**DEPARTMENT OF ECE**

**R 18-PG SYLLABUS**

**I Semester**

| S. No. | Core or Elective | Course Code | Course Name | L | T | P | IM | EM | CR |
|---|---|---|---|---|---|---|---|---|---|
| 1 | Core 1 | 1854101 | Digital System Design | 3 | 0 | 0 | 40 | 60 | 3 |
| 2 | Core 2 | 1854102 | Digital Communication Techniques | 3 | 0 | 0 | 40 | 60 | 3 |
| 3 | PE I | 1854103<br><br>1854104<br>1854105 | 1.Analog & Digital CMOS VLSI Design<br>2.Low power VLSI<br>3.SoC Design | 3 | 0 | 0 | 40 | 60 | 3 |
| 4 | PE II | 1854106<br><br>1854107<br><br>1854108 | 1.Digital Image & Video Processing<br>2. Wireless & Mobile Communications<br>3. Advanced Communication Networks | 3 | 0 | 0 | 40 | 60 | 3 |
| 5 | | 1800109 | Research Methodology & IPR | 2 | 0 | 0 | 40 | 60 | 2 |
| 6 | Core | 1854110 | DSD Lab | 0 | 0 | 4 | 50 | 50 | 2 |
| 7 | Core | 1854111 | DCT Lab | 0 | 0 | 4 | 50 | 50 | 2 |
| 8 | Audit Course | 1870A02 | Disaster Management | 2 | 0 | 0 | 40 | 0 | 0 |
| Total: | | | | 16 | 0 | 8 | 300 | 400 | 18 |

**II Semester**

| S. No. | Core or Elective | Course Code | Course Name | L | T | P | IM | EM | CR |
|---|---|---|---|---|---|---|---|---|---|
| 1 | Core 3 | 1854201 | Microcontrollers & Programmable DSP Processors | 3 | 0 | 0 | 40 | 60 | 3 |
| 2 | Core 4 | 1854202 | Advanced DSP | 3 | 0 | 0 | 40 | 60 | 3 |
| 3 | PE III | 1854203<br><br><br>1854204<br><br>1854205 | 1.Advanced Computer Architecture<br>2.IOT & Applications<br>3.VLSI Signal Processing | 3 | 0 | 0 | 40 | 60 | 3 |
| 4 | PE IV | 1854206<br><br><br>1854207<br><br>1854208 | 1.Detection & Estimation Theory<br>2.Optical Networks<br>3.Biomedical Signal Processing | 3 | 0 | 0 | 40 | 60 | 3 |
| 5 | Core | 1854209 | Mini Project with Seminar | 0 | 0 | 4 | 100 | 0 | 2 |
| 6 | Core | 1854210 | Microcontrollers and Programmable DSP Processors Lab | 0 | 0 | 4 | 50 | 50 | 2 |
| 7 | Core | 1854211 | Advanced DSP Lab | 0 | 0 | 4 | 50 | 50 | 2 |
| 8 | Audit Course | 1870A01 | English for Research paper writing | 2 | 0 | 0 | 40 | 0 | 0 |
| Total: | | | | 14 | 0 | 12 | 360 | 340 | 18 |

**III Semester**

| S. No. | Core or | Course | Course Name | L | T | P | IM | EM | CR |
|---|---|---|---|---|---|---|---|---|---|

| | Elective | Code | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 1 | PE V | 1854301<br><br>1854302<br><br><br>1854303 | 1.Microcomputer System Design<br>2. Joint Time Frequency Analysis & MRA<br>3. Pattern recognition & Machine learning | 3 | 0 | 0 | 40 | 60 | 3 |
| 2 | OE | 1871304<br><br>1871305<br>1871306<br><br>1871307<br><br><br><br>1871308<br><br>1871309 | 1.Business Analytics<br>2.Industrial Safety<br>3.Operations Research<br>4.Cost Management of Engineering Projects<br>5.Composite Materials<br>6.Waste to Energy | 3 | 0 | 0 | 40 | 60 | 3 |
| 3 | Major Project | 1854310 | Dissertation Phase I | 0 | 0 | 20 | 100 | 100 | 10 |
| Total: | | | | 6 | 0 | 20 | 180 | 220 | 16 |

**IV Semester**

| S. No. | Core or Elective | Course Code | Course Name | L | T | P | IM | EM | CR |
|---|---|---|---|---|---|---|---|---|---|
| 1 | Major Project | 1854401 | Dissertation Phase II | 0 | 0 | 32 | 50 | 50 | 16 |
| Total: | | | | 0 | 0 | 32 | 50 | 50 | 16 |

**Syllabus contents:**

**M.Tech. I Sem.**

## Core1: Digital System Design

**Course Objectives:**

1. To understand about the finite state model, capabilities and limitations of FSM and fundamental mode model.
2. To understand how to design the digital circuits using ROM's, PLA's and PAL's.
3. To understand about the SM charts and their realization and to implement a binary multiplier and a dice game controller.
4. To understand about Fault Modeling & Test Pattern Generation and to learn different algorithms for fault diagnosis of Combinational circuits and to know different methods for fault diagnosis of Sequential circuits.

**Course Outcomes**:

1. The students have the knowledge about the finite state model, capabilities and limitations of FSM and fundamental mode model.
2. The students are able to design the digital circuits using ROM's, PLA's and PAL's.
3. The students are able to draw the SM charts and their realization and to implement a binary multiplier and a dice game controller.
4. The students have the knowledge of Fault Modeling & Test Pattern Generation and different algorithms for fault diagnosis of Combinational circuits and are familiar to use different methods for fault diagnosis of Sequential circuits

### UNIT I

**Design of Digital Systems:** ASM charts, Hardware description language and control sequence method, design of sequential circuits using ROMs and PLAs, sequential circuit design using CPLD, FPGAs.

