# Savitribai Phule Pune University, Pune

## BE(Electronics & Telecommunication)

## (2012 course revised syllabus )

**( w.e.f. June 2015)**

# BE (E & TC) Structure
# 2012 Course w.e.f. June 2015
# Semester-I

| Subject Code | Subject | Teaching Scheme | | | Examination Scheme | | | | | Marks |
|---|---|---|---|---|---|---|---|---|---|---|
| | | LECT | TUT | PR | In Semester Assessment Phase I | PR | OR | TW | End Semester Examination Phase II | Total |
| 404181 | VLSI Design & Technology | 3 | | | 30 | | | | 70 | 100 |
| 404182 | Computer Networks | 3 | | | 30 | | | | 70 | 100 |
| 404183 | Microwave Engineering | 4 | | | 30 | | | | 70 | 100 |
| 404184 | Elective I | 3 | | | 30 | | | | 70 | 100 |
| 404185 | Elective II | 3 | | | 30 | | | | 70 | 100 |
| 404186 | Lab Practice I (CN & MWE) | | | 4 | | | 50 | 50 | | 100 |
| 404187 | Lab Practice II (VLSI &Elective I) | | | 4 | | 50 | | 50 | | 100 |
| 404188 | Project Phase I | | 2 | | | | 50 | | | 50 |
| | **Total** | **16** | 2 | 8 | 150 | 50 | 100 | 100 | 350 | 750 |

**Elective I**

1. Digital Image Processing
2. Embedded Systems & RTOS
3. Software Defined Radio
4. Industrial Drives and Control

**Elective II**

1. Multi rate & Adaptive Signal Processing
2. Electronic Product Design
3. PLCs and Automation
4. Artificial Intelligence

# Semester-II

| Subject Code | Subject | Teaching Scheme | | | Examination Scheme | | | | | Marks |
|---|---|---|---|---|---|---|---|---|---|---|
| | | LECT | TUT | PR | In Semester Assessment Phase I | PR | OR | TW | End Semester Examination Phase II | Total |
| 404189 | Mobile Communication | 4 | | | 30 | | | | 70 | 100 |
| 404190 | Broadband Communication Systems | 4 | | | 30 | | | | 70 | 100 |
| 404191 | Elective III | 3 | | | 30 | | | | 70 | 100 |
| 404192 | Elective IV | 3 | | | 30 | | | | 70 | 100 |
| 404193 | Lab Practice III(MC & BCS) | | | 4 | | | 50 | 50 | | 100 |
| 404194 | Lab Practice IV(Elective III) | | | 2 | | 50 | | 50 | | 100 |
| 404195 | Project Phase II | | 6 | | | 50 | | 100 | | 150 |
| | **Total** | **14** | **6** | **6** | **120** | **100** | **50** | **200** | **280** | **750** |

**Elective III**

1. Speech & Audio Signal Processing
2. RF Circuit Design
3. Audio Video Engineering
4. Soft Computing

**Elective IV**

1. Biomedical Signal Processing
2. Nano Electronics & MEMS
3. Detection & Estimation Theory
4. Wireless Networks
5. Open Elective*

***Any one subject 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). Repetition of subjects or topics is to be avoided.**

**Dr. D. S. Bormane**
**Chairman, BOS(Electronics)**

# VLSI Design & Technology(404181)

| | | |
|---|---|---|
| **Teaching Scheme:**<br>Lectures: 3 Hrs/ Week | | **Examination Scheme:**<br>In Semester Assessment:<br>Phase I : 30<br>End Semester Examination:<br>Phase II: 70 |

## Course Objectives:

- To study HDL based design approach.
- To learn digital CMOS logic design.
- To nurture students with CMOS analog circuit designs.
- To realize importance of testability in logic circuit design.
- To overview SoC issues and understand PLD architectures with advanced features.

## Course Outcomes:

Aftersuccessfully completing the course, students will be able to

- Model digital circuit with HDL, simulate, synthesis and prototype in PLDs.
- Understand chip level issues and need of testability.
- Design analog & digital CMOS circuits for specified applications.

### Unit I: VHDL Modeling 7L

Data objects, Data types, Entity, Architecture & types of modeling, Sequential statements, Concurrent statements, Packages, Sub programs, Attributes, VHDL Test bench, Test benches using text files. VHDL modeling of Combinational, Sequential logics & FSM, Meta-stability.

### Unit II: PLD Architectures 7L

PROM, PLA, PAL: Architectures and applications. Software Design Flow. CPLD Architecture, Features, Specifications, Applications. FPGA Architecture, Features, Specifications, Applications.

### Unit III: SoC& Interconnect 6L

Clock skew, Clock distribution techniques, clock jitter. Supply and ground bounce, power distribution techniques. Power optimization. Interconnect routing techniques; wire parasitic, Signal integrity issues. I/O architecture, pad design. Architectures for low power.

### Unit IV: Digital CMOS Circuits 7L

MOS Capacitor, MOS Transistor theory, C-V characteristics, Non ideal I-V effects, Technology

Scaling. CMOS inverters, DC transfer characteristics, Power components, Power delay product. Transmission gate. CMOS combo logic design. Delays: RC delay model, Effective resistance, Gate and diffusion capacitance, Equivalent RC circuits; Linear delay model, Logical effort, Parasitic delay, Delay in a logic gate, Path logical efforts.

Unit V: Analog CMOS Design 7L

Current sink and source, Current mirror. Active load, Current source and Push-pull inverters. Common source, Common drain, Common gate amplifiers. Cascode amplifier, Differential amplifier, Operational amplifier.

Unit VI: Testability6L

Types of fault, Need of Design for Testability (DFT), Testability, Fault models, Path sensitizing, Sequential circuit test, BIST, Test pattern generation, JTAG & Boundary scan, TAP Controller.

**Text Books**


1. Charles H. Roth, "Digital systems design using VHDL", PWS.
2. Wyane Wolf, "Modern VLSI Design (System on Chip)", PHI Publication.


**Reference Books**


1. Allen Holberg, "Analog CMOS Design", Oxford University Press.
2. Neil H. E. Weste, David Money Harris, "CMOS VLSI Design: A Circuit & System Perspective", Pearson Publication

# Computer Networks(404182)

| | | |
|---|---|---|
| **Teaching Scheme:**<br>Lectures:3 Hrs/ Week | | **Examination Scheme:**<br>In Semester Assessment:<br>Phase I : 30<br>End Semester Examination:<br>Phase II: 70 |
| | | |

## Course Objectives:

- Understand state-of-the-art in network protocols, architectures, and applications
- To provide students with a theoretical and practical base in computer networks issues
- Define the basic terminology of computer networks
- Recognize the individual components of the big picture of computer networks
- Outline the basic network configurations
- List the layers of the TCP/IP and OSI model and describe the duties of each layer
- Understand the transmission methods underlying LAN and WAN technologies.

## Course Outcomes:

After successfully completing the course students will be able to

- Understand fundamental underlying principles of computer networking
- Describe and analyze the hardware, software, components of a network and the interrelations.
- Analyze the requirements for a given organizational structure and select the most appropriate networking architecture and technologies;
- Have a basic knowledge of the use of cryptography and network security;
- Have a basic knowledge of installing and configuring networking applications.
- Specify and identify deficiencies in existing protocols, and then go onto select new and better protocols.

## Unit I: Physical Layer 6L

Data Communications, Networks, Network types, Protocol layering, OSI model, Layers in OSI model, TCP / IP protocol suite, Addressing, Guided and Unguided Transmission media. Switching: Circuit switched networks, Packet Switching, Structure of a switch.

## Unit II: Data Link Layer 6L

Introduction to Data link Layer, DLC Services, DLL protocols, HDLC, PPP, Media Access Control: Random Access, Controlled Access, Channelization. Wired LAN:Ethernet Protocol, Standard Ethernet, Fast Ethernet, Giagabit Ethernet, 10 Gigabit Ethernet.

Unit III:Wireless LANS & Virtual Circuit Networks 6L

Introduction, Wireless LANS: IEEE 802.11 project, Bluetooth, Zigbee, Connecting devices and Virtual LANS: Connecting devices, Virtual LANS.

Unit IV:Network Layer6L

Network Layer Services, Packet Switching, Network layer performance, IPv4, addresses, Forwarding of IP packets, Network layer protocols: IP, ICMPv4, Mobile IP, Unicast Routing: Introduction, Routing Algorithms, Unicast Routing protocols, Multicast Routing Introduction, Next Generation IP:IPv6 Addressing, The IPv6 protocol, ICMPv6, Transition from IPv4 to IPv6.

Unit V:Transport Layer 6L

Introduction, Transport layer protocols and services, Port numbers User Datagram Protocol (UDP), Transmission Control protocol (TCP), SCTP, Quality of services: Dataflow characteristics, Flow Control.

Unit VI:Application Layer 6L

Introduction, World Wide Web and HTTP, FTP, Electronic mail, Telnet, Name System (DNS), Cryptography and Network Security: Introduction, Symmetric key ciphers and Asymmetric key Ciphers**,** Introduction to network security.

**Text Books**


1. Behrouz A. Foruzan, "Data communication and Networking", Tata McGraw-Hill,5th Edition
2. James F. Kurouse& W. Rouse, "Computer Networking: A Top down Approach", 6th Edition, 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. Greg Tomsho, Ed Tittel, David Johnson. "Guide to Networking Essentials", fifth edition, Thomson India Learning, 2007.

