	
Unit VI	**Quiz, Case Studies and Student Presentations**
Illustrative IIOT applications in Engineering Disciplines – Civil, Chemical, Electrical, E & TC, Mechanical and Metallurgical.	

References

1. Internet of Things (A Hands-on-Approach) ISBN: 978-0996025515 - by ArshdeepBahga and Vijay Madisetti.
2. Inside the Internet of Things (IoT), Deloitte University Press.
3. Internet of Things- From Research and Innovation to Market Deployment; By Ovidiu& Peter; River Publishers Series.
4.Five thoughts from the Father of the Internet of Things; by By Phil Wainewright - Kevin Ashton, who coined the word IoT.

Savitribai Phule Pune University
Fourth Year of Information Technology (2015 Course)
414469B: Audit Course-VI
Entrepreneurship

Today Entrepreneurship & Start -Ups are Key Words. Developing Entrepreneurs & Jobs is National Requirement. Separate PPT - presentation from our EEC Group can be Guideline as Reference Though reference books are available, it is best to see - Google Search videos and films that elaborate most of these concepts. You tube is a rich source of such content on each of these topics. This module also helps students get better prepared for interviews and group discussions.

Course Objectives:

1. To get the detailed about Entrepreneurship.
2. To understand the abilities to become an Entrepreneur.
3. To understand how Business Finance concepts can be implemented.

Course Outcomes:

By the end of the course, students should be able to

1. Expand your knowledge of Entrepreneurship & Startups.
2. Discover how you can use Entrepreneur Qualities.
3. Expand the practical knowledge of Finance, Legal-Patents, Intellectual Property, and Business Associations.
4. Expand the understanding of Deliverables & Achieving Target.

Unit I	**Introduction To Entrepreneurship & Favorable Environment for Startups**

Overview of Entrepreneurship and its need.

Unit II	**Entrepreneur - Qualities, Strengths & Challenges - Govt. Regulations & Taxes**

Qualities and its strength, challenges as well as respective government originations.

Unit III	**Road Map - Goal Setting & Methodology, Case Studies**

Successful case studies and appropriate methodology.

Unit IV	**Skill Sets required- Communication, Linguistic, Analytical & Abstract Thinking Engineering etc.**

Soft skills and hard skills required to become a successful entrepreneur.

References

1. Burns, Paul, 1949- author. Title: Entrepreneurship and small business.
2. Hisrich R D and Peters M P; “Entrepreneurship”; 5th Edition Tata McGraw-Hill.

Savitribai Phule Pune University
Fourth Year of Information Technology(2015 Course)
414469C: Audit Course-VI
Cognitive computing

This course explores the area of cognitive computing and its implications for today's world of big data analytics and evidence-based decision making. Topics covered include: cognitive computing design principles, natural language processing, knowledge representation, Students will have an opportunity to build cognitive applications, as well as explore how knowledge-based artificial intelligence and deep learning are impacting the field of data science.

This course is open to students in Business Intelligence and Analytics, Information Systems, and Masters of Business Administration, or with the permission of the instructor

Course Objectives:

1. To develop algorithms that use AI and machine learning along with human interaction and feedback to help humans make choices/decisions.
2. To get the detailed about appealing new model for application development.
3. To understand how to evaluate patterns and complex relationships in large unstructured data sets.
4. To understand how Cognitive computing supports human reasoning by evaluating data in context and presenting relevant findings along with the evidence that justifies the answers.

Course Outcomes:

By the end of the course, students should be able to

1. Understand and discuss what cognitive computing is, and how it differs from traditional approaches.
2. Plan and use the primary tools associated with cognitive computing.
3. Plan and execute a project that leverages cognitive computing.
4. Understand and discuss the business implications of cognitive computing.

Unit I	**Introduction to Cognitive Systems and computation, Knowledge based AI**

Cognitive systems, Different modes of Computing: Turning machine Lambda, Calculus, Hyper Computing, Super Computing, Pan Computing and Interactive Computing.

Unit II	**Cognitive Functioning**

Learning, Memorising, Adaptation, Self Origination, Control, Thinking, Reasoning, Decision Making & Judgement.

Unit III	**Mental States**

Belief Desire Intention (BDI) emotion and feeting. Computation of Cognitive Functioning in machines: Robotics, Human Robotics Interaction, Hepatic.

Unit IV	**Perception and sensing**

Hardware machines of vision and audition with reference to human and machine.

References

1. Hurwitz, Kaufman, and Bowles, Cognitive Computing and Big Data Analytics, Wiley, Indianapolis, IN, 2005, ISBN: 978-1-118-89662-4.

Savitribai Phule Pune University
Fourth Year of Information Technology (2015 Course)
414469D: Audit Course-VI
AI and Robotics

Robotics is a branch of AI, which is composed of Electrical Engineering, Mechanical Engineering, and Computer Science for designing, construction, and application of robots. The robots have mechanical construction, form, or shape designed to accomplish a particular task. They have electrical components which power and control the machinery. They contain some level of computer program that determines what, when and how a robot does something.

Course Objectives:

1. To get the detailed robotics and rapid development.
2. To understand the robots functions.
3. To understand how mechanical devices converting into intelligent machines through a branch of computer science called artificial intelligence (AI).

Course Outcomes:

By the end of the course, students should be able to

1. The goal of this course is to familiarize the students with the basic concepts of robotics, artificial intelligence and intelligent machines.
2. It will help students to understand and apply principles, methodology and techniques of intelligent systems to robotics.

Unit I	Intelligent Robotics

Automation and Robots, Robot Classification, Robot Specifications, Sensory perception, Robot control and Intelligence.

Unit II	Direct Kinematics

Coordinate Frames, Rotations, Homogeneous Coordinates, The arm Equation, (DK analysis of - 2 Axis and 3 Axis Planar robot, Four axis SCARA Robot, Five axis Articulated robot).

Unit III	Inverse Kinematics

General Properties of Solutions, Tool Configuration, (IK analysis of - 2 Axis and 3 Axis Planar robot, Four axis SCARA Robot, Five axis Articulated robot).

Unit IV	Workspace Analysis and Trajectory Planning

Workspace analysis, Work envelope of 4-axis SCARA Robot, Work envelope of 5-axis articulated Robot, Workspace Fixtures, The pick-and-place operation, Continuous-Path Motion, Interpolated Motion, Straight Line Motion.

References:

1. Robotics and AI", Andrew Staugaard, PHI.
2. Fundamentals of Robotics- Analysis and Control", Robert Schilling, Pearson Education.
3. Introduction to Robotics", J. J. Craig, Pearson Education.
4. "Robotics", Fu, Gonzales and Lee, McGraw Hill.
5. "Artificial Intelligence: Structures and Strategies for Complex Problem Solving", George F. Luger, Pearson Education.
6. "Industrial Robotics- Technology, programming, and applications", Groover, Weiss, Nagel and Odrey, McGraw Hill
7. Elaine Rich and Kevin Knight, "Artificial Intelligence", TMH.

Faculty of Science & Technology
Savitribai Phule Pune University, Pune
Maharashtra, India

Curriculum
for
Second Year of Information Technology
(2019 Course)
(With effect from AY 2020-21)

I N D E X

Home

Savitribai Phule Pune University, Pune Bachelor of Information Technology	
Program Educational Objectives	
PEO1	**Possess strong fundamental concepts in mathematics, science, engineering and Technology to address technological challenges.**
PEO2	**Possess knowledge and skills in the field of Computer Science and Information Technology for analyzing, designing and implementing complex engineering problems of any domain with innovative approaches.**
PEO3	**Possess an attitude and aptitude for research, entrepreneurship and higher studies in the field of Computer Science and Information Technology.**
PEO4	**Have commitment to ethical practices, societal contributions through communities and life-long learning.**
PEO5	**Possess better communication, presentation, time management and teamwork skills leading to responsible & competent professionals and will be able to address challenges in the field of IT at global level.**

Home

Program Outcomes

Students are expected to know and be able to–

PO1	**Engineering knowledge**	**An ability to apply knowledge of mathematics, computing, science, engineering and technology.**
PO2	**Problem analysis**	**An ability to define a problem and provide a systematic solution with the help of conducting experiments, analyzing the problem and interpreting the data.**
PO3	**Design / Development of Solutions**	**An ability to design, implement, and evaluate a software or a software/hardware system, component, or process to meet desired needs within realistic constraints.**
PO4	**Conduct Investigations of Complex Problems**	**An ability to identify, formulates, and provides systematic solutions to complex engineering/Technology problems.**
PO5	**Modern Tool Usage**	**An ability to use the techniques, skills, and modern engineering technology tools, standard processes necessary for practice as a IT professional.**
PO6	**The Engineer and Society**	**An ability to apply mathematical foundations, algorithmic principles, and computer science theory in the modeling and design of computer-based systems with necessary constraints and assumptions.**
PO7	**Environment and Sustainability**	**An ability to analyze and provide solution for the local and global impact of information technology on individuals, organizations and society.**
PO8	**Ethics**	**An ability to understand professional, ethical, legal, security and social issues and responsibilities.**
PO9	**Individual and Team Work**	**An ability to function effectively as an individual or as a team member to accomplish a desired goal(s).**
PO10	**Communication Skills**	**An ability to engage in life-long learning and continuing professional development to cope up with fast changes in the technologies/tools with the help of electives, professional organizations and extra-curricular activities.**
PO11	**Project Management and Finance**	**An ability to communicate effectively in engineering community at large by means of effective presentations, report writing, paper publications, demonstrations.**
PO12	**Life-long Learning**	**An ability to understand engineering, management, financial aspects, performance, optimizations and time complexity necessary for professional practice.**

Home

Program Specific Outcomes (PSO)	
A graduate of the Information Technology Program will demonstrate-	
PSO1	An ability to apply the theoretical concepts and practical knowledge of Information Technology in analysis, design, development and management of information processing systems and applications in the interdisciplinary domain.
PSO2	An ability to analyze a problem, and identify and define the computing infrastructure and operations requirements appropriate to its solution. IT graduates should be able to work on large-scale computing systems.
PSO3	An understanding of professional, business and business processes, ethical, legal, security and social issues and responsibilities.
PSO4	Practice communication and decision-making skills through the use of appropriate technology and be ready for professional responsibilities.

Savitribai Phule Pune University
Second Year of Information Technology Engineering(2019 Course)
(With effect from Academic Year 2020-21)

Semester-III

Course Code	Course Name	Teaching Scheme (Hours/Week)			Examination Scheme and Marks						Credit			
		Theory	Practical	Tutorial	IN-Sem	End-Sem	TW	PR	OR	Total	TH	PR	TUT	Total
214441	Discrete Mathematics	03	-	01	30	70	25	-	-	125	03	--	01	04
214442	Logic Design and Computer Organization	03	-	-	30	70	-	-	-	100	03	-	-	03
214443	Data Structures and Algorithms	03	-	-	30	70	-	-	-	100	03	-	-	03
214444	Object Oriented Programming	03	-	-	30	70	-	-	-	100	03	-	-	03
214445	Basics of Computer Network	03	-	-	30	70	-	-	-	100	03	-	-	03
214446	Logic Design Computer Organization Lab	-	02	-	-	-	25	25	-	50	-	01	-	01
214447	Data Structures and Algorithms Lab	-	04	-	-	-	25	25	-	50	-	02	-	02
214448	Object Oriented Programming Lab	-	04	-	-	-	25	25	-	50	-	02	-	02
214449	Soft Skill Lab	-	02	-	-	-	25	-	-	25	-	01	-	01
214450	Mandatory Audit Course 3	-	-	-	-	-	-	-	-	-	Non Credit			-
Total		15	12	01	150	350	125	75	--	700	15	06	01	22

Abbreviations:
TH: Theory TW: Term Work PR: Practical
OR: Oral TUT: Tutorial

Note: Students of S.E. (Information Technology) can opt any one of the audit course from the list of audit courses prescribed by BoS (Information Technology)

#Mandatory Audit Course 3:
- **214450A- Ethics and values in IT**
- **214450B - Quantitative Aptitude and Logical Reasoning**
- **214450C- Language Study- Japanese- Module**
- **214450D-Cyber Security and Law**

Home

Savitribai Phule Pune University, Pune
Second Year of Information Technology Engineering (2019 Course)
(With effect from Academic Year 2020-21)

Semester-IV

Course Code	Course Name	Teaching Scheme (Hours/Week)			Examination Scheme and Marks						Credit			
		Theory	Practical	Tutorial	IN-Sem	End-Sem	TW	PR	OR	Total	TH	PR	TUT	Total
207003	Engineering Mathematics- III	03	-	01	30	70	25	-	-	125	03	--	01	04
214451	Processor Architecture	03	-	-	30	70	-	-	-	100	03	-	-	03
214452	Database Management System	03	-	-	30	70	-	-	-	100	03	-	-	03
214453	Computer Graphics	03	-	-	30	70	-	-	-	100	03	-	-	03
214454	Software Engineering	03	-	-	30	70	-	-	-	100	03	-	-	03
214455	Programming Skill Development Lab	-	02	-	-	-	25	25	-	50	-	01	-	01
214456	Database Management System Lab	-	04	-	-	-	25	25		50	-	02	-	02
214457	Computer Graphics Lab	-	02	-	-	-	-	25	-	25	-	01	-	01
214458	Project Based Learning	-	04	-	-	-	50	-	-	50	-	02	-	02
214459	Mandatory Audit Course 4	-	-	-	-	-	-	-	-	-	Non Credit			-
Total		15	12	01	150	350	125	75	-	700	15	06	01	22

Abbreviations:

TH: Theory TW: Term Work PR: Practical

OR: Oral TUT: Tutorial

Note: Students of S.E. (Information Technology) can opt any one of the audit course from the list of audit courses prescribed by BoS (Information Technology)

#Mandatory Audit Course 4:

- **214459A - Water Supply and Treatment**
- **214459B - Language Study- Japanese- Module II**
- **214459C - Waste Management and Pollution Control**
- **214459D - Intellectual Property Rights**

INSTRUCTIONS

- Practical or Tutorial must be conducted in batches and number of batches per division should be as per guidelines from regulatory bodies.
- Required minimum number of experiments/ assignments in practical/ tutorial shall be conducted as mentioned in the syllabi of respective subjects. The list of experiments/assignments is prescribed in the syllabi.
- In addition to the prescribed list, the instructor for practical/ tutorial may design one or two additional experiments/assignments relating to the subject covering some of the research/application areas of the concerned subject.
- For practical/tutorial subject, each experiment/assignment, the student must prepare a write-up consisting of assignment statement, objective(s)/outcome(s), algorithm(s), flow charts/UML diagram(s), important test cases, test case validation report etc.
- The faculty member/instructor should prepare a rubric for the assessment of practical and tutorial. Assessment of tutorial work is part of term-work examination. Term-work Examination at second year of engineering course shall be internal continuous assessment only.
- Project based learning (PBL) requires mentoring and internal continuous assessment by faculty throughout the semester for successful completion of the tasks assigned to the students. A teaching workload of 4 hours/week/batch is associated with PBL subject should be allocated to the faculty conducting PBL mentoring and internal continuous assessment. The students in a Batch may be divided into sub-groups of 5 to 6 students for easing the process of internal continuous assessment. Assignments/activities/models/ projects etc. completed under project-based learning will be considered for internal continuous assessment, evaluation, and award of credits for PBL subjects.
- Audit course is a mandatory non-credit course. The faculty member should prepare the rubric(s) for the assessment of audit course at the start of semester. The assessment should be carried out based on the said rubric(s) only and report should be prepared and submitted to the department at the end of semester.
- Case Studies may be assigned as a self-study to students and to be excluded from theory examinations.
- All the rules, regulations and guidelines issued by regulatory authorities from time to time for effective conduction of curriculum, assessment and evaluation are to be strictly followed.

SEMESTER – III

Home

Savitribai Phule Pune University, Pune
Second Year Information Technology (2019 Course)
214441: Discrete Mathematics

Teaching Scheme:	Credit Scheme:	Examination Scheme:
Theory (TH) : 03 hrs/week Tutorial(TUT): 01 hrs/week	03 01	Mid_Semester : 30 Marks End_Semester : 70 Marks Term Work : 25 Marks

Prerequisite Courses, if any: Basic Mathematics

Companion Course, if any:

Course Objectives:

1. To gain sound knowledge to formulate and solve problems with sets and propositions.
2. To understand and solve counting problems by applying elementary counting techniques to solve problems of discrete probability.
3. To understand Graph and Tree terminologies and models to be applied in real life problems.
4. To recognize types of relation, formulate and solve problems with relations and functions.
5. To understand basics of number theory and its applications.
6. To understand the various types' algebraic structures and its applications.

Course Outcomes:

On completion of the course, students will be able to–

CO1: Formulate and apply formal proof techniques and solve the problems with logical reasoning.
CO2: Analyze and evaluate the combinatorial problems by using probability theory.
CO3: Apply the concepts of graph theory to devise mathematical models.
CO4: Analyze types of relations and functions to provide solution to computational problems.
CO5: Identify techniques of number theory and its application.
CO6: Identify fundamental algebraic structures.

COURSE CONTENTS

Unit I	Sets And Propositions	(06 hrs + 2 hrs Tutorial)

Sets: Sets, Combinations of Sets, Venn Diagram, Finite and Infinite Sets, Countable Sets, Multisets, Principle of Inclusion and Exclusion, Mathematical Induction.

Propositions: Propositions, Logical Connectives, Conditional and Bi-conditional Propositions, Logical Equivalence, Validity of Arguments by using Truth Tables, Predicates and Quantifiers, Normal forms.

Applications of Sets and Propositions.

Mapping of Course Outcomes for Unit I	CO1

Unit II	Combinatorics And Discrete Probability	(06 hrs + 2 hrs Tutorial)

Combinatorics: Rules of Sum and Product, Permutations, Combinations.

Discrete Probability: Discrete Probability, Conditional Probability, Bayes Theorem, Information and Mutual Information, Applications of Combinatorics and Discrete Probability.

Mapping of Course Outcomes for Unit II	**CO2**	
Unit III	**Graph Theory**	**(06 hrs + 2hrs Tutorial)**
Graphs: Basic Terminologies, Multi-Graphs, Weighted Graphs, Sub Graphs, Isomorphic graphs, Complete Graphs, Regular Graphs, Bipartite Graphs, Operations on Graphs, Paths, Circuits, Hamiltonian and Eulerian graphs, Travelling Salesman Problem, Factors of Graphs, Planar Graphs, Graph Colouring. **Trees:** Tree Terminologies, Rooted Trees, Path Length in Rooted Trees, Prefix Codes, Spanning Trees, Fundamental Cut Sets and Circuits, Max flow –Min Cut Theorem (Transport Network). Applications of Graph Theory.		
Mapping of Course Outcomes for Unit III	**CO3**	
Unit IV	**Relations And Functions**	**(06 hrs + 2hrs Tutorial)**
Relations: Properties of Binary Relations, Closure of Relations, Warshall'sAlgorithm, Equivalence Relations, Partitions, Partial Ordering Relations, Lattices, Chains and Anti Chains. **Functions:** Functions, Composition of Functions, Invertible Functions, Pigeonhole Principle, Discrete Numeric Functions. **Recurrence Relations:** Recurrence Relation, Linear Recurrence Relations with Constant Coefficients, Total Solutions, Applications of Relations and Functions.		
Mapping of Course Outcomes for Unit IV	**CO4**	
Unit V	**Introduction To Number Theory**	**(06 hrs + 2hrs Tutorial)**
Divisibility of Integers: Properties of Divisibility, Division Algorithm, Greatest Common Divisor GCD and its Properties, Euclidean Algorithm, Extended Euclidean Algorithm, Prime Factorization Theorem, Congruence Relation, Modular Arithmetic, Euler Phi Function, Euler's Theorem, Fermat's Little Theorem, Additive and Multiplicative Inverses, Chinese Remainder Theorem.		
Mapping of Course Outcomes for Unit V	**CO5**	
Unit VI	**Algebraic Structures**	**(06 hrs + 2hrs Tutorial)**
Algebraic Structures: Introduction Semigroup, Monoid, Group, Abelian Group, Permutation Groups, Cosets, Normal Subgroup, Codes and Group Codes, Ring, Integral Domain, Field. Applications of Algebraic Structures.		
Mapping of Course Outcomes for Unit VI	**CO6**	
Text Books:		
1. C. L. Liu and D. P. Mohapatra, "Elements of Discrete Mathematics", 4th Edition, McGraw-Hill 2. Kenneth H. Rosen, "Discrete Mathematics and its Applications", & 7th edition, McGraw-Hill		

Reference Books:

1. Bernard Kolman, Robert C. Busby, Sharon Cutler Ross, "Discrete mathematical structures", 6th edition, Prentice Hall of India
2. Edgar G. Goodaire, Michael M. Parmenter, "Discrete Mathematics with Graph Theory", 3rd Edition, Pearson Education
3. Tremblay J. S., "Discrete mathematical structures with application", 3rdEdition, Tata McGraw Hill
4. Lipschutz Seymour, "Discrete mathematics", 4th Edition, Tata McGraw-Hill
5. Johnsonbaugh Richard, "Discrete Mathematics", 7th edition, Pearson
6. Biggs Norman L, "Discrete mathematics", 6th edition, Oxford
7. David M. Burton, "Elementary Number Theory", &7th Edition, McGraw-Hill

Guidelines for Tutorial and Term Work

- Tutorial shall be engaged in four batches (batch size of 20 students maximum) per division.
- Term work shall be based on continuous assessment of six assignments (one per each unit) and performance in internal tests.

Examples on various topics of respective unit must be explained and discussed will be covered in tutorial sessions based on following:

1. **Problems for deep understanding of concepts.**
2. **Identify applications and device mathematical models for real time problems.**

Sr. No.	Name of the Tutorial	Description	Applicable CO
1	Introduction to Set Theory	Formulate problems to illustrate 1. Sets, universal sets, multisets, and operations on sets such as union, intersection, complement and set difference. 2. Introduce sets as mathematical model to classify data sets.	**CO1**
2	Propositional Logic	Formulate problems that comprises 1. Translation of English sentences into logical propositions by using logical connectives. 2. Proof for logical equivalences by using truth table analysis. 3. Propositions by using Predicates and Quantifiers. 4. Conjunctive and Disjunctive Normal Forms. 5. 5. Proof by using Mathematical Induction	**CO1**
3	Combinatorics	Design problems to illustrate counting techniques by using 1. Permutation and Combinations 2. Permutation with repetition	**CO2**

Sr. No.	Name of the Tutorial	Description	Applicable CO
		3. Properties of *nCr and nPr* 4. Addition and Multiplication Principle	
4	Discrete Probability	Formulate problems for better understanding of 1. Discrete Probability 2. Conditional Probability and Bay's theorem Identify applications of probability to Computer Science	**CO2**
5	Graph Theory	Design problems to study 1. Graph properties and operations on graphs 2. Connectedness, Hamiltonian and Eulerian graphs. 3. Introduce graph as a mathematical model to understand transport, communication, and social networks.	**CO3**
6	Tree	Problems to be formulated on 1. Prefix codes, Huffman codes 2. Fundamental cut sets and Fundamental circuits 3. Transport network by using Maximum Flow Minimum cut Theorem 4. Identify applications of tree for Searching Algorithms, Polish notation	**CO3**
7	Relations and Functions	Problems to understand 1. Types of Relations 2. Equivalence relation and Equivalence classes 3. Transitive closure by using Warshall's Algorithm. 4. Injective, Surjective and Bijective Functions. 5. Pigeonhole principle and its applications	**CO4**
8	Recurrence Relation	Problems based on 1. Formation of recurrence relation 2. Solving homogeneous recurrence relation with constant coefficients 3. Solving non-homogeneous recurrence relations to find total solution. 4. Identify applications of recurrence relation in counting.	**CO4**
9	Introduction to Number Theory	Problems to illustrate concepts such as- 1. Divisibility and its properties 2. Greatest common divisor and its properties 3. Prime numbers and prime factorization theorem to find GCD and LCM of two numbers	**CO5**
10	Modular Arithmetic	Problems to demonstrate applications of- 1. Euler's theorem and Fermat's theorem in counting remainders 2. Linear congruences 3. Chinese Remainder Theorem 4. Applications of Modular arithmetic to Cryptography and Security	**CO5**

Sr. No.	Name of the Tutorial	Description	Applicable CO
11	Algebraic Structures-I	Problems to be formulated to illustrate 1. Concept of algebraic structure 2. Examples of semigroup, monoid, group and abelian group 3. Generating group codes by using normal subgroups 4. Application of Algebraic Structure in operator overloading.	**CO6**
12	Algebraic Structures-II	Problems to illustrate 1. Definition and examples of Ring, types of Ring 2. Zero divisors and Integral domain 3. Multiplicative inverses in different rings, and Field 4. Identify Applications of Ring and Field in Coding Theory	**CO6**

* Subject Teacher can design different tasks to students as well can accept the student ideas within the above stated guidelines.

Case Study

Sr. No.	Unit	Case Study	Description	Applicable CO
1	Unit-I	Apply rules of logic to explain Barber's paradox, The Lair's paradox	i. Discuss logical paradoxes like, Jourdain's card paradox, Barber's paradox, The Lair's paradox etc. by using rules of mathematical logic. Explain how these paradoxes are resolved ii. Describe the limitations of classical logic and how fuzzy logic is applied to practical applications	**CO1**
2	Unit-II	Demonstrate counting techniques to form telephone numbering plan.	**i.** Discuss ways in which telephone numbering plan can be extended to accommodate the rapid demand for more telephone numbers, for each numbering plan find how different telephone numbers can be formed.	**CO2**
3	Unit-III	Model a social network group as a connected graph and study simple properties of graphs	**i.** Investigate the properties of web graph, analyze web graphs by correlating the graph theoretic concepts with properties of web graph **ii.** Construct a social network graph, for example graph for Whats-App group	**CO3**

Sr. No.	Unit	Case Study	Description	Applicable CO
			of your friends. Study the properties of social network graph **iii.** Define and analyze AVL-tree, Quad-tree. Describe heaps, how heap can be built by using tree. Identify practical applications of these special trees	
4	Unit-IV	Demonstrate the correlation of the concept of relations with the relational database	**i.**Describe basic principles of relational databases. Find the correlation between relational databases and relations that you have studied. **ii.**Describe the importance of fuzzy relations in smart applications **iii.**Built input-output models by using function for simple machines.	**CO4**
5	Unit-V	Generate a public key cryptosystem with small primes*p, q* for a set of alphabets.	**i.**Apply the number theoretic concepts to generate public keys and private keys for public key cryptography **ii.** Find the day of the week for any given date by using congruence relation.	**CO5**
6	Unit-VI	Demonstrate the application of group properties in generating group codes.	**i.**Correlate the properties of binary operation with operator overloading. **ii.**Identify applications of encoding-decoding functions in satellite communication.	**CO6**

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Savitribai Phule Pune University, Pune
Second Year Information Technology (2019 Course)
214442:Logic Design & Computer Organization

Teaching Scheme:	Credit Scheme:	Examination Scheme:
Theory(TH) :03hrs/week	3	Mid_Semester: 30 Marks End_Semester: 70 Marks

Prerequisite Courses, if any: Basics of electronics engineering

Companion Course, if any:

Course Objectives:

1. To make undergraduates, aware of different levels of abstraction of computer systems from hardware perspective.
2. To make undergraduates, understand the functions, characteristics of various components of Computer& in particular processor & memory.

Course Outcomes:

On completion of the course, students will be able to–

CO1: Perform basic binary arithmetic & simplify logic expressions.

CO2: Grasp the operations of logic ICs and Implement combinational logic functions using ICs.

CO3: Comprehend the operations of basic memory cell types and Implement sequential logic functions using ICs.

CO4: Elucidate the functions & organization of various blocks of CPU.

CO5: Understand CPU instruction characteristics, enhancement features of CPU.

CO6: Describe an assortment of memory types (with their characteristics) used in computer systems and basic principle of interfacing input, output devices.

COURSE CONTENTS

Mapping of Course Outcomes for Unit I	CO1	
Unit 1	**Introduction To Digital Electronics**	**06 hrs**

Digital Logic families: Digital IC Characteristics; **TTL:** Standard TTL characteristics, Operation of TTL NAND gate; **CMOS:** Standard CMOS characteristics, operation of CMOS NAND gate; Comparison of TTL & CMOS.

Signed Binary number representation and Arithmetic: Sign Magnitude, 1's complement & 2's complement representation, unsigned Binary arithmetic (addition, subtraction, multiplication, and division), subtraction using 2's complement; IEEE Standard 754 Floating point number representations.

Codes: Binary , BCD, octal , hexadecimal , Excess-3 , Gray code & their conversions

Logic minimization: Representation of logic functions: logic statement, truth table, SOP form, POS form; Simplification of logical functions using K-Maps up to 4 variables.

Case Study:1) CMOS 4000 series ICs 2) practical applications of various codes in computers 3) four basic arithmetic operations using floating point numbers in a calculator.		
Mapping of Course Outcomes for Unit I	**CO1**	
Unit 2	**Combinational Logic Design**	**06 hrs**
Design using SSI chips: Code converters, Half- Adder, Full Adder, Half Subtractor, Full Subtractor, n bit Binary adder. **Introduction to MSI chips:** Multiplexer (IC 74153), Demultiplexer (IC 74138), Decoder (74238) Encoder (IC 74147), Binary adder (IC 7483) **Design using MSI chips:** BCD adder & subtractor using IC 7483, Implementation of logic functions using IC 74153 & 74138.		
Case Study : Use of combinational logic design in 7 segment display interface		
Mapping of Course Outcomes for Unit II	**CO2**	
Unit 3	**Sequential Logic Design**	**06 hrs**
Introduction to sequential circuits: Difference between combinational circuits and sequential circuits; Memory element-latch & Flip-Flop**.** **Flip- Flops:** Logic diagram, truth table & excitation table of SR, JK, D, T flip flops; Conversion from one FF to another , Study of flip flops with regard to asynchronous and synchronous, Preset & Clear, Master Slave configuration ; Study of 7474, 7476 flip flop ICs. **Application of flip-flops**: Counters- asynchronous, synchronous and modulo n counters, study of 7490 modulus n counter ICs & their applications to implement mod counters; Registers- shift register types (SISO, SIPO, PISO &PIPO)& applications.		
Case Study : Use of sequential logic design in a simple traffic light controller		
Mapping of Course Outcomes for Unit III	**CO3**	
Unit 4	**Computer Organization &Processor**	**06 hrs**
Computer organization & computer architecture, organization, functions & types of computer units- CPU(typical organization ,Functions , Types), Memory (Types & their uses in computer), IO(types & functions) & system bus(Address, data & control , Typical control lines, Multiple-Bus Hierarchies); Von Neumann & Harvard architecture; Instruction cycle **Processor:** Single bus organization of CPU; ALU(ALU signals, functions & types); Register (types & functions of user visible, control & status registers such as general purpose, address registers, data registers, flags, PC, MAR, MBR, IR)& control unit (control signals & typical organization of hard wired & microprogrammed CU). Micro Operations (fetch, indirect, execute, interrupt) and control signals for these micro operations.		
Case Study : 8086 processor , PCI bus		

Mapping of Course Outcomes for Unit IV	**CO4**	
Unit 5	**Processor Instructions &Processor Enhancements**	**06 hrs**

Instruction : elements of machine instruction ; instruction representation (Opcode& mnemonics, Assembly language elements) ; Instruction Format & 0-1-2-3 address formats, Types of operands

Addressing modes; Instruction types based on operations (functions & examples of each); key characteristics of RISC& CISC; Interrupt: its purpose, types , classes & interrupt handling (ISR , multiple interrupts), exceptions; instruction pipelining(operation & speed up)

Multiprocessor systems: Taxonomy of Parallel Processor Architectures, two types of MIMD clusters & SMP (organization & benefits) & multicore processor (various Alternatives & advantages 0f multicores), typical features of multicore intel core i7.

Case Study : 8086 Assembly language programming

Mapping of Course Outcomes for Unit V	**CO5**	
Unit 6	**Memory &Input / Output Systems**	**06 hrs**

Memory Systems: Characteristics of Memory Systems, Memory Hierarchy, signals to connect memory to processor, memory read & write cycle, characteristics of semiconductor memory: SRAM, DRAM &ROM, Cache **Memory –** Principle of Locality, Organization, Mapping functions, write policies, Replacement policies, Multilevel Caches, Cache Coherence,

Input / Output Systems: I/O Module, Programmed I/O, Interrupt Driven I/O, Direct Memory Access (DMA).

Case Study : USB flash drive

Mapping of Course Outcomes for Unit VI	**CO6**

Text Books:

1. "Modern Digital Electronics", R.P. Jain, Tata McGraw-Hill, Third Edition
2. "Computer organization and architecture, designing for performance" by William Stallings , Prentice Hall ,Eighth edition

Reference Books:

1. "Digital Design", M Morris Mano, Prentice Hall, Third Edition
2. "Computer organization" , Hamacher and Zaky, Fifth Edition
3. "Computer Organization and Design: The Hardware Software Interface" D. Patterson, J. Hennessy, Fourth Edition, Morgan Kaufmann
4. " Microprocessors and interfacing-programming and hardware" Douglas V. Hall and SSSP Rao, McGraw-Hill ,Third Edition

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Savitribai Phule Pune University, Pune

Second Year Information Technology (2019 Course)

214443:Data Structure & Algorithms

Teaching Scheme:	Credit Scheme:	Examination Scheme:
Theory(TH):03hrs/week	03	Mid_Semester: 30 Marks End_Semester: 70 Marks

Prerequisite Courses, if any: Fundamental knowledge of programming language and basics of algorithms

Companion Course, if any: Discrete Structures/Discrete Mathematics

Course Objectives:

1. To study data structures and their implementations and applications.
2. To learn different searching and sorting techniques.
3. To study some advanced data structures such as trees, graphs and tables.
4. To learn different file organizations.
5. To learn algorithm development and analysis of algorithms.

Course Outcomes:

On completion of the course, students will be able to–

CO1: Perform basic analysis of algorithms with respect to time and space complexity.
CO2: Select appropriate searching and/or sorting techniques in the application development.
CO3: Implement abstract data type (ADT) and data structures for given application.
CO4: Design algorithms based on techniques like brute -force, divide and conquer, greedy, etc.
CO5: Apply implement learned algorithm design techniques and data structures to solve problems.
CO6: Design different hashing functions and use files organizations.

COURSE CONTENTS

Unit- I	Introduction	07hrs

Introduction to Data Structures: Concept of data, Data object, Data structure, Concept of Primitive and non-primitive, linear and Nonlinear, static and dynamic, persistent and ephemeral data structures, Definition of ADT

Analysis of algorithm: Frequency count and its importance in analysis of an algorithm, Time complexity & Space complexity of an algorithm Big 'O', 'Ω' and 'Θ' notations,

Sequential Organization: Single and multidimensional array and address calculation.

Linked Organization: Concept of linked organization, Singly Linked List, Doubly Linked List, Circular Linked List (Operations: Create, Display, Search, Insert, Delete).

Case Study	**Set Operation, String Operation**
Mapping of Course Outcomes for Unit I	**CO1, CO3, CO5**

Unit- II	Searching and Sorting	06 hrs

Searching and sorting: Need of searching and sorting, Concept of internal and external sorting, sort stability, Searching methods: Linear and binary search algorithms, Fibonacci Series.

Sorting methods: Bubble, insertion, Quick, Merge, shell and comparison of all sorting methods.
Analyze Insertion sort, Quick Sort, binary search, hashing for Best, Worst and Average case.

<table>
<tr><td>Case Study</td><td colspan="2">Study and Analyze Selection sort, bucket sort,radix sort.</td></tr>
<tr><td>Mapping of Course Outcomes for Unit II</td><td colspan="2">CO1, CO2, CO4, CO5</td></tr>
<tr><th>Unit- III</th><th>Stack &Queue</th><th>06 hrs</th></tr>
<tr><td colspan="3">Stack: Concept of stack, Concept of implicit and explicit stack, stack as an ADT using sequential and linked organization, Applications of stack: recursion, converting expressions from infix to postfix or prefix form, evaluating postfix or prefix form.
Queue: Concept of queues as ADT, Implementation of queue using array and linked organization, Concept of circular queue, double ended queue, Applications of queue: priority queue.</td></tr>
<tr><td>Case Study</td><td colspan="2">Reversing a string, balanced parentheses in algebraic expressions, Towers of Hanoi problem, double ended queue as Stack and Queue.</td></tr>
<tr><td>Mapping of Course Outcomes for Unit III</td><td colspan="2">CO1, CO3, CO4,CO5</td></tr>
<tr><th>Unit- IV</th><th>Trees</th><th>06 hrs</th></tr>
<tr><td colspan="3">Tree : Trees and binary trees-concept and terminology, Expression tree, Binary tree as an ADT, , Binary search tree, Recursive and Non recursive algorithms for binary tree traversals ,Binary search tree as ADT(Insert Search Delete, level wise Display)
Threaded binary tree: Concept of threaded binary tree (inorder, preorder and postorder). Preorder and In-order traversals of in-order threaded binary tree, Applications of trees.</td></tr>
<tr><td>Case Study</td><td colspan="2">Construction of BST from pre and postorder traversal, Expression Tree construction</td></tr>
<tr><td>Mapping of Course Outcomes for Unit IV</td><td colspan="2">CO1, CO2, CO3, CO5</td></tr>
<tr><th>Unit- V</th><th>Graph and Symbol Table</th><th>07hrs</th></tr>
<tr><td colspan="3">Graph -Concept and terminologies, Graph as an ADT, Representation of graphs using adjacency matrix and adjacency list, Breadth First Search traversal, Depth First Search traversal, Prim’s and Kruskal’s algorithms for minimum spanning tree, Shortest path using Dijkstra's algorithm, topological sorting.
Symbol Table -Notion of Symbol Table, OBST, AVL Trees
Heap: Heap data structure, Min and Max Heap, Heap sort, applications of heap</td></tr>
<tr><td>Case Study</td><td colspan="2">Consider a network of computers connected to each other. The connection has various parameters associated with it as distance, propagation delay, bandwidth (capacity of carrying data), etc. Based on these parameters, decide which path should be chosen to send data from one computer to every other on the network.
In a system, jobs are submitted for execution at different times. If the system is idle, the job is taken for executed immediately. If there is a job in execution, the newly submitted job is added to a queue. The jobs are assigned a number, which indicates tells the priority of the jobs. The system must execute the high priority jobs first for execution. Implement the above said system using heap data structure.</td></tr>
<tr><td>Mapping of Course Outcomes for Unit V</td><td colspan="2">CO1, CO2, CO3, CO4, CO5</td></tr>
</table>

Unit- VI	Hashing and File Organization	06 hrs
Hashing: Hash tables and scattered tables: Basic concepts, hash function, characteristics of good hash function, Different key-to-address transformations techniques, synonyms or collisions, collision resolution techniques- linear probing, quadratic probing, rehashing, chaining with and without replacement. **File:**Concept of File, File types and file organization (sequential, index sequential and Direct Access), Comparison of different file organizations.		
Case Study	**What are the advantages of binary tree and binary search in file handling?** **Study Hashing techniques for expandable Files(Extendible, Dynamic and Linear Hashing)**	
Mapping of Course Outcomes for Unit VI	**CO1, CO3,CO5,CO6**	

Text Books:

1. E. Horowitz, S. Sahni, D. Mehta, "Fundamentals of Data Structures in C++", Galgotia Book Source, New Delhi, 1995, ISBN 16782928
2. Y. Langsam, M. Augenstin, A. Tannenbaum, "Data Structures using C and C++", 2nd Edition, Prentice Hall of India, 2002, ISBN-81-203-1177-9.

Reference Books:

1. G. A.V, PAI , “Data Structures and Algorithms “, McGraw Hill, ISBN -13: 978-0-07-066726-6
2. A. Tharp ,"File Organization and Processing", 2008 ,Willey India edition, 9788126518685
3. M. Folk, B. Zoellick, G. Riccardi, "File Structure An Object Oriented Approach with C++", Pearson Education, 2002, ISBN 81 - 7808 - 131 - 8.
4. M. Welss, “Data Structures and Algorithm Analysis in C++", 2nd edition, Pearson Education, 2002, ISBN-81-7808-670-0

Home

Savitribai Phule Pune University
Second Year Information Technology (2019 Course)
214444: Object-Oriented Programming

Teaching Scheme:	Credit Scheme:	Examination Scheme:
Theory (TH): 03hrs/Week	03	Mid_Semester: 30 Marks End_Semester: 70 Marks

Prerequisites: Principles of Programming Languages

Course Objectives:

1. Apply concepts of object-oriented paradigm.
2. Design and implement models for real life problems by using object-oriented programming.
3. Develop object-oriented programming skills.

Course Outcomes:

On completion of the course, students will be able to–

CO1: Differentiate various programming paradigms.

CO2: Identify classes, objects, methods, and handle object creation, initialization, and Destruction to model real-world problems.

CO3: Identify relationship among objects using inheritance and polymorphism principles.

CO4: Handle different types of exceptions and perform generic programming.

CO5: Use of files for persistent data storage for real world application.

CO6: Apply appropriate design patterns to provide object-oriented solutions.

COURSE CONTENTS

Unit I	Foundations of Object Oriented Programming	06 hrs

Introduction OOP : Software Evolution, Introduction to Procedural, Modular, Object-Oriented and Generic Programming Techniques, Limitations of Procedural Programming, Need of Object-Oriented Programming, Fundamentals of Object-Oriented Programming: Objects, Classes, Data Members, Methods, Messages, Data Encapsulation, Data Abstraction and Information Hiding, Inheritance, Polymorphism, Static and Dynamic Binding, Message Passing.

Case Study	**Model a real world scenario (vehicle class, fruit class, student management in university etc.) using Object Oriented Paradigm**
Mapping Course Outcomes for Unit 1	**CO1**

Unit II	Classes, Objects and Methods	06 hrs

Class: Creating a Class, Visibility/Access Modifiers, Encapsulation, Methods: Adding a Method to Class, Returning a Value, Adding a Method That Takes Parameters, The 'this' Keyword, Method Overloading, Object Creation, Using Object as a Parameters, Returning Object, Array of Objects, Memory Allocation: 'new', Memory Recovery: 'delete', Static Data Members, Static Methods, Forward Declaration, Class as Abstract Data Types (ADTs), Classes as Objects.

Case Study	**Represent a vector using class and include appropriate methods to perform various tasks.**

Mapping of Course Outcomes for Unit II	**CO2**	
Unit III	**Constructors and Destructors**	**06 hrs**
Constructors: Introduction, Use of Constructor, Characteristics of Constructors, Types of Constructor, Constructor Overloading, Dynamic Initialization of an Object, Constructor with Default Arguments, Symbolic Constants, Garbage Collection: Destructors and Finalizes.		
Case Study	**A book shop inventory**	
Mapping of Course Outcomes for Unit III	**CO2**	
Unit IV	**Inheritance and Polymorphism**	**06 hrs**
Inheritance: Introduction, Need of Inheritance, Types of Inheritance, Benefits of Inheritance, Cost of Inheritance, Constructors in derived Classes, Method Overriding, Abstract Classes and Interfaces. Polymorphism and Software Reuse: Introduction, Types of Polymorphism (Compile Time and Run Time Polymorphism), Mechanisms for Software Reuse, Efficiency and Polymorphism		
Case Study	**A bank account system**	
Mapping of Course Outcomes for Unit IV	**CO3**	
Unit V	**Exception Handling and Generic Programming**	**06 hrs**
Exception: Errors, Types of Errors, Exception and its Types, Exception-Handling Fundamentals, Uncaught Exception, Using try and Catch, Multiple Catch Clauses, Nested Try Statements, User Define Exception using Throw. **Generics:** What are Generics? Introduction to Language Specific Collection Interface: List Interface and Set Interface, Collection Classes: ArrayList Class and LinkedList Class.		
Case Study	**Exception handling and generic programming using array list (ArrayList class)**	
Mapping of Course Outcomes for Unit V	**CO4**	
Unit VI	**File Handling and Design Patterns**	**06 hrs**
File Handling: Introduction, Concepts of Stream, Stream Classes, Byte Stream Classes, Character Stream, Classes, Using Stream, and Other Useful I/O Classes, Using the File Class, Input/output Exceptions, Creation of Files, Reading/Writing Character, Reading/Writing Bytes, Handling Primitive Data Types, Concatenating and Buffering Files, Random Access Files. **Design Patterns:** Introduction, Types of Design Patterns, Adapter, Singleton, Iterator		
Case Study	**Student Management System**	
Mapping of Course Outcomes for Unit VI	**CO5 and CO6**	
Text Book:		
1. An Introduction to Object Oriented Programming (3rd Ed), by Timothy A. Budd, published by Addison-Wesley,2002		

2. E. Balaguruswamy, “Object Oriented Programming Using C++ and Java”, Tata McGraw Hill
Reference Books:
1. Object-Oriented Programming and Java by Danny Poo (Author), Derek Kiong (Author), Swarnalatha Ashok (Author)Springer; 2nd ed. 2008 edition (12 October 2007), ISBN-10: 1846289629, ISBN-13: 978-1846289620,2007 2. Java The complete reference, 9th edition, Herbert Schildt, McGraw Hill Education (India) Pvt. Ltd. 3. Object-Oriented Design Using Java, Dale Skrien, McGraw-Hill Publishing, 2008, ISBN - 0077423097, 9780077423094. 4. UML for Java Programmers by Robert C. Martin, Prentice Hall, ISBN 0131428489,2003.

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Savitribai Phule Pune University, Pune

Second Year Information Technology (2019 Course)

214445: Basics of Computer Network

Teaching Scheme:	Credit Scheme:	Examination Scheme:
Theory(TH):03hrs/week	03	Mid_Semester: 30 Marks End_Semester: 70 Marks

Prerequisite Courses, if any: Basics of communication

Course Objectives:

1. To understand the fundamentals of communication system.
2. To understand the basics of internetworking.
3. To understand services and protocols used at Physical, Data Link, Network, Transport Layer.

Course Outcomes:

On completion of the course, students will be able to–

CO1: Understand and explain the concepts of communication theory and compare functions of OSI and TCP/IP model.
CO2: Analyze data link layer services, error detection and correction, linear block codes, cyclic Codes, framing and flow control protocols.
CO3: Compare different access techniques, channelization and IEEE standards.
CO4: Apply the skills of subnetting, supernetting and routing mechanisms.
CO5: Differentiate IPv4 and IPv6.
CO6: Illustrate services and protocols used at transport layer.

COURSE CONTENTS

Unit I	Data Communication and Network Models	06 hrs

Introduction to communication Theory - Basics of data communication, Types of Signals, A/D, D/A, A/A, D/D Signal Conversion Methods, Bandwidth Utilization and Data Rate Limits, Multiplexing Techniques, Data rate limits, Topologies, Noise, types of noise, Shannon Hartley Theorem, Channel capacity, Nyquist and Shannon Theorem, Bandwidth S/N trade off.