# Microwave Engineering(404183)

| | | |
|---|---|---|
| **Teaching Scheme:**<br>Lectures: 4 Hrs/ Week | | **Examination Scheme:**<br>In Semester Assessment:<br>Phase I : 30<br>End Semester Examination:<br>Phase II: 70 |

## Course Objectives:

- To lay the foundation for microwave engineering
- To understand the applications of microwave engineering
- Carryout the microwave network analysis.

## Course Outcomes:

Aftersuccessfully completing the course students will be able to

- Formulate the wave equation in wave guide for analysis.
- Identify the use of microwave components and devices in microwave applications.
- Understand the working principles of all the microwave tubes
- Understand the working principles of all the solid state devices
- Choose a suitable microwave tube and solid state device for a particular application
- Carry out the microwave network analysis
- Choose a suitable microwave measurement instruments and carry out the required measurements.

## Unit I : Transmission Lines and Waveguides 8L

Introduction to Microwaves engineering: History of Microwaves, Microwave Frequency bands. Applications of Microwave.

General solution for TEM, TE and TM waves,Parallel plate waveguide, and rectangular waveguide. Wave guide parameters. Introduction tocoaxial line, Rectangular waveguide cavity resonators, Circular waveguide cavity resonators

## Unit II : Microwave Components 8L

**Multi port junctions**: Construction and operation of E-plane, H-plane, Magic Tee and Directional couplers.

**Ferrites components**: - Ferrite Composition and characteristics, Faraday rotation, Construction and operation of Gyrator, Isolator and Circulator.

**Striplines**: Structural details and applications of Striplines, Microstrip line, Parallel Strip line, Coplanar Strip line, Shielded Strip Line.

## Unit III : Microwave Network Analysis 6L

Introduction and applications of Impedance and Equivalent voltages and currents, Impedance and Admittance matrices, The Transmission (ABCD) matrix

**Scattering Matrix**:-Significance, formulation and properties. S-Matrix calculations for-2 port network junction, E plane, H-plane and E-H (Magic Tee) Tees, Directional coupler, Isolator and Circulator. Related problems.

## Unit IV : Microwave Tubes 8L

Limitations of conventional tubes, O and M type classification of microwave tubes, reentrant cavity, velocity modulation.

**O type tubes**

**Two cavity Klystron**: Construction and principle of operation, velocity modulation and bunching process Applegate diagram.

**Reflex Klystron**: Construction and principle of operation, velocity modulation and bunching process, Applegate diagram, Oscillating modes, o/p characteristics, efficiency, electronic & mechanical tuning.

**M-type tubes**

**Magnetron**: Construction and Principle of operation of 8 cavity cylindrical travelling wave magnetron, hull cutoff condition, modes of resonance, PI mode operation, o/p characteristics, Applications.

**Slow wave devices**

Advantages of slow wave devices, **Helix TWT**: Construction and principle of operation, Applications.

## Unit V :Microwave Solid State Devices8L

Microwave bipolar transistor, FET, MESFET, Varactor Diode, PIN Diode, Shottky Barrier Diode, Tunnel Diode, TEDs, Gunn Diodes, IMPATT diode and TRAPATT diode. Structural details, Principle of operation, various modes, specifications, and applications of all these devices.

## Unit VI : Microwave Measurements 6L

Measurement devices: Slotted line, Tunable detector, VSWR meter, Power Meter, S-parameter measurement, frequency measurements, Power measurement, Attenuation measurement, Phase shift measurement, VSWR measurement, Impedance measurement, Q of cavity resonator measurement

| **Text Books** |
| --- |
| 1. Samuel Y. Liao, “Microwave Devices and Circuits”, 3rd edition, Pearson<br>2. David M. Pozar, “Microwave Engineering", Fourth edition, Wiley. |
| |
| **Reference Books** |
| 1. M. Kulkarni, “Microwave and Radar engineering”, 3rd edition, Umesh Publications<br>2. ML Sisodia& GS Raghuvamshi, “Microwave Circuits and Passive Devices”Wiley, 1987<br>3. M L Sisodia& G S Raghuvanshi, “Basic Microwave Techniques and Laboratory Manual”, New Age International (P) Limited, Publishers. |
| |

# Digital Image Processing(404184)

| | | |
|---|---|---|
| **Teaching Scheme:**<br>Lectures:3 Hrs/ Week | | **Examination Scheme:**<br>In Semester Assessment:<br>Phase I : 30<br>End Semester Examination:<br>Phase II: 70 |

## Course Objectives:

- To learn the fundamental concepts of Digital Image Processing.
- To study basic image processing operations.
- To understand image analysis algorithms.
- To expose students to current applications in the field of digital image processing.

## Course Outcomes:

After successfully completing the course students will be able to

- Develop and implement algorithms for digital image processing.
- Apply image processing algorithms for practical object recognition applications.

## Unit I : Fundamentals of Image Processing 6L

Steps in image processing, Human visual system, Sampling & quantization, Representing digital images, Spatial & gray-level resolution, Image file formats, Basic relationships between pixels, Distance Measures. Basic operations on images-image addition, subtraction, logical operations, scaling, translation, rotation. Image Histogram. Color fundamentals & models – RGB, HSI YIQ.

## Unit II: Image Enhancement and Restoration 6L

Spatial domain enhancement: Point operations-Log transformation, Power-law transformation, Piecewise linear transformations, Histogram equalization. Filtering operations- Image smoothing, Image sharpening.

Frequency domain enhancement: 2D DFT, Smoothing and Sharpening in frequency domain.Homomorphic filtering.

Restoration: Noise models, Restoration using Inverse filtering and Wiener filtering

## Unit III: Image Compression 6L

Types of redundancy, Fidelity criteria, Lossless compression – Runlength coding, Huffman coding, Bit-plane coding, Arithmetic coding. Introduction to DCT, Wavelet transform. Lossy compression – DCT based compression, Wavelet based compression. Image and Video Compression Standards – JPEG, MPEG.

## Unit IV: Image Segmentation and Morphological Operations 6L

Image Segmentation: Point Detections, Line detection, Edge Detection-First order derivative – Prewitt and Sobel. Second order derivative – LoG, DoG, Canny. Edge linking, Hough Transform, Thresholding – Global, Adaptive. Otsu's Method. Region Growing, Region Splitting and Merging. Morphological Operations: Dilation, Erosion, Opening, Closing, Hit-or-Miss transform, Boundary Detection, Thinning, Thickening, Skeleton.

## Unit V: Representation and Description 6L

Representation – Chain codes, Polygonal approximation, Signatures. Boundary Descriptors – Shape numbers, Fourier Descriptors, Statistical moments. Regional Descriptors – Topological, Texture. Principal Components for Description.

## Unit VI: Object Recognition and Applications 6L

Feature extraction, Patterns and Pattern Classes, Representation of Pattern classes, Types of classification algorithms, Minimum distance classifier, Correlation based classifier, Bayes classifier. Applications: Biometric Authentication, Character Recognition, Content based Image Retrieval, Remote Sensing, Medical application of Image processing

**Text Books**


1. Rafael C. Gonzalez and Richard E. Woods, "Digital Image Processing", Third Edition, - Pearson Education
2. S Sridhar, "Digital Image Processing", Oxford University Press.


**Reference Books**


1. Rafael C. Gonzalez, Richard E. Woods, and Steven L. Eddins, "Digital Image Processing Using MATLAB", Second Edition, - Tata McGraw Hill Publication
2. S Jayaraman, S Esakkirajan, T Veerakumar, "Digital Image Processing", Tata McGraw Hill Publication


**List of Experiments:**

**Note: Experiments are to be performed using software preferably open source.**

1. To perform basic operations on images.
2. To perform conversion between color spaces.
3. To perform histogram equalization.
4. To perform image filtering in spatial domain.
5. To perform image filtering in frequency domain.
6. To perform image restoration.
7. To perform image compression using DCT / Wavelet transform.
8. To perform edge detection using various masks.
9. To perform global and adaptive thresholding.
10. To apply morphological operators on an image.
11. To obtain boundary / regional descriptors of an image.
12. To perform image classification / recognition

# Embedded Systems & RTOS(404184)

| **Teaching Scheme:** | | **Examination Scheme:** |
|---|---|---|
| Lectures: 3 Hrs/ Week | | In Semester Assessment:<br>Phase I : 30<br>End Semester Examination:<br>Phase II: 70 |

## Course Objectives:

- To understand the Embedded system design issues.
- To learn real time operating system concepts.
- To understand the Embedded Linux environment
- To learn Embedded software development and testing process.

## Course Outcomes:

Aftersuccessfully completing the course students will be able to

- Get insight of design metrics of Embedded systems to design real time applications to match recent trends in technology.
- Understand Real time systems concepts.
- Understand Linux operating system and device drivers.
- Get to know the hardware – software co design issues and testing methodology for Embedded system.