Network Models And addressing - OSI Model TCP/IP Model (Data Format, Addressing Mechanisms, Devices)

Case Study	**Study of Physical layer components such as Cable, NIC, hub, etc. available in the computers /laboratories of your department**
Mapping of Course Outcomes for Unit I	CO1

Unit II	Error Detection, Correction and Data Link Control	06 hrs

Data Link Layer: Data Link Layer Services, Error Detection and Correction: Introduction, Error Detection and Error Correction. Linear Block Codes: hamming code, Hamming Distance, parity check code. Cyclic Codes: CRC (Polynomials), Advantages of Cyclic Codes, Other Cyclic Codes (Examples: CHECKSUM: One's Complement, Internet Checksum). Framing: fixed-size framing, variable size framing. Flow control: flow control protocols. Noiseless channels: simplest protocol, stop-and-wait

protocol. **Noisy channels:** stop-and-wait Automatic Repeat Request (ARQ), go-back-n ARQ, Selective repeat ARQ, piggybacking.		
Case Study	**Draw PPPoE connection diagram with multiple devices, FFTH connection diagram**	
Mapping of Course Outcomes for Unit II	**CO2**	
Unit III	**Multi-Access Mechanism and Ethernet Standards**	**06 hrs**
Random Access Techniques: CSMA, CSMA/CD, CSMA/CA, Controlled Access Techniques: Reservation, Polling, Token Passing, Channelization: FDMA, TDMA, CDMA, Ethernet: IEEE Standards-802.3, 802.4, 802.5, 802.6 Comparison of Ethernet Standards: Standard Ethernet, Fast Ethernet, Gigabit Ethernet with reference to MAC layer and Physical Layer (Wired Network Only)		
Case Study	**Campus network design case study**	
Mapping of Course Outcomes for Unit III	**CO3**	
Unit IV	**Network Layer: Services and Addressing**	**06 hrs**
Network Layer : Network Layer Services, IPv4 Addresses: Static and Dynamic Configuration Classful and Classless Addressing, Special Addresses, NAT, Subnetting, Supernetting, Delivery and Forwarding of IP Packet, Structure of Router, IPv4: Datagrams, Fragmentation, Options, Checksum, IPv6Addressing: Notations, Address Space, Packet Format, Transition from Ipv4 to IPv6		
Case Study	**Visit server room of campus and understand how IP addressing is done for your respective Campus →Institute→Department**	
Mapping of Course Outcomes for Unit IV	**CO4, CO5**	
Unit V	**Network Layer : Routing Protocols**	**06 hrs**
Routing: Metric, Static vs Dynamic Routing Tables, Routing Protocol, Unicast Routing Protocols - Optimality Principle, Intra and Inter Domain Routing, Shortest Path Routing, Flooding, Distant Vector Routing, Link State Routing, Path Vector Routing Interior Gateway Routing Protocol- OSPF, EIGRP, RIP, Exterior Gateway Routing Protocol– BGP		
Case Study	**Case study on network simulation tools such as Packet tracer**	
Mapping of Course Outcomes for Unit V	**CO4**	
Unit VI	**TRANSPORT LAYER - SERVICES AND PROTOCOLS**	**06 hrs**
Transport layer : Transport layer services(Duties), TCP: COTS, TCP header, Services, Segments, Connection Establishment, Flow control, Congestion Control, Congestion Control Algorithms, Leaky Bucket, Token Bucket and QoS, Timers, UDP: CLTS, UDP header, Datagram, Services, Applications, Socket: Primitives, TCP & UDP Sockets.		
Case Study	**Case study on Client server model using simple socket programming,** **Case Study on Transport Layer Security - Firewall (Stateless Packet**	

	Filtering), Stateful, Application
Mapping of Course Outcomes for Unit VI	**CO6**
Text Books:	
1. Behrouz A. Forouzan, TCP/IP Protocol Suite, McGraw Hill Education, ISBN: 978-0-07-070652-1, 4th Edition 2. Andrew S. Tanenbaum, David J. Wethrall, Computer Network, Pearson Education, ISBN: 978-0-13-212695-3	
Reference Books:	
1. Kurose Ross, Computer Networking: A Top Down Approach Featuring the Internet, Pearson Education, ISBN: 978-81-7758-878-1 2. Behrouz A. Forouzan, Data Communication and Networking, McGraw Hill Education, ISBN: 978-1-25-906475-3, 5th Edition 3. Mayank Dave, Computer Network, Cengage Learning, ISBN: 978-81-315-0986-9	

Home

Savitribai Phule Pune University, Pune
Second Year Information Technology (2019 Course)
214446: Logic Design &Computer Organization Lab

Teaching Scheme:	Credit Scheme:	Examination Scheme:
Practical (PR) : 02hrs/week	01	PR : 25Marks TW : 25Marks

Prerequisites: Basic Electronics Engineering

Course Objectives :

1. To design & implement combinational and sequential circuits.
2. To learn simulation of digital systems.

Course Outcomes :

On completion of the course, students will be able to–

CO1: Use logic function representation for simplification with K-Maps and design Combinational logic circuits using SSI & MSI chips.

CO2: Design Sequential Logic circuits: MOD counters using synchronous counters.

CO3: Understand the basics of simulator tool & to simulate basic blocks such as ALU & memory.

Guidelines for Instructor's Manual

The faculty member should prepare the laboratory manual for all the experiments and it should be made available to students and laboratory instructor/assistant. The instructor's manual should include prologue, university syllabus, conduction& Assessment guidelines, topics under consideration concept, objectives, outcomes, algorithms, sample test cases, data sheets of various elements of computer system, ICs, tools and references.

Guidelines for Student's Lab Journal

1. The laboratory assignments are to be submitted by student in the form of journal. The Journal consists of Certificate, table of contents, and handwritten write-up of each assignment.(Title, Objectives, Problem Statement, Outcomes, software & Hardware requirements, Date of Completion, Assessment grade/marks and assessor's sign, Theory Concept, circuit diagram, pin configuration, conclusion/analysis, printouts of the output using coding standards, sample test cases etc.)
2. Practical Examination will be based on the term work.
3. The practical examination should be conducted if the teamwork is completed, submitted by the student and is duly assessed, certified by concerned faculty and head of the department.
4. All the assignment mentioned in the syllabus must be conducted.

Guidelines for Lab /TW Assessment

1. Examiners will assess the term work based on performance of students; methodology adopted for implementation of practical assignment, timely submission of assignment in the form of handwritten write-up along with results of implemented assignment, attendance etc.
2. Examiners will judge the understanding of the practical performed in the examination by asking some questions related to theory & implementation of experiments he/she has carried out.
3. Appropriate knowledge of usage of necessary tools software and hardware such as ICs, digital

trainer kits, IC tester& simulation software, should be checked by the faculty member.

Guidelines for Laboratory Conduction

The instructor is expected to understand the prerequisites, technological aspects, utility and recent trends related to the topic. The instructor may set multiple sets of assignments. It is appreciated if the assignments are based on real world problems/applications. Use of open source software is encouraged.

Guidelines for Practical Examination

Both internal and external examiners should jointly set problem statements for practical examination. During practical assessment, the expert evaluator should give the maximum weightage to the satisfactory implementation of the problem statement. The supplementary and relevant questions may be asked at the time of evaluation to judge the student's understanding of the fundamentals, effective and efficient implementation. The evaluation should be done by both external and internal examiners.

List of Laboratory Assignments

Group A

Combinational Logic Design– CO1

1. Design and implement 4-bit BCD to Excess-3 code
2. Design and implement 1 digit BCD adder usingIC7483
3. Design and implement following using multiplexer IC 74153 1) full adder 2) Any three variable function (cascade method)
4. Design and implement full subtractor using decoder IC 74138

Group B

Sequential Logic Design– CO 2

1. Design and implement 3 bit Up and 3 bit Down Asynchronous Counters using master slave JK flip-flop IC 7476
2. Design and implement 3 bit Up and 3 bit Down Synchronous Counters using master slave JK flip-flop IC 7476
3. Design and implement Modulo 'N' counter using IC7490. (N= 100 max)

Group C

Computer organization– CO 3

Any **two** of following , using virtual lab simulator

1. Design& simulate single bit RAM cell **OR** 4 address*2bit memory using 8 single bit RAM cells.
2. Design& simulate single bit ALU with four functions(AND, OR, XOR, ADD).
3. Design& simulation of single instruction CPU.

Student should submit term work in the form of a journal based on the above assignments.

Note - Instructor should take care that datasheets of all the required ICs are available in the laboratory& students will be able to verify the functionality of ICs being used.
Reference Books:
1. R.P. Jain, "Modern Digital Electronics", 3rd Edition, Tata McGraw-Hill, ISBN:0-07-049492-4. 2. Virtual Lab simulator Link **http://vlabs.iitkgp.ac.in/coa/**

Home

Savitribai Phule Pune University, Pune
Second Year Information Technology (2019 Course)
214447: Data Structure & Algorithms Lab

Teaching Scheme:	Credit Scheme:	Examination Scheme:
Practical (PR) : 04 hrs/week	02	PR : 25 Marks TW: 25 Marks

Prerequisite Courses, if any: Fundamental knowledge of programming language and basics of algorithms

Course Objectives:

1. To study data structures and their implementations and applications.
2. To learn different searching and sorting techniques.
3. To study some advanced data structures such as trees, graphs and tables.
4. To learn different file organizations.
5. To learn algorithm development and analysis of algorithms.

Course Outcomes:

On completion of the course, students will be able to–

CO1: Analyze algorithms and to determine algorithm correctness and time efficiency class.

CO2: Implement abstract data type (ADT) and data structures for given application.

CO3: Design algorithms based on techniques like brute -force, divide and conquer, greedy, etc.).

CO4: Solve problems using algorithmic design techniques and data structures.

CO5: Analyze of algorithms with respect to time and space complexity.

Guidelines for Instructor's Manual

The faculty member should prepare the laboratory manual for all the experiments and it should be made available to students and laboratory instructor/Assistant.

The instructor's manual should include prologue, university syllabus, conduction & Assessment guidelines, topics under consideration-concept, objectives, outcomes, algorithm written in pseudo language, sample test cases and references. Experiments to be conducted in C++.

Guidelines for Student's Lab Journal

1. The laboratory assignments are to be submitted by students in the form of journals. The Journal consists of prologue, Certificate, table of contents, and handwritten write-up of each assignment (Title, Objectives, Problem Statement, Outcomes, software & Hardware requirements, Date of Completion, Assessment grade/marks and assessor's sign, Theory-Concept, algorithms, printouts of the code written using coding standards, sample test cases etc.)
2. Practical Examination will be based on the term work.
3. Candidate is expected to know the theory involved in the experiment.
4. The practical examination should be conducted if the journal of the candidate is completed in all respects and certified by concerned faculty and head of the department.

5. All the assignment mentioned in the syllabus must be conducted.

Guidelines for Lab /TW Assessment

1. Examiners will assess the term work based on performance of students considering the parameters such as timely conduction of practical assignment, methodology adopted for implementation of practical assignment, timely submission of assignment in the form of handwritten write-up along with results of implemented assignment, attendance etc.
2. Examiners will judge the understanding of the practical performed in the examination by asking some questions related to theory & implementation of experiments he/she has carried out.
3. Appropriate knowledge of usage of software and hardware such as compiler, debugger, coding standards, algorithm to be implemented etc. should be checked by the concerned faculty member(s).

Guidelines for Laboratory Conduction

The instructor is expected to frame the assignments by understanding the prerequisites, technological aspects, utility and recent trends related to the topic. The instructor may set multiple sets of assignments and distribute among batches of students. It is appreciated if the assignments are based on real world problems/applications.

All the assignments should be conducted on multicore hardware and 64-bit open-source software.

Guidelines for Practical Examination

Both internal and external examiners should jointly set problem statements for practical examination. During practical assessment, the expert evaluator should give the maximum weightage to the satisfactory implementation of the problem statement. The supplementary and relevant questions may be asked at the time of evaluation to judge the student's understanding of the fundamentals, effective and efficient implementation. The evaluation should be done by both external and internal examiners.

List of Assignments

Virtual Laboratory

- https://ds1-iiith.vlabs.ac.in/data-structures-1/
- https://ds2-iiith.vlabs.ac.in/data-structures-2/
- http://cse01-iiith.vlabs.ac.in/

1. Searching and Sorting -- CO1, CO2, CO3, CO5

Consider a student database of SEIT class (at least 15 records). Database contains different fields of every student like Roll No, Name and SGPA.(array of structure)

a) Design a roll call list, arrange list of students according to roll numbers in ascending order (Use Bubble Sort)
b) Arrange list of students alphabetically. (Use Insertion sort)
c) Arrange list of students to find out first ten toppers from a class. (Use Quick sort)
d) Search students according to SGPA. If more than one student having same SGPA, then print list of all students having same SGPA.
e) Search a particular student according to name using binary search without recursion. (all the

student records having the presence of search key should be displayed)

(Note: Implement either Bubble sort or Insertion Sort.)

2. Stack -- CO1, CO2, CO3, CO5

Implement stack as an abstract data type using singly linked list and use this ADT for conversion of infix expression to postfix, prefix and evaluation of postfix and prefix expression.

3. Circular Queue -- CO1, CO2, CO3, CO5

Implement Circular Queue using Array. Perform following operations on it.

a) Insertion (Enqueue)
b) Deletion (Dequeue)
c) Display

(Note: Handle queue full condition by considering a fixed size of a queue.)

4. Expression Tree -- CO1, CO2, CO3, CO5

Construct an Expression Tree from postfix and prefix expression. Perform recursive and non-recursive In-order, pre-order and post-order traversals.

5. Binary Search Tree -- CO1, CO2, CO3, CO5

Implement binary search tree and perform following operations:

a) Insert (Handle insertion of duplicate entry)
b) Delete
c) Search
d) Display tree (Traversal)
e) Display - Depth of tree
f) Display - Mirror image
g) Create a copy
h) Display all parent nodes with their child nodes
i) Display leaf nodes
j) Display tree level wise

(Note: Insertion, Deletion, Search and Traversal are compulsory, from rest of operations, perform Any three)

6. Threaded Binary Tree -- CO1, CO2, CO3, CO5

Implement In-order Threaded Binary Tree and traverse it in In-order and Pre-order.

7. Graph: Minimum Spanning Tree -- CO1, CO2, CO3, CO5

Represent a graph of your college campus using adjacency list /adjacency matrix. Nodes should represent the various departments/institutes and links should represent the distance between them. Find minimum spanning tree

a) Using Kruskal's algorithm.
b) Using Prim's algorithm.

8. Graph: Shortest Path Algorithm -- CO1, CO2, CO3, CO5

Represent a graph of city using adjacency matrix /adjacency list. Nodes should represent the various landmarks and links should represent the distance between them. Find the shortest path using Dijkstra's algorithm from single source to all destination.

9. Heap Sort -- CO1, CO2, CO4

Implement Heap sort to sort given set of values using max or min heap.

10. FILE Handling -- CO1, CO3, CO5

Department maintains student's database. The file contains roll number, name, division and address. Write a program to create a sequential file to store and maintain student data. It should allow the user to add, delete information of student. Display information of particular student. If record of student does not exist an appropriate message is displayed. If student record is found it should display the student details.

Text Books :

1. Richard F. Gilberg, Behrouz A. Forouzan, "Data Structures: A Pseudocode Approach using C++", Cengage Learning, 5th Edition, ISBN 978-8131504925
2. Mark Allen Weiss, "Data structures and Algorithm Analysis in C++ ", Pearson Education India, 3 edition (2007), ISBN 978-8131714744
3. Ellis Horowitz, Sartaj Sahni, Dinesh Mehta, "Fundamentals of Data Structures in C++", University Press (2008), ISBN 978-8173716065

Reference Books

1. Hemant Jain, "Problem Solving in Data Structures & Algorithms using C++", CreateSpace Independent Publishing Platform (2017), ISBN 978-1542396479
2. G A V PAI, "DATA STRUCTURES and Algorithms Concepts, Techniques and Applications", McGraw Hill (2017), ISBN 978-0070667266
3. Michael T. Goodrich, Roberto Tamassia, David Mount, "Data Structures and Algorithms in C++ ", Wiley (2007), ISBN 978-8126512607
4. E Balagurusamy, "Object-Oriented Programming with C++", McGraw Hill Education; Seventh edition (2017), ISBN 978-9352607990

Savitribai Phule Pune University, Pune Second Year Information Technology (2019 Course) 214448: Object Oriented Programming Lab		
Teaching Scheme:	**Credit Scheme:**	**Examination Scheme:**
Practical (PR) : 04 hrs/week	**02**	**PR: 25 Marks** **TW: 25 Marks**

Prerequisites: Student should have knowledge of programming language.

Course Objectives:

1. Apply concepts of object-oriented paradigm.
2. Design and implement models for real life problems by using object-oriented programming.
3. Develop object-oriented programming skills.

Course Outcomes:

On completion of the course, students will be able to–

CO1: Differentiate various programming paradigms.

CO2: Identify classes, objects, methods, and handle object creation, initialization, and destruction to model real-world problems.

CO3: Identify relationship among objects using inheritance and polymorphism.

CO4: Handle different types of exceptions and perform generic programming.

CO5: Use file handling for real world application.

CO6: Apply appropriate design patterns to provide object-oriented solutions.

Guidelines for Instructor's Manual

The instructor‘s manual is to be developed as a hands-on resource and reference. The instructor's manual need to include prologue (about University/program/ institute/ department/foreword/ preface etc.), University syllabus, conduction & Assessment guidelines, topics under consideration concept, objectives, outcomes, set of typical applications/assignments/ guidelines, and references.

Guidelines for Student's Lab Journal

1. The laboratory assignments are to be submitted by student in the form of journal.
2. Journal consists of prologue, Certificate, table of contents, and handwritten write-up of each assignment (Title, Objectives, Problem Statement, Outcomes, software & Hardware requirements, Date of Completion, Assessment grade/marks and assessor's sign, Theory- OOP feature/Concept in brief, algorithm, flowchart, test cases, conclusion/analysis.
3. Program codes with sample output of all performed assignments are to be submitted as hardcopy.
4. As a conscious effort and little contribution towards Green IT and environment awareness, attaching printed papers as part of write-ups and program listing to journal may be avoided.
5. Use of DVD containing students programs maintained by lab In-charge is highly encouraged.
6. For reference one or two journals may be maintained with program prints at Laboratory.

Guidelines for Lab /TW Assessment

1. Continuous assessment of laboratory work is done based on overall performance and lab

assignments performance of student.

2. Each lab assignment assessment will assign grade/marks based on parameters with appropriate weightage.
3. Suggested parameters for overall assessment as well as each lab assignment assessment include- timely completion, performance, innovation, efficient codes, punctuality and neatness.

Guidelines for Practical Examination

Both internal and external examiners should jointly set problem statements. During practical assessment, the expert evaluator should give the maximum weightage to the satisfactory implementation of the problem statement. The supplementary and relevant questions may be asked at the time of evaluation to test the student's for advanced learning, understanding of the fundamentals, effective and efficient implementation. So encouraging efforts, transparent evaluation and fair approach of the evaluator will not create any uncertainty or doubt in the minds of the students.

Guidelines for Laboratory Conduction

The instructor is expected to frame the assignments by understanding the prerequisites, technological aspects, utility and recent trends related to the topic. The assignment framing policy need to address the average students and inclusive of an element to attract and promote the intelligent students. The instructor may set multiple sets of assignments without changing its complexity level and distribute among batches of students. Encourage students for the use of industry coding standards such as appropriate use of Hungarian notation, Indentation and comments. Use of open source software is encouraged. Set of suggested assignment list is provided, instructors may take different case studies with similar complexity level. Operating System recommended :- 64-bit Open source Linux or its derivative
Programming tools recommended: - JAVA IDE

List of Assignments

1.Classes and object -- CO1 and CO2

Design a class 'Complex 'with data members for real and imaginary part. Provide default and Parameterized constructors. Write a program to perform arithmetic operations of two complex numbers.

2. Polymorphism -- CO3

Identify commonalities and differences between Publication, Book and Magazine classes. Title, Price, Copies are common instance variables and saleCopy is common method. The differences are, Bookclass has author and orderCopies(). Magazine Class has methods orderQty, Current issue, receiveissue().Write a program to find how many copies of the given books are ordered and display total sale of publication.

3.Inheritance -- CO3

Design and develop inheritance for a given case study, identify objects and relationships and implement inheritance wherever applicable. Employee class hasEmp_name, Emp_id, Address, Mail_id, and Mobile_noas members. Inherit the classes: Programmer, Team Lead, Assistant Project Manager and Project Manager from employee class. Add Basic Pay (BP) as the member of all the inherited classes with 97% of BP as DA, 10 % of BP as HRA, 12% of BP as PF, 0.1% of BP for staff club fund. Generate pay slips for the employees with their gross and net salary.

4.Dynamic Binding -- CO3

Design a base class shape with two double type values and member functions to input the data and compute_area() for calculating area of shape. Derive two classes: triangle and rectangle. Make compute_area() as abstract function and redefine this function in the derived class to suit their requirements. Write a program that accepts dimensions of triangle/rectangle and display calculated area. Implement dynamic binding for given case study.

5.Interface -- CO1, CO3

Design and develop a context for given case study and implement an interface for Vehicles Consider the example of vehicles like bicycle, car and bike. All Vehicles have common functionalities such as Gear Change, Speed up and apply breaks. Make an interface and put all these common functionalities. Bicycle, Bike, Car classes should be implemented for all these functionalities in their own class in their own way.

6.Exception handling -- CO4

Implement a program to handle Arithmetic exception, Array Index Out of Bounds. The user enters two numbers Num1 and Num2. The division of Num1 and Num2 is displayed. If Num1 and Num2 are not integers, the program would throw a Number Format Exception. If Num2 were zero, the program would throw an Arithmetic Exception. Display the exception.

7.Template -- CO4

Implement a generic program using any collection class to count the number of elements in a collection that have a specific property such as even numbers, odd number, prime number and palindromes.

8.File Handling -- CO5

Implement a program for maintaining a database of student records using Files.
Student has Student_id,name, Roll_no, Class, marks and address. Display the data for few students.

1. Create Database
2. Display Database
3. Delete Records
4. Update Record
5. Search Record

9.Case Study -- CO2, CO5

Using concepts of Object-Oriented programming develop solution for any one application

1) Banking system having following operations :

1. Create an account 2. Deposit money 3. Withdraw money 4. Honor daily withdrawal limit
5. Check the balance 6. Display Account information.

2) Inventory management system having following operations :
1. List of all products 2. Display individual product information 3. Purchase 4. Shipping
5. Balance stock6. Loss and Profit calculation.

10. Factory Design Pattern -- CO6

Implement Factory design pattern for the given context. Consider Car building process, which requires many steps from allocating accessories to final makeup. These steps should be written as methods and should be called while creating an instance of a specific car type. Hatchback, Sedan, SUV could be the subclasses of Car class. Car class and its subclasses, CarFactory and Test Factory Pattern should be implemented.

11. Strategy Design Pattern -- CO6

Implement and apply Strategy Design pattern for simple Shopping Cart where three payment strategies are used such as Credit Card, PayPal, Bit Coin. Create an interface for strategy pattern and give concrete implementation for payment.

Text Books:

1. E. Balagurusamy, “Programming with Java – A Primer”, Tata – McGraw-Hill Publication, 4th Edition, 2019
2. Kathy Sierra, “OCA /OCP Java SE 7 Programmer I & II Study Guide”(Exams 1Z0-803 & IZ-804) Oracle Press (2017)
3. Steven Holzner et al. “Java 2 Programming”, Black Book, Dreamtech Press, 2009

Reference Books:

1. H.M. Deitel, P.J. Deitel, “Java - How to Program”, PHI Publication, 6th Edition, 2005
2. Bruce Eckel, “Thinking in Java”, PHI Publication
3. Poo, Danny, Kiong, Derek, Ashok, Swarnalatha,“ Object-Oriented Programming and Java”, ISBN 978-1-84628-963-7
4. Erich Gamma,Richard Helm ,Ralph Johnson,JohnVlissides, “Design Patterns ,Elements of Reusable Object- Oriented Software” ISBN-13: 978-0201633610
5. RohitJoshi, “Java Design patterns, Reusable solutions to common problems” Java Code Geeks

Home

Savitribai Phule Pune University Second Year Information Technology (2019 Course) 214449: Soft Skill Lab		
Teaching Scheme:	**Credit Scheme :**	**Examination Scheme:**
Practical (PR) : 02 hrs/Week	**01**	**TW : 25 Marks**

Prerequisites , If any: ------

Course Objectives:

1. To facilitate a holistic development of students while focusing on enhancing soft skills.
2. To highlight the need to improve soft skills among engineering students so as to become good professionals.
3. To develop and nurture the soft skills of the students through individual and group activities.
4. To expose students to right attitudinal and behavioural aspects and assist in building the same through activities.

Course Outcomes:

On completion of the course, students will be able to–

CO1: Introspect about individual's goals, aspirations by evaluating one's SWOC and think creatively.

CO2: Develop effective communication skills including Listening, Reading, Writing and Speaking.

CO3: Constructively participate in group discussion, meetings and prepare and deliver Presentations.

CO4: Write precise briefs or reports and technical documents.

CO5: Practice professional etiquette, present oneself confidently and successfully handle personal interviews .

CO6: Function effectively in multi-disciplinary and heterogeneous teams through the knowledge of team work, Inter-personal relationships, conflict management and leadership quality.

COURSE CONTENTS

Unit I	**Introspective & Self Development**	**04 hrs**
Introduction to soft skills, SWOC analysis, planning career, setting short-term & long-term goals, identifying difference between jobs & career, aligning aspirations with individual skills, understanding self-esteem, developing discipline and critically evaluating oneself		
Mapping of Course Outcomes for Unit I	**CO1, CO6**	
Unit II	**Communication Skills**	**04 hrs**
Essentiality of good communication skills, importance of feedback, different types of communication, barriers in communication and how to overcome these barriers, significance of non-verbal messages as augmentation to verbal communication, group discussion, listening vs hearing, reading to comprehend, learning to skim and scan to extract relevant information, effective digital communication		
Mapping of Course Outcomes for Unit II	**CO2, CO3, CO5**	

Unit III	**Language and Writing Skills**	**04 hrs**
Fundamentals of english grammar, improve lexical resource, essential steps to improve spoken and written english, business vocabulary, writing – email, resume, formal letter, official communication, essay, presentation – planning, organizing, preparing and delivering professional presentation		
Mapping of Course Outcomes for Unit III	**CO2, CO4**	
Unit IV	**Leadership Skills and Group Dynamics**	**04 hrs**
Understanding corporate culture and leadership skills, difference between a leader and a manager, importance of resilience in a professional surrounding, developing empathy and emotional intelligence, being assertive and confident, 4-Ds of decision making, creative and solution-centric thinking, resolving conflicts, working cohesively as a team to achieve success, five qualities of an effective team – positivity, respect for others, trust, goal-focused, supportiveness		
Mapping of Course Outcomes for Unit IV	**CO1, CO5, CO6**	
Unit V	**Ethics, Professional Etiquette**	**04 hrs**
Understanding ethics and morals, importance of professional ethics, hindrances due to absence of work ethics, professional etiquette – introductions, with colleagues, attire, events, dinning, telephone, travelling, netiquette, social media, writing		
Mapping of Course Outcomes for Unit V	**CO5, CO6**	
Unit VI	**Stress And Time Management**	**04 hrs**
Stress as integral part of life, identifying signs and sources of stress, steps to cope with stress – open communication, positive thinking, belief in oneself, ability to handle failure, retrospective thinking for future learning, organizing skills to enhance time management, focusing on goals, smart work vs hard work, prioritizing activities, perils of procrastination, daily evaluation of "to-do" list.		
Mapping of Course Outcomes for Unit VI	**CO1, CO3, CO6**	
Text Book :		
1. Gajendra Singh Chauhan, Sangeeta Sharma,"Soft Skills – An Integrated Approach to Maximize Personality", WILEY INDIA, ISBN:13:9788126556397		
Reference Books :		
1. Indrajit Bhattacharya, "An Approach to Communication Skills", Delhi, DhanpatRai, 2008 2. Simon Sweeney, "English for Business Communication", Cambridge University Press, ISBN 13:978-0521754507 3. Sanjay Kumar and Pushpa Lata, "Communication Skills", Oxford University Press, ISBN 10:9780199457069 4. Atkinson and Hilgard, "Introduction to Psychology", 14th Edition, Geoffrey Loftus, ISBN-10:0155050699, 2003 5. Kenneth G. Mcgee, "Heads Up: How to Anticipate Business Surprises & Seize Opportunities		

First", Harvard Business School Press, Boston, Massachusetts, 2004, ISBN 10:1591392993
6. Krishnaswami, N. and Sriraman T., "Creative English for Communication" , Macmillan

Guidelines for Student's Lab Journal and TW Assessment

Each student should have a Lab Workbook (sample workbook attached) which outlines each lab activity conducted. The student must respond by writing out their learning outcomes and elaborating the activities performed in the lab. Continuous assessment of laboratory work is to be done based on overall performance and lab assignments and performance of student. Each lab assignment assessment will be assigned grade/marks based on parameters with appropriate weightage. Suggested parameters for overall assessment as well as each lab assignment assessment include- timely completion, performance, punctuality, neatness, enthusiasm, participation and contribution in various activities-SWOC analysis, presentations, team activity, event management, group discussion, group exercises and interpersonal skills and similar other activities/assignments.

Guidelines for Conduction of Soft Skills Lab

The teacher may design specific assignments that can highlight the learning outcomes of each unit. Each activity conducted in the lab should begin with a brief introduction of the topic, purpose of the activity from a professional point of view and end with the learning outcomes as feedback from students. Most of the lab sessions can be designed to be inclusive; allowing students to learn skills experientially; which will benefit them in the professional environment. Every student must be given sufficient opportunity to participate in each activity and constructive feedback from the instructor / facilitator at the end of the activity should learn towards encouraging students to work on improving their skills. Activities should be designed to respect cultural, emotional and social standing of students. Some of the activities can be designed to cater to enhancement of multiple skills – For e.g. – Team Building Activity can highlight 'open communication', 'group discussion', 'respecting perspectives', 'leadership skills', 'focus on goals' which can help students improve their inherent interpersonal skills.
At least one session should be dedicated to an interactive session that will be delivered by an expert from the industry; giving the students an exposure to professional expectations.

Virtual Laboratory

- https://ve-iitg.vlabs.ac.in/

Recommended List of Lab Sessions

1. Introduction of Self / SWOC Analysis -- CO1, CO4

a. Explain how to introduce oneself in a professional manner and presenting oneself positively Name, Academic Profile, Achievements, Career Aspirations, Personal Information (hobbies, family, social).
b. Focus on introspection and become aware of one's Strengths, Weakness, Opportunities and Challenges.
Students can write down their SWOC in a matrix and the teacher can discuss the gist personally.

2. Career Goals and Planning -- CO1, CO4

a. Make students understand the difference between a job and a career. Elaborate steps on how to plan a career.
Students can choose a career and they should write down what skills, knowledge, steps are need

to be successful in that particular career and how they can get the right opportunity.

b. Explain to students how to plan short term and long term goals.
Think and write down their short-term goals and long terms goals. Teacher can read and discuss (provide basic counselling) about the choices written.

3. Public Speaking -- (Choose any 2) -- CO3, CO2

a. Prepared Speech
Topics will be shared with students and they will be given 10 minutes to prepare and 3 minutes to deliver followed by Q&A from audience. Teacher will evaluate each student based on content, communication skills, logical and cohesive presentation of topic, perspective of student, ability to handle questions and respond positively.

b. Extempore Speech
Various topics will be laid out in front of the audience and each student is to pick one topic and speak about the topic for 5 minutes followed by Q&A from audience. Teacher will evaluate each student based on ability to think on his/her feet, content, communication skills, logical and cohesive presentation of topic, perspective of student, ability to handle questions and respond positively.

c. Reviewing an Editorial article
Either using e-paper / printed copy, students have to select a recent editorial (that is non-controversial), read it and explain to the audience what the editor's perspective is and what the student's perspective is.

d. Book Review
Each student will orally present to the audience his/her review of a book that he/she has recently read.

4. Group Discussion -- CO3, CO2

a. The class will be divided into groups of 8 – 10 students in for a discussion lasting 10 minutes.

b. Topics should be topical and non-controversial. After each group finishes its discussion, the teacher will give critical feedback including areas of improvement. The teacher should act as a moderator / observer only

5. Listening and Reading Skills -- CO2

a. Listening Worksheets to be distributed among students
Each student will be given specifically designed worksheets that contain blanks / matching / MCQs that are designed to an audio (chosen by the faculty). Students have to listen to the audio (only once) and complete the worksheet as the audio plays. This will help reiterate active listening as well as deriving information (listening to information between the lines)

b. Reading Comprehension Worksheets to be distributed/displayed to students
Teacher will choose reading passages from non-technical domains, design worksheets with questions for students to answer. This will enhance student's reading skills by learning how to skim and scan for information.

6. Writing Skills (Choose any 2) -- CO2

a. Letter / Email Writing
After explaining to the students the highlights of effective writing, students can be asked to write (using digital platforms / paper-based) letter to an organization with the following subject matter,

i. Requesting opportunity to present his/her product.
ii. Complaining about a faulty product / service.

iii. Apologizing on behalf of one's team for the error that occurred.
iv. Providing explanation for a false accusation by a client.

b. Report Writing

After describing various formats to write report and explaining how to write a report, each student should be asked to write a report (digital/ paper-based) on any of the following topics,

i. Industrial visit.
ii. Project participated in.
iii. Business / Research Proposal.

c. Resume Writing

The teacher should conduct a brief session outlining the importance of a CV / Resume and students can write / type out their own resumes

i. Share various professional formats.
ii. Focus on highlighting individual strengths.
iii. Develop personalized professional goals / statement at the beginning of the resume.

7. Team Building Activities -- CO3, CO4

The class will be divided into groups of 4-5 students in each group and an activity will be given to each group.
The activities chosen for each team should be competitive and should involve every student in the team. The activities may be conducted indoors or outdoors depending on infrastructure. While selecting the team, ensure that each team has a mix of students who have varied skills. The teacher should give critical feedback including areas of improvement at the end of the activity.

8. Expert Lecture -- CO4

Highlighting the need to manage stress and time, experts from the fields of health and fitness, counselling, training, medical or corporate HR may be invited to deliver a participatory session that focus on helping students to cope with parental, social, peer and career pressures.

9. Lateral and Creative Thinking -- CO1, CO4

Every student needs to step out of the linear thinking and develop lateral and creative thinking. Teacher can develop creative activities in the classroom / lab that will help students enhance their creative thinking. Some of the suggested activities,

i. Each group (3-4 students) can be given random unrelated items and they will be given sufficient time to come up with creative ideas on how the objects can be used for activities / purposes other than its intended one.
ii. Each student is given a random line and he/she has to spin a fictional story and tell it to the class (3 minutes). Each story should have a beginning, middle and end.
iii. Each group (3-4 students) can be given a fictional / hypothetical dangerous situation and they have to find a solution to that problem. They can present it to the other teams who will then get the opportunity to pick flaws in the ideas.

10. Mock Interviews -- CO2, CO3

Student has to undergo interview session and the teacher should seek the assistance of another faculty member / TPO Officer/ Alumni to act as interview panel. Students will be informed beforehand about the job profile that they are appearing the interview for and they have to come prepared with a printed copy of their resume, formally dressed. Questions will include technical as well as HR. Interviewer can choose to give problems to solve using technical skills. Students will be graded on the basis of their technical knowledge, ability to answer questions well, presentation of self, body language and verbal skills.

11. Presentation Skills -- CO2, CO3
Every student will have to choose a topic of his/her choice and make a 5-minute presentation using audio-video aids / PPT. The topic can either be technical or non-technical. Focus and evaluation of each presentation should be the depth of knowledge about the topic, originality of perspective on the topic, well-researched or not, verbal and non-verbal skills and ability to answer questions effectively. Plagiarism should be discredit and students should be instructed about it.
12. Corporate and Business Etiquette -- CO4, CO1
The teacher can design an interactive session that allows students to be involved in understanding the requirements of a corporate environment. This can be done using innovative quiz competition in the classroom and the teacher explaining the concept / relevance of that particular aspect in the professional context. Alternatively, the teacher can invite professionals to have an interactive session with students about various aspects of professional etiquette.

Home

Savitribai Phule Pune University, Pune

Second Year Information Technology (2019 Course)

214450 (A): Mandatory Audit Course 3:

Ethics and Values in Information Technology

Teaching Scheme:	Credit Scheme:	Examination Scheme:
01hrs/week	Non Credit	Audit Course

Prerequisite Courses, if any:--

Course Objectives:

1. To understand and implement the values and principles in the field of Information Technology.
2. To nurture honest and responsible professionals in Information Technology.
3. To develop student's understanding about social/ professional ethical issues related to Information Technology.
4. To inculcate professional ethics in the field of IT.

Course Outcomes:

On completion of this course students will be able to-

CO1: Adapt the global ethical principles and modern ethical issues.
CO2: Apprehend ethics in the business relationships and practices of IT.
CO3: Implement trustworthy computing to manage risk and security vulnerabilities.
CO4: Analyse concerns of privacy, privacy rights in information-gathering practices in IT.

COURSE CONTENTS

Unit -I	An Overview of Ethics	03hrs

An overview of Ethics: Brief about ethics, Ethics in the Business World, Ethics in IT.

Ethics for IT professionals and IT users: **IT professionals:** Changing Professional Services, Professional Relationships, Codes of Ethics, awareness of IT malpractices, **IT Users***:* Common Ethical Issues for IT Users, Supporting the Ethical Practices of IT Users.

Mapping of Course Outcomes for Unit I	CO1 , CO2

Unit- II	Computer And Internet Crime	03hrs

Introduction: IT security incidents, Types of Exploits, Types of Perpetrators, Laws for Prosecuting Computer Attacks, Implementing Trustworthy Computing, Risk and Vulnerability Assessment, Educating Employees, Contractors, and Part-Time Workers, Establishing a Security Policy

Privacy: The right of Privacy, Privacy Protection and the Law, Key Privacy and Anonymity Issues Identity Theft, Consumer Profiling, Treating Consumer Data Responsibility, Workplace Monitoring

Freedom of Expression: Defamation and Hate Speech, Key issues, Controlling Access to Information on the Internet, Anonymity on the Internet, Corporate Blogging, Pornography

Mapping of Course Outcomes for Unit II	CO3, CO4

Unit- III	Social Networking &Ethics of IT Organization	03 hrs

Social Networking: Brief about Social Networking, **Social Networking Ethical Issues***:* Cyber bullying, Cyber stalking, Encounters with Sexual Predators, Uploading of Inappropriate Material,

Online Virtual Worlds: Crime in Virtual Worlds, Educational and Business Uses of Virtual Worlds.

Ethics of IT Organization: Key Ethical Issues for Organizations, of Workers, Outsourcing, Whistle-blowing, Code of Ethics and Professional Conduct.

Mapping of Course Outcomes for Unit III	**CO2, CO3, CO4**

Unit - IV	Case Study	03hrs

Malware, Medical Implants, Abusive Workplace Behaviour, Automated Active Response Weaponry, Malicious Inputs to Content Filters.

Mapping of Course Outcomes for Unit IV	**CO1, CO2, CO3, CO4**

Text Books:

1. George Reynolds,"Ethics in Information Technology", Cengage learning, 5th Edition
2. R. Subramanian, "Professional Ethics", OXFORD University Press, Second Edition

Reference Books:

1. William Lillie,"An Introduction to Ethics", Allied Publishers
2. Charles b. Fleddermann, "Engineering Ethics", Prentice Hall
3. M.Govindarajan,S.Natarajan&V.S.Senthilkumar, "Engineering Ethics &Human Values", PHI Learning
4. "ACM Code of Ethics and Professional Conduct Case Studies" **https://www.acm.org/code-of-ethics/case-studies**
5. "Case Studies of Ethics", **https://flylib.com/books/en/4.269.1.115/1/**
6. "UNODC Case Studies" **https://www.unodc.org/e4j/en/integrity-ethics/module-12/exercises/case-studies.html**

Evaluation :

Students should select any one of the topic in a group of 3 to 5. Students should submit a written report and make a presentation on the topic. The task should not be repeated among students. Report will be evaluated by the faculty as per rubrics defined by him/her/them at start of course.

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Savitribai Phule Pune University, Pune

Second Year Information Technology (2019 Course)

214450 (B) : Mandatory Audit Course3:

Quantitative Aptitude & Logical Reasoning

Teaching Scheme:	Credit Scheme:	Examination Scheme:
01hrs/week	Non Credit	Audit Course

Prerequisite Courses, if any:--

Course Objectives:

1. To develop the quantitative, logical and verbal abilities.
2. To enable learners to interpret the data accurately.
3. To build logical thinking ability among the learners.
4. To enable students to comprehend the English text.

Course Outcomes:

On completion of the course, learner will be able to ---

CO1: Apply basic concepts of quantitative abilities

CO2: Use logical reasoning for solving real world problems

CO3: Compete in examinations like internships, industry placements, postgraduate admissions, civil services etc.

COURSE CONTENTS

Unit I	Fundamental Quantitative Abilities	03 hrs
Concepts and Problems on Number System, HCF and LCM, Average, Ratio and Proportion, Percentage, Year month days counting, SI units and measurements		
Mapping of Course Outcomes for Unit I	**CO1, CO2, CO3**	
Unit II	**Arithmetic Quantitative Abilities**	**02 hrs**
Concepts and Problems on Ages, Profit and loss, Simple and Compound interest, Time value of money, Time and distance, Time and Work, Geometry and Coordinate Geometry, logarithms		
Mapping of Course Outcomes for Unit II	**CO1, CO2, CO3**	
Unit III	**Logical Reasoning Ability**	**02 hrs**
Number Series, Pattern recognition, Alpha Numerical, Letter & Symbol Series , Numerical and Alphabet Puzzles, Seating Arrangement		
Mapping of Course Outcomes for Unit III	**CO2,CO3**	
Unit IV	**Thinking and Reasoning**	**02 hrs**
Objective Reasoning, Graph and Plots, Data sufficiency, Blood Relation, Coding deductive logic, Logical word sequence		

Mapping of Course Outcomes for Unit IV	**CO2, CO3**	
Unit V	**Verbal Ability**	**03 hrs**
Synonyms, Antonyms, Contextual Vocabulary, Error Identification, Sentence Correction, Sentence Improvement, Subject-Verb agreement, Tenses and Articles, Reading Comprehension, Preposition & Conjunction		
Mapping of Course Outcomes for Unit V	**CO1, CO2, CO3**	

Text Books:

1. Quantitative abilities by Arun Sharma, Motilal Uk Books Of India, 2012
2. Quantitative Aptitude for Competitive Examinations by R S Agrawal
3. Verbal and Non-Verbal reasoning by R S Agrawal

Evaluation :

Students should select any one of the topic in a group of 3 to 5. Students should submit a written report and make a presentation on the topic. The task should not be repeated among students. Report will be evaluated by the faculty as per rubrics defined by him/her/them at start of course.

Home

Savitribai Phule Pune University, Pune

Second Year Information Technology (2019 Course)

214450 (C) : Mandatory Audit Course 3:
Language Study Japanese -Module I

Teaching Scheme:	Credit Scheme:	Examination Scheme:
01hrs/week	Non Credit	Audit Course

Prerequisite Courses, if any: Audit Course 4: Language Study Japanese: Module-II

Course Objectives:

1. To teach pronunciation and intonation of Japanese sounds.
2. To enable students to comprehend and speak simple sentences in Japanese.
3. To introduce Japanese language at the basic level, to enable students to read and write the phonetic scripts, *Hiragana* and *Katakana,* and approx.100 *Kanji.,*
4. To teach some aspects of Japanese society and culture.

Course Outcomes:

On completion of the course, learner will be able to --

CO1: Converse with simple sentences in Japanese.
CO2: Recognize and read simple sentences in Japanese.
CO3: Write simple sentences in Japanese.
CO4: Be aware about Japanese society and people.

COURSE CONTENTS

Unit I	Japanese Oral Expression	(02 hrs + 04 hrs Self Study)

Oral practice of pronunciation and intonation of Japanese sounds, Japanese greetings, self-introduction, identifying things, time of the day, calendar; counting using Japanese numerical classifiers; describing things; making comparisons; talking of daily activities, kinship terms used for address and reference, seasons, giving and receiving, shopping; making requests, talking of one's likes and dislikes

Mapping of Course Outcomes for Unit I	CO1

Unit II	Japanese Kana and Kanji	(02 hrs + 04 hrs Self Study)

Introduction of the Japanese writing system, i.e. *Hiragana*, *Katakana* and *Kanji* (100-120), word-building, writing foreign names and loan words in Katakana

Mapping of Course Outcomes for Unit II	CO2, CO3

Unit III	Japanese Greetings	(02 hrs + 04 hrs Self Study)

Basic sentence patterns to be applied in self-introduction, identifying things; time of the day; calendar; counting using Japanese numerical classifiers; describing things; making comparisons; talking of daily activities; kinship terms used for address and reference; seasons; giving and receiving; shopping; making requests; talking of one's likes and dislikes

Mapping of Course Outcomes for Unit III	**CO1**	
Unit IV	**Japanese Comprehension**	**(02 hrs+ 04 hrs Self Study)**
Extensive practice of basic patterns at the elementary level through drills and exercises		
Mapping of Course Outcomes for Unit IV	**CO1, CO2**	
Unit V	**Speaking Japanese**	**(02 hrs + 4 hrs Self Study)**
Simple conversation in situations such as describing things, making comparisons, talking of daily activities, giving and receiving of gifts, talking of illnesses and visit to a doctor, shopping, making requests, talking of one's likes and dislikes, talking on telephone etc.		
Mapping of Course Outcomes for Unit V	**CO1**	
Unit VI	**Social Environment of Japan**	**(02 hrs + 4 hrs Self Study)**
An introduction to some aspects of Japanese culture such as festivals, Japanese seasons, Japanese people and their love for nature; Japanese food, sports; society; geography; education system; Japan and the world etc. The objective is to create general awareness in students about life in Japan.		
Mapping of Course Outcomes for Unit VI	**CO4**	

E-Resources for Learning Support:

a. https://www.duolingo.com/course/ja/en/Learn-Japanese
b. https://www.freejapaneselessons.com/
c. https://minato-jf.jp/ **(Japan Foundation)**

Text Books:

1. Taeko Kamiya, Japanese For Fun Phrasebook & Dictionary: The Easy Way to Learn Japanese Quickly, Rev Edition 2017 Tuttle Publishing, (ISBN 10- 4805313986, ISBN 13 -9784805313985)
2. Eri Banno, Genki I: An Integrated Course in Elementary Japanese , 3rd Edition 2020, The Japan Times, (ISBN13: 9784789017305)
3. Sushama Jain, Japan : The Living Culture, Har-anand Publications, 2009, (ISBN 10: 8124114870 / ISBN 13: 9788124114872)

Reference Books:

1. Kanji Power Handbook for the Japanese Language Proficiency Test, 1994, ARC Press (ISBN: 9784872343144)
2. Yukiko Ogata, Kana Sumitani, Yasuko Hidari, Yukiko Watanabe, Nihongo fun and Easy -I Survival Japanese Conversation for Beginners,
3. Eriko Sato, Japanese Demystified: A Self-Teaching Guide, 2008, McGraw-Hill Companies, McGraw-Hill Demystified Series (ISBN 10-0071477268, ISBN 13-9780071477260)

Evaluation :

Students should select any one of the topic in a group of 3 to 5. Students should submit a written report and make a presentation on the topic. The task should not be repeated among students. Report will be evaluated by the faculty as per rubrics defined by him/her/them at start of course.

Home

Savitribai Phule Pune University, Pune
Second Year Information Technology (2019 Course)
214450 (D) : Mandatory Audit Course 3: Cyber Security and Law

Teaching Scheme:	Credit Scheme:	Examination Scheme:
01hrs/week	Non Credit	Audit Course

Prerequisite Courses, if any: Basics of Computer

Course Objectives:

1. Understand basics of computer and cyber security.
2. To study the information technology law.
3. To understand reasons for cybercrime.
4. To learn investigation techniques.

Course Outcomes:

On completion of the course, learner will be able to --

CO1: Understand the basic concepts of cyber security and its abilities

CO2: Analyse and evaluate the cyber security needs of an organization.

CO3: Understand the importance of cyber laws and its practices.

CO4: Determine and analyse software vulnerabilities and security solutions to reduce the risk of exploitation

COURSE CONTENTS

Unit I	Basics of Cyber Security	04 hrs

Information Security Definition and Concepts, Overview of Security Threats , Goals of Security, , Limitations and Challenges in cyber security , Types of Security attacks, Network Security, Malicious Codes, Intrusion detection systems, Hacking Techniques, Password cracking , Insecure Network Connections ,Concept of Firewall and Security.

Mapping of Course Outcomes for Unit I	CO1, CO2

Unit II	Cyber Laws	04 hrs

Introduction, Definition and origin, Cybercrime and Information security, Classification of Cybercrimes, The legal perspectives- Indian perspective- IT Act 2000, Global perspective, Categories of Cybercrime, Reasonable Security Practices

Mapping of Course Outcomes for Unit II	CO2, CO3, CO4

Unit III	Cyber Crime	04 hrs

Definition of Cyber Crime & Computer related Crimes, Classification &Differentiation between traditional crime and cybercrimes, Data Theft, Hacking, Spreading Virus &Worms, Phishing, Cyber Stalking/ Bullying, Identity Theft &Impersonation, Credit card & Online Banking Frauds , Denial of Service Attacks , Cyber terrorism etc.. , Search and Seizure Procedures of Digital Evidence- Data

Acquisition ,Data Analysis, Reporting, Cybercrime Scenario in India	
Mapping of Course Outcomes for Unit III	**CO2, CO3, CO4**
Text Books:	
1. William Stallings, "Computer Security: Principles and Practices", Pearson 6th Ed, ISBN: 978-0-13-335469-0 2. Nina Godbole, Sunit Belapure, "Cyber Security- Understanding Cyber Crimes, Computer Forensics and Legal Perspectives", Wiley India Pvt.Ltd, ISBN- 978-81-265-2179-1 3. Nina Godbole , "Information Systems Security" , Wiley India Pvt. Ltd, ISBN -978-81-265-1692-6 4. Mark Merkow, "Information Security-Principles and Practices", Pearson Ed., ISBN- 978-81-317-1288-7 5. Bernard Menezes, "Network Security and Cryptography", Cengage Learning, ISBN-978-81-315-1349-1 6. "The Information Technology Act, 2000; Bare Act" – Professional Book Publishers	
Evaluation :	
Students should select any one of the topic in a group of 3 to 5. Students should submit a written report and make a presentation on the topic. The task should not be repeated among students. Report will be evaluated by the faculty as per rubrics defined by him/her/them at start of course.	

SEMESTER – IV

Home

Savitribai Phule Pune University, Pune
Second Year Information Technology (2019 Course)
207003: Engineering Mathematics III

Teaching Scheme:	Credit Scheme:	Examination Scheme:
Theory (TH) : 03 hrs/week Tutorial (TUT) :01 hrs/ week	03 01	Mid_Semester: 30 Marks End_Semester: 70 Marks TW : 25 Marks

Prerequisites: Differential & Integral calculus, Taylor series, Differential equations of first order and first degree, Fourier series, Collection, Classification and Representation of data.

Course Objectives:

1. To make the students familiarize with concepts and techniques in Linear differential equations, Fourier transform& Z-transform, Statistical methods, Probability theory and Numerical methods.2. The aim is to equip them with the techniques to understand advanced level mathematics and its applications that would enhance thinking power, useful in their disciplines.

Course Outcomes:

On completion of this course student will be able to –

CO1: Solve Linear differential equations, essential in modelling and design of computer-based systems.

CO2: Apply concept of Fourier transform and Z-transform and its applications to continuous and discrete systems and image processing.

CO3: Apply Statistical methods like correlation& regression analysis and probability theory for data analysis and predictions in machine learning.

CO4: Solve Algebraic &Transcendental equations and System of linear equations using numerical techniques.

CO5: Obtain Interpolating polynomials, numerical differentiation and integration, numerical solutions of ordinary differential equations used in modern scientific computing.

COURSE CONTENTS

Unit I	Linear Differential Equations	06 hrs

LDE of n^{th} order with constant coefficients, Complementary function, Particular integral, General method, Short methods, Method of variation of parameters, Cauchy's & Legendre's DE, Simultaneous & Symmetric simultaneous DE.

Unit II	Transforms	06 hrs

Fourier Transform (**FT**): Complex exponential form of Fourier series, Fourier integral theorem, Fourier Sine & Cosine integrals, Fourier transform, Fourier Sine & Cosine transforms and their inverses, Discrete Fourier Transform.

Z –Transform(ZT): Introduction, Definition, Standard properties, ZT of standard sequences and their inverses. Solution of difference equations.

Unit III	Statistics	06 hrs

Measures of central tendency, Measures of dispersion, Coefficient of variation, Moments, Skewness and Kurtosis, Curve fitting: fitting of straight line, parabola and related curves, Correlation and Regression, Reliability of Regression Estimates.

Unit IV	**Probability and Probability Distributions**	**06 hrs**

Probability, Theorems on Probability, Bayes theorem, Random variables, Mathematical Expectation, Probability density function, Probability distributions: Binomial, Poisson, Normal and Hyper geometric, Sampling distributions, Test of Hypothesis: Chi-Square test, t-test.

Unit V	**Numerical Methods**	**06 hrs**

Numerical Solution of Algebraic and Transcendental equations: Bisection, Secant, Regula-Falsi, Newton–Raphson and Successive Approximation Methods, Convergence and Stability.
Numerical Solutions of System of linear equations: Gauss elimination, LU Decomposition, Cholesky, Jacobi and Gauss-Seidel Methods.

Unit VI	**Numerical Methods**	**06hrs**

Interpolation: Finite Differences, Newton's and Lagrange's Interpolation formulae, Numerical Differentiation. Numerical Integration: Trapezoidal and Simpson's rules, Bound of truncation error.
Solution of Ordinary differential equations: Euler's, Modified Euler's, Runge-Kutta 4th order methods and Predictor-Corrector methods

Text Books:

1. B.V. Ramana, "Higher Engineering Mathematics", Tata McGraw-Hill
2. B. S. Grewal, "Higher Engineering Mathematics", Khanna Publication, Delhi

Reference Books:

1. Erwin Kreyszig, "Advanced Engineering Mathematics", 10ed, Wiley India
2. M. D. Greenberg, "Advanced Engineering Mathematics", 2edPearson Education
3. Peter V. O'Neil , "Advanced Engineering Mathematics", 7ed,Cengage Learning
4. S. L. Ross , "Differential Equations", 3e, Wiley India
5. Sheldon M. Ross, "Introduction to Probability and Statistics for Engineers and Scientists", 5e, Elsevier Academic Press
6. M. K. Jain, S. R. K. Iyengar And R. K. Jain1, "Numerical Methods for Scientific and Engineering Computation", 5e,New Age International Publication

Guidelines for Tutorial and Term Work:

i) Tutorial shall be engaged in four batches (batch size of 20 students maximum) per division.
ii) Term work shall be based on continuous assessment of six assignments (one per each unit) and performance in internal tests.

Home

Savitribai Phule Pune University, Pune

Second Year Information Technology (2019 Course)

214451: Processor Architecture

Teaching Scheme:	Credit Scheme:	Examination Scheme:
Theory(TH): 03hrs/week	**03**	**Mid_Semester: 30 Marks** **End_Semester: 70 Marks**

Prerequisites: Logic Design & Computer Organization

Course Objectives :

1. To study architectural details of PIC 18 microcontroller.
2. To study applications of PIC through various interfacing devices.

Course Outcomes :

On completion of this course student will be able to –

CO1: Apprehend architecture and memory organization of PIC 18 microcontroller.

CO2: Implement embedded C programming for PIC 18.

CO3: Use concepts of timers and interrupts of PIC 18.

CO4: Demonstrate real life applications using PIC 18.

CO5: Analyze architectural details of ARM processor.

COURSE CONTENTS

Unit I	PIC Microcontroller Architecture	06 hrs

Introduction: introduction to microcontroller, Brief history of microcontrollers, Difference between microprocessor and microcontroller, Criteria for selection of microcontroller,

PIC18FXXX: Features and architecture, comparison of PIC 18 series microcontrollers; PIC18F458/452 Pin out connection, Registers of PIC18F,

Program and data memory organization: The Program Counter and Programmable ROM space in the PIC, File register and Access bank, Bank switching in PIC18;

Addressing modes: Addressing modes with instruction example, Oscillator configurations, Reset operations, Brownout reset, Watchdog timer, Power down modes & Configuration registers.

Mapping of Course Outcomes for Unit I	**CO1,CO2**

Unit II	PIC I/O Ports and Timer	06 hrs

I/O Port: I/O Port structure with programming: I/O Port structure, I/O Port programming, I/O Bit manipulation Programming.

Timer/Counter: Registers used for Timer/Counter operation, Delay calculations, Programming of Timers using Embedded C.

Case Study	**Traffic light signal controller using Timer/Counter**
Mapping of Course Outcomes for Unit II	**CO2, CO3**

Unit III	PIC Interrupts & Interfacing-I	06 hrs

PIC Interrupts: Interrupt Vs Polling, IVT, Steps in executing interrupt, Sources of interrupts; Enabling and disabling interrupts, Interrupt registers, Priority of interrupts, Programming of: Timer using interrupts, External hardware interrupts, Serial communication interrupt; Interfacing of LED, Interfacing 16X2 LCD (8 bits) and Key board (4 x 4 Matrix), Interfacing Relay & Buzzer.		
Mapping of Course Outcomes for Unit III	**CO2, CO3, CO4**	
Unit IV	**PIC Interfacing-II**	**06 hrs**
CCP modes: Capture, Compare and PWM generation; DC Motor speed control with CCP, Stepper motor interfacing with PIC, **Basics of Serial communication protocols:** Study of RS232, I2C, SPI, UART, Serial communication programming using Embedded C.		
Mapping of Course Outcomes for Unit IV	**CO2, CO4**	
Unit V	**PIC Interfacing-III**	**06 hrs**
Interfacing : Interfacing of ADC and DAC 0808 with PIC, Temperature sensor interfacing using ADC and I2C with PIC, Interfacing of RTC (DS1306) using I2C with PIC, Interfacing of EEPROM using SPI with PIC,		
Case Study	**Home protection system, All programs in Embedded C**	
Mapping of Course Outcomes for Unit V	**CO2, CO4**	
Unit VI	**Current Trends in Processor Architecture**	**06 hrs**
ARM & RISC :ARM and RISC design philosophy, Introduction to ARM processor & its versions ARM 7, ARM 9, ARM 11, Features& advantages of ARM processor, Suitability of ARM processor in embedded applications, ARM 7 dataflow model, Programmers model. CPSR & SPSR registers, Modes of operation, Difference between PIC and ARM.		
Mapping of for Unit VI	**CO5**	
Text Books:		
1. Muhammad Ali Mazidi , Danny Causey, RolinMcKinlay, "PIC Microcontroller and Embedded Systems: Using Assembly and C for PIC18", 4th Edition by,Pearson international edition 2. Andrew N. Sloss, Dominic Symes, Chris Wright, Morgan, "ARM System Developer's Guide Designing and Optimizing System Software", Kaufmann Publishers		
Reference Books:		
1. Peatman, John B, "Design with PIC Microcontroller", Pearson Education PTE 2. Ramesh Gaonkar, "Fundamentals of Microcontrollers and Applications In Embedded Systems(with the PIC18 Microcontroller Family)"Thomson/Delmar Learning; 1 edition (January 8, 2007), ISBN:978-1401879143 3. Microchip's PIC18FXXX Data Sheet 4. Muhammad Ali Mazidi, SarmadNaimi,"ARM Assembly Language Programming & Architecture"		

Home

Savitribai Phule Pune University, Pune
Second Year Information Technology (2019 Course)
214452: Database Management System

Teaching Scheme:	Credit Scheme:	Examination Scheme:
Theory(TH):03hrs/week	03	Mid_Semester: 30 Marks End_Semester: 70 Marks

Prerequisite Courses, if any: Discrete Mathematics

Course Objectives:

1. The objective of the course is to present an introduction to database management system as a subject in its own right.
2. To understand the fundamental concepts of Relational Database management system.
3. To present SQL and procedural interfaces to SQL comprehensively.
4. To provide a strong formal foundation in Relational Database Concepts, database concepts, technology and practice &to introduce the concepts of Query Processing.
5. To introduce the concepts of Transaction Processing and to present the issues and techniques relating to concurrency and recovery in multi-user database environments.
6. To introduce the recent trends in database technology.

Course Outcomes:

On completion of this course student will be able to --

CO1: Apply fundamental elements of database management systems.

CO2: Design ER-models to represent simple database application scenarios.

CO3: Formulate SQL queries on data for relational databases.

CO4: Improve the database design by normalization & to incorporate query processing.

CO5: Apply ACID properties for transaction management and concurrency control.

CO6: Analyze various database architectures and technologies.

COURSE CONTENTS

Unit I	Introduction to DBMS	06 hrs

Introduction : Basic concepts, Advantages of DBMS over file processing systems, Data abstraction, Database languages, Data models, Data independence, Components of a DBMS, Overall structure of DBMS, Multi-user DBMS architecture, System catalogs, Data Modeling: Basic concepts, Entity, attributes, relationships, constraints, keys.

Case Study	**MySQL Database**
Mapping of Course Outcomes for Unit I	**CO1**

Unit II	Relational Model	06 hrs

ER and EER diagrams: Components of ER model, Conventions, Converting ER diagrams into tables Relational Model: Basic concepts, Attributes and Domains, Codd's rules.

Relational Integrity: Nulls, Entity, Referential integrities, Enterprise constraints, Views, Schema diagram		
Case Study	**Student / Timetable / Reservation / any data Management System**	
Mapping of Course Outcomes for Unit II	**CO2**	
Unit III	**Introduction to SQL - PL/SQL**	**06 hrs**
Introduction to SQL: Characteristics and advantages SQL Data Types, Literals, DDL, DML, SQL Operators Tables: Creating, Modifying, Deleting, Views: Creating, Dropping, Updation using Views, Indexes, Nulls. **SQL DML Queries**: SELECT query and clauses, Set operations, Tuple Variables, Set comparison, Ordering of Tuples , Aggregate Functions, Nested Queries, Database Modification using SQL Insert, Update, Delete Queries, Stored Procedure, Triggers, Programmatic **SQL** : Embedded SQL, Dynamic SQL, ODBC		
Case Study	**Employee database system**	
Mapping of Course Outcomes for Unit III	**CO3**	
Unit IV	**Database Design & Query Processing**	**06 hrs**
Relational Databases Design: Purpose of Normalization, Data Redundancy and Update Anomalies, Functional Dependencies. The process of Normalization: 1NF, 2NF, 3NF, BCNF. Introduction to **Query Processing:** Overview, Measures of Query cost, Selection and Join operations, Evaluation of Expressions **Introduction to Query optimization:** Estimation, Transformation of Relational Expression		
Case Study	**Employee Database design**	
Mapping of Course Outcomes for Unit IV	**CO4**	
Unit V	**Transaction & Concurrency Control**	**06 hrs**
Transaction Management: Basic concept of a Transaction, Properties of Transactions, Database Architecture, Concept of Schedule, Serial Schedule. **Serializability:** Conflict and View, Cascaded aborts Recoverable and Non-recoverable Schedules. **Concurrency Control:** Need Locking methods Dead locks, Time stamping Methods. Optimistic Techniques, Multi-version Concurrency Control. **Different crash recovery methods:** Shadow-Paging, Log-based Recovery: Deferred and Immediate, Check Points		
Case Study	**Banking Transaction**	
Mapping of Course Outcomes for Unit V	**CO5**	

Unit VI	Advanced Databases	06 hrs
Database Architectures: Centralized and Client-Server Architectures, 2 Tier and 3 Tier Architecture, Introduction to Parallel Databases, Key elements of Parallel Database Processing, Architecture of Parallel Databases, Introduction to Distributed Databases, Architecture of Distributed Databases, Distributed Database Design. **Emerging Database Technologies:** Introduction, No SQL Databases- Internet Databases, Cloud databases, Mobile Databases, SQLite database, XML databases		
Case Study	**RealmDB, ORMLite, Couchbase Lite**	
Mapping of Course Outcomes for Unit VI	**CO6**	

Text Books:

1. Silberschatz A., Korth H., Sudarshan S. "Database System Concepts", 6th edition, Tata McGraw Hill Publishers
2. G. K. Gupta "Database Management Systems" , Tata McGraw Hill

Reference Books:

1. Rab P., Coronel C. "Database Systems Design, Implementation and Management", 5th edition, Thomson Course Technology, 2002
2. Elmasri R., Navathe S. " Fundamentals of Database Systems", 4th edition, Pearson Education, 2003
3. Date C. " An Introduction to Database Systems", 7th edition, Pearson Education, 2002
4. Ramkrishna R., Gehrke J. " Database Management Systems", 3rd edition, McGraw Hill

Web Resources:

https://nptel.ac.in/courses/106/105/106105175/

Home

Savitribai Phule Pune University, Pune Second Year Information Technology (2019 Course) **214453: Computer Graphics**		
Teaching Scheme:	**Credit Scheme:**	**Examination Scheme:**
Theory (TH): 03 hrs/week	**03**	**Mid_Semester: 30 Marks** **End_Semester: 70 Marks**

Prerequisite Courses, if any: Basic Geometry, Trigonometry, Vectors and Matrices, Data Structures and Algorithms

Course Objectives:

1. Understand the foundations of computer graphics: hardware systems, math basis, light and color.
2. Understand the complexities of modeling realistic objects through modeling complex scenes using a high-level scene description language.
3. Become acquainted with some advanced topics in computer graphics. The student should gain an expanded vocabulary for discussing issues relevant to computer graphics (including both the underlying mathematics and the actual programming).
4. The student should gain an appreciation and understanding of the hardware and software utilized in constructing computer graphics applications.
5. The student should gain a comprehension of windows, clipping and view-ports in relation to images displayed on screen.
6. The student should gain an understanding of geometric, mathematical and algorithmic concepts necessary for programming computer graphics.

Course Outcomes:

On completion of the course, students will be able to–

CO1: Apply mathematical and logical aspects for developing elementary graphics operations like scan conversion of points, lines, circle, and apply it for problem solving.

CO2: Employ techniques of geometrical transforms to produce, position and manipulate Objects in 2 dimensional and 3-dimensional space respectively.

CO3: Describe mapping from a world coordinates to device coordinates, clipping, and projections in order to produce 3D images on 2D output device.

CO4: Apply concepts of rendering, shading, animation, curves and fractals using computer graphics tools in design, development and testing of 2D, 3D modeling applications.

CO5: Perceive the concepts of virtual reality.

COURSE CONTENTS

Unit – I	**Computer Graphics Basic, OpenGL and Line, Circle Drawing**	**06 hrs**

Introduction CG :Introduction to computer graphics, basics of graphics systems, raster and random scan, basic display processor

OpenGL – Introduction – Graphics function, OpenGL Interface, primitives and attributes, Control functions, programming events.

<table>
<tr><td colspan="3">Line Drawing: DDA Line drawing algorithm, Bresenham Line drawing algorithm
Circle Drawing: Bresenham circle drawing algorithm.
Character Generation: Stroke principle, starburst principle, bitmap method. Introduction to aliasing and anti-aliasing.</td></tr>
<tr><td>Case Study</td><td colspan="2">Computer-generated imagery (CGI)</td></tr>
<tr><td>Mapping of Course Outcomes for Unit I</td><td colspan="2">CO1</td></tr>
<tr><td>Unit – II</td><td>Polygons, 2D Transformations</td><td>06 hrs</td></tr>
<tr><td colspan="3">Polygons: Polygons and its types, inside test,
Polygon filling methods: Seed Fill – Flood fill and Boundary Fill, Scan-line Fill algorithms,
2D Transformations: Translation, Scaling, Rotation, Reflection and Shearing, Matrix representation and homogeneous coordinate system, composite transformations.</td></tr>
<tr><td>Case Study</td><td colspan="2">Transformation of an Object in Computer Graphics: Mathematical Matrix Theory</td></tr>
<tr><td>Mapping of Course Outcomes for Unit II</td><td colspan="2">CO2</td></tr>
<tr><td>Unit – III</td><td>Windowing, Clipping,3D Transformation, Projections</td><td>06 hrs</td></tr>
<tr><td colspan="3">Windowing: Concept of window and viewport, viewing transformations
Line Clipping: Cohen Sutherland method of line clipping
Polygon Clipping: Sutherland Hodgeman method for convex and concave polygon clipping.
3D Transformation: Translation, scaling, rotation about X, Y, Z & arbitrary axis, and reflection about XY, YZ, XZ & arbitrary plane.
Projections: Types of projections- Parallel, Perspective
Parallel: oblique – Cavalier, Cabinet, Orthographic – isometric, diametric, trimetric
Perspective: vanishing points as 1 point, 2 point and 3 point.</td></tr>
<tr><td>Case Study</td><td colspan="2">3D Rendering and Modeling</td></tr>
<tr><td>Mapping of Course Outcomes for Unit III</td><td colspan="2">CO2 & CO3</td></tr>
<tr><td>Unit – IV</td><td>Segments, Illumination models, colour models and shading</td><td>06 hrs</td></tr>
<tr><td colspan="3">Segments: Introduction, Segment table, segment creation, closing, deleting, renaming, and visibility.
Illumination models: Light sources, ambient light, diffuse light, specular reflection, the Phong model, combined diffuse and specular reflections with multiple light sources.
Color Models: CIE Chromaticity Diagram, Color Gamut, RGB, CMY, YCbCr,HSVcolor models.
Shading Algorithms: Constant intensity shading, Halftone, Gourand and Phong Shading.</td></tr>
<tr><td>Case Study</td><td colspan="2">Best practices in Day lighting& Passive Systems for Smaller Commercial Buildings</td></tr>
<tr><td>Mapping of Course Outcomes for Unit IV</td><td colspan="2">CO4</td></tr>
</table>

Unit – V	Curves, fractals and Animation	06 hrs
Curves: Introduction, interpolation and approximation, Spline Interpolation Methods – hermite interpolation, Bezier curves, B-Splines. **Fractals:** Introduction, Classification, fractal Dimension, Fractal dimension and surfaces, Hilbert curve, Koch Curve. **Animation:** Basics of animation, types of animation, principles of animation, design of animation sequences, animation languages, key frame, morphing, motion specification. Methods of controlling animation, frame-by-frame animation techniques, real-time animation techniques.		
Case Study	**3D Animation services for character expressions.**	
Mapping of Course Outcomes for Unit V	**CO4**	
Unit – VI	**Virtual Reality**	**06 hrs**
Introduction of Virtual Reality: Fundamental Concept, Three I's of virtual reality and Classic Components of VR systems, Applications of VR systems. **Multiple Modals of Input and Output Interface in Virtual Reality:** Input – 3D position Trackers and its types, Navigation and Manipulation Interfaces, Gesture Interfaces, Graphics Displays – HMD and CAVE, Sound Displays, Haptic Feedback **Rendering Pipeline:** Graphics rendering Pipeline, Haptics Rendering Pipeline Modeling in Virtual Reality: Concepts of Geometric Modeling, Kinematic Modeling, Physical modeling and Behavior modeling.		
Case Study	**Virtual reality in aviation and Space travel Training**	
Mapping of Course Outcomes for Unit VI	**CO5**	

Test Books

1. D. Hearn, M. Baker, "Computer Graphics – C Version", 2nd Edition, Pearson Education, 2002, ISBN81 – 7808 – 794 – 4
2. S. Harrington, "Computer Graphics", 2nd Edition, McGraw-Hill Publications, 1987, ISBN 0 – 07 –100472 – 6
3. Grigore C. Burdea, Philippe Coiffet, "Virtual Reality Technology", second edition, Wiley India Edition, ISBN 81-265-0789-6

Reference books

1. D. Rogers, "Procedural Elements for Computer Graphics", 2nd Edition, Tata McGraw-HillPublication, 2001, ISBN 0 – 07 – 047371 – 4.
2. J. Foley, V. Dam, S. Feiner, J. Hughes, "Computer Graphics Principles and Practice", 2nd Edition, Pearson Education, 2003, ISBN 81 – 7808 – 038 – 9.
3. Foley, "Computer Graphics: Principles & Practice in C", 2e, ISBN 9788131705056, Pearson Edu.
4. F.S. Hill JR, "Computer Graphics Using Open GL", Pearson Education

Home

Savitribai Phule Pune University, Pune
Second Year Information Technology (2019 Course)
214454: Software Engineering

Teaching Scheme:	Credit Scheme:	Examination Scheme:
Theory(TH) : 03 hrs/week	03	Mid_Semester: 30 Marks End_Semester: 70 Marks

Prerequisite Courses, if any: Fundamentals of Programming Languages

Course Objectives:

1. To learn the principles of Software Engineering.
2. To learn and understand methods of capturing, specifying, visualizing and analyzing software requirements.
3. To know design principles to software project development.
4. To learn basics of IT project management.
5. To understand software quality attributes and testing principles.
6. To introduce formal methods and recent trends in Software Engineering.

Course Outcomes:

On completion of the course, students will be able to --

CO1: Classify various software application domains.
CO2: Analyze software requirements by using various modeling techniques.
CO3: Translate the requirement models into design models.
CO4: Apply planning and estimation to any project.
CO5: Use quality attributes and testing principles in software development life cycle.
CO6: Discuss recent trends in Software engineering by using CASE and agile tools.

COURSE CONTENTS

Unit I	Introduction To Software Engineering	06 hrs

Software Engineering Fundamentals: Nature of Software, Software Engineering Practice, Software Process, Software Myths.
Process Models : A Generic Process Model, Linear Sequential Development Model, Iterative Development Model, The incremental Development Model
Agile software development: Agile manifesto, agility principles, Agile methods, myth of planned development, Introduction to Extreme programming and Scrum.
Agile Practices: test driven development, pair programming, continuous integration in DevOps , Refactoring

Case Study	**An information system – Library Management system**
Mapping of Course Outcomes for Unit I	**CO1**

Unit II	Requirements Engineering & Analysis	06 hrs

Requirements Engineering: User and system requirements, Functional and non-functional requirements, requirements engineering (elicitation, specification, validation, negotiation) prioritizing requirements (Kano diagram), requirement traceability matrix(RTM)
Software Requirements Specification (SRS): software requirements Specification document,

<table>
<tr><td colspan="3">structure of SRS, writing a SRS, structured SRS for online shopping,
Requirements Analysis: Analysis Model, data modeling, scenario based modeling, class based modeling, Flow oriented modeling, behavioral modeling-Introduction to UML diagrams</td></tr>
<tr><td colspan="3">Case Study : Library Management system</td></tr>
<tr><td>Mapping of Course Outcomes for Unit II</td><td colspan="2">CO2</td></tr>
<tr><td>Unit III</td><td>Design Engineering</td><td>06 hrs</td></tr>
<tr><td colspan="3">Design Engineering : Design Process & quality, Design Concepts, design Model, Pattern-based Software Design. Architectural Design :Design Decisions, Views, Patterns, Application Architectures,
Component level Design: component, Designing class based components, conducting component-level design, User Interface Design: The golden rules, Interface Design steps& Analysis, Design Evaluation</td></tr>
<tr><td colspan="3">Case Study : Web App Design / Library Management System</td></tr>
<tr><td>Mapping of Course Outcomes for Unit III</td><td colspan="2">CO3</td></tr>
<tr><td>Unit IV</td><td>Project Planning, Management And Estimation</td><td>6 hrs</td></tr>
<tr><td colspan="3">Project Planning: Project initiation, Planning Scope Management, Creating the Work Breakdown Structure, scheduling: Importance of Project Schedules, Developing the Schedule using Gantt Charts, PERT/ CPM
Project Management: The Management Spectrum, People, Product, Process, Project, The W5HH Principle, Metrics in the Process and Project Domains, Software Measurement: size &function-oriented metrics(FP & LOC), Metrics for Project
Project Estimation: Software Project Estimation, Decomposition Techniques, Cost Estimation Tools and Techniques, Typical Problems with IT Cost Estimates.</td></tr>
<tr><td colspan="3">Case Study: Project Management tool like OpenProj or MS Project</td></tr>
<tr><td>Mapping of Course Outcomes for Unit IV</td><td colspan="2">CO4</td></tr>
<tr><td>Unit V</td><td>Software Quality And Testing</td><td>06 hrs</td></tr>
<tr><td colspan="3">Quality Concepts: Quality, software quality, Quality Metrics, software quality dilemma, achieving software quality
Software Testing: Introduction to Software Testing, Principles of Testing, Test plan, Test case, Types of Testing, Verification & Validation, Testing strategies, Defect Management, Defect Life Cycle, Bug Reporting, debugging.</td></tr>
<tr><td colspan="3">Case Study : Software testing tool like selenium</td></tr>
<tr><td>Mapping of Course Outcomes for Unit V</td><td colspan="2">CO5</td></tr>
<tr><td>Unit VI</td><td>Formal Methods Recent Trends In Software Engineering</td><td>06 hrs</td></tr>
<tr><td colspan="3">Recent Trends in SE : SCM, Risk Management, Technology evolution, process trends, collaborative development, software reuse, test-driven development, global software development challenges, CASE – taxonomy, tool-kits, workbenches, environments, components of CASE, categories (upper, lower and integrated CASE tools), Introduction to agile tools Jira, Kanban</td></tr>
<tr><td colspan="3">Case Study : CASE software/ HP Quality Center (QC) / Jira</td></tr>
</table>

Mapping of Course Outcomes for Unit VI	**CO6**

Text Books:

1. Roger Pressman, "Software Engineering:A Practitioner's Approach", McGraw Hill,ISBN 0-07-337597-7
2. Ian Sommerville, "Software Engineering",Addison and Wesley, ISBN 0-13-703515-2

Reference Books:

1. Joseph Phillips, "IT Project Management-On Track From start to Finish", Tata Mc Graw-Hill,ISBN13:978-0-07106727-0,ISBN-10:0-07-106727-2
2. Pankaj Jalote, "Software Engineering: A Precise Approach",Wiley India, ISBN: 9788-1265-2311-5
3. Marchewka, "Information Technology Project Management",Willey India, ISBN: 9788-1265-4394-6
4. Rajib Mall, "Fundamentals of Software Engineering",Prentice Hall India, ISBN-13:9788-1203-4898-1

Home

Savitribai Phule Pune University, Pune
Second Year Information Technology (2019 Course)
214455: Programming Skill Development Lab

Teaching Scheme:	Credit Scheme:	Examination Scheme:
Theory(TH) :02hrs/week	01	PR: 25Marks TW: 25Marks

Prerequisites: Computer Organization and Architecture

Course Objectives:
1. To learn embedded C programming and PIC18FXXXmicrocontrollers.
2. To learn interfacing of real-world input and output devices to PIC18FXXX microcontroller

Course Outcomes:

On completion of this course student will be able to --

CO1: Apply concepts related to embedded C programming.

CO2: Develop and Execute embedded C program to perform array addition, block transfer, sorting operations

CO3: Perform interfacing of real-world input and output devices to PIC18FXXX microcontroller.

CO4: Use source prototype platform like Raspberry-Pi/Beagle board/Arduino.

Guidelines for Instructor's Manual

The faculty member should prepare the laboratory manual for all the experiments and it should be made available to students and laboratory instructor/Assistant. The instructor's manual should include prologue, university syllabus, conduction & Assessment guidelines, topics under consideration- concept, objectives, outcomes, algorithm, sample test cases etc.

Guidelines for Student's Lab Journal

1. The laboratory assignments should be submitted by students in the form of journal. The Journal consists of Certificate, table of contents, and write-up of each assignment (Title, Objectives, Problem Statement, Outcomes, software & Hardware requirements, Date of Completion, Assessment grade/marks and assessor's sign, Theory- Concept, circuit diagram, pin configuration, conclusion/analysis).
2. As a conscious effort and little contribution towards Green IT and environment awareness, attaching printed papers as part of program listing to journal may be avoided.
3. Use of Digital media like shared drive containing students' programs maintained by lab In-charge is highly encouraged.
4. Practical Examination will be based on the term work submitted by the student in the form of journal.
5. Candidate is expected to know the theory involved in the experiment.
6. The practical examination should be conducted if the journal of the candidate is completed in all respects and certified by concerned faculty and head of the department.
7. All the assignment mentioned in the syllabus must be conducted.

Guidelines for Lab /TW Assessment

1. Examiners will assess the term work based on performance of students considering the parameters such as timely conduction of practical assignment, methodology adopted for

implementation of practical assignment, timely submission of assignment in the form of write-up along with results of implemented assignment, attendance etc.

2. Examiners will judge the understanding of the practical performed in the examination by asking some questions related to theory & implementation of experiments he/she has carried out.
3. Necessary knowledge of usage of software and hardware of PIC18FXXX microcontrollers and its interfacing kits should be checked by the concerned faculty members.

Guidelines for Laboratory Conduction

The instructor is expected to frame the assignments by understanding the prerequisites, technological aspects, utility and recent trends related to the topic. The instructor may set multiple sets of assignments and distribute among batches of students. It is appreciated if the assignments are based on real world problems/applications.

Guidelines for Practical Examination

Both internal and external examiners should jointly set problem statements for practical examination. During practical assessment, the expert evaluator should give the maximum weightage to the satisfactory implementation of the problem statement. The supplementary and relevant questions may be asked at the time of evaluation to judge the student's understanding of the fundamentals, effective and efficient implementation. The evaluation should be done by both external and internal examiners.

Suggested List of Laboratory Assignments

Suggested List of Laboratory Assignments Group A (Any Three):

Mapping of Course Outcomes for Group A -- CO1 , CO2

1. Study of Embedded C programming language (Overview, syntax, One simple program like addition of two numbers).
2. Write an Embedded C program to add array of n numbers.
3. Write an Embedded C program to transfer elements from one location to another for following:
i) Internal to internal memory transfer
ii) Internal to external memory transfer
4. Write an Embedded C menu driven program for :
i) Multiply 8 bit number by 8 bit number
ii) Divide 8 bit number by 8 bit number
5. Write an Embedded C program for sorting the numbers in ascending and descending order.

Group B (Any Three):

Mapping of Course Outcomes for Group B -- CO3

6. Write an Embedded C program to interface PIC 18FXXX with LED & blinking it using specified delay.
7. Write an Embedded C program for Timer programming ISR based buzzer on/off.
8. Write an Embedded C program for External interrupt input switch press, output at relay.
9. Write an Embedded C program for LCD interfacing with PIC 18FXXX.

Group C (Any two):

Mapping of Course Outcomes for Group C -- CO3

10. Write an Embedded C program for Generating PWM signal for servo motor/DC motor. **11.** Write an Embedded C program for PC to PC serial communication using UART. **12.** Write an Embedded C program for Temperature sensor interfacing using ADC & display on LCD.
Group D:
Mapping of Course Outcomes for Group D -- CO4
13. Study of Arduino board and understand the OS installation process on Raspberry-pi. **14.** Write simple program using Open source prototype platform like Raspberry-Pi/Beagle board/Arduino for digital read/write using LED and switch Analog read/write using sensor and actuators.
Reference Books :
1. Mazidi, Rolin McKinlay and Danny Causey, 'PIC Microcontroller and Embedded Systems using Assembly and C for PIC18", Pearson Education 2. "Raspberry Pi for Beginners", 2nd Edition book" e-book. 3. Peatman, John B, "Design with PIC Microcontroller", Pearson Education PTE, 4. Ramesh Gaonkar, "Fundamentals of Microcontrollers and Applications In Embedded Systems (with the PIC18 Microcontroller Family)"Thomson/Delmar Learning; 1 edition (January 8, 2007), ISBN:978-1401879143.

Home

Savitribai Phule Pune University, Pune Second Year Information Technology (2019 Course) 214456: Database Management System Lab		
Teaching Scheme:	**Credit Scheme:**	**Examination Scheme:**
Practical (PR):04hrs/week	**02**	**PR: 25 Marks** **TW: 25 Marks**

Prerequisites: Data structures and Software engineering principles and practices.

Course Objectives :

1. Understand the fundamental concepts of database management. These concepts include aspects of database design, database languages, and database-system implementation.
2. To provide a strong formal foundation in database concepts, recent technologies and best industry practices.
3. To give systematic database design approaches covering conceptual design, logical design and an overview of physical design.
4. To learn the SQL database system.
5. To learn and understand various Database Architectures and its use for application development.
6. To program PL/SQL including stored procedures, stored functions, cursors and packages.

Course Outcomes :

On completion of this course student will be able to --

CO1: Install and configure database systems.
CO2: Analyze database models & entity relationship models.
CO3 : Design and implement a database schema for a given problem-domain
CO4: Implement relational database systems.
CO5: Populate and query a database using SQL DDL / DML / DCL commands.
CO6 : Design a backend database of any one organization: CASE STUDY

Guidelines for Instructor's Manual

The faculty member should prepare the laboratory manual for all the experiments and it should be made available to students and laboratory instructor/Assistant.

Guidelines for Student's Lab Journal

1. Student should submit term work in the form of journal with write-ups based on specified list of assignments.
2. Practical and Oral Examination will be based on all the assignments in the lab manual
3. Candidate is expected to know the theory involved in the experiment.
4. The practical examination should be conducted only if the journal of the candidate is complete in all respects.

Guidelines for Oral /Practical Assessment

1. Examiners will assess the student based on performance of students considering the parameters such as timely conduction of practical assignment, methodology adopted for implementation of practical assignment, timely submission of assignment in the form of handwritten write-up along with results of implemented assignment, attendance etc.

2. Examiners will judge the understanding of the practical performed in the examination by asking some questions related to theory & implementation of experiments he/she has carried out.
3. Appropriate knowledge of usage of software and hardware related to respective laboratory should be checked by the concerned faculty member.

Suggested List of Laboratory Assignments

Group A: Study of Databases

Mapping of Course Outcomes Group A -- CO1

1. Study of MySQL Open source software. Discuss the characteristics like efficiency, scalability, performance and transactional properties
2. Install and configure client and server of MySQL.(Show all commands and necessary steps for installation and configuration)
3. Study of SQLite: What is SQLite? Uses of Sqlite. Building and installing SQLite.

Group B: MySQL

Mapping of Course Outcomes Group B -- CO2, CO3, CO4, CO5

1. Design any database with at least 3 entities and relationships between them. Draw suitable ER/EER diagram for the system.
2. Design and implement a database (for assignment no 1) using DDL statements and apply normalization on them
3. Create Table with primary key and foreign key constraints.
   a. Alter table with add n modify   b. Drop table
4. Perform following SQL queries on the database created in assignment 1.
   - Implementation of relational operators in SQL
   - Boolean operators and pattern matching
   - Arithmetic operations and built in functions
   - Group functions
   - Processing Date and Time functions
   - Complex queries and set operators
5. Execute DDL/DML statements which demonstrate the use of views. Update the base table using its corresponding view. Also consider restrictions on updatable views and perform view creation from multiple tables.

Group C: PL/SQL

Mapping of Course Outcomes Group C -- CO6

1. Write and execute PL/SQL stored procedure and function to perform a suitable task on the database. Demonstrate its use.
2. Write and execute suitable database triggers .Consider row level and statement level triggers.
3. Write a PL/SQL block to implement all types of cursor.

Group D: Relational Database Design

Mapping of Course Outcomes Group D -- CO5, CO6

Design and case study of any organization (back end only), Project Proposal and High Level SRS

To prepare for project, do the following:

1. Form teams of around 3 to 4 people
2. Create requirements document with the following information:-
    a. Give one or two paragraph description of your goals for the topic(s).
    b. List what all types of users will be accessing your application
    c. List the various functionalities that your application will support. Explain each in about a paragraph worth of detail.
    d. List the hardware and software requirements at the backend and at the front end.
    e. Give an estimate of the number of users of each type, the expected load (transactions per day), and the expected database size.

Project ER Diagram and Database Design

For ER diagram and Database design following guidelines can be used:

1. Draw an ER diagram of your project.
2. Reduce this ER diagram into the tables and complete database design.
3. Subsequently, list all the functional dependencies on each table that you expect will hold.
4. Check that the database schema is in 3NF/BCNF. If it is not, apply normalization. Use non-loss decomposition and bring the database schema in 3NF/BCNF.

Give the ER diagram and the data dictionary as part of the requirement specifications file which you created for the project proposal.

Reference Books:

1. Dr. P. S. Deshpande, “SQL and PL/SQL for Oracle 10g Black Book”, DreamTech
2. Ivan Bayross, “SQL, PL/SQL: The Programming Language of Oracle”, BPB Publication
3. Reese G., Yarger R., King T., Williums H, “Managing and Using MySQL”, Shroff Publishers and Distributors Pvt. Ltd., ISBN: 81 - 7366 - 465 – X, 2nd Edition
4. Eric Redmond, Jim Wilson, “Seven databases in seven weeks”, SPD, ISBN: 978-93-5023-91
5. Jay Kreibich, Using SQLite, SPD, ISBN: 978-93-5110-934-1, 1st edition

Home

Savitribai Phule Pune University, Pune Second Year Information Technology (2019 Course) 214457: Computer Graphics Lab		
Teaching Scheme:	**Credit Scheme:**	**Examination Scheme:**
Practical (PR) :02hrs/week	**02**	**PR : 25 Marks** **TW: 25 Marks**

Prerequisites: Basic Geometry, Trigonometry, Vectors and Matrices, Data Structures and Algorithms

Course Objectives :

1. To acquaint the learners with the concepts of OpenGL.
2. To acquaint the learners with the basic concepts of Computer Graphics.
3. To implement the various algorithms for generating and rendering the objects.
4. To get familiar with mathematics behind the transformations.
5. To understand and apply various methods and techniques regarding animation.

Course Outcomes :

On completion of this course student will be able to --

CO1: Apply line& circle drawing algorithms to draw the objects.

CO2: Apply polygon filling methods for the object.

CO3: Apply polygon clipping algorithms for the object.

CO4: Apply the 2D transformations on the object.

CO5: Implement the curve generation algorithms.

CO6: Demonstrate the animation of any object using animation principles.

Guidelines for Instructor's Manual

The faculty member should prepare the laboratory manual for all the experiments and it should be made available to students and laboratory instructor/Assistant.

Guidelines for Student's Lab Journal

1. Student should submit term work in the form of journal with write-ups based on specified list of assignments.
2. Practical and Oral Examination will be based on all the assignments in the lab manual
3. Candidate is expected to know the theory involved in the experiment.
4. The practical examination should be conducted if and only if the journal of the candidate is complete in all respects.

Guidelines for Lab /TW Assessment

1. Examiners will assess the student based on performance of students considering the parameters such as timely conduction of practical assignment, methodology adopted for implementation of practical assignment, timely submission of assignment in the form of write-ups along with results of implemented assignment, attendance etc.
2. Examiners will judge the understanding of the practical performed in the examination by asking some questions related to theory & implementation of experiments he/she has carried

out.

3. Appropriate knowledge of usage of software related to respective laboratory should be checked by the concerned faculty member.

Guidelines for Laboratory Conduction

1. All the assignments should be implemented in C++ with OpenGL libraries.
2. Assignment 1 (week 1) should cover all the basic functions of openGL to get students familiar with Graphics Environment. Hence, this assignment is not included in Practical Exam.
3. The different objects/shapes/patterns should be drawn for implementation of drawing algorithm.
4. All the assignments should explore the conceptual understanding of students.
5. The keyboard/Mouse interfaces should be used wherever possible.

Guidelines for PRACTICAL EXAM conduction

1. There will be 2 problem statements options and student will have to perform any one.
2. All the problem statements carry equal weightage.

Virtual Laboratory

- https://cse18-iiith.vlabs.ac.in/
- http://vlabs.iitb.ac.in/vlabs-dev/labs/cglab/index.php

Suggested List of Laboratory Assignments

1. Install and explore the OpenGL -- **CO1**

2. Implement DDA and Bresenham line drawing algorithm to draw: i) Simple Line ii) Dotted Line iii) Dashed Line iv) Solid line ;using mouse interface Divide the screen in four quadrants with center as (0, 0). The line should work for all the slopes positive as well as negative.

3. Implement Bresenham circle drawing algorithm to draw any object. The object should be displayed in all the quadrants with respect to center and radius- **C02**

4. Implement the following polygon filling methods : i) Flood fill / Seed fill ii) Boundary fill ; using mouse click, keyboard interface and menu driven programming**- CO4**

5. Implement Cohen Sutherland polygon clipping method to clip the polygon with respect the viewport and window. Use mouse click, keyboard interface - **CO4**

6.Implement following 2D transformations on the object with respect to axis : – **CO5**

i) Scaling ii) Rotation about arbitrary point iii) Reflection

7. Generate fractal patterns using i) Bezier ii) Koch Curve - **CO5**

8. Implement animation principles for any object - **CO6**

Text Books

1. S. Harrington, “Computer Graphics”, 2nd Edition, McGraw-Hill Publications, 1987, ISBN 0-07-100472-6

2. D. Rogers, "Procedural Elements for Computer Graphics", 2nd Edition, McGraw-Hill Publications, 1987, ISBN 0-07-047371-4
3. F.S. Hill JR, "Computer Graphics Using OpenGL", Pearson Education

Reference Books

1. Graphics Principles and Practice", 2nd Edition, Pearson Education, 2003, ISBN 81 – 7808 – 038 – 9
2. D.Hearn, M. Baker, "Computer Graphics – C Version", 2nd Edition, Pearson Education, 2002, ISBN81 – 7808 – 794 – 4
3. D. Rogers, J. Adams, "Mathematical Elements for Computer Graphics", 2nd Edition, Tata McGraw-Hill Publication, 2002, ISBN 0 – 07 – 048677 – 8
4. Zhigang Xiang, Roy Plastock, "Computer Graphics", Schaum's Series outlines
5. Shirley, Marschner, "Fundamentals of Computer Graphics", Third Ed, A K Peters SPD
6. D.P. Mukharjee, Debasish Jana, "Computer Graphics Algorithms and implementation", PHI Learning
7. Samuel R. Buss, "3D Computer Graphics", Cambridge University Press
8. Mario Zechner, Robert Green, "Beginning Android 4 Games Development", Apress, ISBN: 978-81-322-0575-3
9. Maurya, "Computer Graphics with Virtual Reality Systems, 2ed.", Wiley, ISBN-9788126550883
10. Foley, "Computer Graphics: Principles & Practice in C", 2e, ISBN 9788131705056, Pearson

Savitribai Phule Pune University, Pune
Second Year Information Technology (2019 Course)
214458: Project Based Learning

Home

Teaching Scheme:	Credit Scheme:	Examination Scheme:
Practical (PR): 04hrs/week	02	TW : 50 Marks

Prerequisite Courses, if any:

Preamble:

Project Based Learning (PBL) is an instructional approach that emphasizes critical-thinking, collaboration and personalized learning. In PBL, student groups engage in meaningful inquiry that is of personal interest to them. These projects are based on problems, which are real-life oriented, curriculum-based and often interdisciplinary. Students decide how to approach a problem and what activities or processes they will perform. They collect information from a variety of sources, analyze, synthesize and derive understanding from it. The real-world focus of PBL activities is central to the process because it motivates students and adds value to their work. Their learning is connected to something real and involves life skills such as collaboration and reflection. The faculty assigned to the group is referred as mentor. Technology enables students and Mentor in various phases of the PBL process. At the end of the PBL, students demonstrate their newly acquired knowledge and are evaluated by how much they have learned and how well they communicate it. Students also conduct self-evaluation to assess their own growth and learning. Throughout this process, the mentor's role is to guide and advise students, rather than to direct and manage student work.