## Unit I:Introduction to Embedded Systems 6L

Introduction to Embedded Systems, Architecture, Classification and Characteristics of Embedded System, Design Process, Design Metrics and optimization of various parameters of embedded system. Embedded processor technology, IC technology, Design technology. Software development life cycle. Various models like waterfall, spiral, V , Rapid Prototyping models and Comparison

## Unit II: Real Time Systems Concepts 6L

Foreground/ Background systems, Critical section of code, Resource, Shared resource, multitasking, Task, Context switch, Kernel, Scheduler, Non-Preemptive Kernel , Preemptive Kernel, Reentrancy, Round robin scheduling, Task Priorities, Static & Dynamic Priority, Priority Inversion, Assigning task priorities, Mutual Exclusion, Deadlock, Clock Tick, Memory requirements, Advantages & disadvantages of real time kernels.

| |
|---|
| Unit III: µCOS II 6L |
| Features of µCOS II. Kernel structure. µCOS II RTOS services:Task management, Time management, Intertask Communication and Synchronization. |
| |
| Unit IV: Embedded Linux Development Environment 6L |
| Need of Linux, Embedded Linux Today, Open Source and the GPL, BIOS Versus Boot loader, Anatomy of an Embedded System, Storage Considerations, Embedded Linux Distributions. Embedded Development Environment, Cross-Development Environment, Host System Requirements, Hosting Target Boards. Development Tools, GNU Debugger, Tracing and Profiling Tools, Binary Utilities. |
| |
| Unit V: Linux Kernel Construction 6L |
| Linux Kernel Background, Linux Kernel Construction, Kernel Build System, Kernel Configuration. Role of a Bootloader, Bootloader Challenges. A Universal Bootloader: Das U-Boot. Porting U-Boot. Device Driver Concepts, Module Utilities, Driver Methods. Linux File System & Concepts |
| |
| Unit VI : Embedded Software Development, Testing Process and Tools 6L |
| Embedded Software development process and tools, Host and Target Machines, linking and Locating Software, Getting Embedded Software into the Target System, Issues in Harware-Software Design and Co-design. Testing on Host Machine, Simulators, Laboratory Tools. Case study of Embedded system like Automatic Chocolate Vending Machine, Mobile Phone. |
| |
| **Text Books** |
| 1. Jean J.Labrosse, "MicroC OS II, The Real-Time Kernel", 2nd edition, CMP Books.<br>2. Christopher Hallinan, "Embedded Linux Primer -A Practical, Real-World Approach "2nd edition, Prentice Hall. |
| **Reference Books** |
| 1. Raj Kamal, "Embedded Systems – Architecture, Programming and Design" 2nd edition, McGraw Hill.<br>2. Frank Vahid and Tony Givargis, " Embedded System Design – A Unified hardware/ Software introduction " 3rd edition, Wiley. |
| **List of Experiments:**<br><br>**Group A: ARM7/ ARM Cortex- M3&µCOS - II Based Experiments (any four)**<br>1. Multitasking in µCOS II RTOS using minimum 3 tasks on ARM7/ ARM Cortex- M3. |

2. Semaphore as signaling & Synchronizing on ARM7/ ARM Cortex- M3.
3. Mailbox implementation for message passing on ARM7/ ARM Cortex- M3.
4. Queue implementation for message passing on ARM7/ ARM Cortex- M3.
5 Implementation of MUTEXusing minimum 3 tasks on ARM7/ ARM Cortex- M3.

**Group B: ARM9 & LINUX Based Experiments (any four)**

6. Download pre-configured Kernel Image, File System, bootloader to target device- ARM9.
7. Writing simple application using embedded Linux on ARM9.
8. Writing "Hello World" device Driver. Loading into & removing from Kernel on ARM9 board.
9. Write a program for I2C based RTC using embedded Linux on ARM9.
10. Using Device driver for GPIO, write a program to blink LED onARM9.
11. Write a program for External InterruptonARM9.

# Software Defined Radio(404184)

| **Teaching Scheme:** | | **Examination Scheme:** |
|---|---|---|
| Lectures: 3 Hrs/ Week | | In Semester Assessment:<br>Phase I : 30<br>End Semester Examination:<br>Phase II: 70 |

## 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:

Aftersuccessfully completing the course students will be able to

- Compare SDR with traditional Hardware Radio HDR
- Implement modern wireless system based on OFDM, MIMO & Smart Antenna
- Build experiment with real wireless waveform and applications, accessing both PHY and MAC, Compare SDR versus MATLAB and Hardware Radio
- Work on open projects and explore their capability to build their own communication system.

## Unit I : Software Defined Radio fundamentals 6L

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

Case study : AM/FM/BPSK/QPSK/OFDM Simulation in Matlab

## Unit II : SDR Architecture 6L

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

Case Study : JTRS –Goals of SCA ,Architectural details ,SDR forum Architecture

## Unit III : Multi Rate Signal Processing 6L

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 6L

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 V : Cognitive Radio 6L

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 6L

Application of 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

**Reference Books:**


1. Markus Dillinger , KambizMadani ,Nancy Alonistioti, Software Defined Radio : Architectures , Systems and Functions ,Wiley
2. Tony .J. Rouphael , RF and DSP for SDR, Elsevier Newness Press ,2008
3. Dr.TajStruman ,Evaluation of SDR –Main Document
4. SDR –Handbook , 8th Edition , PENTEK
5. Bruce a. Fette , Cognitive Radio Technology, Newness, Elsevier


**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

# Industrial Drives and Control(404184)

| | | |
|---|---|---|
| **Teaching Scheme:**<br>Lectures: 3 Hrs/ Week<br>Practical: 2 Hrs/ Week | | **Examination Scheme:**<br>In Semester Assessment:<br>Phase I : 30<br>End Semester Examination:<br>Phase II: 70 |

## 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:

- 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.
- 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.
- 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.
- Learn and understand working of cylindrical-rotor motor, salient-pole motor, reluctance motor, and permanent-magnet motors.
- Learn closed loop V/f control and load-commutated inverter (LCI) control. Variable reluctance & permanent magnet stepper motors & drives, switched reluctance motors & drives, brushless DC and AC motors & drives.

## Unit I: DC Drives 6L

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 II: Induction Motor Drives & Control 6L |
| 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 III: Special Motor Drives I 6L |
| Cylindrical rotor motor Drive, Salient pole motor Drive, Switched reluctance motor (SRM) drive, Synchronous Reluctance motor drive, self-controlled synchronous motor drives |
| Unit IV: Special Motor Drives II 6L |
| Permanent magnet Brushless DC motor drive, Permanent magnet AC synchronous motor drive, Variable reluctance & permanent magnet stepper motor, Stepper motor drives, Servo motor Drives. |
| Unit V: Drive Applications in Renewable Energy 6L |
| Power Electronics for wind power systems<br>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<br>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.<br>Power Electronics for Photovoltaic Power Systems<br>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: Applications of Artificial neural network and fuzzy logic in Drives 6L |
| Fuzzy logic Principle and applications: Introduction, Fuzzy sets, Fuzzy system, Fuzzy control, Fuzzy logic based induction motor speed control.<br>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<br>2. 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

**List of Experiments (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. V/f controlled AC induction motor drive
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 drive using PSIM/Matlab/MathCad
10. Simulation of Closed loop controlled AC motor drive using PSIM / Matlab/MathCad/ open source software

.

# Multi-rate and Adaptive Signal Processing(404185)

| | | |
|---|---|---|
| **Teaching Scheme:**<br>Lectures: 3Hrs/ Week | | **Examination Scheme:**<br>In Semester Assessment:<br>Phase I : 30<br>End Semester Examination:<br>Phase II: 70 |

## Course Objectives:

1. To extend students understanding of DSP concepts for designing filters and filter-banks
2. To understand various Multirate DSP applications
3. To extend MultirateconceptsintoMultiresolution analysis.
4. To make student learn the need of adaptive-ness in digital filters

## Course Outcomes:

1. The student will use theory of multirate processing for design of basic systems.
2. The student will be able to performmultiresolutionanalysis using Haar wavelet.
3. The student will show skills for design of adaptive filter for Wiener filter.

## Unit I: Basics Signal Processing 6L

Review of Fourier Transform ,Time and frequency averages, Time Bandwidth product, Stationary and Non-stationary signals. Limitations of Fourier Transform.
Review of Correlation: Auto and Cross, Covariance: Auto and Cross, Energy and Power signals, Spectral Density: Energy and Power, Parsevals Theorem. Concept of Function Space. Definition of Harr scaling and wavelet function. Difference between Fourier basis and Harr basis functions. Finding orthogonal projections of energy signals with finite support using Harr scaling and wavelet function.

## Unit II: Multi-rate DSP6L

Need for Multi-rate DSP, Decimation by factor D , Interpolation by factor I, Sampling rate conversion by rational factor I/D, Design of practical sampling rate converters, software implementation of sampling rate converters (Decimators and Interpolators), sample rate conversion using poly-phase filter structures

## Unit III: Time Frequency Representation of signals 6L

Time Frequency description of signals, Concept of Instantaneous frequency and Complex signal, Uncertainty principle, need for joint time frequency representation ,tiling diagrams. Short

Time Fourier Transform, Wigner Ville distribution, Continuous Wavelet Transform, Discretization of STFT & CWT, Spectrograms and Scalograms

## Unit IV:Time-Frequency (Wavelet) Analysis of signals 6L

Discrete Wavelet Transform and its relation to multi-rate filter banks. Decomposition of signals using Harr two band filter bank structure. Perfect reconstruction conditions.Axiomatic definition of Multi Resolution Analysis (MRA).Wavelet Packet Analysis versus Wavelet analysis.Problems on Wavelet analysis and Wavelet packet analysis.