Companion Course: Online courses relevant to the project, along with expert lecture on Intellectual property rights, patents and software engineering.

Course Objectives :

1. To learn the various processes involved in project based learning.
2. To develop critical thinking and engineering problem solving skills amongst the students.
3. To explain the roles and responsibilities of IT engineers to the solution of engineering problems within the social, environmental and economic context.
4. To equip the students with knowledge and skills require to develop solutions for the problems coming from various Hackathon.

Course Outcomes

On completion of the course, student will be able to --

CO1: Design solution to real life problems and analyze its concerns through shared cognition.
CO2: Apply learning by doing approach in PBL to promote lifelong learning.
CO3: Tackle technical challenges for solving real world problems with team efforts.
CO4: Collaborate and engage in multi-disciplinary learning environments.

COURSE CONTENTS
Group Structure
Group structure should enable students to work in mentor–monitored groups. The students plan, manage and complete a task/project / activity which addresses the stated problem. 1. There should be a team of 3 to 6 students who will work cohesively. 2. A Mentor should be assigned to individual groups who will help them with learning and development process.
Selection of Project/Problem
1. The project scope/topic can be from any field/area, but selection related to IT technical aspect is desirous. 2. The project/problem done in first year engineering could be extended further, based on its potential and significance analysis. 3. Project/problem requiring solutions through conceptual model development and use of software tools should be preferred. 4. Different alternate approaches such as theoretical, practical, working model, demonstration or software analysis should be used in solving/implementing of project/problem. 5. The project/problem requiring multi-disciplinary approach to solve it, should be preferred. 6. Problem may require in depth study of specific practical, scientific or technical domain. 7. Hands-on activities, organizational and field visits, interacting with research institutes and expert consultation should be included in the approach to make students aware of latest technologies.
Assessment
The department should be committed to assess and evaluate both student performance and solution impact. Progress of PBL will be monitored regularly on weekly basis. Weekly review of the work is necessary. During process of monitoring and continuous assessment and evaluation the individual and team performance is to be measured by mentor. Students must maintain an institutional culture of authentic collaboration, self- motivation, peer-learning and personal responsiveness. The institution/department should support students in this regard through guidance/orientation programs and the provision of appropriate resources and services. Supervisor/mentor and students must actively participate in assessment and evaluation processes. Group may demonstrate their knowledge and skills by developing a public product and/or report and/or presentation. **1.** Individual assessment for each student (Understanding individual capacity, role and involvement in the project). **2.** Group assessment (roles defined, distribution of work, intra-team communication and togetherness. **3.** Documentation and presentation.

Evaluation and Continuous Assessment
It is recommended that the all activities are to be recorded in PBL workbook, regular assessment of work to be done and proper documents are to be maintained at college end by both students as well as mentor. The PBL workbook will reflect accountability, punctuality, technical writing ability and work flow of the task undertaken. Continuous Assessment Sheet (CAS) is to be maintained by all mentors/department. Recommended parameters for assessment, evaluation and weightage: 1. Idea Inception (5%) 2. Outcomes of PBL/Problem Solving Skills/Solution provided/Final product**(40%)** (Individual assessment and team assessment) 3. Documentation (Gathering requirements, design & modeling, implementation/execution, use of technology and final report, other documents **(25 %)** 4. Potential for the patent**(10%)** 5. Demonstration (Presentation, User Interface, Usability etc.) **(10%)** 6. Contest Participation/ publication **(5%)** 7. Awareness /Consideration of Environment/ Social /Ethics/ Safety measures/Legal aspects **(5%).** Design the rubrics based on the above parameters for evaluation of student performance
Faculty / Mentor is expected to perform following activities
Faculty/ Mentor is expected to perform following activities: Revision of PBL concepts Skill assessment of students Formation of diversified and balanced groups Share information about patent, copyright and publications to make students aware about it Discussion of sample case studies Design of the rubrics for evaluation of student performance Discussion of the rubrics with students Weekly Assessment of the deliverables such as Presentation, Report, Concept map, logbook Scaffolding of the students Summative and Formative assessment
Reference Books:
1. Project-Based Learning, Edutopia, March 14,2016. 2. What is PBL? Buck Institute forEducation. 3. www.schoology.com 4. www.wikipedia.org 5. www.howstuffworks.com

Home

Savitribai Phule Pune University, Pune
Second Year Information Technology (2019Course)
214459 (A) : Mandatory Audit course 4:
Water Supply and Management

Teaching Scheme:	Credit Scheme:	Examination Scheme:
01hrs/week	Non Credit	Audit Course

Prerequisite Courses: Basic knowledge of environmental science and mathematics

Course Objectives:

1. Enable the student to understand the various components of environment in and around the earth crust and understand the effects of it over plants, animals, etc
2. Understand the important concepts of good water supply system to a city/town or a village
3. Understand the need of conservation of rain water and its applications
4. Understand the sources, effects, prevention and control measures of water pollution and its legislative aspects.

Course Outcomes:

On completion of the course, learner will be able to --

CO1: Relate the relations between the environment and ecology, estimating water requirement for public water supply scheme.

CO2: Assess the quality of water as per BIS and select the appropriate treatment method required for the water source.

CO3: Analyze the suitable distribution system for a locality and know the appurtenances used.

CO4: Summarize the arrangement of water supply and fittings in a building.

CO5: Determine the need of conservation of water and rural water supply.

CO6: Identify the sources of water pollution and suitable control measures.

COURSE CONTENTS

Unit I	Introduction To Environment, Water Requirement And Water Sources	02 hrs

ENVIRONMENT AND ECOLOGY: Atmosphere, Lithosphere, Hydrosphere, Biosphere. Relation between Plant, Animals and Environment. Eco System, Man and Ecology.

WATER REQUIREMENT: Necessity of water supply, Methods of population forecasting (Arithmetical, Geometrical and Incremental Increase method), Water Requirements for a) Domestic Purpose b) Industrial Use c) Fire Fighting d) Public Purpose e) Losses. Per Capita Demand and Factors affecting it. Total Quantity of Water Required for a Town.

SOURCES OF WATER: Surface Sources - Lakes, Streams, Rivers. Impounded Reservoirs. Underground Sources - Infiltration Galleries, Infiltration Wells and Springs

Mapping of Course Outcomes for Unit I	CO1

Unit II	Quality And Treatment Of Water	02 hrs

QUALITY OF WATER: Impurities of water - organic and inorganic classification and examination of water. Physical - temperature, color, turbidity, taste and odour. Chemical - pH Value, Total Solids, Hardness, Chlorides, Iron and Manganese, Fluoride and Dissolved Oxygen. Bacteriological- E-coli, Most Probable Number (MPN), Quality Standards for Domestic purpose as perBIS.

TREATMENT OF WATER: Flow diagram of different units of treatment, brief description of constructional details, working and operation of the following units - plain sedimentation, sedimentation with coagulation, flocculation, filtration-Slow sand filters, Rapid sand filters and pressure filters (nodesign) Disinfection of water, Chlorination		
Mapping of Course Outcomes for Unit II	**CO2**	
Unit III	**Water Distribution System**	**02 hrs**
DISTRIBUTION SYSTEM: General Requirements, Systems of Distribution- Gravity System, Combined System, Direct Pumping. Maintenance of required pressure in Distribution Systems. Storage- Underground, Ground Level And OverheadServiceReservoirs– Sketch,NecessityandAccessories.Typesoflay- out : dead end, grid iron, radial and ring systems, their merits and demerits and their suitability **APPURTENANCES IN DISTRIBUTION SYSTEM:** Use of Sluice Valves, Check Valves, Air Valves, Scour Valves, Zero Velocity Valves, Fire Hydrants, Water Meter		
Mapping of Course Outcomes for Unit III	**CO3**	
Unit IV	**Water Supply In Buildings**	**02 hrs**
Water Supply arrangement in Buildings: General lay-outofwatersupplyarrangementforsingleandmulti-storiedbuildingsasperB.I.S code of practice. Pipe Materials- Plastic Pipes, High Density Polythene Pipes, Densified cast iron pipes, Merits and Demerits. Connections from water main to buildings. Water supply fittings - their description and uses, water main, service pipes, supply pipe, distribution pipe, domestic storage tank, stop cock, ferrule, goose neck, water tap, Modern systems of Potable water purification-(RO, UV, Activated carbon), Hot water supply - electric and solar waterheaters.		
Mapping of Course Outcomes for Unit IV	**CO4**	
Unit V	**Water Conservation**	**02hrs**
WATER CONSERVATION: Conservation of rain water, roof water harvesting, recharging of ground water. RURAL WATER SUPPLY: Rural water supply systems, Disinfection of well water.		
Case Studies:	Refer suggested list of Case studies/ Students activities	
Mapping of Course Outcomes for Unit V	**CO5**	
Unit VI	**Water Pollution And Pollution control**	**02 hrs**
WATER POLLUTION AND CONTROL: Sources of water pollution, types and its effects, Prevention and control measures of water pollution, Legal aspects regarding water pollution control.		

Mapping of Course Outcomes for Unit V	**CO6**

Reference Books :

1. S.K.Garg, Water Supply Engineering Vol-I, Khanna Publishers
2. G.S.Birdie,Water Supply & Sanitary Engineering-including Environmental Engineering, water And air pollution and Ecology, Dhanpat RaiandSons publishers,ISBN:81-87433-31-0
3. Dr. P.N. Modi, Environmental Engg.-Vol-I, Standard BookHouse
4. A.K.Chatterji,WaterSupply,WasteDisposalandEnvironmentalPollution Engineering, Khanna publishers

SUGGESTED LIST OF CASE STUDIES/STUDENTACTIVITIES

1. Collect the information about biotic and a biotic component of surrounding environment and frame relation among them
2. Estimatethetotalquantityofwaterrequiredforatown/locality/Institute
3. Prepare map and written report for surface and underground sources of water in the neighborhood
4. Visit nearby Certified Water testing laboratories and identify various tests conducted on water
5. Visit Water Treatment Plant and collect details of unit operations and processes involved in it.
6. Study the distribution system of water supply of your locality
7. Visit a newly constructed building and study plumbing work
8. Study a rooftop rain water harvesting system of existing building
9. Study a Solar water heating system and collect necessary data
10. Collect a necessary data/information about issues related to water pollution and Prepare report/presentation

Evaluation:

Students should select any one of the above topic in a group of 3 to 5. Students should submit a written report and make a presentation on the topic. The task should not be repeated among students. Report will be evaluated by the faculty as per rubrics defined by him/her/them at start of course.

Home

Savitribai Phule Pune University, Pune Second Year Information Technology (2019Course) 214459 (B): Mandatory Audit course 4 : Language Study Japanese : Module - II		
Teaching Scheme:	**Credit Scheme:**	**Examination Scheme:**
01hrs/week	**Non Credit**	**Audit Course**

Prerequisite Courses: Audit Course 3: Language Study Japanese: Module-I

Course Objectives :

1. To develop the Japanese communicative competence of students with small sentence formation.to make primitive social conversation in Japanese.
2. To enable students with comprehension ability of Japanese grammar.
3. To enable students to translate simple conversations from English to Japanese and vice a versa.
4. To make students aware about Japanese Culture and Customs.

Course Outcomes :

On completion of the course, learner will be able to --

CO1: Have Japanese Communicative competence for primitive Social conversation in Japanese
CO2: Comprehend Grammar of Japanese Script
CO3: Translate simple sentences from Japanese to English and vice a versa
CO4: Be aware about Japanese society and people

COURSE CONTENTS

Unit I	**Japanese Conversation**	**(02 hrs +04hrs Self Study)**
Oral practice of conversation in situations such as declining an invitation, reporting an event, narrating a story, short formal speeches on occasions such as welcoming, introducing and thanking a guest, talking about Japanese and Indian festivals, hostel life etc		
Mapping of Course Outcomes for Unit I	**CO1**	
Unit II	**Japanese Text and Kanji**	**(02hrs +04 hrs Self Study)**
Diverse texts based on Japanese culture, customs, history, food habits, and science etc, for the development of communicative competence of students; skimming, scanning of texts with emphasis on advanced sentence patterns, grammatical structures and idiomatic phrases, reading and writing of approximately 400 *kanji*.		
Mapping of Course Outcomes for Unit II	**CO2,CO3**	
Unit III	**Japanese Grammar and Composition**	**(02 hrs +04 hrs Self Study)**
Basic sentence patterns to be applied in self introduction, identifying things; time of the day; calendar; counting using Japanese numerical classifiers; describing things; making comparisons; talking of daily activities; kinship terms used for address and reference; seasons; giving and receiving; shopping; making requests; talking of one's likes and dislikes		

Mapping of Course Outcomes for Unit III	**CO2, CO3**	
Unit IV	**Japanese – English Translation**	**(02hrs +04 hrs Self Study)**
Practice in English to Japanese and Japanese to English translation of short passages on various topics such as culture, society, religion and life style taken from books, newspapers, magazines, internet etc.		
Mapping of Course Outcomes for Unit IV	**CO3**	
Unit V	**Language and Literature of Japan**	**(02 hrs.)**
History of Japanese language, literary trends, religions, spread of Chinese influence, development of art and culture in Japan.		
Mapping of Course Outcomes for Unit V	**CO4**	

E-Resources for Learning Support:

1. https://www.duolingo.com/course/ja/en/Learn-Japanese
2. https://www.freejapaneselessons.com/
3. https://minato-jf.jp/ **(Japan Foundation)**

Text Books:

1. EriBanno, Genki I: An Integrated Course in Elementary Japanese , 3rd Edition 2020, The Japan Times, (ISBN13: 9784789017305)
2. George Trombley , Yukari Takenaka, Japanese From Zero, 6th Edition, Learn From Zero Publishers (ISBN10- 0976998122, ISBN13-9780976998129)
3. Tae Kim, A Guide to Japanese Grammar, 2012, CreateSpace Publishing, (ISBN-1469968142, ISBN13- 9781469968148) http://www.guidetojapanese.org/learn/grammar

Reference Books:

1. Yukiko Ogata, Kana Sumitani, Yasuko Hidari, Yukiko Watanabe, Nihongo fun and Easy -II, Basic Grammar for Conversation
2. Nobuo Akiyama, Carol Akiyama, Japanese Grammar (Barron's Grammar), 3rd edition 2012, Barrons Educational Series
3. Storry Richard, A History Of Modern Japan, 1973, Penguin Books Ltd,
4. James W. Heisig, Remembering the Kanji 1 : A Complete Course on How Not To Forget the Meaning and Writing of Japanese Characters, 6h Edition, University of Hawai'i Press (ISBN10-0824835921, ISBN13-9780824835927)

Evaluation:

Students should select any one of the above topic in a group of 3 to 5. Students should submit a written report and make a presentation on the topic. The task should not be repeated among students. Report will be evaluated by the faculty as per rubrics defined by him/her/them at start of course.

Home

Savitribai Phule Pune University, Pune
Second Year Information Technology (2019Course)
214459 (C): Mandatory Audit course 4 :
e-Waste Management and Pollution Control

Teaching Scheme:	Credit Scheme:	Examination Scheme:
01hrs/week	Non Credit course	Audit Course

Prerequisite Courses: if any: --

Course Objectives :

1. To make the students aware about importance of environmental study.
2. To study impact of professional engineering products in societal contexts.
3. To understand impact of professional engineering products in environmental contexts.
4. To learn e-waste management and e-waste recycling process.
5. To understand causes, effects and control measures of environment pollutions.
6. To learn impact of environment controlling methods on human health.

Course Outcomes :

On completion of the course, learner will be able to --

CO1: Discuss various types of e-waste sources.
CO2: Understand impact of various e-wastes.
CO3: Identify characteristics of various e-Waste pollutants.
CO4: Understand process of e-Waste Recycling and relevant technologies.
CO5: Discuss causes, effects and control measures of different environment pollution.
CO6: Demonstrate Safe methods for disposal of e-waste and controlling the pollution.

COURSE CONTENTS

Unit I	E-Waste Overview and Sources	02 hrs

e-waste Overview: What is e-waste, E-waste growth- An overview, hazards of e-waste **Sources of e-wastes:** Discarded computers, televisions. VCRs. stereos, copiers, fax machines, electric lamps, cell phones, audio equipment and batteries if improperly disposed.

Mapping of Course Outcomes for Unit I	CO1

Unit II	Impact of various e-wastes	02 hrs

Solder in printed circuit boards, glass panels and monitors, Chip resistors and semiconductors, Relays and switches, Printed Circuit Boards, Cabling and computer housing, Plastic housing of electronic equipment and circuit boards, Front panel of CRTs, Motherboards.

Mapping of Course Outcomes for Unit II	CO2

Unit III	E- Waste pollutants and Characteristics	02 hrs

Digital dump yard, how to minimize e-waste, Hazardous substances waste Electrical and Electronic Equipment, characteristics of pollutants, batteries, electrical and electronic

components, plastic and flame retardants, circuit boards, pollutants in waste electrical and electronic equipment.		
Mapping of Course Outcomes for Unit III	**CO3**	
Unit IV	**E-Waste Recycling**	**02 hrs**
Overview of e-Waste recycling, Technologies for recovery of resources from electronic waste, resource recovery potential of e-waste, steps in recycling and recovery of materials-mechanical processing, technologies for recovery of materials		
Mapping of Course Outcomes for Unit IV	**CO4**	
Unit V	**Environmental Pollution**	**02 hrs**
Causes and effects and control measures of: Air pollution, Water pollution, Soil pollution, Marine pollution, Noise pollution, Thermal pollution, nuclear hazards, Role of an individual in prevention of pollution, Pollution case studies: Pollution caused because of electronic waste material and measures for controlling.		
Mapping of Course Outcomes for Unit V	**CO5**	
Unit VI	**Impact on human health and Pollution Controlling**	**02 hrs**
Impact of products from e-waste in human health, Current disposal methods of e-waste, e-waste recycling technologies and methods recycling pose a risk to environmental and human health. Safe methods for disposal of e-waste and controlling relevant pollution.		
Mapping of Course Outcomes for Unit VI	**CO6**	

E-Resources from Learning Support
1.https://nptel.ac.in/courses/105/105/105105169/ **2.https://www.ugc.ac.in/oldpdf/modelcurriculum/env.pdf**

Text Books
1. E-Waste Managing the Digital Dump Yard, Edited by Vishakha Munshi,ICFAI University Press,2007. 2. Text Book of Environmental Studies for undergraduate Courses by Bharucha Erach,University Press, II- Edition 2013 Available online free edition.

Reference Books
1. E-waste: Implications, Regulations and Management in India and Current Global Best Practices, Edited by Rakesh Johri, The Energy and Resources Institute, New Delhi,2008

Evaluation:
Students should select any one of the above topic in a group of 3 to 5. Students should submit a written report and make a presentation on the topic. The task should not be repeated among students. Report will be evaluated by the faculty as per rubrics defined by him/her/them at start of course.

Home

Savitribai Phule Pune University, Pune
Second Year Information Technology (2019Course)
214459 (D): Mandatory Audit course 4 :
Intellectual Property Rights

Teaching Scheme:	Credit Scheme:	Examination Scheme:
01hrs/week	Non Credit	Audit Course

Prerequisite Courses, if any: ---

Course Objectives

1. To introduce fundamental aspects of Intellectual property Rights (IPR)
2. To disseminate knowledge about types of IP like Patents, Copyrights, Trade Secrets
3. To make students aware about current trends in IPR and their importance
4. To motivate students for innovative thinking and making inventions

Course Outcomes

On completion of the course, learner will be able to --

CO1: Exhibit the concepts of Intellectual Property Rights
CO2: Differentiate among different IPR
CO3: Formulate and characterize innovative ideas and inventions into IPR
CO4: Demonstrate knowledge of advances in patent law and IP regulations

COURSE CONTENTS

Unit I	Overview Of Intellectual Property	02 hrs
Introduction and the need for intellectual property right (IPR) - Types of Intellectual Property Rights: Patent, Copyright, Trade Mark, Design, Geographical Indication, Plant Varieties and Layout Design – Genetic Resources and Traditional Knowledge – Trade Secret.		
Mapping of Course Outcomes for Unit I	**CO1, CO2**	
Unit II	**Patents**	**04 hrs**
What is invention? Patentability criteria: Novelty, Non-Obviousness (Inventive Steps), Industrial Application, Non- Patentable Subject Matter, Patent Search, Patent Registration Procedure, Rights and Duties of Patentee, Assignment and license, Infringement.		
Mapping of Course Outcomes for Unit II	**CO3, CO4**	
Unit III	**Copyrights**	**02 hrs**
Concept of Copyright –Copyright Subject matter: original literary, dramatic, musical, artistic works; cinematograph films and sound recordings - Registration Procedure, Term of protection, Ownership of copyright, Assignment and license of copyright - Infringement		
Mapping of Course Outcomes for Unit III	**CO3**	

Unit IV	**Trademarks**	**02 hrs**
Nature of Trademarks - Different kinds of trademarks (, logos, signatures, symbols, well known marks, brand names, certification and service marks) – Trademarks that can't be registered– Trademarks registration procedure - Rights of holder and assignment and licensing of marks - Infringement		
Mapping of Course Outcomes for Unit IV	**CO3**	
Unit V	**Advances in IP Laws and Government policies**	**02 hrs**
Amendments and India`s New National IP Policy, Promoting IPR policy for Start-ups, Career Opportunities in IP - IPR in current scenario		
Mapping of Course Outcomes for Unit V	**CO4**	

Text Books
1. Niraja Pandey, Khush deep Dharni (2014), "Intellectual Property Rights", PHI 2. Nithyananda K V. (2019). Intellectual Property Rights: Protection and Management. India, IN: Cengage Learning India Private Limited

Reference Books
1. Mishra, "An introduction to Intellectual property Rights", Central Law Publications
2. Ahuja, V K. (2017). Law relating to Intellectual Property Rights. India, IN: Lexis Nexis

Evaluation:
Students should select any one of the above topic in a group of 3 to 5. Students should submit a written report and make a presentation on the topic. The task should not be repeated among students. Report will be evaluated by the faculty as per rubrics defined by him/her/them at start of course.

Savitribai Phule Pune University

Faculty of Science and Technology

Syllabus for Final Year of Mechanical Engineering

(Course 2015)

Savitribai Phule Pune University

B. E. (Mechanical) (2015 Course) Semester – I

Code	Subject	Teaching Scheme Hrs / week			Examination Scheme					Total Marks	Credits	
		Lecture	Tut	Pract	In Sem	End Sem	TW	PR	OR		Theory	TW/ Pr/OR
402041	Hydraulics and Pneumatics	3	-	2	30	70	25	-	25	150	3	1
402042	CAD CAM Automation	3	-	2	30	70	25	50	-	175	3	1
402043	Dynamics of Machinery	4	-	2	30	70	25	-	25	150	4	1
402044	Elective-I	3	-	2	30	70	25	-	-	125	3	1
402045	Elective-II	3	-	-	30	70	-	-	-	100	3	-
402046	Project-I	-	-	4	-	-	25	-	25	50	-	2
Total		16	-	12	150	350	125	50	75	750	16	6
											22	

B. E. (Mechanical) (2015 Course) Semester – II

Code	Subject	Teaching Scheme Hrs / week			Examination Scheme					Total Marks	Credits	
		Lecture	Tut	Pract	In Sem	End Sem	TW	PR	OR		Theory	TW/ Pr/OR
402047	Energy Engineering	3	-	2	30	70	25	-	25	150	3	1
402048	Mechanical System Design	4	-	2	30 (1.5 Hrs)	70 (3 Hrs)	25	-	50	175	4	1
402049	Elective-III	3	-	2	30	70	25	-	-	125	3	1
402050	Elective-IV	3	-	-	30	70	-	-	-	100	3	-
402051	Project-II	-	-	12	-	-	100	-	100	200	-	6
Total		13	-	18	120	280	175	-	175	750	13	9
											22	

Elective – I		Elective – II	
Code	Subject	Code	Subject
402044 A	Finite Element Analysis	402045 A	Automobile Engineering
402044 B	Computational Fluid Dynamics	402045 B	Operation Research
402044 C	Heating Ventilation and Air Conditioning	402045 C	Energy Audit and Management
		402045 D	Open Elective**

Elective – III		Elective – IV	
402049 A	Tribology	402050 A	Advanced Manufacturing Processes
402049 B	Industrial Engineering	402050 B	Solar & Wind Energy
402049 C	Robotics	402050 C	Product Design and Development
		402050 D	Open Elective**

: Open Elective – Board of studies (BoS) – Mechanical and Automobile Engineering will declare the list of subjects, which can be taken under open electives or any other Electives that are being taught in the current semester, to the same level, as Elective – II and Elective -IV under engineering faculty in the individual college and Industry can define new elective subject with proper syllabus using defined framework of Elective II and Elective IV and ***get it approved from board of studies and other necessary statutory systems in the Savitribai Phule Pune University, Pune, before 30th November* of previous academic year in which the subject to be introduced . Without prior approval from University statutory system, no one can introduce the open elective in curriculum.

Savitribai Phule Pune University
Final Year of Mechanical Engineering (2015 Course)

Course Code : 402041 **Course Name : Hydraulics and Pneumatics**

Teaching Scheme:		Credits		Examination Scheme:				
Theory	: 03 Hrs Per Week	TH	: 03	Theory	In-Sem	: 30	PR	: --
Practical	: 02 hrs per week	TW	: 01		End-Sem	: 70	OR	: 25
							TW	: 25

Pre-requisites	: Fluid Mechanics, Manufacturing Processes and Machines, Mechatronics

Course Objectives:

- To study governing laws used in fluid power systems
- To study fluid power applications
- To study working principles of various components
- To study selection of different components
- To study how to design fluid power systems
- To study low cost automation

Course Outcomes:

On completion of the course, students will be able to -

- Understand working principle of components used in hydraulic & pneumatic systems
- Identify various applications of hydraulic & pneumatic systems
- Selection of appropriate components required for hydraulic and pneumatic systems
- Analyse hydraulic and pneumatic systems for industrial/mobile applications
- Design a system according to the requirements
- Develop and apply knowledge to various applications

Course Contents

Unit 1: Basics of Fluid Power and Pumps **6 Hrs**

Fluid power basics, advantages and limitations, fluid power distribution, standard symbols, energy loss in hydraulic systems.

Pumps - types, classification, principle of working and constructional details of vane pumps, gear pumps, radial and axial plunger pumps, screw pumps, power and efficiency calculations, and characteristics curves.

Unit 2: Actuators and Power Unit **6 Hrs**

Linear and rotary actuators- types, construction and characteristics. Cylinder mountings, cushioning of cylinders.

Power units and accessories - types of power units, reservoir assembly, constructional details. Accumulators, Intensifiers, Pressure and Temperature switches /sensors, level sensors.

Unit 3: Fluid Power Control **6 Hrs**

Direction control valves - center positions, methods of actuation, two stage valves, Flow control valves - pressure and temperature compensated. Pressure control valves - pressure reducing valve, sequence valve, unloading valve, brake valve, back pressure valve, counter balance valve, check valves, prefill valve, servo valves, cartridge valves, proportional valves.

Unit 4: Hydraulic Circuits and Contamination Control **6 Hrs**

Hydraulic circuits: Simple reciprocating, regenerative, speed control (meter in, meter out and bleed off), sequencing, synchronization, traverse and feed, automatic reciprocating, fail safe circuit, counter balance circuit, actuator locking, unloading circuit, motor breaking circuit etc.

Contamination control: Contamination, sources of contamination, suction strainer, filters, filtration, filter ratings.

Unit 5: Pneumatics – Components, Control Valves and Circuits **6 Hrs**

Compressors - Types, principle of working and constructional details. Comparison of pneumatic with hydraulic power transmissions. Types of filters, pressure regulators, lubricators, mufflers, dryers, direction control valves, pneumatic actuators, shuttle valve, two pressure valve, quick exhaust valve and time delay valves, electro-pneumatics. Speed regulating methods, pneumatic circuits, reciprocating, cascading time delay etc. Application of pneumatics in low cost automation and in industrial automation.

Unit 6: System Analysis and Design **6 Hrs**

Calculation of piston velocity, thrust under static and dynamic applications, considering friction, inertia loads, design considerations for cylinders, Design of hydraulic/pneumatic circuits for practical application, selection of different components such as reservoir, control elements, actuators, accumulator, intensifier, filters, pumps. (Students are advised to refer manufacturers' catalogues for design and use simulation tool like Automation Studio for analysis).

Books

Text :

1. Esposito A, Fluid Power with application, Prentice Hall
2. Majumdar S.R, Oil Hydraulic system- Principle and maintenance ,Tata McGraw Hill
3. Majumdar S.R, Pneumatics Systems Principles and Maintenance ,Tata McGraw Hill
4. Stewart H. L, Hydraulics and Pneumatics , Taraporewala Publication

References :

1. Pipenger J.J, Industrial Hydraulics, McGraw Hill
2. Pinches, Industrial Fluid Power, Prentice Hall
3. Yeaple, Fluid Power Design Handbook
4. Andrew A. Parr, Hydraulics and Pneumatics, Elsevier Science and Technology Books
5. ISO - 1219, Fluid Systems and components, Graphic Symbols
6. Standard Manufacturer's Catalogues

Term Work shall consist of following experiments and assignments:

1. Test on Gear/Vane/Piston pump and plotting performance characteristics
2. Following experiments to be done on hydraulic trainer (any 3)
    a) Regenerative circuit
    b) Speed control circuit
    c) Sequencing circuit
    d) Traverse and feed circuit etc.
3. Following experiments to be done on pneumatic trainer (any 3)

a) Automatic reciprocating circuit
b) Speed control circuit
c) Pneumatic circuit involving Shuttle valve/ Quick exhaust valve / Two pressure valve
d) Electro pneumatic circuits

4. Test on pressure relief valve/flow control valve
5. Test on linear /rotary actuator
6. Design of simple hydraulic systems used in practice using manufacturers' catalogue and analysis using software such as Automation Studio.
7. Design of simple pneumatic systems used in practice using manufacturers' catalogue and analysis using software such as Automation Studio.
8. Industrial visit to study Hydraulic / Pneumatic based Automation systems
9. Assignment: Symbols for different components as per standards
10. Assignment: Trouble shooting procedures
11. Assignment: Standard specifications of hydraulic/ pneumatic components using manufacturer's catalogues.

Savitribai Phule Pune University

Final Year of Mechanical Engineering (2015 Course)

Course Code : 402042 **Course Name : CAD CAM and Automation**

Teaching Scheme:		**Credits**		**Examination Scheme:**		
Theory	**: 03 Hrs Per Week**	**TH**	**: 03**	**Theory**	**In-Sem : 30**	**PR : 50**
Practical	**: 02 hrs per week**	**TW**	**: 01**		**End-Sem : 70**	**OR : --**
						TW : 25

Pre-requisites	**:** Engineering Graphics, Engineering Mathematics, Numerical Methods & Optimization, Computer Aided Machine Drawing, Strength of Materials, Manufacturing Processes

Course Objectives:

- To apply homogeneous transformation matrix for geometrical transformations of 2D/3D CAD entities
- To model mathematically analytical and synthetic curves, surfaces
- To predict performance of simple mechanical components viz. beam, shafts, plates, trusses using FEA (Mathematical and Software treatment)
- To generate CNC program for appropriate manufacturing techniques viz. turning and milling
- To select and apply suitable Rapid Prototyping techniques for engineering applications
- To study role and components of different Automation strategies.

Course Outcomes:

On completion of the course, students will be able to -

- Apply homogeneous transformation matrix for geometrical transformations of 2D CAD entities for basic geometric transformations.
- Use analytical and synthetic curves and surfaces in part modeling.
- Do real times analysis of simple mechanical elements like beams, trusses, etc. and comment on safety of engineering components using analysis software.
- Generate CNC program for Turning / Milling and generate tool path using CAM software.
- Demonstrate understanding of various rapid manufacturing techniques and develop competency in designing and developing products using rapid manufacturing technology.
- Understand the robot systems and their applications in manufacturing industries.

Course Contents

Unit 1: Computer Graphics **6 Hrs**

Transformations (2D & 3D) : Introduction, Formulation, Translation, Shear, Rotation, Scaling and reflection, Homogeneous representation, Concatenated transformation, Mapping of geometric models, Inverse transformations, Introduction to 3D transformation (Theory + Numerical treatment only for 2D – Max 3 vertices)

Projections : Orthographic, Isometric, Perspective projections (Only theory)

Unit 2: Geometric Modeling **6 Hrs**

Curves – Introduction, Analytical curves (Line, circle, ellipse, parabola, hyperbola), Synthetic curves (Hermite Cubic Spline, Bezier, B-Spline Curve) [Numerical on Line, Circle, Ellipse, Hermite Cubic

Spline, Bezier]
Surfaces – Introduction, Surface representation, Analytic surfaces, Synthetic Surfaces, Hermite bicubic, Bezier, B-Spline, Coons patch surface, Applications in freeform surfaces [only Theory]
Solids - Introduction, Geometry and Topology, Solid Representation, Boundary Representation, Euler's equation, Constructive Solid Geometry (CSG), Boolean operation for CSG [only Theory]

Unit 3: Finite Element Analysis (FEA) 6 Hrs

Introduction : Brief History of FEM, Finite Element Terminology (nodes, elements, domain, continuum, Degrees of freedom, loads and constraints), General FEM procedure, Applications of FEM in various fields, meshing, p and h formulation, Advantages and disadvantages of FEM [Only theory]
One Dimensional Problem: Finite element modeling, coordinate and linear shape function, Assembly of Global Stiffness Matrix and Load Vector, Properties of Stiffness Matrix, Finite Element Equations, Temperature Effects. [Theory + Numerical – composite shaft, spring elements in series and parallel]
Trusses : Introduction, 2D Trusses, Assembly of Global Stiffness Matrix [Numerical limited to 4X4 matrix]

Unit 4: Computer Aided Manufacturing (CAM) 6 Hrs

Introduction to Computer Aided Manufacturing (CAM), Coordinate system, Working principal of CNC Lathe, Turning Centers, Milling Machine, Steps in developing CNC part program, Tool and geometric compensations, subroutine and Do loop using canned cycle. [Only theory – 2 hrs]
CNC Lathe part programming (FANUC) : Linear and circular interpolation, Canned cycles for facing, threading, grooving, etc. [Theory + Program]
*CNC Milling part programming (FANUC)***:** Linear and circular interpolation, Pocketing, contouring and drilling cycles. [Theory + Program]

Unit 5: Advanced Manufacturing Method 6 Hrs

Product Life Cycle: Introduction, Need, Components/Elements of PLM, Collaborative Engineering. [Only theory]
Rapid Prototyping : Introduction, classification of RP Processes (SLA, LOM, SLS, FDM, 3D printing), Working principle, features, models & specification of process, application, advantages and disadvantages, Rapid Tooling and STL format, Concept of 4D Rapid Prototyping. [Only theory]

Unit 6: Automation 6 Hrs

Automation : Introduction, Automation strategies, Types of Automation - Hard and Soft Automation, Flexible Manufacturing System – Types, Advantages, Limitations, AGVs and AS/RS [Only theory]
*Group Technology***:** Introduction, Coding Methods, Concepts of Computer Integrated Manufacturing (CIM) and Computer Aided Process Planning (CAPP), Variant & Generative methods of CAPP, advantages of CAPP. [Only theory]
Robotics: RIA definition of Robot, Laws of robotics, Classification of robots, robot anatomy, Point to point and continuous path robotic systems, Joints, End Effectors, Grippers - Mechanical, Magnetic and Pneumatic, Applications. [Only theory]

Books

Text :

1. Ibrahim Zeid and R. Sivasubramanian - CAD/CAM - Theory and Practice Tata McGraw Hill Publishing Co. 2009

2. Chandrupatla T. R. and Belegunda A. D. -Introduction to Finite Elements in Engineering - Prentice Hall India.
3. Nitin S. Gokhale, Practical Finite Element Analysis, Finite To Infinite; First Edition edition, ISBN-10: 8190619500 ISBN-13: 978-8190619509
4. S. K. Sinha, CNC Programming using Fanuc Custom Macro B, McGraw-Hill Professional
5. S. R. Deb, Robotics Technology and Flexible Automation, Tata McGraw Hill.

References :

1. Ibraim Zeid, Mastering CAD/CAM – Tata McGraw Hill Publishing Co. 2000
2. Segerling L. J. - Applied Finite Elements Analysis, John Wiley and Sons
3. Seshu P. Text book of Finite Element Analysis, PHI Learning Private Ltd. New Delhi, 2010
4. Rao P. N., Introduction to CAD/CAM Tata McGraw Hill Publishing Co.
5. B. S. Pabla, M. Adithan, CNC Machines, New Age International, 1994
6. Groover M.P.-Automation, production systems and computer integrated manufacturing�' - Prentice Hall of India
7. Ian Gibson, David W. Rosen, Brent Stucker, Additive Manufacturing Technologies: Rapid Prototyping to Direct Digital Manufacturing, Springer
8. Geoffrey Boothroyd, Peter Dewhurst, Winston A. Knight, Product Design for Manufacture and Assembly, Third Edition ,CRC Press
9. Antti Saaksvuori, Anselmi Immonen, Product Life Cycle Management -Springer, 1st Edition, 2003

Term Work shall consist of following experiments and assignments:

1. Demonstration of Application Programming Interface (API).
2. Stress and deflection analysis of Beam (FEA).
3. Stress and deflection analysis of 2D truss (FEA).
4. Stress and deflection analysis of any Mechanical Component using FEA software and validate the results by analytical methods (FEA).
5. Tool path generation and simulation for Turning – Grooving and Threading with help of suitable software.
6. Tool path generation and simulation for Milling – Facing, Pocketing, Contouring and drilling, etc. with help of suitable software.
7. Case study on Rapid Prototyping - Exporting STL files from 3D CAD models, structure of STL files, etc.
8. Case study based on modeling and analysis of structural system (Industry Based)
9. Manufacturing of machine component using additive manufacturing or Using CNC simulator software.
10. Assignment on Robot simulation
11. Industrial Visit Report on Automation and Robotics

Savitribai Phule Pune University
Final Year of Mechanical Engineering (2015 Course)

Course Code : 402043 **Course Name : Dynamics of Machinery**

Teaching Scheme:		**Credits**		**Examination Scheme:**		
Theory	**: 04 Hrs Per Week**	**TH**	**: 04**	**Theory**	**In-Sem : 30**	**PR : --**
Practical	**: 02 hrs per week**	**TW**	**: 01**		**End-Sem : 70**	**OR : 25**
						TW : 25

Pre-requisites:	Strength of Materials, Engineering Mechanics, Engineering Mathematics and Numerical Methods,

Course Objectives:

- To conversant with balancing problems of machines.
- To understand fundamentals of free and forced vibrations.
- To develop competency in understanding of vibration and noise in Industry.
- To develop analytical competency in solving vibration problems.
- To understand the various techniques of measurement and control of vibration and noise.

Course Outcomes:

On completion of the course, students will be able to -

- Apply balancing technique for static and dynamic balancing of multi cylinder inline and radial engines.
- Estimate natural frequency for single DOF undamped & damped free vibratory systems.
- Determine response to forced vibrations due to harmonic excitation, base excitation and excitation due to unbalance forces.
- Estimate natural frequencies, mode shapes for 2 DOF undamped free longitudinal and torsional vibratory systems.
- Describe vibration measuring instruments for industrial / real life applications along with suitable method for vibration control.
- Explain noise, its measurement & noise reduction techniques for industry and day today life problems.

Course Contents

UNIT 1: Single Degree of Freedom Systems – Free Vibration **10 Hrs**

Fundamentals of Vibration : Elements of a vibratory system, vector representation of S.H.M., degrees of freedom, Introduction to Physical and Mathematical modeling of vibratory systems : Bicycle, Motor bike and Quarter Car. types of vibration, equivalent stiffness and damping, formulation of differential equation of motion (Newton, D'Alembert and energy method)

*Undamped free vibrations***:** Natural frequency for longitudinal, transverse and torsional vibratory systems.

Damped free vibrations: Different types of damping, Viscous damping – over damped, critically damped and under damped systems, initial conditions, logarithmic decrement, Dry friction or coulomb damping - frequency and rate of decay of oscillations.

UNIT 2: Single Degree of Freedom Systems - Forced Vibrations **8 Hrs**

Forced vibrations of longitudinal and torsional systems, Frequency Response to harmonic excitation, excitation due to rotating and reciprocating unbalance, base excitation, magnification factor, Force and Motion transmissibility, Quality Factor. Half power bandwidth method, Critical speed of shaft having single rotor of undamped systems.

UNIT 3: Two Degree of Freedom Systems – Undamped Vibrations **8 Hrs**

Free vibration of spring coupled systems – longitudinal and torsional, torsionally equivalent shafts, natural frequency and mode shapes, Eigen value and Eigen vector by Matrix method, Combined rectilinear and angular motion, Vibrations of Geared systems.

UNIT 4: Balancing **8 Hrs**

Static and dynamic balancing, balancing of rotating masses in single and several planes, primary and secondary balancing of reciprocating masses, balancing in single cylinder engines, balancing in multi-cylinder in-line engines, direct and reverse cranks method -radial and V engines.

UNIT 5: Measurement and Control of Vibration **8 Hrs**

A) Measurement: Vibration Measuring Instruments, Accelerometers, Impact hammer, Vibration shakers, Vibration Analyzer, Vibration based condition monitoring, Analysis of Vibration Spectrum, Standards related to measurement of vibration, Human response to vibrations.

B) Control : Vibration control methods, passive, semi active (Introduction to Electro-Rheological & Magneto-Rheological dampers) and active vibration control, control of excitation at the source, control of natural frequency, Vibration isolators, Tuned Dynamic Vibration Absorbers, Introduction to Torsional Damper

UNIT 6: Introduction to Noise **6 Hrs**

Fundamentals of noise Sound concepts, Decibel Level, white noise, weighted sound pressure level, Logarithmic addition, subtraction and averaging, sound intensity, noise measurement, sound fields, octave band, sound reflection, absorption and transmission, acoustic material & its characteristics, Noise control at the Source, along the path and at the receiver, pass-by-noise, Reverberation chamber, Anechoic Chamber, Human Exposure to Noise and Noise standards.

Books

Text :

1. S. S. Rao, Mechanical Vibrations, Pearson Education Inc. New Delhi.
2. G. K. Grover, Mechanical Vibrations, New Chand and Bros.,Roorkee
3. Wiiliam J Palm III, Mechanical Vibration, Wiley India Pvt. Ltd, New Delhi
4. Uicker J. John, Jr, Pennock Gordon R, Shigley Joseph E., Theory of Machines and Mechanisms, International Version, OXFORD University Press, New Delhi.
5. M L Munjal, Noise and Vibration Control, Cambridge University Press India

References :

1. Weaver, Vibration Problems in Engineering, 5th Edition Wiley India Pvt. Ltd, New Delhi.
2. Bell, L. H. and Bell, D. H., Industrial Noise Control – Fundamentals and Applications‖, Marcel Dekker Inc.
3. Alok Sinha, Vibration of Mechanical System, Cambridge university Press , India
4. Debabrata Nag, Mechanical Vibrations, Wiley India Pvt. Ltd, New Delhi.
5. Kelly S. G., Mechanical Vibrations, Schaums outlines, Tata McGraw Hill Publishing Co. Ltd., New Delhi.

6. Meirovitch, L., Elements of Mechanical Vibrations‖, McGraw Hill.
7. Ver, Noise and Vibration Control Engineering, Wiley India Pvt. Ltd, New Delhi.
8. Bies, D. and Hansen, C., Engineering Noise Control - Theory and Practice, Taylor and Francis.
9. Shrikant Bhave, Mechanical Vibrations Theory and Practice, Pearson, New Delhi

Term Work shall consist of following experiments and assignments:

A] Compulsory Experiments (Sr. No. 1 to 6)

1. Balancing of wheel / rotor on computerized balancing machine OR Experimental verification of dynamic balancing of rotating masses.
2. To determine the natural frequency of damped vibration of single degree freedom system and to find it‘s damping coefficient.
3. To obtain frequency response curves of single degree freedom system of vibration for different amount of damping.
4. To verify natural frequency of torsional vibration of two rotor system and position of node.
5. To determine natural frequency of transverse vibration of beam using vibration analyzer.
6. Noise measurement and analysis using vibration Analyzer.

B] Any Two Experiments from the following :

1. To determine critical speed of shaft with single rotor.
2. Experimental verification of principle of dynamic vibration absorber.
3. Experiment on shock absorbers and to plot its characteristic curve.
4. A case study (Industrial visit / In-house) based on Conditioning Monitoring and Fault Diagnosis.

C] List of Compulsory Assignment :

1. Simulation (using suitable software) of free response of SDOF damped system to demonstrate different damping conditions by solving differential equation numerically.

OR

2. Simulation (using suitable software) of total response of SDOF damped system to harmonic excitation by solving differential equation numerically.

Savitribai Phule Pune University
Final Year of Mechanical Engineering (2015 Course)

Course Code : 402044 A **Course Name : Elective – I Finite Element Analysis**

Teaching Scheme:		Credits		Examination Scheme:		
Theory	: 03 Hrs Per Week	TH	: 03	Theory	In-Sem : 30	PR : --
Practical	: 02 hrs per week	TW	: 01		End-Sem : 70	OR : --
						TW : 25

Pre-requisites : Fluid Mechanics, Heat transfer, Numerical methods, Programming Languages.

Course Objectives:

- To understand the philosophy and general procedure of Finite Element Method as applied to solid mechanics and thermal analysis problems.
- To familiarize students with the displacement-based finite element method for displacement and stress analysis and to introduce related analytical and computer tools.
- It provides a bridge between hand calculations based on mechanics of materials and machine design and numerical solutions for more complex geometries and loading states.
- To study approximate nature of the finite element method and convergence of results are examined.
- It provides some experience with a commercial FEM code and some practical modeling exercises .