## Unit V: Adaptive Filters 6L

Need of adaptive filters, adaptive filters as noise cancellation, configuration of adaptive filters, main components of adaptive filters, Basic Wiener filter theory-Wiener-Hopf Equation, Adaptive Algorithms: LMS basic adaptive algorithm, Implementation of basic LMS algorithm. Recursive least square algorithms (RLS).

## Unit VI:Applications of Multi- rate and adaptive signal processing techniques 6L

Efficient D/A conversion in Hi-fi systems. Subband coding of speech signals. Adaptive telephone echo cancellation. Application of wavelets in compression and de-noising. Advantages of Harr Lifting scheme in signal filtering. Problems on Harr Lifting scheme and de-noising.

**Text Books:**


1. John G. Proakis, Manolakis, "Digital Signal Processing, Principles, Algorithms and Applications", Pearson education, Fourth Edition, 2007.
2. E. C. Ifeachor and B. W. Jervis, "Digital Signal Processing- A Practical Approach", 2nd Edition, Pearson education. 2007.
3. Leon Cohen, "Time-Frequency Analysis", Prentice Hall,1995.


**Reference Books:**


1. S. D. Apte, "Advanced Digital Signal Processing," Wiley Publications, 2014.
2. K.P Soman, K.I Ramchandran, N.G.Reshmi , "Insight into Wavelets- from theory to Practice," PHI Learning Private Limited, Third Edition, 2010.

# Electronic Product Design(404185)

| | | |
|---|---|---|
| **Teaching Scheme:**<br>Lectures: 3 Hrs./ Week | | **Examination Scheme:**<br>In Semester Assessment:<br>Phase I : 30<br>End Semester Examination:<br>Phase II: 70 |

## Course Objectives:

- To understand the stages of product (hardware/ software) design and development.
- To learn the different considerations of analog, digital and mixed circuit design.
- To be acquainted with methods of PCB design and different tools used for PCB Design.
- To understand the importance of testing in product design cycle. `
- To understand the processes and importance of documentation.

## Course Outcomes:

Aftersuccessfully completing the course students will be able to

- Understand various stages of hardware, software and PCB design.
- Importance of product test & test specifications.
- Special design considerations and importance of documentation.

### Unit I: Introduction to Electronic Product Design 6L

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 6L

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 6L

Types of Software. Waterfall model of software development. Models, metrics and software limitations. Risk abatement and failure preventions. Software bugs and testing. Good

programming practice. User interface .Embedded, Real time software.

Unit IV: PCB design 6L

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 6L

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 : Documentation6L

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 university press.
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", CRC press.

# PLC&Automation(404185)

| | | |
|---|---|---|
| **Teaching Scheme:**<br>Lectures: 3 Hrs/ Week | | **Examination Scheme:**<br>In Semester Assessment:<br>Phase I : 30<br>End Semester Examination:<br>Phase II: 70 |
| | | |

## Course Objectives:

- Ability to recognize industrial control problems suitable for PLC control
- An over view of technology of advanced topics such as SCADA, DCS Systems, Digital Controller, CNC Machines.
- The ability to select the essential elements and practices needed to develop and implement the Engineering Automation using PLC approach.

## Course Outcomes:

Aftersuccessfully completing the course students will be able to

- Understand PLC architecture, PLC addressing concepts.
- Develop PLC ladder programs for simple industrial applications.
- Design Automation systems for industrial applications.

## Unit I: Process Control & Automation 6L

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 6L

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 6L

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: PLC and Human Machine Interface (HMI) 6L

Functions of PLC, Advantages, Architecture, working of PLC, Selection of PLC, Networking of PLCs, Ladder Programming, Interfacing Input and Output devices with PLC, PLC based automated systems. High frequency inputs. PLC programming standard IEC61131, Soft PLC techniques. **IT Interfaces required:** for ERP, MIS, MES. **Supporting Applications interfaces**: RFID, Barcode, Vision Systems**. HMI:** Block Diagram, Types, Advantages, Applications.

Unit V: SCADA & Distributed control system 6L

Elements of SCADA, Features of SCADA, MTU- functions of MTU, RTU- Functions of RTU, Applications of SCADA, Communications in SCADA- types & methods used, Mediums used for communication, Introduction to DCS, Architecture of DCS, Input and output modules, communication module, Specifications of DCS.

Unit VI: Automation and CNC (Computer Numeric Control) Machines 6L

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
3. Stuart A. Boyer, SCADA supervisory control and data acquisition, ISA Publication


**Reference Books**


1. John W. Webb, Ronold A Reis, "Programmable Logic Controllers, Principles and Applications"; 5th Edition, Prentice Hall of India Pvt. Ltd
2. Kilian, "Modern control technology: components & systems, Delmar 2nd edition.
3. Bela G Liptak, *Process software and digital networks,* 3rd edition, 2002.
4. Pollack. Herman, W & Robinson., T. "Computer Numerical Control", Prentice Hall. NJ.
5. Pabla, B.S. &Adithan, M. "CNC Machines", New Age Publishers, New Delhi

# Artificial Intelligence(404185)

| **Teaching Scheme:** | | **Examination Scheme:** |
|---|---|---|
| Lectures: 3Hrs/ Week | | In Semester Assessment:<br>Phase I : 30<br>End Semester Examination:<br>Phase II: 70 |

## 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 emerging technology.
- To understand the concepts of machine learning, probabilistic reasoning, robotics, computer vision, and natural language processing.
- To understand the numerous applications and huge possibilities in the field of AI that go beyond the normal human imagination.

## Course Outcomes:

After successfully completing the course students will be able to

- Design and implement key components of intelligent agents and expert systems.
- To apply knowledge representation techniques and problem solving strategies to common AI applications.
- Applyand integrate various artificial intelligence techniques in intelligent system development as well as understand the importance of maintaining intelligent systems.
- Build rule-based and other knowledge-intensive problem solvers.

## Unit I : Foundation 6L

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 7L

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 6L

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, Ontological Engineering, Categories and objects, Actions - Simulation and events, Mental events and mental objects.

## Unit IV : Learning 6L

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 : Perception and Expert System 5L

Visual perception-Waltz's algorithm, Introduction to Expert System, Architecture and functionality, Example Expert system

## Unit VI : Natural Language Understanding 6L

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**


1. Nils J. Nilsson, "Artificial Intelligence: A new Synthesis", Harcourt Asia Pvt. Ltd.
2. George F. Luger, "Artificial Intelligence-Structures and Strategies for Complex Problem Solving", Pearson Education/ PHI.

# Lab Practice - I (404186)

## CN and MWE

| **Teaching Scheme:** | | **Examination Scheme:** |
|---|---|---|
| Practical: 4 Hrs/week | | OR: 50Marks<br>TW:50Marks |

## Computer Networks

**List of the Experiments(Minimum 8 experiments are to be performed).**

1. Implementation of LAN using suitable multiuser Windows operating System and demonstrating client-server and peer to peer mode of configuration.
2. Installation and configuration of Web server.
3. Installation and configuration of FTP Server.
4. 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.
5. Socket Programming for client/Server application using Linux OS.
6. Installation and configuration of Telnet server for Telnet communication.
7. Installation and configuration of Proxy server.
8. Installation and configuration of DHCP server.
9. Study of IP Addresses subnetting and CIDR
10. Study of Network Protocol Analyzer tool/software.
11. Study of network monitoring tool/software.
12. Configuration of router & study of routing between LAN's
13. Simulating LAN or WAN using suitable network simulator.
14. Write a program for Encryption and Decryption
15. Write a program for implementation of Shortest Path algorithm.
16. Simulating LAN or WAN using suitable network simulator.
17. Study of wireless LANs (Demonstrating Data communication with Wi-Fi, Bluetooth networking etc).

## Microwave Engineering

**List of the Experiments(Minimum 8 experiments are to be performed):**

1. Study of microwave components and equipments.
2. Reflex Klystron as a Microwave source in laboratory and plot its mode characteristics.
3. Measurement of the free space wavelength of the microwave (for TE 10 mode) with the help of the X-band microwave test bench and verify with its theoretical calculation.
4. Study of Gunn Diode & PIN Modulator as a Microwave source. Plot the V-I characteristics.

5. Verification of Port Characteristics of Microwave Tees (E, H, E-H Planes).
6. Verification of Port Characteristics of Directional Coupler. Calculation of coupling factor, insertion loss and directivity.
7. Verification of Port Characteristics of Isolator and Circulator. Also calculation of insertion loss and isolation in dB.
8. Study of slotted section with probe carriage. Measure the VSWR for various values of terminating impedances (open/short/matched termination).
9. Study the Network Analyzer, Carry out the measurements of s-parameter measurement for the various microstrip components.
10. Explain in detail the concept of RF power measurement. Carry out the RF power measurement using microwave bench
11. To test and verify Microwave Integrated Circuits using Microstrip trainer kit and finds parameters, and plot the frequency response.

# Lab Practice - II (404187)

## VLSI and Elective I

| **Teaching Scheme:** | | **Examination Scheme:** |
|---|---|---|
| Practical: 4 Hrs/week | | PR: 50Marks<br>TW:50Marks |

## VLSI

**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.
4. D flip-flop.

## Elective I

Experiments to be chosen based on Elective I(Minimum 8 experiments are to be performed)

# Project Phase-I (404188)

| | | |
|---|---|---|
| **Teaching Scheme:**<br>Tutorial: 2Hrs/week | | **Examination Scheme:**<br>TW: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 work assessment.