Course Outcomes:

On completion of the course, students will be able to -

- Understand the different techniques used to solve mechanical engineering problems.
- Derive and use 1-D and 2-D element stiffness matrices and load vectors from various methods to solve for displacements and stresses.
- Apply mechanics of materials and machine design topics to provide preliminary results used for testing the reasonableness of finite element results.
- Explain the inner workings of a finite element code for linear stress, displacement, temperature and modal analysis.
- Use commercial finite element analysis software to solve complex problems in solid mechanics and heat transfer.
- Interpret the results of finite element analyses and make an assessment of the results in terms of modeling (physics assumptions) errors, discretization (mesh density and refinement toward convergence) errors, and numerical (round-off) errors.

Course Contents

Unit 1: Fundamental Concepts of FEA **6 Hrs**

Introduction: Solution methodologies to solve engineering problems, governing equations, mathematical modelling of field problems in engineering, discrete and continuous models.

Brief history of FEM, Finite Element terminology (nodes, elements, domain, continuum, degrees of freedom, loads & constraints), general steps involved in FEM, applications of FEM in various fields, advantages and disadvantages of FEM, consistent units system, essential and natural boundary conditions, symmetric boundary conditions.

Introduction to different approaches used in FEA : Direct approach, Variational formulation-Principal of Minimum Potential Energy (PMPE), Galerkin weighted residual method, Principle of Virtual Work, Rayleigh-Ritz method, relation between FEM and Rayleigh-Ritz method

Types of Analysis (Introduction) : Linear static analysis, Non-linear analysis, Dynamic analysis, Linear buckling analysis, Thermal analysis, Fatigue analysis, Crash analysis.

Unit 2: 1D Elements **6 Hrs**

Types of 1D elements, displacement function, global and local coordinate systems, polynomial form of interpolation functions- linear, quadratic and cubic, properties of shape function, primary and secondary variables.

Formulation of elemental stiffness matrix and load vector for bar, truss and beam using any approach, Formulation of load vector due to uniform temperature change (only for bar).

Assembly of global stiffness matrix and load vector, properties of stiffness matrix, half bandwidth, treatment of boundary conditions- elimination approach, stress and reaction forces calculations

Unit 3: 2D Elements **6 Hrs**

Two-Dimensional Stress Analysis: Plane Stress/Strain problems in 2D elasticity, constitutive relations

Constant Strain Triangle(CST), Liner Strain Rectangle (LSR), displacement function, Pascal‘s triangle, compatibility and completeness requirement, geometric isotropy, convergence requirements, strain filed, stress filed, Formulation of element stiffness matrix and load vector for Plane Stress/Strain problems

Assembly of global stiffness matrix and load vector, Boundary conditions, solving for primary variables (displacement), stress calculations

Unit 4: Isoparametric Elements and Numerical Integration **6 Hrs**

Concept of isoparametric elements, Terms isoparametric, super parametric and subparametric.

Coordinate mapping : Natural coordinates, Area coordinates (for triangular elements), higher order triangular and quadrilateral elements (Lagrangean and serendipity elements), geometry associative mesh, quality checks, mesh refinement- p vs h refinements, Uniqueness of mapping - Jacobian matrix.

Numerical integration: Gauss Quadrature in one and two dimension, Order of Gauss integration, full and reduced integration, sub-modeling, substructuring.

Unit 5: 1D Steady State Heat Transfer Problems **6 Hrs**

Introduction, One dimensional steady-state heat transfer problem- Governing differential equation, Finite Element formulation using Galerkin’s approach for composite wall and thin Fin , essential and natural boundary conditions and solving for temperature distribution

Unit 6: Dynamic Analysis **6 Hrs**

Types of dynamic analysis, general dynamic equation of motion, lumped and consistent mass, Mass matrices formulation of bar, truss and beam element.

Undamped-free vibration: Eigenvalue problem, evaluation of eigenvalues and eigenvectors (characteristic polynomial technique).

Books

Text :

1. Daryl L, A First Course in the Finite Element Method,. Logan, 2007.
2. G Lakshmi Narasaiah, Finite Element Analysis, B S Publications, 2008.
3. Y.M.Desai, T.I.Eldho and A.H.Shah, Finite Element Method with Applications in Engineering, Pearson Education, 2011
4. Chandrupatla T. R. and Belegunda A. D., Introduction to Finite Elements in Engineering, Prentice Hall India, 2002.
5. P., Seshu, Text book of Finite Element Analysis, PHI Learning Private Ltd. , New Delhi, 2010.

References :

1. Bathe K. J., Finite Element Procedures Prentice, Hall of India (P) Ltd., New Delhi.
2. R. D. Cook, et al., Concepts and Applications of Finite Element Analysis. Wiley, India
3. Kwon Y. W., Bang H., Finite Element Method using MATLAB, CRC Press, 1997
4. Peter Kattan, MATLAB Guides to Finite Elements- An Interactive Approach, Springer, 2008.
5. S. Moaveni, Finite element analysis, theory and application with Ansys, Prentice Hall
6. Erdogan Madenci and Ibrahim Guven, "The Finite Element Method and Applications in Engineering Using Ansys", Springer, 2006.
7. David V. Hutton, Fundamental of Finite Element Analysis, Tata McGraw-Hill
8. Gokhale N. S., et al., Practical Finite Element Analysis, Finite to Infinite, Pune, 2008.

Term Work shall consist of following assignments:

Practical's to be performed: Minimum 7 including

- Any three practical's *from Practical No. 1 to 4** and
- Any three practical *from Practical No. 5 to 9***
- in Open source or Commercial Software

1. Computer program for stress analysis of 1D bar using linear and quadratic elements. Show the variation of stress and strain within the element for linear and quadratic bar element
2. Computer program for stress analysis of 2-D truss subjected to plane forces
3. Computer programs for (i) modal analysis and, (ii) stress analysis for 1-D beam (simply supported or cantilever beams)
4. Computer program for 1-D temperature analysis
5. Static stress concentration factor calculation for a plate with center hole subjected to axial loading in tension using FEA software
6. Modal analysis of any machine component using FEA software.
7. Stress and deflection analysis of any machine component consisting of 3-D elements using FEA software.
8. Elasto-plastic stress analysis of plate using FEA software
9. Coupled Thermal-Structural Analysis using FEA software

*1 Students can write the program in any of the programming language such as FORTRAN, C, C++, MATLAB, Python, VB.

*2 Minimum number of elements considered should be 10 or more.

*3 Validate results of the program with analytical method or commercial FEA software such as Abaqus, ANSYS, Msc-Nastran, Optistruct / Radioss, Comsol-Multiphysics, etc.

**1 Students should do convergence study for all assignment problems.
**2 Use different element types from element library,
**3 If possible use submodel / symmetry option.

Savitribai Phule Pune University
Final Year of Mechanical Engineering (2015 Course)

Course Code : 402044 B				**Course Name : Elective – I Computational Fluid Dynamics**		
Teaching Scheme:		**Credits**		**Examination Scheme:**		
Theory	**: 03 Hrs Per Week**	**TH**	**: 03**	**Theory**	**In-Sem : 30**	**PR : --**
Practical	**: 02 hrs per week**	**TW**	**: 01**		**End-Sem : 70**	**OR : --**
						TW : 25

Pre-requisites : Fluid Mechanics, Heat transfer, Numerical methods, Programming Languages.

Course Objectives:

- Students should be able to model fluid / heat transfer problems and apply fundamental conservation principles.
- Students should be able to do discretize the governing equations by Finite Difference Method and Finite volume Method.
- Students should be able to develop programming skills by in-house code development for conduction, convection and fluid dynamics problems.
- Students should be able to solve basic convection and diffusion equations and understands the role in fluid flow and heat transfer.
- To prepare the students for research leading to higher studies.
- To prepare the students for career in CAE industry using software tools.

Course Outcomes:

On completion of the course, students will be able to -

- Analyze and model fluid flow and heat transfer problems.
- Generate high quality grids and interpret the correctness of numerical results with physics.
- Conceptualize the programming skills.
- Use a CFD tool effectively for practical problems and research.

Course Contents

Unit 1: Introduction to CFD **6 Hrs**

Introduction to Computational Fluid Dynamics, Derivation and physical interpretation of governing equations (conservation of mass, momentum and energy) in differential form, Concept of substantial derivative, divergence and curl of velocity, Mathematical behavior of Governing Equations and boundary conditions.

Unit 2: Solution to Conduction Equation **6 Hrs**

Introduction to FEA, FDM and FVM, Solution of two dimensional steady and unsteady heat conduction equation using finite volume method (Implicit and Explicit) with Dirichlet, Neumann, Robbin boundary conditions, Stability Criteria.

Unit 3: Solution to Advection Equation **6 Hrs**

Solution of two dimensional steady and unsteady heat advection equation using finite volume method (Implicit and Explicit) with Dirichlet BC, Stability Criteria, Introduction to first order upwind, CD, second order upwind and QUICK convection schemes.

Unit 4: Solution to Convection-Diffusion Equation **6 Hrs**

Solution of two dimensional steady and unsteady heat convection-diffusion equation for slug flow using finite volume method (Implicit and Explicit), Stability Criteria, 1-D transient convection-diffusion system, Peclet Number

Unit 5: Solution to Navier – Stokes Equation **6 Hrs**

Solution of Navier-Stoke‘s equation for incompressible flow using SIMPLE algorithms for lid driven cavity flow problem, Introduction to external flow simulation.

Unit 6: Introduction to Turbulence Modeling **6 Hrs**

Introduction to turbulence models, Reynolds Averaged Navier-Stokes equations (RANS), One equation model (Derivation) and two equation model.

Books

Text :

1. John D Anderson: Computational Fluid Dynamics- The Basics with Applications, McGraw-Hill
2. Atul Sharma, Introduction to Computational Fluid Dynamics: Development, Application and Analysis, Wiley
3. Suhas V. Patankar, Numerical Heat Transfer and Fluid Flow, Hemisphere Publishing Corporation
4. A. W. Date, Introduction to Computational Fluid Dynamics, Cambridge Univ. Press, USA.
5. H. Versteeg, and W.Malalasekara, An Introduction to Computational Fluid Dynamics: The Finite Volume Method, Pearson.
6. T. J. Chung, Computational Fluid Dynamics, Cambridge University Press.
7. J. Tu, G.-H. Yeoh and C. Liu: Computational Fluid Dynamics: A practical approach, Elsevier.
8. H. Schlichting and K. Gersten, Boundary-Layer Theory, Springer.

References :

1. H. Tennekes and J. L. Lumley, A First Course in Turbulence, MIT Press.
2. David C. Wilcox, Turbulence Modeling for CFD, DCW Industries

Term Work shall consist of following assignments:

Practical’s to be performed: Minimum 7 including

- Any three practical’s with programming language (*from Practical No. 1 to 8*) and
- Any three practical in Open source or Commercial Software (*from Practical No. 9 to 16*)
- Mini project (*Practical No.16*) in Open source or Commercial Software tool

1. One-dimensional steady state conduction using finite volume method
2. One-dimensional unsteady state conduction using finite volume method
3. Two-dimensional steady state conduction using finite volume method
4. Two-dimensional unsteady state conduction using finite volume method
5. Two-dimensional advection using finite volume method
6. One-dimensional conduction convection problem using finite volume method
7. One-dimensional conduction convection problem using finite volume method
8. Solution of Navier Stokes equation using SIMPLE algorithm for Lid Driven Cavity flow

problem

9. Numerical simulation and analysis of boundary layer over a flat plate (Blausius Equation)
10. Numerical simulation and analysis of boundary layer for a
11. Developing flow through Pipe
12. Fully developed flow through a pipe
13. CFD Analysis of external flow: Circular Cylinder or Airfoil (NACA 0012)
14. CFD analysis of heat transfer in pin fin.
15. Numerical simulation and analysis of 2D square lid driven cavity. Effect of Reynolds number on the vorticity patterns.
16. Mini project on any practical application. Students should take a problem of their choice and verify the CFD solution with experimental data / research paper. (Mandatory)

Savitribai Phule Pune University
Final Year of Mechanical Engineering (2015 Course)

Course Code : 402044 C **Course Name : Elective – I**

Heating, Ventilation, Air Conditioning and Refrigeration Engineering

Teaching Scheme:		Credits		Examination Scheme:			
Theory	: 03 Hrs Per Week	TH	: 03	Theory	In-Sem : 30	PR	: --
Practical	: 02 hrs per week	TW	: 01		End-Sem : 70	OR	: --
						TW	: 25

Pre-requisites:	Thermodynamics I and II, Refrigeration and Air Conditioning

Course Objectives:

- To understand the recent vapour compression cycle
- To provide the knowledge of analyze thermal design of refrigeration system components
- To understand practical aspects of vapour compression system
- To provide the knowledge of basic concepts of ventilation, infiltration and space distribution techniques
- To inculcate techniques of estimating building envelop load.
- To understand the working non-conventional air-conditioning systems.

Course Outcomes:

On completion of the course, students will be able to -

- Determine the performance parameters of trans-critical & ejector refrigeration systems
- Estimate thermal performance of compressor, evaporator, condenser and cooling tower.
- Describe refrigerant piping design, capacity & safety controls and balancing of vapour compressor system.
- Explain importance of indoor and outdoor design conditions, IAQ, ventilation and air distribution system.
- Estimate heat transmission through building walls using CLTD and decrement factor &time lag methods with energy-efficient and cost-effective measures for building envelope.
- Explain working of types of desiccant, evaporative, thermal storage, radiant cooling, clean room and heat pump air-conditioning systems.

Course Contents

Unit 1: Advanced Vapour Compression Cycles **4 Hrs**

Review of vapour compression cycle, Trans-critical cycle and their types retical treatment) Ejector refrigeration cycle and their types. Presentation of cycle on P-h and T-s chart.

Unit 2: Thermal Design of Refrigeration System Components **8 Hrs**

Compressor : Characteristic curves of reciprocating & Centrifugal compressors, sizing of reciprocating compressor

Evaporator : Standards & Codes, Performance analysis of Dx evaporator,

Condenser: Standards & Codes, air-cooled condenser, shell & tube condenser and evaporative condenser.

Expansion Devices : Standards & Codes, Operating Characteristics, Liquid Charge in the Sensing Bulb , Hunting of Thermostatic Expansion Valve
Cooling Tower: Types & design of cooling towers, cooling tower thermal performance, tower efficiency.

Unit 3: Practical Aspects of Vapour Compression System — 6 Hrs

Refrigerant Piping : Copper Tubing, Piping Design for Reciprocating Refrigeration Systems, Size of Copper Tube, Refrigeration Load, and Pressure Drop, Sizing Procedure, Suction Line, Discharge Line (Hot-Gas Line), Liquid Line
Capacity Controls : Capacity Controls of reciprocating, centrifugal and scroll compressors
Safety Controls: Low-Pressure and High-Pressure Controls. Low-Temperature Control, Frost Control, Oil Pressure Failure Control. Motor Overload Control.
Vapour compression system balance: Performance characteristics of the condensing unit & compressor-capillary tube.

Unit 4: Ventilation and Infiltration — 6 Hrs

Indoor Design Criteria and Thermal Comfort : Basic parameters, factors affecting thermal comforts, Comfort-Discomfort Diagrams, Indoor Temperature, Relative Humidity, and Air Velocity
Indoor Air Quality : Indoor Air Contaminants, Basic Strategies to Improve Indoor Air Quality,
Outdoor Design Conditions : Outdoor Air Requirements for Occupants, The Use of Outdoor Weather Data in Design, Outdoor Weather Characteristics and Their Influence
Ventilation for cooling : Natural ventilation, mechanical ventilation
Space air distribution: Design of air distribution systems, Types of air distribution devices: Airflow patterns inside conditioned space: Stratified mixing flow: Cold air distribution: Displacement flow: *Spot cooling / heating*: Selection of supply air outlets.

Unit 5: Heat Load Estimation in Building Structures — 6 Hrs

Solar radiation, Heat gain through fenestrations, Space load characteristics, cooling load and coil load calculations, Overall heat transmission coefficient, air spaces, sol-air temperature, Decrement factor & time lag method,, Cooling load Temperature Difference method (CLTD) or Equivalent Temperature Differential (ETD), detailed calculation procedure using CLTD method, Total heat balance.
Energy-efficient and cost-effective measures for building envelope**,** Concept of ECBC

Unit 6: Advanced Air-conditioning Systems — 6 Hrs

Desiccant-Based Air Conditioning Systems : Introduction, Sorbents & Desiccants, Dehumidification, Liquid Spray Tower, Solid Packed Tower, Rotary Desiccant Dehumidifiers, Hybrid Cycles, Solid Desiccant Air-Conditioning (Theoretical treatment)
Evaporative-Cooling Air Conditioning Systems, Thermal Storage Air Conditioning Systems, Clean-Room Air Conditioning Systems, Radiant cooling. (Theoretical treatment)
Heat Pump Systems: Heat Pump Cycle, different heats pump Circuits.

Books

Text :

1. Arora R.C., Refrigeration and Air Conditioning, PHI, India
2. Dossat Ray J., Principal of Refrigeration, Pearson, India
3. Arora C P, Refrigeration and Air Conditioning, Tata McGraw Hill

4. Manohar Prasad, Refrigeration and Air-conditioning, Wiley Eastern Limited, 1983

References :

1. Threlkeld J.L., Thermal Environmental Engineering, Prentice Hall Inc. New Delhi
2. ASHRAE Handbook (HVAC Equipments)
3. Stocker W.F. and Jones J.W., Refrigeration and Air-conditioning, McGraw Hill International editions 1982.
4. Roger Legg, Air conditioning systems: Design, Commissioning and maintenance
5. Shan Wang, Handbook of Refrigeration and Air Conditioning, McGrawHill Publications
6. Wilbert Stocker, Industrial Refrigeration, McGrawHill Publications
7. Keith Harold, Absorption chillers and Heat Pumps, McGrawHill publications
8. ASHRAE, Air Conditioning System Design Manual, IInd edition, ASHRAE.

Term Work shall consist of following assignments:

1. Performance Simulation of Central Air-conditioning plant using Newton Raphson Method.
2. Performance analysis of Counter flow or cross flow cooling tower
3. Building heat load simulation using suitable software (Trace 700, Energy plus etc.)
4. Design of cold storage with process layout.

Savitribai Phule Pune University
Final Year of Mechanical Engineering (2015 Course)

Course Code : 402045 A | **Course Name : Elective – II Automobile Engineering**

Teaching Scheme:		**Credits**		**Examination Scheme:**					
Theory	**: 03 Hrs Per Week**	**TH**	**: 03**	**Theory**	**In-Sem**	**: 30**	**PR**	**: --**
Practical	**: --**	**TW**	**: --**		**End-Sem**	**: 70**	**OR**	**: --**
							TW	**: --**

Pre-requisites	**:** I. C. Engines, Theory of Machines, Basics of Electrical and Electronics

Course Objectives:

- To make the student conversant with fundamentals of automobile systems.
- To develop competencies in performance analysis of vehicles.
- To make the student conversant with automobile safety, electrical system and vehicle maintenance.
- To understand the emerging trends of electric vehicles, hybrid electric vehicles and solar vehicles. .

Course Outcomes:

On completion of the course, students will be able to -

- To compare and select the proper automotive system for the vehicle.
- To analyse the performance of the vehicle.
- To diagnose the faults of automobile vehicles.
- To apply the knowledge of EVs, HEVs and solar vehicles

Course Contents

Unit 1: Introduction and Drive Train **6 Hrs**

Introduction: Current scenario in Indian auto/ancillary industries, vehicle specifications and classification.

Chassis and Frames: Types of chassis layout with reference to power plant locations and drive, various types of frames, constructional details.

Drive Train: Types of transmission system, necessity and selection of clutch, necessity of gear box and different types, fluid flywheel, torque convertor, continuous variable transmission, , overdrive, propeller shaft, final drive and differential.

Unit 2: Axles, Wheels and Tyres, Steering System **6 Hrs**

Axles: Purpose, requirement and types of front and rear axle, loads acting on rear axles.

Wheels and tyres: Wheel construction, alloy wheel, wheel balancing, type of tyres, tyre construction, tyre materials, factors affecting tyre life.

Steering system : Steering mechanism, steering geometry, cornering force, slip angle, scrub radius, steering characteristics, steering linkages and gearbox, power steering, collapsible steering, reversibility of steering, four wheel steering, wheel alignment.

Unit 3: Suspension and Brake System **6 Hrs**

Suspension : Types of suspension linkages, types of suspension springs- leaf, coil, air springs, hydro gas, rubber suspension, interconnected suspension, self levelling suspension (active suspension), shock absorbers (hydraulic and air).

Brake systems: Drum, disc, mechanical, hydraulic, air brakes, vacuum, power assisted brakes, hand brake, ABS, EBD.

Unit 4: Vehicle Performance and Safety **6 Hrs**

Vehicle performance: Parameters, vehicle resistances, traction and tractive effort, power requirement for propulsion, road performance curves (numericals), stability of vehicles, vehicle testing on chassis dynamometer.

Vehicle safety: Types of active and passive safety, vehicle interior and ergonomics, NVH in automobiles.

Unit 5: Electrical System and Vehicle Maintenance **6 Hrs**

Batteries : Principles and construction of lead-acid battery, characteristics of battery, rating capacity and efficiency of batteries, various tests on battery condition, charging methods, introduction to lithium batteries.

Electrical system and accessories : Insulated and earth return systems, positive and negative earth systems, electrical fuel pump, speedometer, fuel, oil and temperature gauges, horn, wiper system, automotive sensors and actuators, electronic control unit/module.

Maintenance: Types of vehicle maintenance, servicing/overhauling of clutch, gear box, propeller shaft, differential, axles, steering system, suspension system, break system, electrical system.

Unit 6: Electric and Hybrid Electric Vehicles **6 Hrs**

Introduction: Concept and environmental importance of EVs, HEVs and solar vehicles.

Electric vehicles: Layout, construction and working.

Hybrid electric vehicles: Types, layout, hybridization factor, plug in hybrid electric vehicles, fuel efficiency analysis.

Challenges and future scope of EVs and HEVs.

Books

Text :

1. K. Newton and W. Seeds, T.K. Garrett, “Motor Vehicle”, 13thEdition, Elsevier publications.
2. Hans Hermann Braess, Ulrich Seiffen, “Handbook of Automotive Engineering”, SAE Publications.
3. William H. Crouse., “Automotive Mechanics”, Tata McGraw Hill Publishing House.
4. Joseph Heitner, “Automotive Mechanics”, C.B.S Publishers and Distributors.
5. SAE Manuals and Standards.
6. .N. K. Giri, Automobile Mechanics
7. P. S. Kohali, Automobile Electrical Equipment, Tata McGraw Hill Publishing House.
8. Narang G. B. S, “Automobile Engineering”, S. Chand and Company Ltd.

References :

1. Dr. Kirpal Singh, “Automobile Engineering”, Volume 1, Standard Publishers distributors.
2. Automobile Mechanics, “Crouse/Anglin”, TATA Mcgraw-Hill.
3. R. B. Gupta, Automobile Engineering, Satya Prakashan.

4. Chris Mi, M .Abul Masrur, Hybrid Electric Vehicles: Principles and Applications with Practical Perspectives, ,Willey.
5. Electric and Hybrid Vehicles, Tom Denton, Routledge.
6. Hybrid Electric Vehicle Technology, Automotive Research and Design, American Technical.
7. Husain, Iqbal, Electric and hybrid vehicles, 2 edition, CRC Press.
8. Ron Hodkinson and John Fenton, Butterworth-Heinemann.Lightweight Electric/ Hybrid Vehicle Design,
9. Ehsani, Yimin Gao, Ali Emadi, Modern Electric, Hybrid Electric, and Fuel Cell Vehicles, Standards media.

Savitribai Phule Pune University
Final Year of Mechanical Engineering (2015 Course)

Course Code : 402045 B **Course Name : Elective – II Operation Research**

Teaching Scheme:		**Credits**		**Examination Scheme:**		
Theory	**: 03 Hrs Per Week**	**TH**	**: 03**	**Theory**	**In-Sem : 30**	**PR : --**
Practical	**: --**	**TW**	**: --**		**End-Sem : 70**	**OR : --**
						TW : --

Pre-requisites	Mathematics I, II and III

Course Objectives:

- To familiarize the students with the use of practice oriented mathematical applications for optimization functions in an organization.
- To familiarize the students with various tools of optimization, probability, statistics and simulation, as applicable in particular scenarios in industry for better management of various resources.

Course Outcomes:

On completion of the course, students will be able to -

- Apply LPP and Decision Theory to solve the problems
- Apply the concept of transportation models to optimize available resources.
- Decide optimal strategies in conflicting situations.
- Implement the project management techniques.
- Minimize the process time
- Optimize multi stage decision making problems

Course Contents

Unit 1: Introduction: Operation Research **6 Hrs**

Introduction: Definition, Evolution and Classification of Quantitative Methods and Operations Research Techniques, Methodology, Advantages and Limitations. Linear Programming Problem: Introduction, Formulation of LPP, Solution of LPP by Two Phase Method only. Decision Theory: Meaning and Steps in Decision Making, Types of Management Decisions, Decision under Certainty, under Risk, under Uncertainty, Decision Trees

Unit 2: Transportation & Assignment Model **6 Hrs**

Introduction, Formulation, Basic Method of Solving Transportation Problem, Optimization Methods like UV and Stepping Stone Method, Assignment Problem- Hungarian Method to solve Assignment Problem.

Unit 3: Theory of Games and Linear Programming **6 Hrs**

Theory of Games : Introduction, Minimax and Maximin Principle, Solution of Game with Saddle Point, Solution by Dominance, Solution by Graphical Method, m x n size Game Problem, Iterative method, Introduction to formulation of games using Linear Programming.

Replacement Analysis: Replacement of Items that Deteriorate, Replacement of Items that Fail

Suddenly.

Unit 4: Project Management **6 Hrs**

Network Models: Fulkerson‘s rule, concept and types of floats, CPM and PERT, Crashing Analysis and Resource Scheduling. Simulation: Introduction, Monte-Carlo Simulation method, Simulation of Inventory and Queuing Problems.

Unit 5: Queuing Theory and Sequencing Models **6 Hrs**

Queuing Theory: Introduction, Basis Structure, Terminology (Kendal‘s Notations) and Applications. *Queuing Model M/M/1*: /FIFO, M/M/c.

Sequencing models : Solution of sequencing Problem - Processing of n jobs through two machines, Processing of n jobs through three machines, Processing of two jobs through m Machines, Processing of n jobs through m Machines

Unit 6: Integer and Dynamic Programming **6 Hrs**

Integer Programming Introduction to Integer Programming, Cutting plane method and Branch and Bound Method. Dynamic Programming: Introduction, DP Model, Applications of DP Model to shortest route problems. Solution of LPP by Dynamic Programming

Books

Text :

1. Prem Kumar Gupta, D. S. Hira, Problems in Operations Research: Principles and Solutions, S. Chand, 1991
2. J. K. Sharma, Operations Research: Theory and Application, Laxmi pub. India.
3. Operations Research, S. D. Sharma, Kedar Nath Ram Nath-Meerut.
4. L.C.Jhamb,Quantative Techniques Vol. I&II, Everest Publication.
5. Manohar Mahajan, Operation Research, Dhanpatrai Publication

References :

1. Hillier F.S., and Lieberman G.J., Operations Research, Eight Edition, Mc. Tata McGraw Hill, India
2. Ravindran, ―Engineering optimization Methods and Applications‖, 2nd edition, Wiley, India
3. Ravindran, Phillips and Solberg, Operations Research Principles and Practice, Second Edition, Mc. WSE Willey,
4. Operations Research - An introduction, Hamdy A Taha, Pearson Education.

Savitribai Phule Pune University
Final Year of Mechanical Engineering (2015 Course)

Course Code : 402045 C **Course Name : Elective – II**

Energy Audit and Management

Teaching Scheme:		**Credits**		**Examination Scheme:**		
Theory	**: 03 Hrs Per Week**	**TH**	**: 03**	**Theory**	**In-Sem : 30**	**PR : --**
Practical	**: --**	**TW**	**: --**		**End-Sem : 70**	**OR : --**
						TW : --

Pre-requisites:	Thermodynamics, Turbo Machines

Course Objectives:

Following concepts to be taught to the students,

- Importance of Energy Management.
- To Carry out Energy Audit.
- Methods to reduce consumption of energy and save cost.
- To improve energy efficiency of overall system.
- Significance of Waste heat recovery and Cogeneration.

Course Outcomes:

On completion of the course, students will be able to -

- Compare energy scenario of India and World.
- Carry out Energy Audit of the Residence / Institute/ Organization.
- Evaluate the project using financial techniques
- Identify and evaluate energy conservation opportunities in Thermal Utilities.
- Identify and evaluate energy conservation opportunities in Electrical Utilities.
- Identify the feasibility of Cogeneration and WHRUse a CFD tool effectively for practical problems and research.

Course Contents

Unit 1: General Aspects of Energy Management **6 Hrs**

Current energy scenario - India and World, Current energy consumption pattern in global and Indian industry, Concept of energy conservation and energy efficiency, Energy and environment, Need of Renewable energy, Principles of Energy management, Energy policy, Energy action planning, Energy security and reliability, Energy reforms.

Unit 2: Energy Audit **6 Hrs**

Need of Energy Audit, Types of energy audit, Components of energy audit, Energy audit methodology, Instruments used in energy audit, Analysis and recommendations of energy audit, Energy audit reporting, Energy audit software, Current Energy Conservation Act.

Unit 3: Energy Economics **6 Hrs**

Costing of Utilities- Determination of cost of steam, natural gas, compressed air and electricity, Financial Analysis Techniques (Numerical) - Simple payback, Time value of money, Net Present Value(NPV), Return on Investment (ROI), Internal Rate of Return (IRR), Risk and Sensitivity analysis.

Unit 4: Energy Efficiency in Thermal Utilities **6 Hrs**

Energy performance assessment (Numerical) and efficiency improvement of Boilers, Furnaces, Heat exchangers, Cooling tower, DG sets, Fans and blowers, Pumps, Compressors, Compressed air system and HVAC systems. Assessment of steam distribution losses, Steam leakages, Steam trapping, Condensate and flash steam recovery system.

Unit 5: Energy efficiency in Electrical Utilities **6 Hrs**

Electricity billing, Electrical load management and maximum demand control, penalties, Power factor improvement and benefits, Selection and location of capacitors. Distribution and transformer losses, Electrical motors- types, efficiency and selection, Speed control, Energy efficient motors, Introduction of Electricity Act 2003,Lamp types and their features, recommended illumination levels, Lighting system performance assessment and efficiency improvement (Numerical)

Unit 6: Cogeneration and Waste Heat Recovery **6 Hrs**

Cogeneration : Need, applications, advantages, classification, Introduction to Trigeneration, Waste heat recovery- Classification, Application, Concept of Pinch analysis, Potential of WHR in Industries, Commercial WHR devices, saving potential. CDM projects and carbon credit calculations.
Case study: Energy Audit of Institute/Department.

Books

References :

1. Handbook of Energy Audit, Albert Thumann P.E. CEM, William J. Younger CEM, The Fairmont Press Inc., 7th Edition.
2. Energy Management Handbook, Wayne C. Turner, The Fairmont Press Inc., 5th Edition, Georgia.
3. Handbook on Energy Audit and Environment management, Abbi Y. A., Jain Shashank, TERI, Press, New Delhi, 2006
4. Energy Performance assessment for equipment and Utility Systems.-Vol. 2,3.4 BEE Govt. of India
5. Boiler Operator‘s Guide Fourth Edition, Anthony L Kohan, McGraw Hill
6. Energy Hand book, Second edition, Von Nostrand Reinhold Company - Robert L. Loftness.
7. www.enrgymanagertraining.com
8. http://www.bee-india.nic.in

Savitribai Phule Pune University

Final Year of Mechanical Engineering (2015 Course)

Course Code : 402046 **Course Name : Project – I**

Teaching Scheme:		**Credits**		**Examination Scheme:**		
Theory	**: --**	**TH**	**: --**	**Theory**	**In-Sem : --**	**PR : --**
Practical	**: 04 hrs per week**	**TW**	**: 02**		**End-Sem : --**	**OR : 25**
						TW : 25

Course Objectives:

- To have ideology of the industrial project.
- Hands on working with tools, tackles and machines
- To carry out literature survey
- To do brain storming for mechanical engineering system

Course Outcomes:

On completion of the course, students will be able to -

- Find out the gap between existing mechanical systems and develop new creative new mechanical system.
- Learn about the literature review
- Get the experience to handle various tools, tackles and machines.

Course Contents

INSTRUCTIONS FOR PROJECT REPORT WRITING (Project Stage I)

It is important that the procedures listed below be carefully followed by all the students of B.E. (Mechanical Engineering).

1. Prepare ***Three Spiral Bound Copies*** of your manuscript.
2. Limit your Project Stage I to *25– 30* pages (preferably)
3. The *footer must include* the following:
   Institute Name, B.E. (Mechanical) Times New Roman 10 pt. and centrally aligned.
4. Page number as second line of footer, Times New Roman 10 pt. centrally aligned.
5. Print the manuscript using
   a) Letter quality computer printing.
   b) The main part of manuscript should be Times New Roman 12 pt. with alignment - justified.
   c) Use 1.5 line spacing.
   d) Entire report shall be of 5- 7 chapters
6. Use the paper size 8.5’’ × 11’’ or A4 (210 × 197 mm). Please follow the margins given below.

Margin Location	**Paper 8.5’’ × 11’’**	**Paper A4 (210 × 197 mm)**
Top	1’’	25.4 mm
Left	1.5’’	37 mm
Bottom	1.25’’	32 mm
Right	1’’	25.4 mm

7. All paragraphs will be *1.5 lines spaced with a one blank line between each paragraph*. Each paragraph will begin with *without any indentation*.
8. *Section titles* should be bold with *14 pt.* typed in all capital letters and should be left aligned.
9. *Sub-Section headings* should be aligning at the left with *12 pt.* bold and Title Case (the first letter of each word is to be capitalized).
10. Illustrations (charts, drawings, photographs, figures) are to be in the text. Use only illustrations really pertinent to the text. Illustrations must be sharp, clear, black and white. Illustrations downloaded from internet are not acceptable.
    a) Illustrations should not be more than two per page. One could be ideal
    b) Figure No. and Title at bottom with 12 pt.
    c) Table No. and Title at top with 12 pt.
    d) Legends below the title in 10 pt.
    e) Leave proper margin in all sides
    f) Illustrations as far as possible should not be photo copied.
11. Photographs if any should be of glossy prints
12. Please use SI system of units only.
13. Please number the pages on the front side, centrally below the footer
14. References should be either in order as they appear in the thesis or in alphabetical order by last name of first author
15. Symbols and notations if any should be included in nomenclature section only
16. Following will be the order of report
    i. Cover page and Front page (*as per the specimen on separate sheet*)
    ii. Certificate from the Institute (*as per the specimen on separate sheet*)
    iii. Acknowledgements
    iv. Contents
    v. List of Figures
    vi. List of Tables
    vii. Nomenclature
    viii. Abstract (A brief abstract of the report not more than 150 words. The heading of abstract i.e. word "Abstract" should be bold, Times New Roman, 12 pt. and should be typed at the center. The contents of abstract should be typed on new line without space between heading and contents. Try to include one or two sentences each on motive, method, key-results and conclusions in Abstract
    1. Introduction (2-3 pages) (TNR – 14 Bold)
        1.1 Problem statement (TNR – 12)
        1.2 Objectives
        1.3 Scope
        1.4 Methodology
        1.5 Organization of Dissertation
    2. Literature Review (12-16 pages)
    Discuss the work done so far by researchers in the domain area and their significant conclusions. No derivations, figures, tables, graphs are expected.
    3. This chapter shall be based on your own simulation work (Analytical/ Numerical/FEM/CFD) (8 - 12 pages)
    4. Experimental Validation - This chapter shall be based on your own experimental work

(2 - 3 pages)

5. Concluding Remarks and Scope for the Future Work (1 - 2 pages)

(IF above Chapters 3, 4, 5 not completed please mention the plan for the same and time period for completion and detail activity chart).

References ANNEXURE (if any) (Put all mathematical derivations, Simulation program as Annexure)

17. All section headings and subheadings should be numbered. For sections use numbers 1, 2, 3, …. and for subheadings 1.1, 1.2, …. etc and section subheadings 2.1.1, 2.1.2, …. etc.
18. References should be given in the body of the text and well spread. No verbatim copy or excessive text from only one or two references. If figures and tables are taken from any reference then indicate source / citatation of it. Please follow the following procedure for references

Reference Books :

Collier, G. J. and Thome, J. R., Convective boiling and condensation, 3rd ed., Oxford University Press, UK, 1996, pp. 110 – 112.

Papers from Journal or Transactions :

Jung, D. S. and Radermacher, R., Transport properties and surface tension of pure and mixed refrigerants, *ASHRAE Trans*, 1991, 97 (1), pp. 90 – 98.

Bansal, P. K., Rupasinghe, A. S. and Jain, A. S., An empirical correction for sizing capillary tubes, *Int. Journal of Refrigeration*, 1996, 19 (8), pp.497 – 505.

Papers from Conference Proceedings :

Colbourne, D. and Ritter, T. J., *Quantitative assessment of flammable refrigerants in room air conditioners*, Proc. of the Sixteenth International Compressor Engineering Conference and Ninth International Refrigeration and Air Conditioning Conference, Purdue University, West Lafayette, Indiana, USA, 2002, pp. 34 – 40.

Reports, Handbooks etc. :

United Nations Environmental Programme, Report of the Refrigeration, Air Conditioning and Heat Pumps, Technical Option Committee, 2002, Assessment - 2002.

ASHRAE Handbook: Refrigeration, 1994 (Chapter 44)

Patent :

Patent no, Country (in parenthesis), date of application, title, year.

Internet :

www.(Site) [Give full length URL] *accessed on date*

A Project Stage-I Report on
(TNR, 16pt, centrally aligned)

Title of the Project Report

(TNR, 27pt, Bold, Centrally Aligned, Title Case)

By
(TNR, 16pt, Centrally Aligned)

Mr. Student's 1 Name
(TNR, 16pt, Centrally Aligned)

Mr. Student's 2 Name
(TNR, 16pt, Centrally Aligned)

Mr. Student's 3 Name
(TNR, 16pt, Centrally Aligned)

Mr. Student's 4 Name
(TNR, 16pt, Centrally Aligned)

Guide
Guide's Name
(TNR, 16pt, Centrally Aligned)

Institute Logo

Department of Mechanical Engineering
Name of the Institute
[2018-19]
(TNR, 22pt, Title Case Centrally Aligned)

Name of the Institute

Institute Logo

C E R T I F I C A T E

This is to certify that ***Mr. (Name of the Student)***, has successfully completed the Project Stage – I entitled "(***Title of the Project)*** " under my supervision, in the partial fulfillment of Bachelor of Engineering - Mechanical Engineering of University of Pune.

Date:

Place:

Guide's Name
Guide

Internal Examiner

HoD Name
Head of the Department

Principal Name
Principal

Seal

Savitribai Phule Pune University
Final Year of Mechanical Engineering (2015 Course)

Course Code : 402047 **Course Name : Energy Engineering**

Teaching Scheme:		Credits		Examination Scheme:			
Theory	: 03 Hrs Per Week	TH	: 03	Theory	In-Sem : 30	PR	: --
Practical	: 02 hrs per week	TW	: 01		End-Sem : 70	OR	: 25
						TW	: 25

Pre-requisites:	Thermodynamics I and II and Heat Transfer

Course Objectives:

- To study the power generation scenario, the components of thermal power plant, improved Rankin cycle, Cogeneration cycle
- To understand details of steam condensing plant, analysis of condenser, the an environmental impacts of thermal power plant, method to reduce various pollution from thermal power plant
- To study layout, component details of hydroelectric power plant, hydrology and elements , types of nuclear power plant
- To understand components; layout of diesel power plant , components; different cycles ; methods to improve thermal efficiency of gas power plant
- To study the working principle , construction of power generation from non-conventional sources of energy
- To learn the different instrumentation in power plant and basics of economics of power generation.

Course Outcomes:

On completion of the course, students will be able to -

- Describe the power generation scenario, the layout components of thermal power plant and analyze the improved Rankin cycle, Cogeneration cycle
- Analyze the steam condensers, recognize the an environmental impacts of thermal power plant and method to control the same
- Recognize the layout, component details of hydroelectric power plant and nuclear power plant
- Realize the details of diesel power plant, gas power plant and analyze gas turbine power cycle
- Emphasize the fundaments of non-conventional power plants
- Describe the different power plant electrical instruments and basic principles of economics of power generation.

Course Contents

Unit 1: Introduction and Thermal Power Plant **6 Hrs**

A) *Power Generation* : global scenario, present status of power generation in India, in Maharashtra, Role of private and governmental organizations, load shedding, carbon credits, pitfalls in power reforms, concept of cascade efficiency.

B) *Thermal Power Plant* : General layout of modern thermal power plant with different circuits, site selection criteria, classification of coal, coal blending, coal beneficiation, selection of coal for thermal power plant, slurry type fuels, pulverized fuel handling systems, fuel burning methods, FBC systems, high pressure boilers, ash handling system, Rankine cycle with reheat and regeneration (Numerical Treatment), steam power plants with process heating (Numerical Treatment)

Unit 2: Steam Condenser and Environmental Impacts of Thermal Power Plant 6 Hrs

A) *Steam Condenser* : Necessity of steam condenser, elements of steam condensing plant, classification, cooling water requirements, condenser efficiency, vacuum efficiency (Numerical Treatment), cooling towers, air leakage and its effects on condenser performance, air pumps (Numerical Treatment for Air Pump capacity)

B) *Environmental impact of thermal power plants* : Different pollutants from thermal power plants, their effects on human health and vegetation, methods to control pollutants such as particulate matter; oxides of sulphur; oxides of nitrogen, dust handling systems, ESP, scrubbers, water pollution, thermal pollution, noise pollution from TPP and its control

Unit 3: Hydroelectric and Nuclear Power Plant 6 Hrs

A) *Hydroelectric Power Plant* : site selection, classification of HEPP (based on head, nature of load, water quantity), criteria for turbine selection, dams, spillways, surge tank and forebay, advantages and disadvantages of HEPP, hydrograph ,flow duration curve ,mass curve, (Numerical Treatment) environmental impacts of HEPP

B) *Nuclear Power Plants* : elements of NPP, types of nuclear reactor (PWR, BWR, CANDU, GCR, LMCR, OMCR, fast breeder, fusion), material for nuclear fuel, cladding, coolants, control rod and shielding, nuclear waste disposal, environmental impacts of NPP

Unit 4: Diesel and Gas Turbine Power plant 6 Hrs

A) *Diesel Power Plants* : applications, components of DPP, different systems of DPP, plant layout, performance of DPP (Numerical Treatment) advantages & disadvantages of diesel power plant, environmental impacts of DPP

B) *Gas Turbine Power Plant* : general layout of GTPP, components of GTPP, open, closed & semi-closed cycle gas turbine plant, Brayton cycle analysis for thermal efficiency, work ratio, maximum & optimum pressure ratio, methods to improve thermal efficiency of GTPP: inter-cooling; reheating & regeneration cycle (numerical treatment), gas and steam turbine combined cycle plant, environmental impacts of GTPP

Unit 5: Non-Conventional Power Plants 6 Hrs

*Solar Power Plant based on***:** flat plate collector, solar ponds, parabolic solar collector, heliostat, solar chimney, SPV cell based plants: working principal, solar photovoltaic systems, applications
*Geothermal Plant***:** superheated steam system, flash type, binary cycle plant.
*Tidal Power Plant***:** components, single basin, double basin systems.
*OTEC Plant***:** principal of working, Claude cycle, Anderson Cycle.
MHD Power Generation : Principal of working, Open Cycle MHD generator, closed cycle MHD generators.
Fuel cell : alkaline, acidic, proton-exchange membrane
Wind Power Plant : wind availability, wind mills and subsystems, classification of wind turbines, operating characteristics, wind solar hybrid power plants, challenges in commercialization of non-conventional power plants, environmental impacts of NCPP

Unit 6: Instrumentation and Economics of Power Plant **6 Hrs**

A) *Power Plant Instruments* : layout of electrical equipment, generator, exciter, generator cooling, short circuits & limiting methods, switch gear, circuit breaker, power transformers, methods of earthling, protective devices & control system used in power plants, measurement of high voltage, current and power, control room

B) *Economics of Power Generation* : cost of electric energy, fixed and operating cost [methods to determine depreciation cost] (Numerical Treatment), selection and type of generation, selection of generation equipment , load curves, performance and operation characteristics of power plants, load division, all terms related to fluctuating load plant (Numerical Treatment)

Books

Text :

1. Domkundwar & Arora, Power Plant Engineering, Dhanpat Rai & Sons, New Delhi
2. Domkundwar & Domkundwar- Solar Energy and Non-Conventional Sources of Energy, Dhanpat Rai& Sons, New Delhi.
3. R.K.Rajput, Power Plant Engineering‖, Laxmi Publications New Delhi.
4. D.K.Chavan & G.K.Phatak, Power Plant Engineering‖, Standard Book House, New Delhi.

References :

1. E.I.Wakil, Power Plant Engineering‖, McGraw Hill Publications New Delhi
2. P.K.Nag, Power Plant Engineering‖, McGraw Hill Publications New Delhi.
3. R.Yadav , Steam and Gas Turbines‖ ,Central Publishing House, Allahabad.
4. G.D.Rai, Non-Conventional Energy Sources, Khanna Publishers,Delhi
5. S.P.Sukhatme, Solar Energy‖ Tata McGraw-Hill Publications, New Delhi
6. G R Nagpal Power Plant Engineering , Khanna Publication

Term Work shall consist of following assignments:

IMP Notes for Term Work:

- Any Eight Experiment should be conducted (*from Experiment No. 1 to 10*) and
- *Experiment No 1, 2, 7,* and *8* are compulsory
- *Experiment No: 3 - 9* can be performed using suitable simulation software

1. Visit to Thermal Power plant /Co-generation Power plant.
2. Visit to HEPP/GTPP/Non-Conventional Power Plants.
3. Study of Fluidized Bed Combustion system.
4. Study of High Pressure Boilers
5. Study of Steam Turbine Systems –governing systems, protective devices, lubricating systems, glands and sealing systems.
6. Study of Co-generation Plants
7. Trial on Steam Power Plant or with help of suitable software to determine
    a) Plant Efficiency, Rankine Efficiency Vs Load
    b) Specific Steam consumption Vs Load
    c) Rate of Energy Input Vs Load
    d) Heat Rate and Incremental heat Rate Vs Load
8. Trial on Diesel Power Plant or with help of suitable software to determine
    a) Plant Efficiency Vs Load

b) Total fuel consumption Vs Load
c) Rate of Energy Input Vs Load
d) Heat Rate and Incremental heat Rate Vs Load

9. Study of Power Plant Instruments.
10. Study of Different Tariff Methods

Savitribai Phule Pune University
Final Year of Mechanical Engineering (2015 Course)

Course Code : 402048 **Course Name : Mechanical System Design**

Teaching Scheme:		Credits		Examination Scheme:			
Theory	: 04 Hrs Per Week	TH	: 04	Theory	In-Sem : 30	PR	: --
Practical	: 02 hrs per week	TW	: 01		End-Sem : 70	OR	: 25
						TW	: 50

Pre-requisites:	Engineering Mechanics, Manufacturing Process, Strength of Materials, Machine design, Engineering Mathematics, Theory of Machines, Dynamics of Machinery, and IC Engines.