2. The report consists of the Literature Survey, basic project work and the size of the report should be maximum of 40 pages.

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 certified copy of report is required to be presented to external examiner at the time of final examination.

# Mobile Communication(404189)

| Teaching Scheme: | | Examination Scheme: |
|---|---|---|
| Lectures: 4Hrs/ Week | | In Semester Assessment:<br>Phase I : 30<br>End Semester Examination:<br>Phase II: 70 |

## Course Objectives:

- To learn and understand the basic principles of Telecommunication switching, traffic and networks
- To learn and understand basic concepts of cellular system, wireless propagation and the techniques used to maximize the capacity of cellular network.
- To learn and understand architecture of GSM and CDMA system.
- To understand mobile management, voice signal processing and coding in GSM and CDMA system

## Course Outcomes:

Aftersuccessfully completing the course students will be able to

- Explain and apply the concepts telecommunication switching, traffic and networks
- Analyze the telecommunication traffic.
- Analyze radio channel and cellular capacity.
- Explain and apply concepts of GSM and CDMA system.

## Unit I : Telecommunication Switching & Traffic 8L

Telecommunication switching: Message switching, Circuit switching, Manual System, Electronic Switching. Digital switching: Switching functions, 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.

## Unit II: Switching Networksand Signaling 8L

Single Stage Networks, Gradings, Link Systems, Grades of service of link systems. Time Division Switching: Space and time switching, Time division switching networks, Synchronization, Call processing Functions, Common Control, Reliability, Availability and Security. Signaling: Customer line signaling. FDM carrier systems, PCM signaling, Inter-register signaling, Common channel signaling principles, CCITT signaling No. 6, CCITT signaling No. 7, Digital customer line signaling.

| Unit III: Cellular Concepts6L |
|---|
| Evolution of Wireless systems, Introduction to cellular telephone system, Frequency reuse, Channel Assignment, Handoff strategies, Cell Splitting, Propagation Mechanism: Free space loss, Reflection, Diffraction, Scattering. Fading and Multipath: Small scale multipath propagation, Impulse response model of multipath channel. Multiple Access Techniques-TDMA, FDMA, CDMA |
| |
| Unit IV: First and Second Generation Mobile Systems6L |
| First Generation Cellular Systems, AMPS, GSM Cellular Telephony: Introduction, Basic GSM Architecture, Basic radio transmission parameters in GSM system, Logical Channels, GSM time hierarchy, GSM burst structure, Description of call setup procedure, Handover, Modifications and derivatives of GSM. |
| |
| Unit V: GSM Services 8L |
| GSM Physical layer: Speech Coding and decoding, GMSK modulation, Data transmission in GSM: Data Services, SMS, HSCSD, GPRS, EDGE. |
| |
| Unit VI : CDMA Based Mobile Systems 8L |
| Motivation for CDMA use, Spreading Sequences, Basic Transmitter and Receiver schemes, Rake Receiver, IS-95 system: Frequency Range, Downlink transmission, Uplink transmission, Power control, Introduction to 3G mobile systems: W-CDMA and cdma-2000. |
| |
| **Text Books** |
| 1. J. E. Flood , "Telecommunications Switching, Traffic and Networks", Pearson Education<br>2. Krzysztof Wesolowski, "Mobile Communication Systems", Wiley Student Edition. |
| **Reference Books** |
| 1. Theodore S Rappaport, "Wireless Communications Principles and Practice" Second Edition, Pearson Education<br>2. John C. Bellamy, "Digital Telephony", Third Edition; Wiley Publications<br>3. ThiagarajanVishwanathan, "Telecommunication Switching Systems and Networks"; PHI Publications<br>4. Wayne Tomasi, "Electronic Communications Systems"; 5th Edition; Pearson Education<br>5. Vijay K Garg, Joseph E Wilkes, "Principles and Applications of GSM" Pearson Education<br>6. Vijay K Garg, Joseph E Wilkes, "IS-95CDMA and CDMA 2000 Cellular/PCS Systems Implementation" Pearson Education<br>7. Mischa Schwartz, "Mobile Wireless Communications", Cambridge University Press |

# Broadband Communication Systems(404190)

| | | |
|---|---|---|
| **Teaching Scheme:**<br>Lectures 3 Hrs/ Week | | **Examination Scheme:**<br>In Semester Assessment:<br>Phase I: 30<br>End Semester Examination:<br>Phase II:70 |

## Course Objectives:

- To understand 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 their subject understanding in Link Design.

## Course Outcomes:

After successfully completing the course students will be able to:

- Carry out Link power budget and Rise Time Budget by proper selection of components and check its viability.
- Carry out Satellite Link design for Up Link and Down Link.

## UNIT I: Light wave System Components 6L

Key Elements of Optical Fiber Systems, 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. Photodetectors: Basic Concepts, Common Photodetectors.

## UNIT II: Lightwave Systems6L

System Architectures, Point-to-Point Links: System Considerations, Design Guidelines: Optical Power Budget, Rise Time Budget, Long-Haul Systems.

## UNIT III: Multichannel Systems6L

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 Launchers6L |
| --- |
| 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: Satellites 6L |
| Satellite Subsystems, Attitude and control systems (AOCS), Telemetry, Tracking, Commandand Monitoring, Power systems, Communication subsystems, Satellite antennas, EquipmentReliability and space qualification. |
| |
| UNIY VI: Satellite Communication Link Design6L |
| Introduction, Basic transmission Theory, System Noise Temperature and G/T Ratio, Designof Downlinks, Satellite Systems using Small Earth Stations, Uplink Design, Design ofSpecified C/N : Combining C/N and C/I values in Satellite Links, System Design Examples |
| |
| **Text Books**<br><br>1. Gerd Keiser, "Optical fiber Communications", Tata McGraw Hill, 4th edition.<br>2. Timothy Pratt, Charles Bostian, Jeremy Allnutt "Satellite Communications", John Wiley & Sons. |
| **Reference Books**<br>1.Govind P. Agrawal, Fiber-Optic Communication Systems, Wiley, 3rd edition.<br>2. Dennis Roody, "Satellite Communications", McGraw Hill |

# Speech and Audio Signal Processing(404191)

| **Teaching Scheme:** | | **Examination Scheme:** |
|---|---|---|
| Lectures: 3 Hrs/ Week | | In Semester Assessment:<br>Phase I : 30<br>End Semester Examination:<br>Phase II: 70 |

## Course Objectives:

- To understand basic concepts and methodologies for the analysis and modeling of speech signal.
- To characterize the speech signal as generated by a speech production model
- To understand the mechanism of speech and audio perception
- To understand the motivation of short-term analysis of speech and audio
- 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 this field.

## Course Outcomes:

After successfully completing the course students will be able to

- Design and implement algorithms for processing speech and audio signals considering the properties of acoustic signals and human hearing.
- Analyze speech signal to extract the characteristic of vocal tract (formants) and vocal cords (pitch).
- Write a program for extracting LPC Parameters using Levinson Durbin algorithm
- Formulate and design a system for speech recognition and speaker recognition

## Unit I: Fundamentals of speech production6L

Anatomy and physiology of speech production, Human speech production mechanism, LTI model for speech production, Nature of speech signal, linear time varying model, articulatory phonetics, acoustic phonetics, Voiced and Unvoiced speech.

## Unit II: Human auditory system 6L

Human auditory system, simplified model of cochlea. Sound pressure level and loudness. Sound intensity and Decibel sound levels. 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.

## Unit III: Time and frequency domain methods for audio processing 6L

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 analysis 6L

Basic principles of linear predictive analysis. Autocorrelation method, covariance method. Solution of LPC equations: Cholesky decomposition, Durbin's recursive solution, lattice formulations and solutions. Frequency domain interpretation of LP analysis. Applications of LPC parameters as pitch detection and formant analysis.

Unit V: Cepstral Analysis 6L

Homomorphic speech processing, Real Cestrum: Long-term real cepstrum, short-term real cepstrum, pitch estimation, format estimation, Mel cepstrum. Complex cepstrum: Long-term complex cepstrum, short-term complex cepstrum.

Unit VI : Speech and Audio processing applications 6L

Speech recognition: complete system for an isolated word recognition with vector quantization /DTW. Speaker recognition: Complete system for speaker identification, verification. Introduction to speech enhancement, Speech enhancement using spectral subtraction method, Introduction to Text to speech conversion, Introduction to Musical instrument classification, Musical Information retrieval.

**Text Books :**


1. Deller J. R. Proakis J. G. and Hanson J. H., "Discrete Time Processing of Speech Signals", Wiley Interscience
2. Ben Gold and Nelson Morgan, "Speech and audio signal processing" Wiley


**Reference Books :**


1. L. R. Rabiner and S.W. Schafer, "Digital processing of speech signals" Pearson Education.
2. Thomas F. Quateri , "Discrete-Time Speech Signal Processing: Principles and Practice" Pearson
3. Dr. ShailaApte, "Speech and audio processing", Wiley India Publication
4. L. R. Rabiner and B. H. Juang, "Fundamentals of speech recognition"
5. Theodoros Giannakopoulos and Aggelospikrakis, " Introduction to audio analysis : A MATLAB Approach : Eleseiver Publication.