Course Objectives:

- To develop competency for system visualization and design.
- To enable student to design cylinders and pressure vessels and to use IS code.
- To enable student select materials and to design internal engine components.
- To introduce student to optimum design and use optimization methods to design mechanical components.
- To enable student to design machine tool gearbox.
- To enable student to design material handling systems.
- Ability to apply the statistical considerations in design and analyze the defects and failure modes in components

Course Outcomes:

On completion of the course, students will be able to -

- Understand the difference between component level design and system level design.
- Design various mechanical systems like pressure vessels, machine tool gear boxes, material handling systems, etc. for the specifications stated/formulated.
- Learn optimum design principles and apply it to mechanical components.
- Handle system level projects from concept to product.

Course Contents

Unit 1: Design of Machine Tool Gear Box **8 Hrs**

Introduction to machine tool gearboxes, design and its applications, basic considerations in design of drives, determination of variable speed range, graphical representation of speed and structure diagram, ray diagram, selection of optimum ray diagram, gearing diagram, deviation diagram.
(Note: Full design problem to be restricted up to 2 Stages only)

Unit 2: Statistical Consideration in Design **8 Hrs**

Frequency distribution-Histogram and frequency polygon, normal distribution - units of central tendency and dispersion- standard deviation - population combinations - design for natural tolerances - design for assembly - statistical analysis of tolerances, mechanical reliability and factor of safety.

Unit 3: Design of Belt Conveyor System for Material Handling **8 Hrs**

System concept, basic principles, objectives of material handling system, unit load and

containerization.
Belt conveyors, Flat belt and troughed belt conveyors, capacity of conveyor, rubber covered and fabric ply belts, belt tensions, conveyor pulleys, belt idlers, tension take-up systems, power requirement of horizontal belt conveyors for frictional resistance of idler and pulleys.

Unit 4: Design of Cylinders and Pressure Vessels **8 Hrs**

Design of Cylinders: Thin and thick cylinders, Lame's equation, Clavarino's and Bernie's equations, design of hydraulic and pneumatic cylinders, auto-frettage and compound cylinders,(No Derivation) gasketed joints in cylindrical vessels (No derivation).

Design of Pressure vessel : Modes of failures in pressure vessels, unfired pressure vessels, classification of pressure vessels as per I. 2825 - categories and types of welded joints, weld joint efficiency, stresses induced in pressure vessels, materials for pressure vessel, thickness of cylindrical shells and design of end closures as per code, nozzles and openings in pressure vessels, reinforcement of openings in shell and end closures - area compensation method, types of vessel supports (theoretical treatment only).

Unit 5: Design of I.C. Engine Components **8 Hrs**

Introduction to selection of material for I. C. engine components, Design of cylinder and cylinder head, construction of cylinder liners, design of piston and piston-pins, piston rings, design of connecting rod. Design of crank-shaft and crank-pin, (Theoretical treatment only).

Unit 6: Optimum Design **8 Hrs**

Objectives of optimum design, adequate and optimum design, Johnson's Method of optimum design, primary design equations, subsidiary design equations and limit equations, optimum design with normal specifications of simple machine elements- tension bar, transmission shaft and helical spring, Pressure vessel Introduction to redundant specifications (Theoretical treatment).

Books

Text :

1. Bhandari V.B. ―Design of Machine Elements‖, Tata McGraw Hill Pub. Co. Ltd.
2. Juvinal R.C, Fundamentals of Machine Components Design, Wiley, India

References :

1. Design Data- P.S.G. College of Technology, Coimbatore.
2. Bhandari, V. B. Machine Design data book, Tata McGraw Hill Publication Co. Ltd.
3. I.S. 2825: Code for unfired pressure vessels.
4. Shigley J. E. and Mischke C.R., ―Mechanical Engineering Design‖, McGraw Hill Pub. Co
5. M. F. Spotts, –Mechanical Design Analysis‖, Prentice Hall Inc.
6. Black P.H. and O. Eugene Adams, –Machine Design‖ McGraw Hill Book Co. Inc.
7. Johnson R.C., ―Mechanical Design Synthesis with Optimization Applications‖, Von Nostrand Reynold Pub.
8. S.K. Basu and D. K. Pal, –Design of Machine Tools, Oxford and IBH Pub Co.
9. Rudenko,‖Material Handling Equipment‖, M.I.R. publishers, Moscow
10. P. Kannaiah ,‖Design of Transmission systems‖, SCIETCH Publications Pvt Ltd.
11. Pandy, N. C. and Shah, C. S., Elements of Machine Design, Charotar Publishing House.
12. Mulani, I. G., ―Belt Conveyors‖
13. Singiresu S. Rao, Engineering Optimization: Theory and Practice, John Wiley & Sons.

14. M.V. Joshi, Process Equipment Design, Mc-Millan.

Term Work shall consist of following assignments:

1. One Design Project:

The design project shall consist of two imperial size sheets (Preferably drawn with 3D/2D CAD software) - one involving assembly drawing with a part list and overall dimensions and the other sheet involving drawings of individual components, manufacturing tolerances, surface finish symbols and geometric tolerances must be specified so as to make it working drawing. A design report giving all necessary calculations of the design of components and assembly should be submitted. Projects shall be in the form of design of mechanical systems including pressure vessel, conveyor system, multi speed gear box, I.C engine, etc.

Each Student shall complete any one of the following assignments.

1. Design of Flywheel.
2. Design for Manufacture, Assembly and safe.
3. Application of Composite Material for different mechanical components.
4. Case study of one patent/ copyright/trademark from the product design point of view.
5. Design of Human Powered system.

Savitribai Phule Pune University
Final Year of Mechanical Engineering (2015 Course)

Course Code : 402049 A **Course Name : Elective – III Tribology**

Teaching Scheme:		Credits		Examination Scheme:			
Theory	: 03 Hrs Per Week	TH	: 03	Theory	In-Sem : 30	PR	: --
Practical	: 02 hrs per week	TW	: 01		End-Sem : 70	OR	: --
						TW	: 25

Pre-requisites	: Physics, Chemistry, Mathematics, Fluid Mechanics, Theory of Machine and Machine Design

Course Objectives:

- To provide the knowledge and importance of Tribology in Design, friction, wear and lubrication aspects of machine components.
- To select proper grade lubricant for specific application.
- To understand the principles of lubrication, lubrication regimes, theories of hydrodynamic and the advanced lubrication techniques.
- To introduce the concept of surface engineering and its importance in tribology.
- To understand the behavior of Tribological components.

Course Outcomes:

On completion of the course, students will be able to -

- The course will enable the students to know the importance of Tribology in Industry.
- The course will enable the students to know the basic concepts of Friction, Wear, Lubrications and their measurements.
- This course will help students to know the performance of different types of bearings and analytical analysis thereof.
- This course will help students to apply the principles of surface engineering for different applications of tribology.

Course Contents

Unit 1: Introduction to Tribology **6 Hrs**

Importance of Tribology in Design, Tribology in Industry, Economic Considerations, Lubrication-Definition, Lubricant properties, Viscosity, its measurements- Numerical, basic modes of lubrication, types of lubricants, Standard Grades of lubricants, selection of lubricants, commonly used lubricants and Hazards, Recycling of used oil, Disposal of used oil, bearing materials, bearing construction, oil seals and gaskets.

Unit 2: Friction and Wear **5 Hrs**

Introduction, Laws of friction, kinds of friction, causes of friction, area of contact, friction measurement, theories of friction.

Types of wear, various factors affecting wear, measurement of wear, wear between solids and flowing liquids, theories of wear

Unit 3: Hydrodynamic Lubrication **7 Hrs**

Theory of hydrodynamic lubrication, mechanism of pressure development in an oil film. Two dimensional Reynolds equation, Petroff's equation, pressure distribution in journal bearings - long & short, Load Carrying capacity, Somerfield number and its importance- Numerical. Introduction to Hydrodynamic Thrust Bearing

Unit 4: Hydrostatic Lubrication **5 Hrs**

Introduction to hydrostatic lubrication, hydrostatic step bearing, load carrying capacity and oil flow through the hydrostatic step bearing- Numerical.

Hydrostatic squeeze film : basic concept, circular and rectangular plate approaching a plane- Numerical

Unit 5: Elasto-hydrodynamic lubrication and Gas Lubrication **5 Hrs**

Elasto - hydrodynamic lubrication: Basic concept, Elasto-hydrodynamic lubrication between two contacting bodies, different regimes in EHL contacts.

Gas lubrication: Introduction, merits and demerits, applications, externally pressurized gas bearings, porous gas bearings, and Dynamic characteristics of gas lubricated bearing.

Unit 6: Surface Engineering **8 Hrs**

Concept and scope of Surface engineering, surface topography, apparent and real area of contact, tribological behavior of asperities contact- contact stress, surface roughness and hydrodynamic action- Numerical, surface coating-plating, fusion process, vapor phase processes, selection of coating for wear and corrosion resistance. Behavior of tribological components- selection of bearings, plain bearings, gears, wire ropes, seals and packings, conveyor belts, other tribological measures.

Books

Text :

1. Basu S.K., Sengupta S. N. and Ahuja B.B. "Fundamentals of Tribology" PHI Learning, Ltd. India.
2. Majumdar B. C. "Introduction to Tribology and Bearings", S. Chand and Company Ltd., New Delhi.

References :

1. Bharat Bhushan, "Principles and Applications of Tribology", John Wiley and Sons.
2. Sahu P., "Engineering Tribology", PHI Learning, Ltd. India
3. Fuller D.D. "Theory and Practice of Lubrication for Engineers". John Wiley and Sons.
4. Neale M. J. "Tribology hand Book", Butterworths. London.
5. Orlov P., "Fundamentals of Machine Design", Vol. IV, MIR Publication.
6. Cameron A. "Basic Lubrication Theory", Wiley Eastern Ltd.
7. 'Hailing J., "Principles of Tribology", McMillan Press Ltd., 1975.
8. Ghosh M.K., Mujumdar B.C. and Sarangi M., "Theory of lubrication", Tata McGraw Hill Education Pvt. Ltd., New Delhi.

Term Work shall consist of following assignments:

A] *Any one case study of the following*

1. Friction in sliding/ rolling contact bearing.
2. Wear of cutting tool.
3. Surface Coating.
4. Sliding/ rolling contact bearing Performance

B] Assignment based on the Tribological design of the system like I C Engine, Machine Tool, Rolling Mill.

OR

Industrial Visit: Students should visit the industry to study the lubrication systems or to study the techniques of surface coating.

Savitribai Phule Pune University
Final Year of Mechanical Engineering (2015 Course)

Course Code : 402049 B **Course Name : Elective – III Industrial Engineering**

Teaching Scheme:		**Credits**		**Examination Scheme:**			
Theory	**: 03 Hrs Per Week**	**TH**	**: 03**	**Theory**	**In-Sem : 30**	**PR**	**: --**
Practical	**: 02 hrs per week**	**TW**	**: 01**		**End-Sem : 70**	**OR**	**: --**
						TW	**: 25**

Pre-requisites:	NIL

Course Objectives:

- To introduce the concepts, principles and framework of contents of Industrial Engineering.
- To acquaint the students with various productivity enhancement techniques.
- To acquaint the students with different aspects of Production Planning and Control and Facility Design.
- To introduce the concepts of various cost accounting and financial management practices as applied in industries.
- To acquaint the students with different aspects of Human Resource activities and Industrial Safety rules.
- To acquaint students with different aspect of simulation modeling for various industrial engineering\applications.

Course Outcomes:

On completion of the course, students will be able to -

- Apply the Industrial Engineering concept
- Understand, analyze and implement different concepts involved in method study.
- Design and Develop different aspects of work system and facilities.
- Understand and Apply Industrial safety standards, financial management practices.
- Undertake project work based on modeling & simulation area.

Course Contents

Unit 1: Introduction to Industrial Engineering and Productivity **6 Hrs**

Definition and Role of Industrial Engineering, Types of production systems and organization structure, Functions of management.

*<u>Measurement of productivity</u>***:** Factors affecting the productivity, Productivity Models and Index (Numerical), Productivity improvement techniques.

<u>Note</u>: *Productivity improvement techniques viz. 5S, Kaizen, TPS, KANBAN, JIT, etc. shall be discussed at the end of this* Unit.

Unit 2: Method Study **6 Hrs**

Work Study: Definition, objective and scope of work-study, Human factors in work-study.
Method Study: Definition, objective and scope of method study, work content, activity recording and exam aids.
Charts to record movements: Operation process charts, flow process charts, travel chart, two-handed chart and multiple activity charts. Principles of motion economy, classification of movements, SIMO chart, and micro motion study.
Definition and installation of the improved method, brief concept about synthetic motion studies.
Introduction to Value Engineering and Value Analysis.

Unit 3: Work Measurements **6 Hrs**

Work Measurements: Definition, objectives and uses, Work measurement techniques.
Work Sampling: Need, confidence levels, sample size determinations, random observation, conducting study with the simple problems.
Time Study: Definition, time study equipment, selection of job, steps in time study. Breaking jobs into elements, recording information, Rating and standard rating, standard performance, scales of rating, factors affecting rate of working, allowances and standard time determination.
Introduction to PMTS and MTM: (Numerical), Introduction to MOST.

Unit 4: Production Planning and Control **6 Hrs**

Introduction: Types of production systems, Need and functions of PPC, Aggregate production planning.
Capacity Planning, ERP: Modules, Master Production Schedule, MRP and MRP-II.
Forecasting Techniques: Causal and time series models, moving average, exponential smoothing, trend and seasonality (Numerical), Demand Control strategies (MTO, MTA, MTS).
Introduction to Supply Chain Management: Basic terminologies.

Unit 5: Facility Design **6 Hrs**

Plant Location : Need and factors influencing plant location,
Plant Layout: Objectives, principles, types of plant layouts, Introduction to Assembly Line Balancing and Layout parameters to evaluate.
Material Handling: Objectives, relation with plant layout, principles. Types and purpose of different material handling equipment, Selection of material handling equipment.
Inventory control and Management: Types of inventories, Need of inventories, terminology, costs, Inventory Models: Basic production models, (with and without shortage and discount), ABC, VED Analysis.

Unit 6: Engineering Economy, Human Resource and Industrial Safety **6 Hrs**

Introduction to Costing: Elements of Cost, Break-Even Analysis (Numerical).
Introduction to Debit and Credit Note, Financial Statements (Profit and loss account and Balance Sheet), Techniques for Evaluation of capital investments.
Human Resource Development: Functions: Manpower Planning, Recruitment, Selection, Training. Concept of KRA (Key Result Areas), Performance Appraisal (Self, Superior, Peer, 3600).
Industrial Safety: Safety Organization, Safety Program

Books

Text :

1. M Mahajan, Industrial Engineering and Production Management, Dhanpat Rai and Co.
2. O. P. Khanna, Industrial engineering and management, Dhanpat Rai publication
3. Martend Telsang, Industrial Engineering, S. Chand Publication.
4. Banga and Sharma, Industrial Organization& Engineering Economics, Khanna publication.

References :

1. Introduction to Work Study by ILO, ISBN 978-81-204-1718-2, Oxford & IBHPublishing Company, New Delhi, Second Indian Adaptation, 2008.
2. H. B. Maynard, K Jell, Maynard's Industrial Engineering Hand Book, McGraw Hill Education.
3. Askin, Design and Analysis of Lean Production System, Wiley, India
4. Zandin K.B., Most Work Measurement Systems, ISBN 0824709535, CRCPress,2002
5. Martin Murry, SAP ERP: Functionality and Technical Configuration, SAP Press; 3rdNew edition (2010).
6. Barnes, Motion and time Study design and Measurement of Work, Wiley India
7. Raid Al-Aomar, Adwerd J Williams, Onur M. Uigen 'Process Simulation using WITNESS', Wiley

Term Work shall consist of following assignments:

- Minimum of *8 Experiments* are compulsory from the following list of Experiments.
- Assignment number *1*, *2*, *3*, *8* and *12* are compulsory.
- It is advisable that, students shall collect data by visiting suitable industry to complete following assignments (*Per batch of Max. 20 students*)
- For completing above assignments *any suitable simulation software* like WITNESS can be used

1. Case study based Assignment on Method Study.
2. Hands on Assignment on application of Work Measurement technique(s).
3. Assignment on simulation of Routing & Scheduling Model
4. Assignment on **s**imulation of Manufacturing System **/** Service System Operations for demand forecasting of the given product using any two methods.
5. Assignment on simulation determination of EOQ and plot the graphs.
6. Assignment on analysis of Manufacturing / Service Operation for Capacity Planning.
7. Case study based assignment on supply chain model.
8. Assignment on analysis of (selected) plant layout modeling and simulation for bottleneck / line balancing.
9. Assignment on analysis of material handling system - modeling simulation for the selected plant layout.
10. Case study based assignment on identification of Key Result Areas for performance appraisal for selected company (3600 feedback).
11. Case study based assignment on cost-revenue model analysis.
12. Assignment on industrial safety audit of selected work environment.

Savitribai Phule Pune University
Final Year of Mechanical Engineering (2015 Course)

Course Code : 402049 C **Course Name : Elective – III Robotics**

Teaching Scheme:		**Credits**		**Examination Scheme:**		
Theory	**: 03 Hrs Per Week**	**TH**	**: 03**	**Theory**	**In-Sem : 30**	**PR : --**
Practical	**: 02 hrs per week**	**TW**	**: 01**		**End-Sem : 70**	**OR : --**
						TW : 25

Pre-requisites:	Engineering Mechanics, TOM, Mechatronics, Basics of Electrical and Electronics Engineering, Control system.

Course Objectives:
- To get acquainted with basic components of robotic systems.
- To study various gripper mechanisms and sensors and understand role of suitable control system.
- To understand statistics & kinematics of robots
- To develop competency in obtaining desired motion of the robot.
- To study various programming methods in robotics.
- To understand need of modern techniques in robotics.

Course Outcomes:

On completion of the course, students will be able to -
- Identify different type of robot configuration with relevant terminology.
- Select suitable sensors, actuators and drives for robotic systems.
- Understand kinematics in robotic systems.
- Design robot with desired motion with suitable trajectory planning.
- Select appropriate robot programming for given application.
- Understand need of IoT, machine learning, simulation in robotics.

Course Contents

Unit 1: **6 Hrs**

*Introduction***:** Basic Concepts, laws of Robotics, Robot anatomy, Classification, structure of robots, point to point and continuous path robotic systems. Robot performance- resolution, accuracy, repeatability, dexterity, compliance, RCC device, Applications.

Robot Grippers: Types of Grippers, Design of gripper, Force analysis for various basic gripper systems including Mechanical, Hydraulic and Pneumatic systems.

Unit 2: **6 Hrs**

*Robotic Sensors***:** Characteristics of sensing devices, Classification, Selection and applications of sensors. Types of Sensors, Need for sensors and vision system in the working and control of a robot. GPS, IMU, Vision, PVDF Tactile (construction, working and selection)

Drives and Control Systems : Types and selection of Drives, Actuators and transmission systems, Types of Controllers, closed loop control, second order linear systems and their control, control law of partitioning, trajectory-following control, modeling and control of a single joint, force control.

Unit 3: **6 Hrs**

Kinematics : Transformation matrices and their arithmetic, link and joint description, Denavit–Hartenberg parameters, frame assignment to links, direct kinematics, kinematics redundancy, kinematics calibration, inverse kinematics of two joints, solvability, algebraic and geometrical methods.

*Velocities and Static Forces in Manipulators***:** Motion of the manipulator links, Jacobians, singularities, static forces, Jacobian in force domain.

Unit 4: **6 Hrs**

Introduction to Dynamics, Trajectory generations, Motion planning and control: Joint and Cartesian space trajectory planning and generation, potential field method for motion planning Manipulator Mechanism Design, Force control and hybrid position/force control

Unit 5: **6 Hrs**

Machine Vision System: Vision System Devices, Image acquisition, Masking, Sampling and quantization, Image Processing Techniques, Masking, Sampling and quantization, Noise reduction methods, Edge detection, Segmentation.

Robot Programming : Methods of robot programming, lead through programming, motion interpolation, branching capabilities, WAIT, SIGNAL and DELAY commands, subroutines, Programming Languages: Robot language structure, Introduction to various types such as RAIL and VAL II

Unit 6: **6 Hrs**

*Artificial Intelligence***:** Introduction, Need and Application, Problem solving through forward and backward search.

Introduction to Internet of Things (Industrial control, Smart Social Network), Industry 4.0, Machine learning

Simulation : Need of simulation, tools, types and techniques of simulation

Books

Text :

1. S. R. Deb, Robotics Technology and Flexible Automation, Tata McGraw Hill.

References :

1. Groover M.P.-Automation, production systems and computer integrated manufacturing‘ - Prentice Hall of India
2. S B Niku, Introduction to Robotics, Analysis, Control, Applications, 2nd Edition, Wiley Publication, 2015.
3. John Craig, Introduction to Robotics, Mechanics and Control, 3rd Edition, Pearson Education, 2009
4. Mathia, Robotics for Electronics Manufacturing, Cambridge Uni. Press, India
5. A Ghosal, Robotics: Fundamental Concepts and Analysis, Oxford University Press, 2013.
6. R K Mittal & I J Nagrath, Robotics and Control, McGraw Hill Publication, 2015.

7. K Astrom & T Hagglund, PID Controllers: Theory, Design and Tuning, 2nd Edition, The Instrumentation, Systems, and Automation Society, 1995.
8. Asfahl, Robots and Manufacturing Automation, Wiley, India, 2012
9. S. K. Saha, Introduction to Robotics, TMH International
10. Ganesh Hegde, Industrial Robotics, Laxmi publication
11. www.roboanalyzer.com

Term Work shall consist of following assignments:

The term work shall consist of detailed report on ***any five*** *of the following practical, essentially with one demonstration, one gripper design and an industrial visit.*

1. Simulation of Cartesian / Cylindrical/Spherical robot.
2. Simulation of Articulated / SCARA robot.
3. Virtual modeling for kinematic and dynamic verification any one robotic structure using suitable software.
4. Design, modeling and analysis of two different types of gripper.
5. Program for linear and non-linear path.
6. Report on industrial application of robot /Industrial visit.

Savitribai Phule Pune University
Final Year of Mechanical Engineering (2015 Course)

Course Code : 402050 A | **Course Name : Elective – IV Advanced Manufacturing Processes**

Teaching Scheme:		**Credits**		**Examination Scheme:**			
Theory	**: 03 Hrs Per Week**	**TH**	**: 03**	**Theory**	**In-Sem : 30**	**PR**	**: --**
Practical	**: --**	**TW**	**: --**		**End-Sem : 70**	**OR**	**: --**
						TW	**: --**

Pre-requisites:	Basic Engineering Science - Physics, Chemistry, Material Science, Engineering Metallurgy, Manufacturing processes

Course Objectives:

- To analyze and identify applications of special forming processes
- To analyze and identify applications of advanced joining processes
- To understand and analyze the basic mechanisms of hybrid non-conventional machining techniques
- To understand various applications and methods of micro and nano fabrication techniques
- To understand advanced Additive Manufacturing (AM) technology for innovations in product development
- To understand various material characterization techniques.

Course Outcomes:

On completion of the course, students will be able to -

- Classify and analyze special forming processes
- Analyze and identify applicability of advanced joining processes
- Understand and analyze the basic mechanisms of hybrid non-conventional machining techniques
- Select appropriate micro and nano fabrication techniques for engineering applications
- Understand and apply various additive manufacturing technology for product development
- Understand material characterization techniques to analyze effects of chemical composition, composition variation, crystal structure, etc.

Course Contents

Unit 1: Special Forming Processes **6 Hrs**

Principle, Machines, Process variables, characteristics, advantages, limitations and application of High Energy Rate Forming process (HERF), High Velocity Forming (HVF), Explosive forming, Magnetic pulse forming, Electro hydraulic forming, Metal spinning, Flow forming, Stretch forming, Incremental sheet metal forming, Petro-forge forming, Micro forming, Micro coining, Micro extrusion, Micro bending/laser bending, fine blanking.

Unit 2: Advanced Joining Processes **6 Hrs**

Friction stir welding, Electron Beam welding, Laser beam welding, Ultrasonic welding, Under water welding, Cryogenic welding, Thermal spray coatings, Welding of plastics and composites, Explosive joining, Adhesive bonding

Unit 3: Hybrid Non-conventional Machining Techniques **6 Hrs**

Introduction to hybrid processes, Abrasive flow finishing, Magnetic abrasive finishing, Abrasive water-jet machining, Wire electric discharge machining, Electrochemical grinding (ECG), Electrochemical Deburring (ECD), Shaped tube electrolytic machining (STEM), Electro-jet Machining (EJM), Electrolytic In-process dressing (ELPD), Ultrasonic assisted EDM, Rotary EDM, Electrochemical discharge Machining (ECDM), Laser surface treatments.

Unit 4: Micro Machining and Nano Fabrication Techniques **6 Hrs**

Introduction, need of micro and nano machining, Machine/setup, Process parameters, Mechanism of material removal, Applications, Advances of the Diamond Turn machining, Ultrasonic micro-machining, Focused Ion Beam Machining, Lithography, photochemical machining, Challenges in micro and nano fabrication techniques.

Unit 5: Additive Manufacturing Processes **6 Hrs**

Introduction and principle of the additive manufacturing process; Generalized additive manufacturing process chain; Classification of additive manufacturing processes and its principle, process steps and materials;

Post-processing of parts manufactured by Additive Manufacturing (AM) processes, Software issues in AM, Design For Additive Manufacturing (DFAM), Applications of Additive Manufacturing in Medical and Aerospace technologies

Unit 6: Material Characterization Techniques **6 Hrs**

Introduction : Material Characterization

Microscopy : Electron Microscopes, Scanning Electron Microscope (SEM), Transmission Electron Microscope (TEM), Scanning Tunneling Microscope (STM), Atomic Force Microscope (AFM), Field Ion Microscope (FIM);

Spectroscopy : Energy-dispersive X-ray spectroscopy (EDX), X-Ray Diffraction (XRD), X-Ray Photoelectron Spectroscopy (XPS), Nuclear Magnetic Resonance Spectroscopy (NMR), Electron Backscatter Diffraction (EBSD)

Books

Text :

1. V. K. Jain, "Advanced Machining Processes", Allied Publishers Pvt. Ltd.
2. M. P Groover., Fundamentals of Modern Manufacturing: Materials, Processes, and Systems, 6^{th} Edition, Wiley 2015
3. A. Ghosh, A. K. Mallik, Manufacturing Science, Affiliated East-West Press Pvt. Ltd., New Delhi

References :

1. ASM: Metal Handbook, Volume 6, "Welding, Brazing and Soldering", Metal Park, Ohio.
2. ASM: Metal Handbook, Volume 14, "Forming", Metal Park, Ohio.
3. R. Balasubramaniam, RamaGopal V. Sarepaka, SathyanSubbiah, Diamond Turn Machining: Theory and Practice, CRC Press, ISBN 9781138748323 - CAT# K32643
4. V. K. Jain, Micro manufacturing Processes, CRC Press ISBN-13: 978-1138076426 ISBN-

10: 1138076422

5. Ian Gibson, David Rosen, B.Stucker, Additive Manufacturing Technologies: 3D Printing, Rapid Prototyping, And Direct Digital Manufacturing, New York, NY : Springer, 2015.
6. Sam Zhang, Lin Li, Ashok Kumar, Materials characterization techniques. Boca Raton: CRC Press. ISBN 1420042947
7. Douglas B. Murphy, Fundamentals of light microscopy and electronic imaging, 2001, Wiley-Liss, Inc. USA
8. Schwartz, A. J., Kumar, M., Adams, B. L., and Field, D. P., eds., 2009, Electron Backscatter Diffraction in Materials Science, Springer US.

Savitribai Phule Pune University
Final Year of Mechanical Engineering (2015 Course)

Course Code : 402050 B | **Course Name : Elective – IV Solar and Wind Energy**

Teaching Scheme:		**Credits**		**Examination Scheme:**			
Theory	**: 03 Hrs Per Week**	**TH**	**: 03**	**Theory**	**In-Sem : 30**	**PR**	**: --**
Practical	**: --**	**TW**	**: --**		**End-Sem : 70**	**OR**	**: --**
						TW	**: --**

Pre-requisites	**:** Basic Mechanical Engineering, Basic Electrical and Electronics Engineering and Heat Transfer

Course Objectives:

- To understand fundamentals of solar and wind energies.
- To understand constructions, working principle and design procedure of solar and wind power plants.
- To apply basic engineering principle to design a simple solar and wind power system.

Course Outcomes:

On completion of the course, students will be able to -

- Design of solar food drier for domestic purpose referring existing system
- Design of parabolic dish solar cooker for domestic purpose referring existing system
- Design of solar photovoltaic system for domestic purpose referring existing system
- Design miniature wind mill for domestic purpose referring existing system

Course Contents

Unit 1: Solar Energy Principles **6 Hrs**

Present solar energy scenario, world energy futures, governing bodies (self-study), solar radiations and its measurements, solar constant, solar radiation geometry, solar radiation data, estimation of average solar radiation, solar radiation on tilted surface.

Unit 2: Solar Thermal Systems and Applications **8 Hrs**

Types of Solar thermal collector, flat plate collector analysis, Evacuated tube collectors (ETC) analysis, its design and application, solar air heaters and its types, solar distillation.

Solar Concentrating collectors: types- line and point concentrator, theory of Concentrating collectors, parabolic trough collector, parabolic dish collector, solar tower, concentrated Fresnel linear receiver (CFLR).

Unit 3: Solar Photovoltaic and Applications **6 Hrs**

Forming the PN junction solar cells & its applications, Structure of a solar cell, types of modules, PV array, solar cell equation, Fill factor and maximum power, Grid aspects of solar power, equipment used in solar photovoltaic plants, Power Conditioning Equipment-inverters, Regulators, Other Devices; System Analysis-Design Procedure, Design Constraints, Other Considerations.

Unit 4: Case Study on Solar Energy Applications **6 Hrs**

Case study 1: Design of solar food drier for domestic purpose referring existing system
Case study 2: Design of parabolic dish solar cooker for domestic purpose referring existing system
Case study 3: Design of solar photovoltaic system for domestic purpose referring existing system

Unit 5: Wind Energy **8 Hrs**

Principle of wind energy conversion; Basic components of wind energy conversion systems; various types and their constructional features; design considerations of horizontal and vertical axis wind machines: analysis of aerodynamic forces acting on wind mill blades and estimation of power output; wind data and site selection considerations, wind energy potential and installation in India.

Unit 6: Case Study on Wind Mill Design **2 Hrs**

Case study on designing miniature wind mill for domestic purpose referring existing system.

Books

Text :

1. G. D. Rai, 'Non-Conventional Energy Sources', Khanna Publisher
2. S. P. Sukhatme, 'Solar Energy: Principles of thermal collections and storage', McGraw Hill
3. Tiwari G N. 'Solar Energy: Fundamentals, design, modeling and Applications', Narosa, 2002

References :

1. Mukund R. Patel, 'Wind And Solar Power Systems: Design, Analysis and Operation, Second Edition', CRC Press
2. Kreith And Kreider, Solar Energy Handbook, McGraw Hill
3. Ray Hunter, 'Wind Energy Conversion: From Theory to Practice', John Wiley and Son Ltd
4. Gary L Johnson, 'Wind Energy Systems', Prentice-Hall Inc., New Jersey
5. Martin O L Hansen, 'Aerodynamics of Wind Turbines', James & James/Earthscan.
6. Goswami D Y, Kreith F, Kreider J F, 'Principles of Solar Engineering', Taylor & Francis
7. Robert Gasch, 'Wind Power Plant Fundamentals, Design, Construction And Operations', Springer
8. C S Solanki, 'Solar Photovoltaic: Fundamentals, Technology And Applications', PHI Learning

Savitribai Phule Pune University
Final Year of Mechanical Engineering (2015 Course)

Course Code : 402050 C | **Course Name : Elective – IV Product Design and Development**

Teaching Scheme:		Credits		Examination Scheme:			
Theory	: 03 Hrs Per Week	TH	: 03	Theory	In-Sem : 30	PR	: --
Practical	: --	TW	: --		End-Sem : 70	OR	: --
						TW	: --

Pre-requisites	: Basic Engineering Science - Physics, Chemistry, Material Science, Engineering Metallurgy, Manufacturing processes

Course Objectives:

To explain student's significance of

- Product design and Product development process
- Customer needs, satisfaction and commercialization of product
- Forward & Reverse Engineering and its role in designing a product
- Design Aspects (DFA, DFMEA, Design for Reliability and Safety)
- Product Life Cycle Management and Product Data Management

Course Outcomes:

On completion of the course, students will be able to -

- Understand essential factors for product design
- Design product as per customer needs and satisfaction
- Understand Processes and concepts during product development
- Understand methods and processes of Forward and Reverse engineering
- Carry various design processes as DFA, DFMEA, design for safety
- Understand the product life cycle and product data management

Course Contents

Unit 1: Introduction to Product Design and Development **6 Hrs**

Definition of product design, Essential Factors for product design, Modern approaches to product design, standardization, simplification and specialization in product design product development, product development versus product design, modern product development process, product testing and validation.

Unit 2: Product Development –Technical and Business Concerns **6 Hrs**

Mission Statement and Technical Questioning, Technology Forecasting and S Curve, Customer Needs and Satisfaction, Customer Needs - Types and Models, tools for Gathering Customer Needs, Customer Population and Market Segmentation.

Unit 3: Product Development from Concept to Product Function **6 Hrs**

Product information gathering, brainstorming and lateral thinking, morphological analysis of product, generating concepts, concept selection - design evaluation, estimation of technical feasibility, concept selection process, Pugh's concept, selection charts, concept scoring, process of concept embodiment, system modeling, functional modeling and decomposition, fast method, subtract and operate procedure, Simulation driven design.

Unit 4: Reverse Engineering **6 Hrs**

Product Teardown Process, Tear Down Methods, Force Flow Diagrams, Measurement and Experimentation, Applications of Product Teardown, Benchmarking Approach and Detailed Procedure, Tools Used in Benchmarking Indented Assembly Cost Analysis, Function -Form Diagrams, Trend Analysis, Setting Product Specifications, Introduction to Product Portfolio and Architecture.

Unit 5: Design for X **6 Hrs**

Design for manufacture, Design for assembly, Design for robustness, Design for safety, Design for reliability, Design for environment, Design for piece part production, manufacturing cost analysis. Local, Regional and Global issues, basic life cycle assessment - basic method, weighed sum assessment method (Numerical), Design Failure mode effect analysis.

Unit 6: Product Life Cycle Management and Product Data Management **6 Hrs**

Introduction, Concept of Product Life Cycle management, Components/Elements of PLM, Customer Involvement, Product Data and Product Workflow, The Link Between Product Data and Product Workflow, Different Phases of Product Life Cycle and corresponding technology.

Books

Text :

1. K. Chitale; R.C. Gupta, Product Design and Manufacturing, Prentice Hall India.
2. Dieter George E., Engineering Design McGraw Hill Pub. Company, 2000.

References :

1. Kevin Otto and Kristin Wood, Product Design: Techniques in Reverse Engineering and New Product Development, Pearson Education Inc.
2. Grieves, Michael, Product Lifecycle Management McGraw Hill
3. Bralla, James G., Handbook of Product Design for Manufacturing, McGraw Hill Pub.
4. Karl Ulrich, product design and development, TMH.

Savitribai Phule Pune University
Final Year of Mechanical Engineering (2015 Course)

Course Code : 402051 **Course Name : Project – II**

Teaching Scheme:		Credits		Examination Scheme:					
Theory	: --	TH	: --	Theory	In-Sem	: --	PR	: --
Practical	: 12 hrs per week	TW	: 06		End-Sem	: --	OR	: 100
							TW	: 100

Course Contents

INSTRUCTIONS FOR PROJECT REPORT WRITING

It is important that the procedures listed below be carefully followed by all the students of B.E. (Mechanical Engineering).

1. Prepare ***Three Hard Bound Copies*** of your manuscript.
2. Limit your Dissertation report to *80– 120* pages (preferably)
3. The *footer must include* the following:
   Institute Name, B.E. (Mechanical) Times New Roman 10 pt. and centrally aligned.
4. Page number as second line of footer, Times New Roman 10 pt. centrally aligned.
5. Print the manuscript using
   a) Letter quality computer printing.
   b) The main part of manuscript should be Times New Roman 12 pt. with alignment - justified.
   c) Use 1.5 line spacing.
   d) Entire report shall be of 5- 7 chapters
6. Use the paper size 8.5’’ × 11’’ or A4 (210 × 197 mm). Please follow the margins given below.

Margin Location	Paper 8.5’’ × 11’’	Paper A4 (210 × 197 mm)
Top	1’’	25.4 mm
Left	1.5’’	37 mm
Bottom	1.25’’	32 mm
Right	1’’	25.4mm

7. All paragraphs will be 1.5 lines spaced with a one blank line between each paragraph. Each paragraph will begin with without any indentation.
8. Section titles should be bold with 14 pt. typed in all capital letters and should be left aligned.
9. Sub-Section headings should be aligning at the left with 12 pt. bold and Title Case (the first letter of each word is to be capitalized).
10. Illustrations (charts, drawings, photographs, figures) are to be in the text. Use only illustrations really pertinent to the text. Illustrations must be sharp, clear, black and white. Illustrations downloaded from internet are not acceptable.
    a) Illustrations should not be more than two per page. One could be ideal
    b) Figure No. and Title at bottom with 12 pt.
    c) Table No. and Title at top with 12 pt.
    d) Legends below the title in 10 pt.
    e) Leave proper margin in all sides

f) Illustrations as far as possible should not be photo copied.

11. Photographs if any should be of glossy prints
12. Please use SI system of units only.
13. Please number the pages on the front side, centrally below the footer
14. References should be either in order as they appear in the thesis or in alphabetical order by last name of first author
15. Symbols and notations if any should be included in nomenclature section only
16. Following will be the order of report
    i. Cover page and Front page (*as per the specimen on separate sheet*)
    ii. Certificate from the Institute (*as per the specimen on separate sheet*)
    iii. Acknowledgements
    iv. Contents
    v. List of Figures
    vi. List of Tables
    vii. Nomenclature
    viii. Abstract (A brief abstract of the report not more than 150 words. The heading of abstract i.e. word “Abstract” should be bold, Times New Roman, 12 pt and should be typed at the center. The contents of abstract should be typed on new line without space between heading and contents. Try to include one or two sentences each on motive, method, key-results and conclusions in Abstract

    1. Introduction (2-3 pages) (TNR – 14 Bold)
        1.1 Problem statement (TNR – 12)
        1.2 Objectives
        1.3 Scope
        1.4 Methodology
        1.5 Organization of Dissertation

    2. Literature Review (20-30 pages)
    Discuss the work done so far by researchers in the domain area and their significant conclusions. No derivations, figures, tables, graphs are expected.

    3. This chapter shall be based on your own simulation work (Analytical/ Numerical/FEM/CFD) (15- 20 pages)

    4. Experimental Validation - This chapter shall be based on your own experimental work (15-20 pages)

    5. Concluding Remarks and Scope for the Future Work (2-3 pages)
    References ANNEXURE (if any) (Put all mathematical derivations, Simulation program as Annexure)

17. All section headings and subheadings should be numbered. For sections use numbers 1, 2, 3, … and for subheadings 1.1, 1.2, …. etc and section subheadings 2.1.1, 2.1.2, …. etc.
18. References should be given in the body of the text and well spread. No verbatim copy or excessive text from only one or two references. If figures and tables are taken from any reference then indicate source / citation of it. Please follow the following procedure for references

    Reference Books :

    Collier, G. J. and Thome, J. R., Convective boiling and condensation, 3rd ed., Oxford

University Press, UK, 1996, pp. 110 – 112.

Papers from Journal or Transactions :
Jung, D. S. and Radermacher, R., Transport properties and surface tension of pure and mixed refrigerants, *ASHRAE Trans*, 1991, 97 (1), pp. 90 – 98.
Bansal, P. K., Rupasinghe, A. S. and Jain, A. S., An empirical correction for sizing capillary tubes, *Int. Journal of Refrigeration*, 1996, 19 (8), pp.497 – 505.

Papers from Conference Proceedings :
Colbourne, D. and Ritter, T. J., *Quantitative assessment of flammable refrigerants in room air conditioners*, Proc. of the Sixteenth International Compressor Engineering Conference and Ninth International Refrigeration and Air Conditioning Conference, Purdue University, West Lafayette, Indiana, USA, 2002, pp. 34 – 40.

Reports, Handbooks etc. :
United Nations Environmental Programme, Report of the Refrigeration, Air Conditioning and Heat Pumps, Technical Option Committee, 2002, Assessment - 2002.
ASHRAE Handbook: Refrigeration, 1994 (Chapter 44)

Patent :
Patent no, Country (in parenthesis), date of application, title, year.

Internet :
www.(Site) [Give full length URL] *accessed on date*

A Project Report on
(TNR, 16pt, centrally aligned)

Title of the Project Report

(TNR, 27pt, Bold, Centrally Aligned, Title Case)

By
(TNR, 16pt, Centrally Aligned)

Mr. Student's 1 Name
(TNR, 16pt, Centrally Aligned)

Mr. Student's 2 Name
(TNR, 16pt, Centrally Aligned)

Mr. Student's 3 Name
(TNR, 16pt, Centrally Aligned)

Mr. Student's 4 Name
(TNR, 16pt, Centrally Aligned)

Guide
Guide's Name
(TNR, 16pt, Centrally Aligned)

Institute Logo

Department of Mechanical Engineering
Name of the Institute
[2018-19]
(TNR, 22pt, Title Case Centrally Aligned)

Name of the Institute

Institute Logo

C E R T I F I C A T E

This is to certify that ***Mr. (Name of the Student)***, has successfully completed the Project Stage – I entitled "(***Title of the Project)***" under my supervision, in the partial fulfillment of Bachelor of Engineering - Mechanical Engineering of University of Pune.

Date:

Place:

Guide's Name
Guide

Internal Examiner

HoD Name
Head of the Department

Principal Name
Principal

External Examiner

Seal

Savitribai Phule Pune University
Faculty of Science & Technology

Curriculum/Syllabus
for
Second Year
Bachelor of Engineering
(Choice Based Credit System)
Mechanical Engineering and Automobile Engineering
(2019 Course)

Board of Studies - Automobile and Mechanical Engineering
(With Effect from Academic Year 2020-21)

Savitribai Phule Pune University

Board of Studies - Automobile and Mechanical Engineering

Undergraduate Program - Automobile Engineering & Mechanical Engineering (2019 pattern)

Course Code	Course Name	Teaching Scheme (Hours/ Week)			Examination Scheme and Marks						Credit			
		TH	**PR**	**TUT**	**ISE**	**ESE**	**TW**	**PR**	**OR**	**TOTAL**	**TH**	**PR**	**TUT**	**TOTAL**
Semester-III														
202041	Solid Mechanics	4	2	-	30	70	-	50	-	150	4	1	-	5
202042	Solid Modeling and Drafting	3	2	-	30	70	-	50	-	150	3	1	-	4
202043	Engineering Thermodynamics	3	2	-	30	70	-	-	25	125	3	1	-	4
202044	Engineering Materials and Metallurgy	3	2	-	30	70	25	-	-	125	3	1	-	4
203156	Electrical and Electronics Engineering	3	2	-	30	70	25	-	-	125	3	1	-	4
202045	Geometric Dimensioning and Tolerancing Lab	-	2	-	-	-	25	-	-	25	-	1	-	1
202046	Audit Course - III	-	-	-	-	-	-	-	-	-	-	-	-	-
	Total	**16**	**12**	**-**	**150**	**350**	**75**	**100**	**25**	**700**	**16**	**6**	**-**	**22**
Semester-IV														
207002	Engineering Mathematics - III	3	-	1	30	70	25	-	-	125	3	-	1	4
202047	Kinematics of Machinery	3	2	-	30	70	-	-	25	125	3	1	-	4
202048	Applied Thermodynamics	3	2	-	30	70	-	-	25	125	3	1	-	4
202049	Fluid Mechanics	3	2	-	30	70	-	-	25	125	3	1	-	4
202050	Manufacturing Processes	3	-	-	30	70	-	-	-	100	3	-	-	3
202051	Machine Shop	-	2	-	-	-	50	-	-	50	-	1	-	1
202052	Project Based Learning - II	-	4	-	-	-	50	-	-	50	-	2		2
202053	Audit Course - IV	-	-	-	-	-	-	-	-	-	-	-	-	-
	Total	**15**	**12**	**1**	**150**	**350**	**125**	**-**	**75**	**700**	**15**	**6**	**1**	**22**

Abbreviations: TH: Theory, **PR**: Practical, **TUT**: Tutorial, **ISE**: In-Semester Exam, **ESE**: End-Semester Exam,**TW**: Term Work, OR: Oral

Note: Interested students of SE (Automobile Engineering and Mechanical Engineering) can opt for any one of the audit course from the list of audit courses prescribed by BoS (Automobile and Mechanical Engineering)

Instructions

- Practical/Tutorial must be conducted in three batches per division only.
- Minimum number of required Experiments/Assignments in PR/ Tutorial shall be carried out as mentioned in the syllabi of respective subjects.
- Assessment of tutorial work has to be carried out as a term-work examination. Term-work Examination at second year of engineering course shall be internal continuous assessment only.
- Project based learning (PBL) requires continuous mentoring by faculty throughout the semester for successful completion of the tasks selected by the students per batch. While assigning the teaching workload of 2 Hrs/week/batch needs to be considered for the faculty involved. The Batch needs to be divided into sub-groups of 5 to 6 students. Assignments / activities / models/ projects etc. under project based learning is carried throughout semester and Credit for PBL has to be awarded on the basis of internal continuous assessment and evaluation at the end of semester.
- Audit course is mandatory but non-credit course. Examination has to be conducted at the end of Semesters for award of grade at institute level. Grade awarded for audit course shall not be calculated for grade point & CGPA.

202041 - Solid Mechanics

Teaching Scheme	Credits	Examination Scheme
Theory : 04 Hr./Week Practical : 02 Hr./Week	**05** Theory : 04 Practical : 01	In-Semester : 30 Marks End-Semester : 70 Marks Practical : 50 Marks

Prerequisite Courses

Engineering Mathematics- I and II, Systems in Mechanical Engineering, Engineering Mechanics

Course Objectives

1. To acquire basic knowledge of stress, strain due to various types of loading.
2. To draw Shear Force and Bending Moment Diagram for transverse loading.
3. To determine Bending, Shear stress, Slope and Deflection on Beam.
4. To solve problems of Torsional shear stress for shaft and Buckling for the column.
5. To apply the concept of Principal Stresses and Theories of Failure.
6. To utilize the concepts of Solid Mechanics on application based combined mode of loading.

Course Outcomes

On completion of the course, learner will be able to

CO1. DEFINE various types of stresses and strain developed on determinate and indeterminate members.

CO2. DRAW Shear force and bending moment diagram for various types of transverse loading and support.

CO3. COMPUTE the slope & deflection, bending stresses and shear stresses on a beam.

CO4. CALCULATE torsional shear stress in shaft and buckling on the column.

CO5. APPLY the concept of principal stresses and theories of failure to determine stresses on a 2-D element.

CO6. UTILIZE the concepts of SFD & BMD, torsion and principal stresses to solve combined loading application based problems.

Course Contents

Unit I — Simple stresses & strains — [10 Hr.]

Simple Stress & Strain: Introduction to types of loads (Static, Dynamic & Impact Loading) and various types of stresses with applications, Hooke's law, Poisson's ratio, Modulus of Elasticity, Modulus of Rigidity, Bulk Modulus. Interrelation between elastic constants, Stress-strain diagram for ductile and brittle materials, factor of safety, Stresses and strains in determinate and indeterminate beam, homogeneous and composite bars under concentrated loads and self-weight, Thermal stresses in plain and composite members

Unit II — Shear Force & Bending Moment Diagrams — [08 Hr.]

SFD & BMD: Introduction to SFD, BMD with application, SFD & BMD for statically determinate beam due to concentrated load, uniformly distributed load, uniformly varying load, couple and combined loading, Relationship between rate of loading, shear force and bending moment, Concept of zero shear force, Maximum bending moment, point of contra-flexure

Unit III — Stresses, Slope & Deflection on Beams — [12 Hr.]

Bending Stress on a Beam: Introduction to bending stress on a beam with application, Theory of Simple bending, assumptions in pure bending, derivation of flexural formula, Moment of inertia of common cross section (Circular, Hollow circular, Rectangular, I & T), Bending stress distribution along the same cross-section

Shear Stress on a Beam: Introduction to transverse shear stress on a beam with application, shear stress distribution diagram along the Circular, Hollow circular, Rectangular, I & T cross-section

Slope & Deflection on a Beam: Introduction to slope & deflection on a beam with application, slope, deflection and Radius of Curvature, Macaulay's Method, Slope and Deflection for all standard beams

Unit IV	Torsion, Buckling	[08 Hr.]

Torsion of circular shafts: Introduction to torsion on a shaft with application, Basic torsion formulae and assumption in torsion theory, Torsion in stepped and composite shafts, Torque transmission on strength and rigidity basis, Torsional Resilience

Torsion on Thin-Walled Tubes: Introduction of Torsion on Thin-Walled Tubes Shaft and its application

Buckling of columns: Introduction to buckling of column with its application, Different column conditions and critical, safe load determination by Euler's theory. Limitations of Euler's Theory

Unit V	Principal Stresses, Theories of Failure	[08 Hr.]

Principal Stresses: Introduction to principal stresses with application, Transformation of Plane Stress, Principal Stresses and planes (Analytical method and Mohr's Circle), Stresses due to combined Normal and Shear stresses

Theories of Elastic failure: Introduction to theories of failure with application, Maximum principal stress theory, Maximum shear stress theory, Maximum distortion energy theory, Maximum principal strain theory, Maximum strain energy theory

Unit VI	Application based combined loading & stresses	[08 Hr.]

(Based on load and stress condition studied in Unit I to Unit V)

Introduction to the Combined Loading and various stresses with application, Free Body Diagram and condition of Equilibrium for determining internal reaction forces, couples for 2-D system, Combined stresses at any cross-section or at any particular point for Industrial and Real life example for the following cases: Combined problem of Normal type of Stresses (Tensile, Compressive and Bending stress), Combined problem of Shear type of stresses (Direct and Torsional Shear stresses), Combined problem of Normal and Shear type of Stresses

Books & Other Resources

Text Books

1. R. K. Bansal, "Strength of Materials", Laxmi Publication
2. S. Ramamurtham, "Strength of material", Dhanpat Rai Publication
3. S.S. Rattan, "Strength of Material", Tata McGraw Hill Publication Co. Ltd.
4. B.K. Sarkar, "Strength of Material", McGraw Hill New Delhi
5. Singer and Pytel, "Strength of materials", Harper and row Publication
6. R. C. Hibbeler, "Mechanics of Materials", Prentice Hall Publication

Reference Books

1. Egor. P. Popov, "Introduction to Mechanics of Solids",Prentice Hall Publication
2. G. H. Ryder, "Strength of Materials", Macmillan Publication
3. Beer and Johnston, "Strength of materials", CBS Publication
4. James M. Gere, "Mechanics of Materials", CL Engineering
5. Timoshenko and Young, "Strength of Materials", CBS Publication, Singapore
6. Prof. S.K. Bhattacharyya, IIT Kharagpur , "NPTEL Web course material" https://drive.google.com/file/d/1N2Eyv9ofPimIT2OSMZeMrSxe68Ulclei/view?usp=sharing

Guidelines for Laboratory Conduction

The student shall complete the following activity as a Term Work

The Termwork shall consist of completion of Practicals, Self-learning Study Assignments and Presentations. Practical examination shall be based on the Termwork undertaken during the semester.

Practical *(Any 6 experiments out of experiment no 1 to 8 from the following list whereas experiment no. 9 and 10 are mandatory. Minimum One experiment must be performed on IoT platform- Virtual Lab)*:

1. Tension test for Ductile material using extensometer on Universal Testing Machine.
2. Compression test for Brittle material on Universal Testing Machine.
3. Shear test of ductile material on Universal Testing Machine.
4. Tension test of Plastic/Composite material on low load capacity Tensile Testing Machine.
5. Measurement of stresses and strains using strain gauges.

6. Experimental verification of flexural formula in bending for cantilever, Simple supported beam.
7. Study and interpretations of stress distribution pattern using Polariscope for Plastic/Acrylic.
8. Experimental verification of torsion formula for circular bar.
9. Verification of results of any two from experiments no 1-8 using any FEA software tools.
10. **Self-learning study practical**: *Following topics are distributed among the group of 3-5 Students and groups need to present and also submit the slides/poster on TW file*.
    a. Experimental stress analysis, Strain Gauges rosette with case study.
    b. Residual stresses and Fatigue life with case study.
    c. Effect of heat treatment on the mechanical properties of a metal with case study.
    d. Mechanical properties of materials, Stresses and Design of components with case study.
    e. Failure Mode Analysis and Stresses with case study.

202042 - Solid Modeling and Drafting

Teaching Scheme	Credits	Examination Scheme
Theory : 03 Hr./Week Practical : 02 Hr./Week	**04** Theory : 03 Practical : 01	In-Semester : 30 Marks End-Semester : 70 Marks Practical : 50 Marks

Prerequisite Courses

Systems in Mechanical Engineering, Engineering Graphics, Engineering Mathematics - I and II

Course Objectives

1. To understand basic structure of CAD systems and their use to create geometric models of simple engineering parts
2. To introduce the curves and surfaces and their implement in geometric modeling
3. To apply basic concepts of 3D modeling, viewing and evaluate mass properties of components and assemblies
4. To apply geometrical transformations in CAD models
5. To understand data exchange standards and translators for various applications
6. To create engineering drawings, design documentation and use in manufacturing activities

Course Outcomes

On completion of the course, learner will be able to

CO1. UNDERSTAND basic concepts of CAD system, need and scope in Product Lifecycle Management

CO2. UTILIZE knowledge of curves and surfacing features and methods to create complex solid geometry

CO3. CONSTRUCT solid models, assemblies using various modeling techniques & PERFORM mass property analysis, including creating and using a coordinate system

CO4. APPLY geometric transformations to simple 2D geometries

CO5. USE CAD model data for various CAD based engineering applications viz. production drawings, 3D printing, FEA, CFD, MBD, CAE, CAM, etc.

CO6. USE PMI & MBD approach for communication

Course Contents

Unit I — Fundamentals of 3D Modeling — [08 Hr.]

Introduction, Product Life Cycle, CAD tools in the design process of Product Cycle, Scope of CAD, Software Modules - Operating System (OS) module, Geometric module, application module, programming module, communication module, Computer Aided Design - Features, requirements and applications

3D Modeling approach - Primitive, Features and Sketching, Types of Geometric models - 2½ extrusions, axisymmetric, composite, 3D objects, difference between wireframe, surface & solid modeling, Modeling strategies

Model viewing: VRML web-based viewing

Unit II — Curves & Surfaces — [08 Hr.]

Curves: Methods of defining Point, Line and Circle, Curve representation - Cartesian and Parametric space, Analytical and Synthetic curves, Parametric equation of line, circle, ellipse, Continuity (C^0, C^1 & C^2), Synthetic Curves - Hermit Cubic Spline, Bezier, B-Spline Curve, Non-Uniform Rational B-Spline curves (NURBS)

Surfaces: Surface representation, Types of Surfaces, Bezier, B-Spline, NURBS Surface, Coons patch surface, Surface Modeling

Reverse Engineering: Introduction, Point Cloud Data (PCD), PCD file formats, Quality issues in PCD, Requirements for conversion of surface models into solid models, Applications of PCD

Unit III — Solid Modeling — [08 Hr.]

Introduction, Geometry and Topology, Solid entities, Solid representation, Fundamentals of Solid modeling, Half spaces, Boundary representation (B-Rep), Constructive Solid Geometry (CSG), Sweep representation, Analytical solid modeling, Parametric solid modeling, feature based modeling, etc., Euler Equation (Validity of 3D solids), Mass Property Calculations

Introduction to Assembly Modeling, Assemblies (Top-down and Bottom-up approach), Design for Manufacturing [DFM], Design for Easy Assembly & Disassembly [DFA], Design for Safety

Unit IV **Geometric Transformation** **[08 Hr.]**

Introduction, Geometric Transformations, Translation, Scaling, Rotation, Reflection/Mirror, Shear, Homogeneous Transformation, Inverse Transformation, Concatenated Transformation (limited to 2D objects with maximum 3 points only), Coordinate systems - Model (MCS), Working (WCS), Screen (SCS) coordinate system, Mapping of coordinate systems

Projections of geometric models - Orthographic and Perspective projections, Design and Engineering applications

Unit V **CAD Data Exchange** **[08 Hr.]**

Introduction, CAD Kernels, CAD Data File, Data interoperability, CAD Data Conversions, challenges in CAD data conversions/remedies, Direct Data Translators, Neutral 3D CAD file formats (DXF, IGES, PDES, STEP, ACIS, Parasolid, STL, etc.), Data Quality

Requirements of CAD file format for 3D Printing (Additive Manufacturing), CAE, FEA, CFD, CAM (Subtractive Manufacturing), Multi-Body Dynamics (Motion Simulations), Computer Aided Inspection (CAI), Computer Aided Technologies (CAx), AR/VR applications, etc., Introduction to CAD Geometry Clean-up for different applications

Unit VI **CAD Customization & Automation** **[08 Hr.]**

Introduction, Limitations of 2D drawings, Introduction to Product and Manufacturing Information (PMI), Model Based Definitions (MBD), Applications of PMI & MBD

CAD Customization: Introduction, advantages and disadvantages, Applications of Customization Interfaces, Product Customization Approaches - Part Modeling Customization, Assembly Modeling Customization, Drawing sheets & PMI Customization, CAD Automation

Introduction to Application Programming Interface (API), Structures of APIs, Coding/Scripting for customization, Introduction to CAD API Development, CAD Files & application handling

Books & Other Resources

Text Books

1. Zeid, I and Sivasubramania, R., (2009), “CAD/CAM : Theory and Practice”, 2nd edition, McGraw Hill Education, ISBN-13: 978-0070151345
2. Rao, P. N., (2017), “CAD/CAM: Principles and Applications”, 3rd edition, McGraw Hill Education, ISBN-13: 978-0070681934
3. Chang, Kuang-Hua, (2015), "e-Design: Computer-Aided Engineering Design", Academic Press, ISBN-13: 978-0123820389

Reference Books

1. Lee, Kunwoo, (1999), "Principles of CAD/CAM/CAE Systems", Pearson/Addison-Wesley, ISBN-13: 978-0201380361
2. Bordegoni, Monica and Rizzi, Caterina, (2011), "Innovation in Product Design: From CAD to Virtual Prototyping", Springer, ISBN-13: 978-1447161875
3. Vukašinovic, Nikola and Duhovnik, Jože, (2019), "Advanced CAD Modeling: Explicit, Parametric, Free-Form CAD and Re-engineering", Springer, ISBN-13: 978-3030023980
4. Um, Dugan, (2018), "Solid Modeling and Applications: Rapid Prototyping, CAD and CAE Theory", 2nd edition, Springer, ISBN-13: 978-3319745930
5. Rogers, D. and Adams, J. A., (2017), “Mathematical Elements for Computer Graphics”, 2nd edition, McGraw Hill Education, ISBN-13: 978-0070486775
6. Hearn, D. D. and Baker, M. P., (2013), "Computer Graphics with OpenGL", 4th edition, Pearson Education India, ISBN-13: 978-9332518711
7. Gokhale, N. S., Deshpande, S. S., Bedekar, S. V. and Thite, A. N., (2008), “Practical Finite Element Analysis”, Finite to Infinite, Pune, India, ISBN-13: 978-8190619509
8. Lee Ambrosius, (2015), “AutoCAD® Platform Customization: User Interface, AutoLISP®, VBA, and Beyond”, John Wiley & Sons, Inc., IN, ISBN-13: 978-1118798904

9. Bucalo, Joe and Bucalo, Neil, (2007), “Customizing SolidWorks for Greater Productivity”, Sheet Metal Guy, LLC, ISBN-13: 978-0979566608
10. Ziethen, Dieter R. (2012), “CATIA V5: Macro Programming with Visual Basic Script”, McGraw-Hill Companies, Inc./Carl Hanser Verlag München, ISBN-13: 978-0071800020, ISBN: 978-007180003-7
11. Programming Manuals of Softwares

Guidelines for Laboratory Conduction

The student shall complete the following activity as a Term Work Journal

Practical

The student shall complete the following Practical in laboratory using suitable CAD modeling software. Learner will demonstrate skills to communicate drawings as per industry standards.

1. 2-D sketching with geometrical and dimensional constraints
2. Solid & Surface modeling for simple mechanical components (Output file as Production drawing and Model Based Definition (MBD)
   (a) Sheet-Metal
   (b) Machining
   (c) Fabrication
   (d) Casting
   (e) Forgings
   (f) Plastic Molding
3. Assembly modeling (Output file as Assembly drawing and detailing) of the parts modeled in Practical assignment-2 using proper assembly constraint conditions and generation of exploded view for assemblies like Couplings, Clutches, Gear Assemblies, Engine/Pump/Turbine Components, Valves, Machine Tools, Automobile Components, Gear-Box, Pressure Vessels, etc.
4. Reverse Engineering of surface/solid modeling using Point Cloud Data.
5. Assembly Modeling by importing parts/components from free online resources like CAD and Product development software websites, forums, blogs, etc.
6. Demonstration on CAD Customization (with introduction to programming languages, interfacing)

202043 - Engineering Thermodynamics

Teaching Scheme	Credits	Examination Scheme
Theory : 03 Hr./Week Practical : 02 Hr./Week	**04** Theory : 03 Practical : 01	In-Semester : 30 Marks End-Semester : 70 Marks Oral : 25 Marks

Prerequisite Courses

Higher Secondary Science courses, Engineering Mathematics - I and II, Engineering Physics, Engineering Chemistry

Course Objectives

1. To introduce the fundamentals of thermodynamics.
2. To understand the concepts of laws of thermodynamics.
3. To apply the concepts of thermodynamics towards open and closed systems.
4. To be acquainted with Entropy generation and Exergy Analysis.
5. To understand the behaviour of a Pure substance and to analyze Vapour power cycles.
6. To undertake the performance analysis of a steam generator.

Course Outcomes

On completion of the course, learner will be able to

CO1. DESCRIBE the basics of thermodynamics with heat and work interactions.
CO2. APPLY laws of thermodynamics to steady flow and non-flow processes.
CO3. APPLY entropy, available and non available energy for an Open and Closed System,
CO4. DETERMINE the properties of steam and their effect on performance of vapour power cycle.
CO5. ANALYSE the fuel combustion process and products of combustion.
CO6. SELECT various instrumentations required for safe and efficient operation of steam generator.

Course Contents

Unit I — Fundamentals of Thermodynamics — [07 Hr.]

Introduction, Review of basic definitions, Zeroth law of Thermodynamics, Macro and Microscopic Approach, State Postulate, State, Path, Process and Cycles, Point function and Path function, quasi static process, Equilibrium, **Temperature** (concepts, scales, international fixed points and measurement of temperature), Constant volume gas thermometer and constant pressure gas thermometer, mercury in glass thermometer.

First Law of Thermodynamics: Concept of heat and work, Sign convention and its conversion. First law of thermodynamics, Joules experiments, Equivalence of heat and work. Application of first law to flow and non-flow Processes and Cycles. Steady flow energy equation (SFEE), Applications of SFEE to various devices such as Nozzle, Turbine, Compressors, Boilers etc. PMM-I kind.

Unit II — Ideal Gas and Second law of Thermodynamics — [08 Hr.]

Properties and Processes of Ideal Gas: Ideal Gas definition, Gas Laws: Boyle's law, Charle's law, Avagadro's Law, Equation of State, Ideal Gas constant and Universal Gas constant, Ideal gas Processes- on P-v and T-s diagrams, Constant Pressure, Constant Volume, Isothermal, Adiabatic, Polytropic, Throttling Processes (Open and Closed systems), Calculations of Heat transfer, Work done, Internal Energy.

Second Law of Thermodynamics: Limitations of first law of thermodynamics, Thermal reservoir, Heat Engine, Refrigerator and Heat pump: Schematic representation, Efficiency and Coefficient of Performance (COP), Kelvin-Planck & Clausius Statement of the Second law of Thermodynamics; PMM-II kind, Equivalence of the two statements; Clausius Inequality, Concept of Reversibility and Irreversibility, Carnot Theorem/Principles, Carnot Cycle.

Unit III — Entropy and Availability — [08 Hr.]

Entropy: Entropy as a property, Clausius Inequality, Principle of increase of Entropy Principle, Entropy changes for an Open and Closed System, Change of Entropy for an ideal gas and Pure Substance, Concept of Entropy generation. Entropy - a measure of Disorder.

Availability: Available and Unavailable Energy, Concept of Availability, Availability of heat source at constant temperature and variable temperature, Availability of non-flow and steady-flow Systems.

Unit IV Properties of Pure substances & Thermodynamics of Vapour Cycle [07 Hr.]

Properties of Pure substances: Formation of steam, Phase changes, Properties of steam, Use of Steam Tables, Study of P-v, T-s and h-s plots (Mollier Chart) for steam, Dryness fraction and its determination, Study of steam calorimeters (Barrel, Separating, Throttling and combined) Non-flow and Steady flow Vapour Processes, Change of Properties, Work and Heat transfer.

Thermodynamics of Vapour Cycle: Rankine Cycle, Comparison of Carnot cycle and Rankine cycle, Introduction to Steam power Plant, Efficiency of Rankine Cycle, Relative Efficiency, Effect of Varying operating parameters like Superheat, Boiler and Condenser Pressure on performance of Rankine cycle, Modified Rankine Cycle.

Unit V Fuels and Combustion [07 Hr.]

Types of fuels, Proximate and ultimate analysis of fuel, Combustion theory, Combustion Equations, Theoretical and Excess air requirements, Equivalence ratio, Analysis of products of combustion, Calorific value - HCV & LCV. Bomb and Boys gas Calorimeters. Flue Gas Analysis using Orsat Apparatus, Exhaust Gas analyser, Enthalpy of formation, Adiabatic flame temperature.

Unit VI Steam Generators & Boiler Draught [08 Hr.]

Steam Generators: Classification, Constructional details of low pressure boilers, Primary Features of high pressure (Power) boilers, Location, Construction and working principle of boiler, Boiler mountings and accessories, Instrumentations required for safe and efficient operation, Introduction to IBR Act, Boiler performance Calculations-Equivalent Evaporation, Boiler efficiency, Heat balance Sheet.

Boiler Draught: Classification, Necessity of Draught, Natural draught, Determination of Height of chimney, Diameter of chimney, condition for maximum discharge, Forced draught, Induced draught, Balanced draught, Draught losses.

Books & Other Resources

Text Books

1. P. K. Nag, “Engineering Thermodynamics”, Tata McGraw Hill Publications
2. R. K. Rajput, “Engineering Thermodynamics”, EVSS Thermo, Laxmi Publications
3. P. L Ballaney, “Thermal Engineering”, Khanna Publishers
4. C.P. Arora, “Thermodynamics”, Tata McGraw Hill
5. Domkundwar, Kothandaraman and Domkundwar,“Thermal Engineering”,Dhanpat Rai Publishers
6. M M Rathore, “Thermal Engineering”, Tata McGraw-Hill

Reference Books

1. Rayner Joel, “Basic Engineering Thermodynamics”, AWL-Addison Wesley
2. Cengel and Boles, “Thermodynamics an Engineering Approach”, McGraw Hill
3. G.VanWylen, R.Sonntag and C.Borgnakke, “Fundamentals of Classical Thermodynamics”, John Wiley & Sons
4. Holman J.P, “Thermodynamics”, McGraw Hill
5. M Achuthan, “Engineering Thermodynamics”, PHI
6. Steam Tables/Data book

Guidelines for Laboratory Conduction

The student shall complete the following activity as Term Work

The Term work shall consist of successful completion of Practicals, and Industrial Visits. Oral Examination shall be based on the term work.

Practical

1. Joule’s experiment to validate, first law of thermodynamics.
2. Survey of temperature sensors used in various thermal systems.
3. Determination of dryness fraction of steam using combined separating and throttling calorimeter.
4. Determination of HCV of solid or gaseous fuel using Bomb or Junker’s calorimeter respectively.

5. Demonstration on Orsat Apparatus.
6. Trial on boiler to determine boiler efficiency, equivalent evaporation and Energy Balance.
7. Thermodynamic Analysis of any System / Model by using any Computer Software.
8. Energy and Exergy analysis of contemporary steam generator.

Industrial Visits

Visit to any Process Industry/Plant having Boiler equipped with Accessories.

The visit report consists of

- Details about the Industry/Process Plant.
- Operational description of the Equipment with specification, its use, capacity, application etc.

202044 - Engineering Materials and Metallurgy

Teaching Scheme	Credits	Examination Scheme
Theory : 03 Hr./Week Practical : 02 Hr./Week	**04** Theory : 03 Practical : 01	In-Semester : 30 Marks End-Semester : 70 Marks Term Work : 25 Marks

Prerequisite Courses

Higher Secondary Science courses, Engineering Physics, Engineering Chemistry, Systems in Mechanical Engineering

Course Objectives

1. To impart fundamental knowledge of material science and engineering.
2. To establish significance of structure property relationship.
3. To explain various characterization techniques.
4. To indicate the importance of heat treatment on structure and properties of materials.
5. To explain the material selection process.

Course Outcomes

On completion of the course, learner will be able to

CO1. COMPARE crystal structures and ASSESS different lattice parameters.

CO2. CORRELATE crystal structures and imperfections in crystals with mechanical behaviour of materials.

CO3. DIFFERENTIATE and DETERMINE mechanical properties using destructive and non-destructive testing of materials.

CO4. IDENTIFY & ESTIMATE different parameters of the system viz., phases, variables, component, grains, grain boundary, and degree of freedom. etc.

CO5. ANALYSE effect of alloying element & heat treatment on properties of ferrous & nonferrous alloy.

CO6. SELECT appropriate materials for various applications.

Course Contents

Unit I — Crystal Structures and Deformation of Materials — [08 Hr.]

Crystal Structures: Study of Crystal structures BCC, FCC, HCP and lattice parameters & properties, Miller indices, Crystal imperfections, and Diffusion Mechanisms

Material Properties: Mechanical (Impact, hardness, etc.), Electrical, optical and Magnetic properties

Deformation of Materials: Elastic deformation, Plastic deformation: slip, twinning, work hardening, baushinger effect, recovery, re-crystallization and grain growth, Fracture: Types of fractures (brittle, ductile), Creep & Fatigue failures

Unit II — Material Testing and Characterization Techniques — [06 Hr.]

Destructive Testing: Impact test, Cupping test and Hardness test

Non-Destructive Testing: Eddy current test, Sonic & Ultrasonic testing, X-ray Radiography testing (Principle and Applications only)

Microscopic Techniques: Sample Preparation and etching procedure, optical microscopy, Electronic microscopy - only SEM, TEM and X-ray diffraction (Principle and Applications only)

Macroscopy: Sulphur printing, flow line observation, spark test

Unit III — Phase Diagrams and Iron-Carbon Diagram — [09 Hr.]

Solid solutions: Introduction, Types, Humerothery rule for substitutional solid solutions

Solidification: Nucleation & crystal growth, solidification of pure metals, solidification of alloys.

Phase Diagrams: Cooling curves, types of phase diagrams, Gibbs phase rules

Iron-Carbon Diagram: Iron-carbon equilibrium diagrams in detail with emphasis in the invariant reactions

Unit IV	Heat Treatments	[08 Hr.]

Austenite transformation in steel: Time temperature transformation diagrams, continuous cooling transformation diagrams. Retained austenite and its effect

Steps in Heat treatment and Cooling Medium

Heat Treatment Processes: Introduction, Annealing (Full annealing, Process annealing, Spheroidise annealing, isothermal annealing, stress relief annealing), Normalising, Hardening, Tempering, Austempering, Martempering, Sub-Zero Treatment, Hardenability

Surface Hardening: Classification, Flame hardening, Induction hardening, Carburising, Nitriding, Carbonitriding

Unit V	Ferrous Materials	[07 Hr.]

Carbon Steel: Classification, types & their composition, properties and Industrial application

Alloy Steels: Classification of alloy steels & Effect of alloying elements, examples of alloy steels, (Stainless steel, Tool steel) sensitization of stainless steel

Designation of carbon steel and alloy steels as per IS, AISI, SAE Standards

Cast Iron: Classification, types & their composition, properties and Industrial application of (White CI, Gray CI, SG CI, Malleable Cast and alloy Cast Iron)

Microstructure and property relationship of various ferrous Materials

Unit VI	Non-Ferrous Materials	[07 Hr.]

Classification of Non-Ferrous Metals: Study of Non-ferrous alloys with Designation, Composition, Microstructure

Mechanical & other properties for Industrial Applications: Copper and its Alloys (Gilding Metal, Cartridge Brass, Muntz Metal, Tin Bronze, Beryllium Bronze), Aluminium and its Alloy (LM5, Duralumin, Y-Alloy, Hinduminum), Nickel and its Alloys (Invar, Inconel), Titanium and its Alloys (α Alloys, α-β Alloys), Cobalt and its Alloys (Stellite Alloys, Alnico), Bearing Alloys (Classification, lead based alloys, tin based alloys), Age Hardening

Microstructure and Property relationship of various Non-ferrous Materials

Recent Material used in Additive Manufacturing: Properties, Composition and Application only

Books & Other Resources

Text Books

1. Dr. V. D. Kodgire & S. V. Kodgire, “Material Science & Metallurgy For Engineers”, Everest Publication.
2. William D. Callister, “Materials Science and Engineering an Introduction”, Jr, John Wiley & Sons, Inc.

Reference Books

1. A. K. Bhargava, C.P. Sharma, “Mechanical Behaviour & Testing of Materials”, P H I Learning Private Ltd.
2. Raghvan V., “Material Science & Engineering”,Prentice Hall of India, New Delhi. 2003
3. Avner, S.H., “Introduction to Physical Metallurgy”, Tata McGraw-Hill, 1997.
4. Higgins R. A., “Engineering Metallurgy”, Viva books Pvt. Ltd.
5. George Ellwood Dieter, “Mechanical Metallurgy”, McGraw-Hill 1988
6. Smith, W.F, Hashemi, J., and Prakash, R., “Materials Science and Engineering in SI Units”, Tata McGraw Hill Education Pvt. Ltd.

Guidelines for Laboratory Conduction

The student shall complete the following activity as a Term Work Journal

Total 10 experiments from the following list must be performed. Term Work of the Student is evaluated based on the completion of Practical, Assignments, and Industrial Visits.

Practical *(Any Seven)*

1. Destructive testing - Hardness testing (Rockwell/Vickers) Hardness conversion number
2. Brinell and Poldi hardness Test

3. Impact Test for Steel, Aluminum, Brass and Copper (Charpy/Izod)
4. Non Destructive testing - Dye Penetrant Test/ Magnetic Particle test/ Ultrasonic Test
5. Steps for Specimen Preparation for microscopic examination & Demonstration of Optical Metallurgical microscope
6. Observation and Drawing of Microstructure of Steels, Cast Iron of various compositions
7. Observation and Drawing of Microstructure of Non Ferrous Metals of various compositions
8. Heat Treatment of steels based on relative hardness
9. Jominy End Quench Test for hardenability

Miniature commitment or Assignments *(Any Two)*

1. Exploration of engineering Alloy (Name, composition, properties, microstructure, Heat treatment, Designation & specific applications)- One student one Alloy or material
2. Examine aspects of component form material and manufacturing process point of view (Name, Material, Drawing, Manufacturing Process, properties, microstructure, Heat treatment, & specific applications) - For example spur gear, Needle etc. One student one component
3. Creep and Fatigue Test (Virtual Lab IIT Bombay)
4. Fluorescence Microscope (Virtual Lab IIT Bombay)

Industrial Visits

To provide awareness and understanding of the course, Compulsory Industrial Visit must be arranged for the students.

The Industrial Visit must be preferably to

- Material & Metallurgy related like Engineering Cluster, NDT Lab, and Nearby NABL lab or
- Any manufacturing unit with material orientation

Student must submit a properly documented Industrial Visit Report.

Guidelines for Instructor's Manual

The Instructor's Manual should contain following related to every experiment:

1. Brief theory related to the experiment
2. Apparatus with their detailed specifications
3. Standard ASME/ IS numbers of test procedure
4. Schematic, Layout/diagram
5. Observation table/graphs.
6. Sample calculations for one/two reading
7. Result table, Graph and Conclusions.
8. 3/4 questions related to the experiment
9. Relevance of practical in industry with recent software of image analysis

Guidelines for Student's Lab Journal

The Student's Lab Journal should contain following related to every experiment:

1. Theory related to the experiment
2. Apparatus with their detailed specifications
3. Schematic, Layout/diagram
4. Observation table/simulation plots/graphs
5. Sample calculations for one/two reading
6. Result table. Graph and Conclusions
7. 3/4 questions related to the experiment
8. Attach Photo of experiment or image related to Experiment

Guidelines for Lab/TW Assessment

1. There should be continuous assessment for the TW
2. Assessment must be based on understanding of theory, attentiveness during practical, and understanding
3. Session, how efficiently the student is able to do connections and get the results
4. Online evolutions of practical with objective type of Questions
5. Timely submission of journal

203156 - Electrical and Electronics Engineering

Teaching Scheme	Credits	Examination Scheme
Theory : 03 Hr./Week Practical : 02 Hr./Week	**04** Theory : 03 Practical : 01	In-Semester : 30 Marks End-Semester : 70 Marks Term Work : 25 Marks

Prerequisite Courses

Basic Electrical Engineering, Basic Electronics Engineering, Systems in Mechanical Engineering

Course Objectives

1. To understand Arduino IDE; an open source platform and its basic programming features
2. To interface Atmega328 based Arduino board with different devices and sensors
3. To study principle of operation of DC machines and speed control of DC motors
4. To know about three phase induction motor working and its applications
5. To get acquainted with Electric Vehicle (EV) technology and subsystems
6. To get familiar with various energy storage devices and electrical drives

Course Outcomes

On completion of the course, learner will be able to

CO1. APPLY programming concepts to UNDERSTAND role of Microprocessor and Microcontroller in embedded systems

CO2. DEVELOP interfacing of different types of sensors and other hardware devices with Atmega328 based Arduino Board

CO3. UNDERSTAND the operation of DC motor, its speed control methods and braking

CO4. DISTINGUISH between types of three phase induction motor and its characteristic features

CO5. EXPLAIN about emerging technology of Electric Vehicle (EV) and its modular subsystems

CO6. CHOOSE energy storage devices and electrical drives for EVs

Course Contents

Unit I — Introduction to Arduino — [08 Hr.]

Introduction to microcontroller and microprocessors, role of embedded systems, open source embedded platforms, Introduction to Arduino IDE- features, IDE overview, Programming concepts: variables, functions, conditional statements, Concept of GPIO in Atmega328 based Arduino board, digital input and output

Unit II — Peripheral Interface — [07 Hr.]

Interfacing of Atmega328 based Arduino board with LED and LCD/serial monitor, serial communication using Arduino IDE, Concept of ADC in Atmega328 based Arduino board, interfacing of Atmega328 based Arduino board with temperature sensor (LM35), LVDT, strain gauge

Unit III — DC Machines — [08 Hr.]

Generating and motoring action, Constructional features of a DC machine, EMF equation of DC machine and its significance in motor

Concept of torque developed by motor and it's equation, Concept of load torque, Types of loads and dynamics of motor and load combination, Characteristics of DC shunt motor, Speed control methods of DC shunt motor, Reversal of direction of rotation of DC motor, Braking in DC motor and its types, Regenerative braking in DC shunt motor

Unit IV — Three Phase Induction Motors — [07 Hr.]

Constructional features, working principle of three phase induction motor, types, torque equation, torque-slip characteristics, effect of rotor resistance on characteristics, modification in squirrel cage motor with deep bar rotor construction

Power stages, efficiency, starters (DOL starter and Star Delta starter), Methods of speed control- voltage and frequency control, variable frequency drive, applications

Unit V **Electric Vehicle (EV) Technology** **[08 Hr.]**

Brief history of Electric Vehicle (EV), Components of EV, Benefits of EV

Types of EVs such as Battery EV, Hybrid EV, Plug-in EV, Fuel Cell EV and their comparison, Challenges faced by EV technology

Subsystems and configurations of EV, Subsystems of Hybrid EV, Configurations of series, parallel and series-parallel Hybrid EV

Impact of EV on grid, Vehicle to grid technology- block diagram

Unit VI **Energy Storage Devices and Electric Drives** **[07 Hr.]**

Storage Devices: Cell construction and working of batteries like Lithium- Iron Phosphate (LFP), Lithium Nickel-Manganese-Cobalt (NMC) and Lithium- Manganese Oxide (LMO), Voltage, Impedance, Ah and Wh Capacity, Cycle Life, Energy density, Power, C-rate and safety aspects

Use of supercapacitor and hydrogen fuel cell in EVs- necessity, advantages and specifications

Factors used in selection of energy storage device in case of EVs, Vehicle Battery Management System - block diagram

Electric Drives: Factors used for selection of the electric motor in EVs

BLDC hub motor drive for EVs, characteristics and speed control of BLDC motor, three phase induction motor drive for EVs

Books & Other Resources

Text Books

1. Barret Steven F, “Arduino Microcontroller Processing for Everyone!”, 3rd Ed, Morgan and Claypool Publishers
2. Michael Margolis, “Arduino Cookbook”, 2nd Ed, O'Reilly Media
3. Hughes Edward, “Electrical and Electronic Technology”, Pearson Education
4. Ashfaq Husain, “Electric Machines”, 3rd Ed, Dhanpat Rai & Sons
5. Bhattacharya S. K., “Electrical Machine”, 3rd Ed, Tata McGraw Hill
6. Nagrath & Kothari, “Electrical Machines”, Tata McGraw Hill
7. Iqbal Hussein, “Electric and Hybrid Vehicles: Design Fundamentals”, CRC Press
8. Mehrdad Ehsani, Yimi Gao, Sebastian E. Gay, Ali Emadi, “Modern Electric, Hybrid Electric and Fuel Cell Vehicles: Fundamentals, Theory and Design”, 2nd Ed, CRC Press

Reference Books

1. Deshmukh Ajay, “Microcontrollers Theory and Applications”, Tata McGraw Hill
2. Massimo Banzi, “Getting Started with Arduino”, 2nd Ed, Maker Media, Inc.
3. Brad Kendall, “Getting Started With Arduino: A Beginner's Guide”, Justin Pot and Angela Alcorn (Editors)
4. Lowe, “Electrical Machines”, Nelson Publications
5. [A.E. Fitzgerald, Charles Kingsley, Stephen D. Umans, “Electrical Machines”, 5th Ed, Tata McGraw Hill
6. Pillai S. K., “A First Course on Electrical Drives”, New Age International (P) Ltd.
7. James Larminie, John Lowry, , “Electric Vehicle Technology Explained”, Wiley
8. Dhameja Sandeep, “Electric Vehicle Battery Systems”, Newnes
9. R. Krishnan,“Permanent Magnet Synchronous and Brushless DC Motor Drives”, CRC Press

Web References

1. www.arduino.cc *(for downloading Arduino IDE and information)*
2. www.alldatasheet.com *(for datasheets of components)*
3. https://spoken-tutorial.org/tutorial-search/ *(for video tutorials on Arduino)*
4. https://swayam.gov.in/NPTEL *(for e-learning courses and video lectures)*

Guidelines for Laboratory Conduction

The student shall complete the following activity as a Term Work

Total 10 experiments from the following list must be performed. Term Work of the Student is evaluated based on the completion of Practical, Assignments using Virtual Laboratory & Detailed Industrial Visit Report and Group Assignment using Case Study/Product Survey.

Practical - Electronics Engineering Laboratory *(Any four experiments to be performed)*

Atmega328 based Arduino board can be used for following interfaces:

1. Interfacing of LED to blink after every 1 sec
2. Display data using serial communication with PC
3. Interfacing of LCD to display given message
4. Interfacing of temperature sensor (LM35) and display output on LCD/serial monitor
5. Interfacing of strain gauge sensor to measure parameters like pressure, weight, etc., and display the measured value
6. Interfacing of LVDT sensor to measure the displacement and display the measured value

Practical - Electrical Engineering Laboratory *(Any four experiments to be performed)*

7. Demonstration of use of starters for DC motor and three phase induction motor along with understanding of specifications on name plates of these machines
8. Brake test on DC shunt motor
9. Study of power electronic converter based DC motor drive
10. Study of electrical braking of DC shunt motor (Rheostatic/ Plugging/regenerative)
11. Load test on three phase induction motor
12. Torque- speed characteristics of three phase induction motor

Assignments using Virtual Laboratory

Virtual Labs project is an initiative of the Ministry of Human Resource Development (MHRD), Government of India under the aegis of National Mission on Education through Information and Communication Technology (NMEICT). Please visit the following link for exploring experiments on Electrical Machines: http://www.vlab.co.in/broad-area-electrical-engineering

Assign following experiments by applying Virtual Labs:

1. Speed control of DC shunt motor by armature and field resistance control
2. Speed control of slip ring induction motor by rotor resistance control

Please refer http://vlabs.iitb.ac.in/vlabs-dev/vlab_bootcamp/bootcamp/Sadhya/experimentlist.html

Assignments using Case Study/Product Survey

Each group consisting of maximum five number of students should carry out a case study/product survey focused on various EVs available in Indian market. *Forming groups and allotment of specific task to the students group should be done at the beginning of semester so that students get sufficient time to carry out the survey and prepare a presentation*.

Students must

- Compare various models in each class.
- Study various main components of EVs
- A formal presentation on case study/product survey must be arranged before class/batch.

Industrial Visits

An industrial visit must be arranged to one of the following establishments during the semester.

The Industrial Visit must be preferably to

- Automation/Manufacturing industries
- Battery/EV Charging Stations
- Retro-fitting Workshops of ICE vehicle to EVs
- EV Service Stations

Student must submit properly documented Detailed Industrial Visit Report in his/her own words.

Instructions for Laboratory Conduction

Electronics Engineering Laboratory

1. The instructor is expected to shortlist necessary experiments from the suggested list of experiments.

2. During the practical session the instructor may divide the total students in groups of 4 to 5 students and assign them different experiments.
3. Each student in the group is supposed to execute the program.
4. The faculty should check the result of all the groups.

Electrical Engineering Laboratory

1. Check whether the MCB / ELCB / main switch is off while preparing the set-up.
2. Make connections as per circuit diagram. Use flexible wire for connection of voltmeter and pressure coil connection of wattmeter. For the rest of the connections, use thick wires. Do not keep the connections loose. Get it checked by the faculty / Lab Assistant.
3. Perform the experiment only in presence of faculty or Lab Assistant.
4. Do the calculations and get these checked from the faculty.
5. After completion of experiment, switch off the MCB / ELCB / main switch.
6. Write the experiment in the journal and get it checked regularly after conducting

Guidelines for Instructor's Manual

The Instructor's Manual should contain following related to every experiment:

1. Brief theory related to the experiment.
2. Connection diagram /circuit diagram
3. Observation table
4. Sample calculations for one reading
5. Result table
6. Graph and Conclusions.
7. Data sheets of the ICs used(if any)

Guidelines for Student's Lab Journal

Electronics Engineering Laboratory

1. Title of the program should be mentioned
2. The algorithm of the program must be written
3. Flow Chart for each program has to be drawn on separate page
4. Input data has to be specified
5. Result of the program should be highlighted

Electrical Engineering Laboratory

1. Lab journal should be hand written
2. Circuit diagrams can be drawn on graph paper
3. Specifications of the instruments/machines used for conduction of practical should be mentioned in respective write-up
4. Conclusion of each experiment should be written by student at the end

Guidelines for Lab/TW/PR Assessment

1. Continuous assessment should be carried out time to time.
2. During assessment, faculty should put the remark by writing the word "Complete" and not simply "C". Put the signature along with the date at the end of experiment and also in the index.
3. Assess each laboratory experiment/virtual lab assignment/report of industrial visit/case study for 10 marks each as per following details:
   Attendance in practical - 02 marks
   Timely completion of journal -03 marks
   Presentation of write-up and results - 02 marks
   Depth of understanding - 03 marks
4. Maintain a continuous assessment sheet on the basis of which final TW marks can be offered.

202045 - Geometric Dimensioning and Tolerancing Lab

Teaching Scheme	Credits	Examination Scheme
Practical : 02 Hr./Week	**01** Practical : 01	Term Work : 25 Marks

Prerequisite Courses

Systems in Mechanical Engineering, Project Based Learning - I, Workshop Practise, Engineering Graphics

Course Objectives

1. To understand requirements of industrial drawings
2. To read, understand and explain basic Geometric Dimensioning & Tolerancing concepts
3. To apply various geometric and dimension tolerances based on type of fit
4. To include surface roughness symbols based on manufacturing process
5. To measure and verify position tolerances with applied material conditions
6. To understand requirements for manufacturing and assembly

Course Outcomes

On completion of the course, learner will be able to

CO1. SELECT appropriate IS and ASME standards for drawing
CO2. READ & ANALYSE variety of industrial drawings
CO3. APPLY geometric and dimensional tolerance, surface finish symbols in drawing
CO4. EVALUATE dimensional tolerance based on type of fit, etc.
CO5. SELECT an appropriate manufacturing process using DFM, DFA, etc.

Guidelines for Laboratory Conduction

The student shall complete the following activity as a Term Work Journal

Total 9 Practical Assignments from the following list must be performed. Term Work of the Student is evaluated based on the completion of Practical, Industrial Visit Report and Group Assignment.

Practical *(Assignment # 1 to 6 & 10 are compulsory; Select any Two from Assignment # 7 to 9)*
The student shall complete the following Practical in laboratory. Learner will demonstrate skills to communicate drawings as per industry standards:

1. Study of drawing sheet layout, Principles of Drawing and various IS Standards & Conventions in Machine Drawing, Dimensioning practices - Terminology & Basic Rules, Styles, Conventions [02 Hr.]
2. GD&T -
   (a) Terminology, Maximum and Minimum Material conditions, Features, Rules for GD&T, Datum Control [02 Hr.]
   (b) Adding GD&T to a Design, Form Tolerances [02 Hr.]
   (c) Orientation Tolerances, Profile Tolerances [02 Hr.]
   (d) Location Tolerances, Run out Tolerances [02 Hr.]
3. Surface finish, Welding symbols [02 Hr.]
4. Study and reading of Industrial Drawings to understand standard industrial practices viz. Dimensioning, GD&T, Surface finish, welding symbols, etc. [04 Hr.]
   (a) Machine Drawing, (b) Production Drawing, (c) Part Drawing,
   (d) Assembly Drawing - (i) Assembly Drawing for Design, (ii) Assembly Drawing for Instruction Manuals, (iii) Exploded Assembly Drawing, (iv) Schematic Assembly Drawing, (v) Patent Drawing, etc.
5. Calculation of Tolerances based on Type of Fits in Assembly [02 Hr.]
6. Tolerance Stacks-Up with suitable examples [02 Hr.]
7. Design for Manufacturing (DFM) with suitable examples [02 Hr.]
8. Design for Assembly and Dis-assembly with suitable examples [02 Hr.]
9. Design for Safety with suitable examples [02 Hr.]
10. Industrial visit / Case study

Books & Other Resources
Text Books 1. Standards: ASME Y14.5 – 2018 2. Narayana, K. L., Kannaiah, P., Venkata Reddy, K., (2016), “Machine Drawing”, 2nd edition, New Age International Publishers, New Delhi, India, ISBN-13: 978-8122440546 3. Bhatt, N. D. and Panchal, V. M., (2014), “Machine Drawing”, Charotar Publishing House Pvt. Ltd, Anand, India, ISBN-13: 978-9385039232
Reference Books 1. Cogorno, G. R., (2020), "Geometric Dimensioning and Tolerancing for Mechanical Design", 3rd edition, McGraw-Hill Education 2. Blokdyk, Gerardus, (2019), "Geometric Dimensioning and Tolerancing: A Complete Guide - 2020 Edition", 5STARCooks 3. Standards: ISO/TR 23605:2018, ISO 1101:2017, SP 46, IS 15054(2001)

202046 - Audit Course - III		
Teaching Scheme	**Credits**	**Examination Scheme**
-	-	-

GUIDELINES FOR CONDUCTION OF AUDIT COURSE

Faculty mentor shall be allotted for individual courses and he/she shall monitor the progress for successful accomplishment of the course. Such monitoring is necessary for ensuring that the concept of self learning is being pursued by the students 'in true letter and spirit'.

- If any course through Swayam/ NPTEL/ virtual platform is selected the minimum duration shall be of 8 weeks.
- However if any of the course duration is less than the desired (8 weeks) the mentor shall ensure that other activities in form of assignments, quizzes, group discussion etc. (allied with the course) for the balance duration should be undertaken.

In addition to credits courses, it is mandatory that there should be an audit course (non-credit course) from second year of Engineering. The student will be awarded grade as AP on successful completion of the audit course. The student may opt for any one of the audit courses in each semester. Such audit courses can help the student to get awareness of different issues which make an impact on human lives and enhance their skill sets to improve their employability. List of audit courses offered in the semester is provided in the curriculum. Students can choose one of the audit courses from the list of courses mentioned. Evaluation of the audit course will be done at institute level.

The student registered for audit course shall be awarded the grade AP and shall be included such grade in the Semester grade report for that course, provided student has the minimum attendance as prescribed by the Savitribai Phule Pune University and satisfactory in-semester performance and secured a passing grade in that audit course. No grade points are associated with this 'AP' grade and performance in these courses is not considered in the calculation of the performance indices SGPA and CGPA. Evaluation of the audit course will be done at institute level itself.