**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 and find Energy and ZCR for different frame rates and comment on the result.
2. Record different vowels as /a/, /e/, /i/, /o/ etc. and extract the pitch as well as first three formant frequencies. Perform similar analysis for different types of unvoiced sounds and comment on the result.
3. Write a program to identify voiced, unvoiced and silence regions of the speech signal.
4. Record a speech signal and perform the spectrographic analysis of the signal using wideband and narrowband spectrogram. Comment on narrowband and wide band spectrogram.
5. Write a program for extracting pitch period for a voiced part of the speech signal using autocorrelation .
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.

# RF Circuit Design(404191)

| | | |
|---|---|---|
| **Teaching Scheme:**<br>Lectures: 3 Hrs/ Week | | **Examination Scheme:**<br>In Semester Assessment:<br>Phase I : 30<br>End Semester Examination:<br>Phase II: 70 |

## Course Objectives:

- To study RF issues related to active and passive components.
- To study circuit design aspects at RF.
- To learn design and modeling of circuits at RF.

## Course Outcomes:

After successfully completion of the course students will be able to -

- Understand behavior of passive components at high frequency and modeling of HF circuit.
- Design HF amplifiers with gain bandwidth parameters.
- Understand Mixer types and characteristics.
- Gain the knowledge about PLLs and Oscillators with respect to their circuit topologies.

## Unit I : RF Behavior of Passive Components 6L

HF Resistors, HF Capacitors, HF Inductors, Chip Components. Circuit Board Considerations: Chip Resistors, Chip Capacitors, Surface Mounted Inductors.

## Unit II : Bandwidth Estimation 6L

Open Circuit Time Constant Method: Observations & Interpretations, Accuracy of OC$\tau$s, Considerations, Design examples. Short Circuit Time Constant Method:Background,Observations & Interpretations, Accuracy of SC$\tau$s, Considerations. Delay of a system in cascade, Rise time of systems in cascade, Relation Between Rise Time and Bandwidth.

## Unit III : High Frequency Amplifier Design 6L

Shunt Peaked Amplifier, Shunt Series peak Amplifier, Two port bandwidth enhancement, Design example. Bandwidth enhancement techniques. Tuned Amplifier: Common Source Amplifier with Single Tuned Load, Analysis of Tuned Amplifier. Neutralization and unilateralization. Characteristics of RF amplifier. Amplifier power relations. Stability

considerations. Stabilization methods.

Unit IV: Low Noise Amplifier Design 6L

MOSFET two port noise parameters, LNA topologies, Power-constrained noise optimization. Design examples: Single ended LNA, Differential LNA. Linearity and large signal performance. Spurious free dynamic range.

Unit V : Oscillators 6L

Problem with Purely Linear Oscillators, Describing Functions, Describing Function for MOS. Colpitts Oscillator: Describing Function Model and Start-up Model of Colpitts Oscillator. Resonators: Quarter-Wave Resonators, Quartz Crystals. Tuned Oscillators: Basic LC Feedback Oscillators, Crystal Oscillator. Negative Resistance Oscillator.

Unit VI : Mixers 6L

Mixer Fundamentals. Significant Characteristics of Mixer: Conversion Gain, Noise Figure, Linearity and Isolation, Spurs. Non Linear Systems as Linear Mixers. Multiplier Based Mixers: Single Balanced Mixer, Linearization techniques of Mixer, Active Double Balanced Mixer. Passive Double Balanced Mixer, Diode Ring Mixers.

**Text Books**


1. Reinhold Ludwig, PavelBretchko, "RF Circuit Design Theory and Applications", Pearson Education.
2. Thomas H. Lee, "The Design of CMOS Radio-Frequency Integrated Circuits", Second Edition, Cambridge Publications.


**Reference Books**


1. T. Yettrdal, Yunhg Cheng, "Devices modeling for analog and RF COMS circuits design", John Wiley publication.
2. Calvin Plett, "Radio frequency Integrated Circuits Design", Artech house.


**List of Experiments:**

1. To plot frequency response of the impedance magnitude of series and parallel LC circuits.
2. To plot the resonant frequency behavior of parallel LC circuit, as a function of resistance R.
3. To determine stability regions of the device and sketch them in the Smith Chart. Assume suitable parameters.
4. To design, prepare layout and simulate CMOS amplifier for given voltage gain and bandwidth.

5. To design, prepare layout and simulate CMOS Collpitt oscillator.
6. To design, prepare layout and simulate CMOS mixer.
7. To design, prepare layout and simulate CMOS LNA.
8. To design, prepare layout and simulate double balance mixer.
9. To design, prepare layout and simulate diode Ring mixer.
10. To design, prepare layout and simulate local oscillator.

# Audio Video Engineering(404191)

| | | |
|---|---|---|
| **Teaching Scheme:**<br>Lectures: 3Hrs/ Week | | **Examination Scheme:**<br>In Semester Assessment:<br>Phase I : 30<br>End Semester Examination:<br>Phase II: 70 |

## 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 and they will be acquainted with different types of analog, digital TV and HDTV systems.
- The students will gate overview of fundamentals of Audio systems and basics Acoustics

## Course Outcomes:

- To study the analysis and synthesis of TV Pictures, Composite Video Signal, Receiver, Picture Tubes and Television Camera Tubes.
- To study the various Colour Television systems with a greater emphasis on television standards.
- To study the advanced topics in Digital Television and High Definition Television.
- To study audio recording systems such CD/DVD recording, Audio Standards, and Acoustics principles.

## Unit I :Fundamentals of Colour Television 8L

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, remote control. Fault finding and servicing equipments like Wobbuloscope, TV Pattern Generator, and Field Strength meter.

## Unit II: Digital TV and Display Devices 6L

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: LED, LCD, TFT, Plasma,

Unit III: HDTV 6L

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, Digital broadcasting, case study (Cricket match, Marathon, Football match).

Unit IV: Advanced TV Systems8L

IP Audio and Video, IPTV systems, Mobile TV, Video transmission in 3G mobile System, IPod(MPEG4 Video player), Digital Video Recorders, Personal Video Recorders, Wi-Fi Audio / Video Transmitter and Receivers. Video Projectors, HD Video projectors, Video Intercom systems/ Video door phones.

Unit V : .Fundamentals of Audio-Video Recording6L

Methods of sound recording & reproduction, optical recording, CD recording, , audio standards. Digital Sound Recording, CD/ DVD player, MP3 player, Blue Ray DVD Players, MPEG, MP3 Player.

Unit VI : Fundamentals of Acoustics 6L

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. Video Demisified, Kelth jack, Penram International Publication.
3. Audio Video Systems, R.G. Gupta, TMH Publication


**Reference Books**


1. S. P. Bali, “Color TV Theory and Practice”.
2. Bernard Grobb, Charles E, “Basic TV and Video Systems”.


**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 / IPTV 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

# SOFT COMPUTING TECHNIQUES(404191)

| | | |
|---|---|---|
| **Teaching Scheme:**<br>Lectures: 3Hrs/ Week | | **Examination Scheme:**<br>In Semester Assessment:<br>Phase I : 30<br>End Semester Examination:<br>Phase II: 70 |

## Course Objectives:

- Introduce a relatively new computing paradigm for creating intelligent machines useful for solving complex real world problems.
- Insight into the tools that make up the soft computing technique: fuzzy logic, artificial neural networks and hybrid systemsTechniques.
- To create awareness of the application areas of soft computing technique
- Provide alternative solutions to the conventional problem solving techniques in image/signal processing, pattern recognition/classification, control system

## Course Outcomes:

Having successfully completing the course students will be able to

- use a new tool /tools to solve a wide variety of real world problems
- find an alternate solution , which may offer more adaptability, resilience and optimization
- Identify the suitable antenna for a given communication system
- Gain knowledge of soft computing domain which opens up a whole new career option
- Tackle real world research problems

## Unit I : Artificial Neural Network -I 8L

Biological neuron, Artificial neuron model, concept of bias and threshold , McCulloch- Pits Neuron Model , implementation of logical AND, OR, XOR functions Soft Topologies of neural networks, learning paradigms: supervised, unsupervised, reinforcement, Linear neuron model : concept of error energy , gradient descent algorithm and application of linear neuron for linear regression, Activation functions : binary , bipolar (linear, signup, log sigmoid, tan sigmoid) Learning mechanisms: Hebbian, Delta Rule o Perceptron and its limitations Draft

## Unit II : Artificial Neural Network-II 8L

Multilayer perceptron (MLP) and back propagation algorithm o Application of MLP for classification and regression o Self- organizing Feature Maps, k- means clustering o Learning vector quantization Radial Basis Function networks: Cover's theorem, mapping functions

(Gaussian, Multi-quadrics, Inverse multiquadrics, Application of RBFN for classification and regression o Hopfield network, associative memories.

Unit III : Fuzzy Logic -I 6L

Concept of Fuzzy number, fuzzy set theory(continuous, discrete) o Operations on fuzzy sets, Fuzzy membership functions (core ,boundary ,support) , primary and composite linguistic terms , Concept of fuzzy relation, composition operation (T-norm,T-conorm) o Fuzzy if-then rules.