Selecting an Audit Course

List of Courses to be opted (Any one) under Audit Course III

- Technical English For Engineers
- Entrepreneurship Development
- Developing soft skills and personality
- Design Thinking
- Foreign Language (preferably German/ Japanese)
- Science, Technology and Society

The titles indicated above are subject to change in time to come and such an alteration (if any) should be brought to the notice of the BoS.

Using NPTEL Platform: (preferable)

NPTEL is an initiative by MHRD to enhance learning effectiveness in the field of technical education by developing curriculum based video courses and web based e-courses. The details of NPTEL courses are available on its official website www.nptel.ac.in

- Students can select any one of the courses mentioned above and has to register for the corresponding online course available on the NPTEL platform as an Audit course.
- Once the course is completed the student can appear for the examination as per the guidelines on the NPTEL portal.
- After clearing the examination successfully; student will be awarded with a certificate.

Assessment of an Audit Course

- The assessment of the course will be done at the institute level. The institute has to maintain the record of the various audit courses opted by the students. The audit course opted by the students could be interdisciplinary.
- During the course students will be submitting the online assignments. A copy of the same can be submitted as a part of term work for the corresponding Audit course.
- On the satisfactory submission of assignments, the institute can mark as "Present" and the student will be awarded the grade AP on the marksheet.

207002 - Engineering Mathematics - III

Teaching Scheme	Credits	Examination Scheme
Theory : 03 Hr./Week Tutorial : 01Hr/Week	**04** Theory : 03 Practical : 01	In-Semester : 30 Marks End-Semester : 70 Marks Term Work : 25 Marks

Prerequisite Courses

Differential & Integral calculus, Differential equations of first order & first degree, Fourier series, Collection, classification and representation of data and Vector algebra.

Course Objectives

1. To make the students familiarize with concepts and techniques in Ordinary & Partial differential equations, Laplace transform & Fourier transform, Statistical methods, Probability theory and Vector calculus.
2. The aim is to equip them with the techniques to understand advanced level mathematics and its applications that would enhance analytical thinking power, useful in their disciplines.

Course Outcomes

On completion of the course, learner will be able to

CO1. SOLVE higher order linear differential equations and its applications to model and analyze mass spring systems.

CO2. APPLY Integral transform techniques such as Laplace transform and Fourier transform to solve differential equations involved in vibration theory, heat transfer and related mechanical engineering applications.

CO3. APPLY Statistical methods like correlation, regression in analyzing and interpreting experimental data applicable to reliability engineering and probability theory in testing and quality control.

CO4. PERFORM Vector differentiation & integration, analyze the vector fields and APPLY to fluid flow problems.

CO5. SOLVE Partial differential equations such as wave equation, one and two dimensional heat flow equations.

Course Contents

Unit I — Linear Differential Equations (LDE) and Applications — [08 Hr.]

LDE of nth order with constant coefficients, Complementary Function, Particular Integral, General method, Short methods, Method of variation of parameters, Cauchy's and Legendre's DE, Simultaneous and Symmetric simultaneous DE. Modelling of Mass-spring systems, Free &Forced damped and undamped systems.

Unit II — Transforms — [08 Hr.]

Laplace Transform **(LT):** LT of standard functions, properties and theorems, Inverse LT, Application of LT to solve LDE.

Fourier Transform **(FT):** Fourier integral theorem, Fourier transform, Fourier sine & cosine transforms, Inverse Fourier Transforms.

Unit III — Statistics — [07 Hr.]

Measures of central tendency, Measures of dispersion, Coefficient of variation, Moments, Skewness and Kurtosis, Curve fitting: fitting of straight line, parabola and related curves, Correlation and Regression, Reliability of Regression Estimates.

Unit IV — Probability and Probability Distributions — [07 Hr.]

Probability, Theorems on Probability, Bayes Theorem, Random variables, Mathematical Expectation, Probability distributions: Binomial, Poisson, Normal, Test of Hypothesis: Chi-Square test, t-test.

UnitV — Vector Calculus — [08 Hr.]

Vector differentiation, Gradient, Divergence and Curl, Directional derivative, Solenoidal & Irrotational fields, Vector identities. Line, Surface and Volume integrals, Green's Lemma, Gauss's Divergence theorem and Stoke's theorem.

Unit VI **Applications of Partial Differential Equations (PDE)** **[08 Hr.]**

Basic concepts, modelling of Vibrating String, Solution of Wave equation, One and two dimensional Heat flow equations, Method of separation of variables, use of Fourier series. Solution of Heat equation by Fourier transforms.

Books & Other Resources

Text Books

1. B.V. Ramana, “Higher Engineering Mathematics”, Tata McGraw-Hill
2. B. S. Grewal, “Higher Engineering Mathematics”, Khanna Publication, Delhi

Reference Books

1. Erwin Kreyszig, “Advanced Engineering Mathematics’, 10e, by Wiley India.
2. M. D. Greenberg, “Advanced Engineering Mathematics”, 2e, by Pearson Education.
3. Peter V. O'Neil , “Advanced Engineering Mathematics”, 7e, by Cengage Learning
4. S. L. Ross, “Differential Equations”, 3e by Wiley India.
5. Sheldon M. Ross, “Introduction to Probability and Statistics for Engineers and Scientists”, 5e, by Elsevier Academic Press

Guidelines for Tutorial and term Work

1. Tutorial shall be engaged in four batches (batch size of 20 students maximum) per division.
2. Term work shall be based on continuous assessment of six assignments (one per each unit) and performance in internal tests.The student shall complete the following activity as a Term Work Journal.

202047 - Kinematics of Machinery

Teaching Scheme	Credits	Examination Scheme
Theory : 03 Hr./Week Practical : 02 Hr./Week	**04** Theory : 03 Practical : 01	In-Semester : 30 Marks End-Semester : 70 Marks Oral : 25 Marks

Prerequisite Courses

Systems in Mechanical Engineering, Engineering Mathematics - I and II, Engineering Physics, Engineering Mechanics, Geometric Modeling & Drafting

Course Objectives

1. To make the students conversant with kinematic analysis of mechanisms applied to real life and industrial applications.
2. To develop the competency to analyze the velocity and acceleration in mechanisms using analytical and graphical approach.
3. To develop the skill to propose and synthesize the mechanisms using graphical and analytical technique.
4. To develop the competency to understand & apply the principles of gear theory to design various applications.
5. To develop the competency to design a cam profile for various follower motions.

Course Outcomes

On completion of the course, learner will be able to

CO1. APPLY kinematic analysis to simple mechanisms

CO2. ANALYZE velocity and acceleration in mechanisms by vector and graphical method

CO3. SYNTHESIZE a four bar mechanism with analytical and graphical methods

CO4. APPLY fundamentals of gear theory as a prerequisite for gear design

CO5. CONSTRUCT cam profile for given follower motion

Course Contents

Unit I — Fundamentals of Mechanism — [07 Hr.]

Kinematic link, Types of links, Kinematic pair, Types of constrained motions, Types of Kinematic pairs, Kinematic chain, Types of joints, Mechanism, Machine, Degree of freedom, Mobility of Mechanism, Inversion, Grashoff's law, Four-Bar Chain and its Inversions, Slider crank Chain and its Inversions, Double slider crank Chain and its Conversions, Mechanisms with Higher pairs, Equivalent Linkages and its Cases - Sliding Pairs in Place of Turning Pairs, Spring in Place of Turning Pairs, Cam Pair in Place of Turning Pairs

Unit II — Kinematic Analysis of Mechanisms: Analytical Method — [07 Hr.]

Analytical methods for displacement, velocity and acceleration analysis of slider crank Mechanism, Velocity and acceleration analysis of Four-Bar and Slider crank mechanisms using Vector and Complex Algebra Methods. Computer-aided Kinematic Analysis of Mechanism like Slider crank and Four-Bar mechanism, Analysis of Single and Double Hook's joint

Unit III — Kinematic Analysis of Mechanisms: Graphical Method — [08 Hr.]

Displacement, velocity and acceleration analysis mechanisms by Relative Velocity Method (Mechanisms up to 6 Links), Instantaneous Centre of Velocity, Kennedy's Theorem, Angular Velocity ratio Theorem, Analysis of mechanism by ICR method (Mechanisms up to 6 Links), Coriolis component of Acceleration (Theoretical treatment only)

Unit IV — Synthesis of Mechanisms — [07 Hr.]

Steps in Synthesis: Type synthesis, Number Synthesis, Dimensional synthesis, Tasks of Kinematic synthesis - Path, function and motion generation (Body guidance), Precision Positions, Chebychev spacing, Mechanical and structural errors

Graphical Synthesis: Inversion and relative pole method for three position synthesis of Four-Bar and Single Slider Crank Mechanisms

Analytical Synthesis: Three position synthesis of Four-Bar mechanism using Freudenstein's equation, Blotch synthesis

Unit V	Kinematics of Gears	[08 Hr.]

Gear: Classification

Spur Gear: Terminology, law of gearing, Involute and cycloidal tooth profile, path of contact, arc of contact, sliding velocity, Interference and undercutting, Minimum number of teeth to avoid interference, Force Analysis (theoretical treatment only)

Helical and Spiral Gears: Terminology, Geometrical Relationships, virtual number of teeth for helical gears

Bevel Gear & Worm and Worm Wheel: Terminology, Geometrical Relationships

Gear Train: Types, Analysis of Epicyclic gear Trains, Holding torque - simple, compound and Epicyclic gear Trains, Torque on Sun and Planetary gear Train, compound Epicyclic gear Train

Unit VI	Mechanisms in Automation Systems	[08 Hr.]

Cams & Followers: Introduction, Classification of Followers and Cams, Terminology of Cam Displacement diagram for the Motion of follower as Uniform velocity, Simple Harmonic Motion (SHM), Uniform Acceleration and Retardation Motion (UARM), Cycloid motion, Cam Profile construction for Knife-edge Follower and Roller Follower, Cam jump Phenomenon

Automation: Introductions, Types of Automation

Method of Work Part Transport: Continuous transfer, Intermittent or Synchronous Transfer, Asynchronous transfer, Different type of transfer mechanisms - Linear transfer mechanisms and Rotary transfer mechanisms

Automated Assembly-Line: Types, Assembly line balancing Buffer Storages, Automated assembly line for car manufacturing, Artificial intelligence in automation

Books & Other Resources

Text Books

1. S. S. Rattan, "Theory of Machines", Third Edition, McGraw Hill Education (India) Pvt. Ltd., New Delhi.
2. Bevan T, "Theory of Machines", Third Edition, Longman Publication
3. G. Ambekar, "Mechanism and Machine Theory", PHI
4. J. J. Uicker, G. R. Pennock, J. E. Shigley, "Theory of Machines and Mechanisms", Fifth Edition, International Student Edition, Oxford

Reference Books

1. Paul E. Sandin, "Robot Mechanisms and Mechanical Devices Illustrated", Tata McGraw Hill Publication
2. Stephen J. Derby, "Design of Automatic Machinery", 2005, Marcel Dekker, New York
3. Neil Sclater, "Mechanisms and Mechanical Devices Sourcebook", Fifth Edition, Tata McGraw Hill Publication
4. Ghosh Malik, "Theory of Mechanism and Machines", East-West Pvt. Ltd.
5. Hannah and Stephans, "Mechanics of Machines", Edward Arnolde Publication
6. R. L. Norton, "Kinematics and Dynamics of Machinery", First Edition, McGraw Hill Education (India) P Ltd. New Delhi
7. Sadhu Singh, "Theory of Machines", Pearson
8. Dr. V. P. Singh, "Theory of Machine", Dhanpatrai and Sons
9. C. S. Sharma & Kamlesh Purohit, "Theory of Machine and Mechanism", PHI
10. M.P. Groover, "Automation, production systems and computer-integrated manufacturing", Prentice-Hall of India Pvt. Ltd, New Delhi

Web References

1. https://nptel.ac.in/courses/112104121/ (NPTEL1, Kinematics of Machines, Prof. Ashok K Mallik, IIT Kanpur)
2. https://nptel.ac.in/courses/112/106/112106270/ (NPTEL2, Theory of Mechanism, Prof. Sujatha Srinivasan, IIT Madras)
3. https://nptel.ac.in/courses/112/105/112105268/ (NPTEL3, Kinematics of Mechanisms and Machines, Prof. Anirvan DasGupta, IIT Kharagpur)

4. https://nptel.ac.in/courses/112/105/112105236/ (NPTEL4, Mechanism and Robot Kinematics, Prof.Anirvan DasGupta, IIT Kharagpur)
5. http://www.cdeep.iitb.ac.in/webpage_data/nptel/Mechanical/Robotics Course/Course_home_lect1.html (NPTEL5, Introduction to Robotics and Automation, IIT Bombay)

Guidelines for Laboratory Conduction

The student shall complete the following activity as a Term Work

Total 10 experiments from the following list must be performed. Term Work of the Student is evaluated based on the completion of Practical, Assignments using Drawing Aids, Assignments using Software & Programming Languages, Assignments using Virtual Laboratory and Detailed Industrial Visit Report.

Practical *(Experiment # 1 is compulsory and Select any Two from Experiment # 2 to 4)*
1. To make a model of any mechanism by using waste material by the group of 4 to 6 students and to give a presentation using PPTs.
2. Speed and torque analysis of epicyclic gear train to determine holding torque.
3. To study and verify cam jump phenomenon.
4. To study manufacturing of gear using gear generation with rack as a cutter and to generate an involute profile.

Assignments using Drawing Aids *(Experiment #1 to 3 and 6 are compulsory and Select any One from Experiment #4-5)*
Do following graphical assignments on Half Imperial drawing sheet:
1. Identify mechanisms in real life and Analyze for types and number of links, pairs, obtain degrees of freedom. Submit the sheet and working video of the mechanism.
2. To solve two problems on velocity and acceleration analysis using relative velocity and acceleration method.
3. To solve two problems on velocity analysis using the ICR method.
4. To draw conjugate profile for any general type of gear tooth.
5. To study various types of gearboxes.
6. To draw cam profile for any two problems with combination of various follower motion with radial and off-set cam.

Assignments using Software *(Any Three Assignments - Minimum one computer programming based and Minimum one based on use of software)*
Do following assignments by using Software or by using Coding/Programming Languages:
1. To design a simple Planer Mechanism by using any software (Geogebra, SAM, Working Model, any 3D Modelling Software, etc.)
2. To do computer programming (using software/programming languages like C, Python, Scilab, Matlab etc.) for Kinematic Analysis of Slider Crank Mechanism using Analytical Method
3. To do computer programming (using software/programming languages like C, Python, Scilab, Matlab etc.) for Kinematic Analysis of Hooke's joint Mechanism using Analytical Method
4. To generate a Cam Profile using any Modelling Software (Mech Analyser, any 3D Modelling Software)
5. To synthesize the Four-Bar and Slider Crank Mechanism (Geogebra, SAM, any 2D/3D Modelling Software)
6. To do computer programming (using software/programming languages like C, Python, Scilab, Matlab etc.) for the Synthesis of Mechanism using Chebychevs spacing, Freudensteins equation and function generation

Assignments using Virtual Laboratory *(minimum Two experiments)*
Please visit the links given below for exploring experiments on Kinematics of Machinery using Virtual Laboratory. Write a Brief Reports of using Virtual Laboratory to perform following assignment:
1. Mechanics-of-Machines Lab (All Experiments), http://mm-nitk.vlabs.ac.in/index.html
2. Mechanisms and Robotics - Oldham Coupling Mechanism, http://vlabs.iitkgp.ernet.in/mr/index.html
3. Mechanisms and Robotics - Quick Return Mechanism, http://vlabs.iitkgp.ernet.in/mr/index.html

4. Mechanisms and Robotics - CAM Follower Mechanism, http://vlabs.iitkgp.ernet.in/mr/index.html

Industrial Visits

A Compulsory industrial visit must be arranged to industries/ establishments consisting automation and mechanization during semester to provide awareness and understanding of the course.

The Industrial Visit must be preferably to

- Manufacturing industries with Assembly-line Automation
- Sugar factory
- Bottle filling plants

Student must submit properly documented Detailed Industrial Visit Report in his/her own words.

Assignments on Content beyond syllabus

Following assignments can be attempted:

1. Forward and Inverse Kinematics of 2R/2P/RP/PR Manipulators using Software (Geogebra, RoboAnalyser, Vlab, etc.)
2. Kinematic Analysis of 6 DOF Industrial Robot using Software (RoboAnalyzer, Vlab, etc.)

202048 - Applied Thermodynamics

Teaching Scheme	Credits	Examination Scheme
Theory : 03 Hr./Week Practical : 02 Hr./Week	**04** Theory : 03 Practical : 01	In-Semester : 30 Marks End-Semester : 70 Marks Oral : 25 Marks

Prerequisite Courses

Engineering Thermodynamics, Systems in Mechanical Engineering, Engineering Mathematics - I, Engineering Mathematics - II

Course Objectives

1. To determine COP of refrigeration cycle and study Psychrometric properties and processes.
2. To study working of engine, Actual, Fuel-Air and Air standard cycle and its Performance.
3. To understand Combustion in SI and CI engines and factors affecting performance parameters
4. To study emission from IC Engines and its controlling method, various emission norms.
5. To estimate performance parameters by conducting a test on I. C. Engines.
6. To determine performance parameters of Positive displacement compressor.

Course Outcomes

On completion of the course, learner will be able to

CO1. DETERMINE COP of refrigeration system and ANALYZE psychrometric processes.
CO2. DISCUSS basics of engine terminology,air standard, fuel air and actual cycles.
CO3. IDENTIFY factors affecting the combustion performance of SI and CI engines.
CO4. DETERMINE performance parameters of IC Engines and emission control.
CO5. EXPLAIN working of various IC Engine systems and use of alternative fuels.
CO6. CALCULATE performance of single and multi stage reciprocating compressors and DISCUSS rotary positive displacement compressors

Course Contents

Unit I — Basics of Refrigeration and Psychrometry — [07 Hr.]

Refrigeration: Reversed Carnot Cycle, unit of refrigeration, Simple Vapour Compression Cycle (VCC), Refrigerating Effect, Compressor Power & COP. Simple Vapor Absorption Cycle (VAC), Comparison between VCC & VAC.

Psychrometry: Introduction, Psychrometry and Psychrometric Properties, Basic Terminologies & Psychrometric Relations, Psychrometric Processes, Psychrometric Chart.

Unit II — Introduction to Internal Combustion (IC) Engine — [06 Hr.]

IC Engine: Components and Construction details, Terminology, Classification, Applications, Intake and exhaust system, Valves actuating mechanisms, Valve timing diagram.

Fuel, Air and Actual Cycle: Air-standard cycles, fuel air cycles, and actual cycles, Effects of variables on performance, various losses, and Comparison of Air standard with Fuel and Actual cycle.

Unit III — SI and CI Engines — [09 Hr.]

SI Engines: Theory of Carburetion and Types of Carburetor, Working of Simple Carburetor, Electronic Fuel Injection System, Combustion stages in SI engines, Abnormal Combustion, Theory of Detonation and Parameters affecting detonations, Rating of fuels in SI engines, Combustion Chambers used in SI Engine.

CI Engines: Fuel Injection system, Construction and Working of Fuel Pump, Fuel Injector and Various types of Nozzle, Combustion stages in CI engines, Theory of knocking and Parameters affecting knocking, Rating of fuels in CI engines, Combustion Chambers used in CI Engines.

Unit IV — IC Engine Testing and Emission — [09 Hr.]

Engine Testing: Engine Testing Procedure, Measurement of indicated power, Brake power, fuel consumption, Air Consumption, Measurement of friction power by Willan’s Line Method and Morse Test, calculation of mean effective pressure, various efficiencies, specific fuel consumption, heat balance sheet of IC Engines and performance Characteristic curves.

Emission & Control: Introduction to Indian Driving Cycle (IDC), European Driving Cycle (EDC), SI and CI Engines Emission and controlling methods, Methods to measure emission such as (Non Dispersive Infrared Red (NDIR), Flame Ionization Detector (FID), Chemiluminescent Analyzer, Smoke meter), Euro Norms and Bharat Stage Norms.

Unit V **Engine Systems and Alternative Fuels** **[07 Hr.]**

Cooling system: Air Cooling, Liquid cooling, **Lubrication system**: Objectives of lubrication system, properties of lubricant, Methods of lubrication system, **Ignition system**: battery coil ignition system, magneto ignition system, Electronics Ignition (CDI, TCI), Maximum Brake Torque (MBT) & spark advance. Supercharging and Turbo-charging.

Alternative Fuels: Bio-diesel, Ethanol, LPG, CNG and Hydrogen.

Unit VI **Compressor** **[07 Hr.]**

Reciprocating Compressor: Applications of compressed air, single stage compressor (without clearance and with clearance volume), volumetric efficiency, isothermal efficiency, effect of clearance volume, free air delivery (FAD), actual indicator diagram for air compressor, Multi staging of compressor, optimum intermediate pressure, intercooler, after cooler, Capacity control of compressors.

Rotary Compressors: Roots blower, Vane type, Screw compressor and Scroll compressor.

Books & Other Resources

Text Books

1. Arora C. P., “Refrigeration and Air Conditioning”, Tata McGraw-Hill
2. V. Ganesan, “Internal Combustion Engines”, Tata McGraw-Hill
3. M. L. Mathur and R.P. Sharma, “A course in Internal combustion engines”, Dhanpat Rai & Co.
4. H.N. Gupta, “Fundamentals of Internal Combustion Engines”, PHI Learning Pvt. Ltd.

Reference Books

1. Dossat Ray J, “Principles of refrigeration, S.I. version”, Willey Eastern Ltd, 2000
2. Heywood, “Internal Combustion Engine Fundamentals”, Tata McGraw-Hill
3. Domkundwar & Domkundwar, “Internal Combustion Engine”, Dhanpat Rai & Co.
4. R. Yadav, “Internal Combustion Engine”, Central Book Depot, Ahmedabad.
5. S.Domkundwar,C.P. Kothandaraman,A.Domkundwar,“Thermal Engineering”,DhanpatRai & Co.

Guidelines for Laboratory Conduction

The student shall complete the following activity as a Term Work

Total 10 of the following list must be performed. During Oral, the Student shall be evaluated based on the completion of Practical, Assignments, Presentations and Detailed Industrial Visit Report.

Practical *(Minimum 6 Practical must be performed)*

1. Trial on Vapour Compression System
2. Trial on Vapour Absorption System
3. Trial on Air-Conditioning Test Rig.
4. Morse Test on Petrol engine.
5. Trial on Diesel engine.
6. Trial on Petrol engine.
7. Trial on variable compression ratio engine.
8. Trial on Positive Displacement Air Compressor.
9. Demonstration on Exhaust Gas Analyser and Smoke meter.

Survey *(Minimum one)*

1. Practical Survey of various fuel supply systems.
2. Practical Survey of supercharged and turbocharged engines.

Activity: *Presentation based*

Compulsory study of following topics must be done by students during semester to gain awareness and further understanding of the course and a presentation of the same should be included in the TW:

1. **Engines**:(any one) Homogeneous charge compression ignition (HCCI)/ Stratified charge

engine/Variable valve timing (VVT)/Variable geometry turbocharger (VGT), etc.

2. **Automotive Field**: (any one) Hydrogen CNG vehicles/Adaptive cruise control system/On-board diagnostic system (OBD) / Electric Battery classification/Fuel Cell vehicle/Rear driving emission (RDE) system

Industrial Visit

A Compulsory industrial visit must be arranged to automobile manufacturing or servicing.

Students must submit properly documented Detailed Industrial Visit Report in his/her own words.

202049 - Fluid Mechanics

Teaching Scheme	Credits	Examination Scheme
Theory : 03 Hr./Week Practical : 02 Hr./Week	**04** Theory : 03 Practical : 01	In-Semester : 30 Marks End-Semester : 70 Marks Oral : 25 Marks

Prerequisite Courses

Engineering Mathematics - I, Engineering Mathematics - II, Engineering Mechanics, Engineering Physics

Course Objectives

1. To understand basic properties of fluids.
2. To learn fluid statics and dynamics
3. To study basics of flow visualization
4. To understand Bernoulli's theorem and its applications.
5. To understand losses in flow, drag and lift forces
6. To learn to establish relation between flow parameters.

Course Outcomes

On completion of the course, learner will be able to

CO1. DETERMINE various properties of fluid

CO2. APPLY the laws of fluid statics and concepts of buoyancy

CO3. IDENTIFY types of fluid flow and terms associated in fluid kinematics

CO4. APPLY principles of fluid dynamics to laminar flow

CO5. ESTIMATE friction and minor losses in internal flows and DETERMINE boundary layer formation over an external surface

CO6. CONSTRUCT mathematical correlation considering dimensionless parameters, also ABLE to predict the performance of prototype using model laws

Course Contents

Unit I — Properties of Fluid — [06 Hr.]

Definition of fluid, concept of continuum, density, specific weight, specific gravity, viscosity, viscosity laws, types of fluid and rheology, measurement of viscosity, application based numerical on viscosity-flow through pipe, lubrication, bearing, brake fluids, parallel plates, rotating shafts etc., vapor pressure surface tension, capillarity, compressibility

Unit II — Fluid Statics — [07 Hr.]

Laws of fluid statics: forces acting on fluid element, pascal's law, hydrostatics law, hydraulic ram
Pressure measurement: pressure scale, piezometer, barometer, manometer - simple, inclined, differential, micro manometer, inverted

Forces acting on surfaces immersed in fluid: total pressure and center of pressure on submerged plane surfaces, curved surface submerged in liquid including numerical on dam gate

Buoyancy: flotation, stability of bodies

Unit III — Fluid Kinematics — [08 Hr.]

Flow description methods, types of flows, velocity and acceleration fields, continuity equation in 1D & 3D flow, flow visualization (path line, stream line and streak line), stream tube, angularity, vorticity, stream function and velocity potential function, flow net

Unit IV — Fluid Dynamics — [10 Hr.]

Euler's equation of motion differential form and Navier Stokes equation, Euler's equation of motion along streamline, Bernoulli's theorem and modified Bernoulli's theorem, stagnation pressure, HGL, TEL

Flow measurement: venturimeter, orifice meter, pitot tubes, static pitot tube, introduction to coriolis flow meter, introduction to orifices, notches & weirs

Laminar flow: Entrance region theory, velocity and shear Stress distribution for laminar flow through pipe, fixed parallel plates and Couette flow, velocity profile of turbulent flow

Unit V **Internal & External Flow** **[09 Hr.]**

Internal Flow: Losses - major & minor losses, hydro dynamically smooth and rough boundaries, Moody's chart, compounding of pipes & equivalent pipe, siphons, transmission of power

External Flow: Boundary layer formation over a flat plate, boundary layer thickness, displacement thickness, momentum thickness and energy thickness, boundary layer separation and methods to control separation, drag and lift concepts, types of drag, drag & lift coefficient, aerofoil, bluff body, streamline body

Unit VI **Dimensional Analysis & Similitude** **[08 Hr.]**

Dimensional Analysis: Introduction, system of dimensions, Dimensional homogeneity, Buckingham-Pi Theorem, repeating variables, dimensionless numbers and their physical significance

Similitude & Model Testing: Model & prototype, similarity, scaling parameters , model laws, objectives , importance and application of model studies.

Books & Other Resources

Text Books

1. Sukumar Pati, "Fluid Mechanics and Hydraulics Machines", TATA McGraw Hill.
2. Munson, Young and Okiishi, "Fundamentals of Fluid Mechanics", Wiley India
3. Potter Wiggert, "Fluid Mechanics", Cengage Learning
4. Fox, Pichard, "Introduction to Fluid Mechanics", McDonald- Wiley
5. Modi P. N. and Seth S. M, "Hydraulics and Fluid Mechanics",Standard Book House.
6. Cengel & Cimbla, "Fluid Mechanics",TATA McGraw-Hill
7. F. M. White, "Fluid Mechanics", TATA McGraw-Hill
8. R. K. Bansal, "Fluid Mechanics & Hydraulic Machines", Laxmi Publication

Reference Books

1. Kundu, Cohen, Dowling, "Fluid Mechanics", Elsevier India
2. Chaim Gutfinger David Pnueli, "Fluid Mechanics" Cambridge University press.
3. Edward Shaughnessy, Ira Katz James Schaffer, "Introduction to Fluid Mechanics",Oxford University Press

Web References

1. https://nptel.ac.in/courses/112/105/112105171/
2. https://nptel.ac.in/courses/112/104/112104118/
3. https://nptel.ac.in/courses/112/105/112105269/
4. http://www.efluids.com/efluids/books/efluids_books.htm
5. http://web.mit.edu/hml/ncfmf.html
6. http://www.efluids.com/efluids/pages/edu_tools.htm
7. https://spoken-tutorial.org/tutorial-search/?search_foss=OpenFOAM&search_language=

Guidelines for Laboratory Conduction

The student shall complete the following activity as a Term Work

Total 10 experiments from the following list must be performed. During Oral, the Student is evaluated based on the completion of Practical, Assignments using Virtual Lab and Detailed Mini project / Industrial Visit Report/ Simulation of fluid flow / Programming using any suitable software.

Practical *(Experiment # 3 & 9 are compulsory; Select any One Simulation of Experiments from Experiment # 4 & 6; Perform any Eight experiments)*

1. Determination of pressure using manometers (minimum two)
2. Determination of fluid viscosity and its variation with temperature.
3. Determination of Metacentric height of floating object.
4. Determination of Reynolds number and flow visualization of laminar and turbulent flow using Reynolds apparatus.
5. Draw flow net using electrical analogy apparatus to calculate discharge for rectangular / enlargement / contraction channel.
6. Verification of modified Bernoulli's equation.
7. Calibration of Orifice meter/ Venturimeter/Notch.
8. Determination of minor/major losses through metal/non-metal pipes.

9. Mini project/Industrial visit/Simulation of fluid flow/Programming using any suitable software

Assignments using Virtual Laboratory *(Any Two Virtual Lab experiments from experiment # 1,2,5,7,8 mentioned above)*

Please visit the links given below for exploring and performing experiments on Fluid Mechanics using Virtual Laboratory. Write brief Reports using Virtual Laboratories:

1. https://eerc03-iiith.vlabs.ac.in/
2. http://fm-nitk.vlabs.ac.in/

202050 - Manufacturing Processes

Teaching Scheme	Credits	Examination Scheme
Theory : 03 Hr./Week	**03** Theory : 03	In-Semester : 30 Marks End-Semester : 70 Marks

Prerequisite Courses

Material Science and Metallurgy, Engineering Physics, Systems in Mechanical Enginering

Course Objectives

1. Describe various sand and permanent mould casting methods, procedure and mould design aspects.
2. Understand basics of metal forming processes, equipment and tooling.
3. Understand sheet metal forming operations and die design procedure.
4. Classify, describe and configure the principles of various welding techniques.
5. Understand plastic processing techniques.
6. To know about composites, its fabrication processes.

Course Outcomes

On completion of the course, learner will be able to

CO1. SELECT appropriate moulding, core making and melting practice and estimate pouring time, solidification rate and DESIGN riser size and location for sand casting process

CO2. UNDERSTAND mechanism of metal forming techniques and CALCULATE load required for flat rolling

CO3. DEMONSTRATE press working operations and APPLY the basic principles to DESIGN dies and tools for forming and shearing operations

CO4. CLASSIFY and EXPLAIN different welding processes and EVALUATE welding characteristics

CO5. DIFFERENTIATE thermoplastics and thermosetting and EXPLAIN polymer processing techniques

CO6. UNDERSTAND the principle of manufacturing of fibre-reinforce composites and metal matrix composites

Course Contents

Unit I — Casting Processes — [07 Hr.]

Introduction to casting processes, Patterns: Pattern materials, types of pattern, allowances pattern design, Moulding sand, Properties of moulding sands, Core making, Melting practices and furnaces, Pouring and Gating system design, Numerical estimation to find mold filling time, Riser design and placement, Principles of cooling and solidification of casting, Directional and Progressive solidification Estimation of solidification rate, Cleaning and Finishing of casting, Defects and remedies, Principle and equipments of Permanent mould casting, Investment casting, Centrifugal casting, Continuous casting

Unit II — Metal Forming Processes — [08 Hr.]

Plastic deformation. Stress-strain diagram for different types of material, Hot and Cold working, Factors affecting plastic deformation, Yield criteria, Concept of flow stress, Forming Limit diagram

Rolling Process: Rolling terminology, Friction in rolling, Calculation of rolling load

Forging: Open and closed die forging, Forging operations

Extrusion: Types, Process parameter

Wire and Tube Drawing: Wire and tube drawing process, Die profile

Friction and lubrication in metal forming, Forming defects, causes and remedies for all forming processes

Unit III — Sheet Metal Forming — [07 Hr.]

Types of sheet metal operations, Press working equipment and terminology, Types of dies, Clearance analysis, Estimation of cutting forces, Centre of pressure and blank size determination, Design of strip lay-out, Blanking die design, Introduction to Drawing, Bending dies, Methods of reducing forces, Formability and forming limit diagrams

Unit IV **Welding Processes** **[08 Hr.]**

Classification of joining processes, Welding terminology and types of joints

Arc Welding Processes: Principles and equipments of Single carbon arc welding, FCAW, TIG, MIG, SAW

Resistance Welding: Spot, Seam and Projection weld process, Heat balance in resistance welding

Gas Welding and Cutting, Soldering, brazing and braze welding

Welding Metallurgy and Heat Affected Zone, Weld inspection, Defects in various joints and their remedies

Unit V **Processing of polymers** **[07 Hr.]**

Thermoplastics and Thermosetting, Processing of polymers, Thermoforming, Extrusion

Moulding: Compression moulding, Transfer moulding, Blow moulding, Rotation moulding, Injection moulding - Process and equipment

Extrusion of Plastic: Type of extruder, extrusion of film, pipe, Cable and Sheet – Principle

Pressure forming and Vacuum forming

Unit VI **Manufacturing of Composites** **[08 Hr.]**

Introduction to composites, Composite properties, Matrices, Fiber reinforcement

Composite Manufacturing Processes: Hand lay-up Process, Spray lay-up, Filament winding process, Resin transfer moulding, Pultrusion, and Compression moulding process, Vacuum impregnation process, Processing of metal matrix composites, Fabrication of ceramic matrix composites, Carbon-carbon composites, Polymer matrix and nano-composites

Books & Other Resources

Text Books

1. P. N. Rao, “Manufacturing Technology Vol. I & II” , Tata McGraw Hill Publishers
2. P. C. Sharma, “Production Engineering”, Khanna Publishers

Reference Books

1. R. K. Jain, “Production Technology”, Khanna Publishers
2. K. C. Chawala, “Composite Materials”, Springer, ISBN 978-0387743646, ISBN 978-0387743653
3. Brent Strong, “Fundamentals of Composites Manufacturing: Materials, Methods”, SME Book series

202051 - Machine Shop

Teaching Scheme	Credits	Examination Scheme
Practical : 02 Hr./Week	**01** Practical : 01	In-Semester : 30 Marks End-Semester : 70 Marks Term Work : 50 Marks

Prerequisite Courses
Workshop Practice

Course Objectives
1. To understand the basic procedures, types of equipment, tooling used for sand casting and metal forming processes through demonstrations and/(or) Industry visits..
2. To understand TIG/ MIG/ Resistance/Gas welding welding techniques.
3. To acquire skills to handle grinding and milling machine and to produce gear by milling.
4. To acquire skills to produce a composite part by manual process.

Course Outcomes
On completion of the course, learner will be able to
CO1. PERFORM welding using TIG/ MIG/ Resistance/Gas welding technique
CO2. MAKE Fibre-reinforced Composites by hand lay-up process or spray lay-up techniques
CO3. PERFORM cylindrical/surface grinding operation and CALCULATE its machining time
CO4. DETERMINE number of indexing movements required and acquire skills to PRODUCE a spur gear on a horizontal milling machine
CO5. PREPARE industry visit report
CO6. UNDERSTAND procedure of plastic processing

Guidelines for Laboratory Conduction

The student shall complete the following activity as a Term Work

Practical *(Select any One Practical from Practical # 1 & 2; Select any Five Practical from Practical # 3 to 8; Perform Total Six Practicals)*
1. To study and observe various stages of casting through demonstration of sand casting process from pattern making, sand mould preparation and melting and pouring of metal.
2. Visit to any foundry/ permanent mould casting industry to demonstrate various stages of casting and make a report on it.
3. A compulsory visit to any one metal forming industry out of: Rolling mill, Forging plant, Wire/Tube drawing unit and prepare a report on it.
4. A demonstration of any one welding technique out of TIG/ MIG/Resistance/Gas welding. A job drawing to be prepared by an individual institute with details of welding process parameters with weld joint design such as edge preparation, type and size of electrode used, welding current, voltage etc.
5. Manufacturing of Fibre-reinforced Composites by hand lay-up process or spray lay-up techniques.
6. Demonstration on any one plastic component like bottle, bottle caps, machine handles etc. by injection moulding process/ by additive manufacturing process.
7. Demonstration on cylindrical grinding/surface grinding operations, measurement of surface roughness produced and estimation of machining time.
8. Demonstration on indexing mechanism. Calculation of index crank and index plate movement by simple/compound/differential indexing and manufacture of spur gear on a milling machine using indexing head.

Instructions for Laboratory Conduction

Please note following instructions regarding Laboratory Conduction:
1. Industrial Visits to be conducted by the Teaching **Faculty** (subject Teacher).
2. Demonstration of Welding machines, Surface/Cylindrical Grinding, Milling machine, Indexing head and calculation of indexing to be taught by a **subject Teacher in Practical slot**.

202052 - Project Based Learning - II

Teaching Scheme	Credits	Examination Scheme
Practical : 04 Hr./Week	**02** Practical : 02	Term Work : 50 Marks

Preamble

Currently, engineering education is undergoing significant structural changes worldwide. The rapidly evolving technological landscape forces educators to constantly reassess the content of engineering curricula in the context of emerging fields and with a multidisciplinary focus. In this process, it is necessary to devise, implement and evaluate innovative pedagogical approaches for the incorporation of these novel subjects into the educational programs without compromising the cultivation of the traditional skills. In this context, the educational community is showing rapidly rising interest in project-based learning approaches.

The mainstream engineering education follows traditional classroom teaching, in which the major focus is mainly on the lecture and the student has very little (if any) choice on the learning process. However rapid development in engineering and technology requires adopting a teaching approach that would assist students not only in developing a core set of industry relevant skills, but also enable them to adapt to changes in their professional career.

Course Objectives

1. To emphasize project based learning activities that are long-term, interdisciplinary and student-centric.
2. To inculcate independent and group learning by solving real world problems with the help of available resources.
3. To be able to develop applications based on the fundamentals of mechanical engineering by possibly applying previously acquired knowledge.
4. To get practical experience in all steps in the life cycle of the development of mechanical systems: specification, design, implementation, and testing.
5. To be able to select and utilize appropriate concepts of mechanical engineering to design and analyze selected mechanical system.

Course Outcomes

On completion of the course, learner will be able to

CO1. IDENTIFY the real-world problem (possibly of interdisciplinary nature) through a rigorous literature survey and formulate / set relevant aims and objectives.

CO2. ANALYZE the results and arrive at valid conclusions.

CO3. PROPOSE a suitable solution based on the fundamentals of mechanical engineering by possibly integration of previously acquired knowledge.

CO4. CONTRIBUTE to society through proposed solutions by strictly following professional ethics and safety measures.

CO5. USE of technology in proposed work and demonstrate learning in oral and written form.

CO6. DEVELOP ability to work as an individual and as a team member.

Group Structure

Working in supervisor/mentor –monitored groups. The students plan, manage and complete a task/project/activity which addresses the stated problem.

1. Create groups of 5 (five) to 6 (six) students in each class
2. A supervisor/mentor teacher is assigned to 3-4 groups or one batch

Project Selection

The project can be selected by undertaking a survey of journal papers, patents or field visit (A problem can be theoretical, practical, social, technical, symbolic, cultural and/or scientific). The problem shall consist of following facets: feasibility of arriving at a solution, analyzing the problem, design and development of the system (hardware or virtual).

There are no commonly shared criteria/ guidelines for what constitutes an acceptable project. Projects vary greatly in the depth of the questions explored, the clarity of the learning goals, the content and structure of the activity undertaken.

Solution to problem-based projects through ***"learning by doing"*** is recommended. The model begins with the identifying of a problem, often growing out of a question or "wondering". This formulated problem then stands as the starting point for learning. A problem can be theoretical, practical, social, technical, symbolic, cultural and/or scientific and grows out of students" wandering within different disciplines and professional environments. As stated in the preamble as the world has adapted and propagated multidisciplinary approach, hence the proposed project activity preferably should not be restricted to only mechanical domain specific projects rather should be Interdisciplinary in nature. However the chosen problem should be integration of other streams of engineering with Mechanical engineering.

Although in a genuine case 100% software/ virtual project topic may be allowed.

Ethical Practices, teamwork and project management:
Use Indian standards or any relevant standards for project manufacturing, respect the time of others, attend the reviews, poster presentation and model exhibitions, strictly follow the deadline of project completion, comply with all legislation requirements that govern workplace health and safety practices.

Effective Documentation
In order to make our engineering graduates capable of preparing effective documentation, it is required for the students to learn the effective writing skills. The PBL final report is expected to consist of the Literature Survey, Problem Statement, Aim and Objectives, System Block Diagram, System Implementation Details, Discussion and Analysis of Results, Conclusion, System Limitations and Future Scope. Many freely available software tools (for instance Mendley (Elsevier), Grammarly) are expected to be used during the preparation of PBL synopsis and final report. It is expected that the PBL guides/mentors shall teach students about utilizing valid sources of information (such as reference papers, books, magazines, etc) related to their PBL topic.

Evaluation & Continuous Assessment
The institution/head shall be committed to ensuring the effective and rigorous implementation of the idea of project based learning. Progress of PBL shall be monitored regularly on a weekly basis. Weekly review of the work shall be necessary. During the process of monitoring and continuous assessment and evaluation the individual and team performance is to be measured. PBL is monitored and continuous assessment is done by supervisor /mentor and authorities. Students must maintain an institutional culture of authentic collaboration, self-motivation, peer-learning and personal responsibility. The institution/department should support students in this regard through guidance/orientation programs and the provision of appropriate resources and services. Supervisor/mentor and Students must actively participate in assessment and evaluation processes.

The effectiveness of the concept PBL lies in rigorous and continuous assessment and evaluation of the student performance. It is recommended that all activities are required to be recorded regularly. A regular assessment of PBL work is required to be maintained at the department in PBL log book by students. It is expected that the PBL log book must include following:

1. Information of students and guide
2. Weekly monitoring by the PBL guide,
3. Assessment sheet for PBL work review by PBL guide and PBL Evaluation Committee (PEC).

The PEC structure shall consist of Head of the department, 1/2 senior faculties of the department and one industry expert (optional). Continuous Assessment Sheet (CAS) is to be maintained by the department.

Recommended parameters for assessment, evaluation and weightage

1. Idea Inception (kind of survey). (10%)
2. Documentation (Gathering requirements, design & modeling, implementation/execution, use of technology and final report, other documents). (15%)
3. Attended reviews, poster presentation and model exhibition. (10%)

4. Demonstration (Poster Presentation, Model Exhibition etc). (10%).
5. Awareness /Consideration of - Environment/ Social /Ethics/ Safety measures/Legal aspects. (5%)
6. Outcome (physical model/prototype/ virtual model/ product development/ assembly & disassembly and analysis of standard mechanism or system, design and development of small applications using Arduino, design of control systems, development of various systems/ subsystems of BAJA/SUPRA/Robots/GoKart/ Sunrisers/Hackathon/ application development and similar activities/ System performance and analysis) (40%)
7. Participation in various competitions/ publication/ copyright/ patent) (10%)

Learning Resources

Reference Books / Research Articles

1. John Larmer, John R. Mergendoller, and Suzie Boss, "Setting the Standard for Project Based Learning"
2. John Larmer and Suzie Boss, "Project Based Teaching: How to Create Rigorous and Engaging Learning Experiences"
3. Erin M. Murphy and Ross Cooper, "Hacking Project Based Learning: 10 Easy Steps to PBL and Inquiry"

Web resources

1. https://www.edutopia.org/project-based-learning
2. www.howstuffworks.com
3. https://www.pblworks.org/
4. www.wikipedia.org

202053 - Audit Course - IV		
Teaching Scheme	**Credits**	**Examination Scheme**
-	-	-

GUIDELINES FOR CONDUCTION OF AUDIT COURSE

Faculty mentor shall be allotted for individual courses and he/she shall monitor the progress for successful accomplishment of the course. Such monitoring is necessary for ensuring that the concept of self learning is being pursued by the students 'in true letter and spirit'.

- If any course through Swayam/ NPTEL/ virtual platform is selected the minimum duration shall be of 8 weeks.
- However if any of the course duration is less than the desired (8 weeks) the mentor shall ensure that other activities in form of assignments, quizzes, group discussion etc. (allied with the course) for the balance duration should be undertaken.

In addition to credits courses, it is mandatory that there should be an audit course (non-credit course) from second year of Engineering. The student will be awarded grade as AP on successful completion of the audit course. The student may opt for any one of the audit courses in each semester. Such audit courses can help the student to get awareness of different issues which make an impact on human lives and enhance their skill sets to improve their employability. List of audit courses offered in the semester is provided in the curriculum. Students can choose one of the audit courses from the list of courses mentioned. Evaluation of the audit course will be done at institute level.

The student registered for audit course shall be awarded the grade AP and shall be included such grade in the Semester grade report for that course, provided student has the minimum attendance as prescribed by the Savitribai Phule Pune University and satisfactory in-semester performance and secured a passing grade in that audit course. No grade points are associated with this 'AP' grade and performance in these courses is not considered in the calculation of the performance indices SGPA and CGPA. Evaluation of the audit course will be done at institute level itself.

Selecting an Audit Course

List of Courses to be opted (Any one) under Audit Course IV

- Language & Mind Emotional Intelligence
- Advanced Foreign Language (preferably German/ Japanese)
- Human Behaviour
- Speaking Effectively
- Business Ethics
- Technical writing/ Research writing

The titles indicated above are subject to change in time to come and such an alteration (if any) should be brought to the notice of the BoS.

Using NPTEL Platform: (preferable)

NPTEL is an initiative by MHRD to enhance learning effectiveness in the field of technical education by developing curriculum based video courses and web based e-courses. The details of NPTEL courses are available on its official website www.nptel.ac.in

- Students can select any one of the courses mentioned above and has to register for the corresponding online course available on the NPTEL platform as an Audit course.
- Once the course is completed the student can appear for the examination as per the guidelines on the NPTEL portal.
- After clearing the examination successfully; student will be awarded with a certificate.

Assessment of an Audit Course

- The assessment of the course will be done at the institute level. The institute has to maintain the record of the various audit courses opted by the students. The audit course opted by the students could be interdisciplinary.
- During the course students will be submitting the online assignments. A copy of the same can be submitted as a part of term work for the corresponding Audit course.
- On the satisfactory submission of assignments, the institute can mark as "Present" and the student will be awarded the grade AP on the mark sheet.