Unit IV : Fuzzy Logic -II 6L

Fuzzification , Membership Value Assignment techniques, De-fuzzification ( Maxmembership principle, Centroid method, Weighted average method), Concept of fuzzy inference, Implication rules- Dienes-Rescher Implication, Mamdani Implication, Zadeh Implication, Fuzzy Inference systems -Mamdani fuzzy model , Sugeno fuzzy model , Tsukamoto fuzzy model, Implementation of a simple two-input single output FIS employing Mamdani model Computing.

Unit V : Fuzzy Control Systems 6L

CONTROL SYSTEM DESIGN PROBLEM 1.5, Control (Decision) Surface, Assumptions in a Fuzzy Control System Design V, Fuzzy Logic Controllers Soft o Comparison with traditional PID control, advantages of FLC, Architecture of a FLC: Mamdani Type , Example Aircraft landing control problem.

Unit VI : Adaptive Neuro-Fuzzy Inference Systems(ANFIS) 6L

ANFIS architecture, Hybrid Learning Algorithm, Advantages and Limitations of ANFIS Application of ANFIS/CANFIS for regression

**Text Books**


1. Fundamentals of Neural Networks: Architectures, Algorithms And Applications, LaureneFausett, Pearson Education, Inc, 2008 .
2. Fuzzy Logic With Engineering Applications, Third Edition Thomas, Timothy Ross, John Wiley & Sons,2010
3. Neuro- Fuzzy and Soft Computing, J.S. Jang, C.T. Sun, E. Mizutani, PHI Learning Private Limited.
4. Principles of Soft Computing , S. N. Sivanandam, S. N. Deepa, John Wiley & Sons, 2007


**Reference Books**


1. Introduction to the theory of neural computation, John Hertz, Anders Krogh, Richard Palmer, Addison –Wesley Publishing Company, 1991

2. Neural NetworksA comprehensive foundation,, Simon Haykin,Prentice Hall International Inc-1999
3. Neural and Adaptive Systems: Fundamentals through Simulations, José C. Principe Neil R. Euliano , W. Curt Lefebvre, John-Wiley & Sons, 2000
4. Pattern Classification, Peter E. Hart, David G. Stork Richard O.Duda,Second Edition,2000
5. Pattern Recognition, SergiosTheodoridis , KonstantinosKoutroumbas, Fourth Edition, Academic Press, 2008
6. A First Course in Fuzzy Logic, Third Edition, Hung T. Nguyen, Elbert A. Walker, Taylor & Francis Group, LLC, 2008
7. Introduction to Fuzzy Logic using MATLAB, S. N. Sivanandam , S.Sumathi, S. N. Deepa, Springer Verlag, 2007

**Practical Sessions: (Use MATLAB / OCTAVE/ SCILAB /any appropriate open source software.)(any 8 experiments)**

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 fuzzy membership functions (triangular, trapezoidal, gbell, PI, Gamma, Gaussian)
7. Implement defuzzyfication (Max-membership principle, Centroid method, Weighted average method)
8. Implement FIS with Mamdani inferencing mechanism
9. A small project: may include classification or regression problem, using any soft computing technique studied earlier

## Biomedical Signal Processing(404192)

| **Teaching Scheme:** Lectures:3Hrs/ Week | | **Examination Scheme:** In Semester Assessment: Phase I : 30 End Semester Examination: Phase II: 70 |
|---|---|---|

## Course Objectives:

1. To understand the basic signals in the field of biomedical.
2. To study origins and characteristics of some of the most commonly used biomedical signals, including ECG, EEG, evoked potentials, and EMG.
3. To understand Sources and characteristics of noise and artifacts in bio signals.
4. To understand use of bio signals in diagnosis, patient monitoring and physiological investigation
5. To explore research domain in biomedical signal processing.
6. To explore application of established engineering methods to complex biomedical signals problems.

## Course Outcomes:

Aftersuccessfully completing the course students will be able to:

- The student will be able to model a biomedical system.
- The student will be able to understand various methods of acquiring bio signals.
- The student will be able to understand various sources of bio signal distortions and its remedial techniques.
- The students will be able to analyze ECG and EEG signal with characteristic feature points.
- The student will have a basic understanding of diagnosing bio-signals and classifying them.

### Unit I : Biomedical Signals 6L

Bioelectric Signals and Electrodes: Bio-potentials and their origin: ECG, EEG, EMG, ENG, ERG, EOG, MEG. Biomedical Instrumentation System, biomedical transducers, electrodes and their characteristics. Origin of bio potentials. Sources and contamination of Noise in bio signals.Motion artifacts and skin Impedance. Classification of biomedical signals.

### Unit II: Cardio Vascular and Nervous System 6L

Cardio Vascular System: Cardiovascular system, Coronary and Peripheral Circulation, Electrical

Activity of the heart, Lead configurations , ECG data acquisition, ECG recorder, Concept of Blood Pressure Measurement, Cardiac output, Heart Sounds.
Nervous System: Nervous System, Structure and functions of Neurons, Electrical activity of nerve cell, Synapse, Reflex action and Receptors.

Unit III:Analysis of Electrical Activity of Heart 6L

ECG signal parameters & their estimation - Use of multiscale analysis for ECG parameters estimation, Noise & Artifacts, ECG Signal Processing: Baseline Wandering, Power line interference, Muscle noise filtering – QRS detection, Highlight the Feature points of ECG and its classification for Normal and Abnormal state using Multilayer Perceptron.

Unit IV: Analysis of Electrical Activity of Brain 6L

Electroencephalogram – Structure of brain, EEG signal acquisition,10-20 electrode placement, EEG rhythms & waveform - categorization of EEG activity - recording techniques - EEG applications- Epilepsy, sleep disorders, brain computer interface. Use of Fourier Transform in EEG Signal Analysis.

Unit V: Analog Signal Processing 6L

Basics of Instrumentation Amplifier, Isolation amplifier, Grounding and shielding techniques.
Integer Filters: Basic design Concept, Low Pass and High Pass Filters, Band Pass, Band Stop and Band Reject Filters. Its application in Biomedical field.
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.

Unit VI: Digital signal Processing 6L

Characteristics, frequency domain representation; Stationary and non-stationary bio-signals, waveform detection, Sampling Theory, Finite data considerations (Edge effects), Z Transform, FIR and IIR filters specific to event detection of ECG.Computation of diagnostic signal parameters of ECG like Heart rate and QRS detection using Multivariate analysis like PCA and ICA.

**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. John L Semmlow, "Bio-signal and Biomedical Image Processing", Marcel Dekker.


**References Books**

1. R.S.Khandpur, “Handbook of Biomedical Instrumentation”, Tata McGraw Hill, New Delhi, 2003, Edition-II.
2. Joseph J. Carr and John M. Brown, “Introduction to Biomedical Equipment Technology”, 4th Edition, Prentice Hall, 2000.
3. Bruce, “Biomedical Signal Processing & Signal Modeling,” Wiley, 2001
4. Sörnmo, “Bioelectrical Signal Processing in Cardiac & Neurological Applications”, Elsevier.
5. C.Reddy “Biomedical Signal Processing: Principles and techniques”, Tata McGraw Hill, New Delhi, 2005.
6. Willis J Tompkins, “Biomedical Signal Processing”, ED, Prentice – Hall, 1993.

# Nano Electronics and MEMS(404192)

| **Teaching Scheme:** | | **Examination Scheme:** |
|---|---|---|
| Lectures:3Hrs/ Week | | In Semester Assessment:<br>Phase I : 30<br>End Semester Examination:<br>Phase II: 70 |

## Course Objectives:

- To understand the processes in Nano electronic manufacturing.
- To understand the construction, characteristics and operation of Nano electronic devices.
- To get acquaint with MEMS technology.
- To gain the concepts of MEMS sensors and measurement methods.

## Course Outcomes:

After successfully completing the course students will,

- Gain knowledge of Nano electronics material, and manufacturing of Nano devices.
- Be introduced to MEMS and its sensors and actuators.
- Understand various measuring methods and tools.

## Unit I: Introduction to materials in Nano Electronics 6L

Band structures in Silicon, Historical development and basic concepts of crystal structure, defects, crystal growth and wafer fabrication, crystal planes and orientation. Modern CMOS technology, construction of MOS Field Effect Transistor, Electrical characterization: IV/CV characterization, temperature dependent characterization.

## Unit II: Semiconductor Nano Electronic manufacturing 6L

Basic understanding of contaminations, Levels of contaminations, Wafer cleaning methods, Lithography: basic concepts of optics, photoresists, wager exposure systems, methods and equipment. Thermal Oxidation: formations of Si and SiO2 interface, types of thermal oxidations and their comparisons. Dopant Diffusion and Ion implantation fundamentals, Thin film deposition, sputtering methods and types, etching process and types.

## Unit III: Nano Electronic Devices 6L

Single Electron devices and Transistors, Quantum particle, Quantum Dot, Logic circuits using quantum dots, nanowires construction and applications, FinFETs, construction of FinFET, properties of FinFETs.

## Unit IV: Introduction to MEMS 6L

Intrinsic characteristics of MEMS, miniaturization, Sensors and actuators, sensor noise and design complexity, packaging and integration, stress and strain, intrinsic stress, torsion deflections, types of beams and deflection of beams.

Unit V: MEMS based sensors and actuators 6L

Electrostatic sensors and Actuators, Thermal sensing and actuation, piezoresistive sensing and actuation, Magnetic actuation. Comparison of major sensing and actuation methods. Case studies of selected MEMS: Acceleration sensors, gyros etc.

Unit VI: Measurements methods and tools 6L

Electrical methods: Hot probe method, Sheet resistance, Hall effect measurements. Physical measurements: Fourier Transform Infrared Spectroscopy, Electron microscopy, Atomic Force Microscope, X-Ray photoelectron Spectroscopy, Profilometers, Reflectrometers.

**Text Books**


1. James D Plummer, Michael d Deal and Peter B Griffin, Silicon VLSI Technology, Fundamentals, Practice and Modeling, Pearson Education.
2. George W Hanson, Fundamentals of Nanoelectronics, Pearson education
3. Chang Liu, Foundations of MEMS, Pearson Education.


**Reference Books**


1. MinhangBao, Analysis and Design Principles of MEMS Devices, Elsevier
2. Byung-Gook Park, Sung Woo Hwang, Young June Park, Nanoelectronic Devices, Pan Stanford Publishing Pte. Ltd.
3. Niraj K. Jha, Deming Chen , " Nano Circuit Design", Springer.

# Detection and Estimation Theory(404192)

| | | |
|---|---|---|
| **Teaching Scheme:**<br>Lectures:3Hrs/ Week | | **Examination Scheme:**<br>In Semester Assessment:<br>Phase I : 30<br>End Semester Examination:<br>Phase III: 70 |

## Course Objectives:

- To understand concepts of statistical decision theory and parameter estimation.
- To study application of detection and estimation theory in filtering, communication and radar.

## Course Outcomes:

After successfully completing the course students will be able to

- Apply suitable hypothesis testing criteria for signal detection problems.
- Use parameter estimation in signal processing and communication problems.
- Design a estimator and detector.

| | |
|---|---|
| Unit I : Statistical Decision Theory | 6L |
| Introduction, Bayes' Criterion-Binary Hypothesis Testing, *M*-ary Hypothesis Testing, Minimax Criterion, Neyman-Pearson Criterion, Composite Hypothesis Testing, Sequential Detection. | |
| Unit II : Parameter Estimation-I | 6L |
| Introduction, Some Criteria for Good Estimators, Maximum Likelihood Estimation, Generalized Likelihood Ratio Test, Bayes' Estimation | |
| Unit III : Parameter Estimation-II | 6L |
| Cramer-Rao Inequality, Multiple Parameter Estimation, Best Linear Unbiased Estimator, Least-Square Estimation, Recursive Least-Square Estimator. | |
| Unit IV : Filtering | 6L |
| Introduction, Linear Transformation and Orthogonality Principle, Wiener Filters, Discrete Wiener Filters, Kalman Filter. | |

| |
|---|
| Unit V : Detection and Parameter Estimation 6L |
| Introduction, Signal Representation, Binary Detection, M-ary Detection, Linear Estimation. |
| |
| Unit VI : Detection Theory in Radar 6L |
| Introduction, Radar Elementary concepts- Range, Range Resolution, and Unambiguous Range, Doppler Shift, Principles of Adaptive CFAR Detection- Target Models, Review of Some CFAR Detectors. |
| |
| **Text Books** |
| 3. MouradBarkat, "Signal detection and Esimation", Artec House, second edition<br>4. S M Kay, "Fundamentals of ststistical Signal Processing, Estimation Theory" PHI Signal Processing Series.<br>5. S M Kay, "Fundamentals of ststistical Signal Processing, Detection Theory" PHI Signal Processing Series. |
| |
| **Reference Books** |
| 8. H.Vincent Poor, "An Introduction to Signal Detection and Estimation", Springer, Second Edition.<br>9. Harry L.,Van Trees, "Detection, Estimation and Modulation Theory", John Wiley & Sons. |

# Wireless Networks(404192)

| | | |
|---|---|---|
| **Teaching Scheme:**<br>Lectures: 3Hrs/ Week | | **Examination Scheme:**<br>In Semester Assessment:<br>Phase I : 30<br>End Semester Examination:<br>Phase II: 70 |

## Course Objectives:

- To study the evolving wireless technologies and standards
- To understand the architectures of various access technologies such as 3G, 4G, WiFi etc.
- To understand various protocols and services provided by next generation netwoks.

## Course Outcomes:

After successfully completing the course student will be able to

- Keep himself updated on latest wireless technologies and trends in the communication field
- Understand the transmission of voice and data through various networks.

### Unit I : Introduction to Wireless Networks 7L

Introduction, Technology and service trends of Emerging Wireless technologies, The Amazing Growth of Mobile Communications, A Little History, Mobile Communications Fundamentals, Mobile Data, WiFi, Bluetooth, Cable Systems, Wireless Migration Options, Harmonization Process.

### Unit II: WiFi and Next Generation WLAN 7L

WiFi (802.11), 802.11 Standards, WiFi Protocols, Frequency Allocation, Modulation and Coding Schemes, Network Architecture, Typical WiFi Configurations, Security, 802.11 Services, Hot Spots, Virtual Private Networks (VPNs), Mobile VPN, VPN Types, WiFi Integration with 3G/4G, Benefits of Convergence of WiFi and Wireless Mobile.

### Unit III: Third Generation Mobile Services 6L

Introduction, Universal Mobile Telecommunications Service (UMTS), UMTS Services, The UMTS Air Interface, Overview of the 3GPP Release 1999 Network Architecture, Overview of the 3GPP Release 4 Network Architecture, Overview of the 3GPP Release 5, All-IP Network Architecture, Overview CDMA2000, TD-CDMA, TD-SCDMA, Commonality among WCDMA, CDMA2000, TD-CDMA, and TD-SCDMA

| Unit IV : LTE | 8L |
|---|---|
| LTE Ecosystem, Standards, Radio Spectrum, LTE Architecture, User Equipment (UE), Enhanced Node B (eNodeB), Core Network (EPC), Radio Channel Components, TD-LTE, Multiple Input Multiple Output, LTE Scheduler, Carrier Aggregation, Cell Search, Cell Reselection, Attach and Default Bearer Activation, Handover (X2, S1, Inter-MME), Self-Organizing Networks (SONs), Relay Cells, Heterogeneous Network (HetNET), Remote Radio Heads (RRH), VoLTE, LTE Advanced | |
| | |
| Unit V : WiMAX | 6L |
| Introduction, Standards, Generic WiMAX Architecture, Core Network, Radio Network, WiMAX Spectrum, Modulation, Channel Structure, Mixed Mode, Interference Mitigation Techniques, Frequency Planning, Features and Applications, Security, QoS, Profiles, Origination, Handover, Femto and SON | |
| | |
| Unit VI : VOIP | 7L |
| Why VoIP?, The Basics of IP Transport, VoIP Challenges, H.323, The Session Initiation Protocol (SIP), Distributed Architecture and Media Gateway Control, VoIP and SS7, VoIP Quality of Service. | |
| | |
| **Text Books** | |
| 1. Clint Smith, P.E., Daniel Collins, "Wireless Networks: Design and Integration for LTE, EVDO, HSPA, and WiMAX", McGrawHill Education, Third Edition<br>2. EldadPerahia, Robert Stacey, "Next Generation Wireless LANs", Cambridge University Press, Second Edition. | |
| | |
| **Reference Books** | |
| 1. Yi-Bang Lin, ImrichChlamtac, "Wireless and Mobile Network Architecture", Wiley India Edition.<br>2. DipankarRaychaudhary, Maria Gerla, "Emerging Wireless Technologies and the Future Mobile Internet", Cambridge University Press.. | |

# Lab Practice - III (404193)

## MC & BCS

| **Teaching Scheme:** | | **Examination Scheme:** |
|---|---|---|
| Practical: 4 Hrs/week | | OR: 50Marks<br>TW:50Marks |

## Mobile Communication

**List of the Experiments(Minimum 8 experiments are to be performed).**

1. Set up and carry out experiment on PSTN TST switch.
2. Set up and carry out experiment on analysis of telecommunication traffic.
3. Simulation of a wireless channel model.
4. Set up and carry out experiment on Mobile phone.
5. Set up and carry out experiment on GSM.
6. Set up and carry out experiment on AT commands.
7. Simulation of Speech coding and decoding.
8. Set up and carry out experiment on GMSK modulation.
9. Set up and carry out experiment on spreading Sequences.
10. Set up and carry out experiment on CDMA.
11. Set up and carry out experiment on3G Mobile.
12. Set up and carry out experiment on VOIP implementation
13. Visit to Mobile Telephone Switching Office (MTSO).

## Broadband Communication Systems

**List of the Experiments(Minimum 8 experiments are to be performed).**

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 areport of visit.(Optional)

## Lab Practice - IV (404194)

| | | |
|---|---|---|
| **Teaching Scheme:**<br>Practical: 2Hrs/week | | **Examination Scheme:**<br>PR: 50Marks<br>TW:50Marks |

**Elective III**

Experiments to be chosen based on Elective III. **(Minimum 8 experiments are to be performed).**

## Project Phase-II (404195)

| | | |
|---|---|---|
| **Teaching Scheme:**<br>Tutorial: 6Hrs/week | | **Examination Scheme:**<br>TW:100 Marks<br>OR: 50 Marks |

**1. Group Size**

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 the work.

**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 is preferable.

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.