### UNIT II

**Fault Modeling & Test Generation :**Fault classes and models – Stuck at faults, bridging faults, transition and intermittent faults, Fault diagnosis of Combinational circuits by conventional methods- Path Sensitization technique, Boolean difference method, Kohavi algorithm.

### UNIT III

**Test Pattern Generation & Fault Diagnosis:** D – algorithm, PODEM, Random testing, Signature Analysis and testing for bridging faults, Design of fault detection.

### UNIT IV

**Programmable Logic Arrays**: Design using PLAs, PLA minimization and PLA folding

Fault models, Test generation and Testable PLA design.

**UNIT V**

**Asynchronous Sequential Machine**: Fundamental mode model, flow table, state reduction, minimal closed covers, races, cycles and hazards.

**Text Books:**


1. Z. Kohavi – "Switching & finite Automata Theory" (TMH)
2. N. N. Biswas – "Logic Design Theory" (PHI)
3. NolmanBalabanian, Bradley Calson – "Digital Logic Design Principles" – Wily Student Edition 2004.


**Reference Books:**


1. Charles H. Roth Jr. – "Fundamentals of Logic Design".
2. Frederick. J. Hill & Peterson – "Computer Aided Logic Design" – Wiley 4$^{th}$ Edition.

**M.Tech I Sem.**

**Core2 : Digital Communication Techniques**

**Course Objectives:**

1. To understand basic components of digital communication systems.
2. To Design optimum receivers for digital modulation techniques.
3. To analyze the error performance of digital modulation techniques.
4. To Design digital communication systems under given power, spectral and error performance constrains.

**Course outcomes:**

At the end of the course, Students will be able to:

1. Design the optimum receivers for digital modulation techniques.
2. Analyze the error performance of digital modulation techniques
3. Design digital communication systems under given power, spectral and error performance Constrains.

## UNIT I

**Deterministic and Random Signal Analysis**

Bandpass and Lowpass Signal Representation , Signal Space Representation of Waveforms- Vector Space Concepts, Signal Space Concepts, Orthogonal Expansions of Signals- Gram-Schmidt Procedure,Some Useful Random Variables , Bounds on Tail Probabilities, Limit Theorems for Sums of Random Variables , Random Processes -Wide-Sense Stationary Random Processes, Cyclostationary Random Processes, Bandpass and Lowpass Random Processes

## UNIT II

**Digital Communication Through Band-Limited Channels**

Design of Band-Limited Signals for No Intersymbol Interference—The NyquistCriterion,Design of Band-Limited Signals with Controlled ISI—Partial-Response Signals, Data Detection for Controlled ISI, Signal Design for Channels with Distortion, Optimum Receiver for Channels with ISI and AWGN - Optimum Maximum-Likelihood Receiver , Linear Equalization - Peak Distortion Criterion, Mean-Square-Error(MSE) Criterion, Performance Characteristics of the MSE Equalizer , Fractionally Spaced Equalizers, Baseband and Pass band Linear Equalizers,Decision-Feedback Equalization -Coefficient Optimization , Performance Characteristics of DFE , Predictive Decision-Feedback Equalizer.

## UNIT III

**Digital Modulation Schemes:**

Introduction,Geometric Representation of Signals,Conversion of the Continuous AWGN Channel into a Vector Channel, Optimum Receivers Using Coherent Detection, Probability of Error, Phase-Shift Keying Techniques Using Coherent Detection, *M*-ary Quadrature Amplitude Modulation, Frequency-Shift Keying Techniques Using Coherent Detection , Comparison of *M*-ary PSK and *M*-ary FSK from an Information-Theoretic Viewpoint, Detection of Signals with

Unknown Phase, Noncoherent Orthogonal Modulation Techniques, Binary Frequency-Shift Keying Using Noncoherent Detection, Differential Phase-Shift Keying, BER Comparison of Signaling Schemes over AWGN Channels.

## UNIT IV

**Synchronization:**

Synchronization Defined, Costs versus Benefits, Receiver Synchronization- Frequency and Phase Synchronization, Symbol Synchronization, Discrete Symbol Modulations, Synchronization with Continuous-Phase Modulations (CPM), Frame Synchronization

## UNIT V

**Multichannel and Multicarrier Systems**

Multichannel Digital Communications in AWGN Channels- Binary Signals, M-ary Orthogonal SignalsMulticarrier Communications - Single-Carrier Versus Multicarrier Modulation , Capacity of a Nonideal Linear Filter Channel , Orthogonal Frequency Division Multiplexing (OFDM), Modulation and Demodulation in an OFDM System , An FFT Algorithm Implementation of an OFDM System, Spectral Characteristics of Multicarrier Signals , Bit and Power Allocation in Multicarrier Modulation, Peak-to-Average Ratio in Multicarrier Modulation, Channel Coding Considerations in Multicarrier Modulation

**Text Books:**


1. J.G. Proakis and MasoudSalehi, Digital Communications, McGraw Hill, 2000 (I,II,V)
2. BernerdSklar, " Digital Communications- Fundamentals & Applications, "Prentice Hall, 2001 (IV)
3. Simon S Haykin, "Digital Communications Systems", Wiley, 2013 (III)


**Reference Books:**


1. Ahmad R S Bahai ,Burton R Saltzberg ,Mustafa Ergen, "Multi-carrier Digital Communications: Theory and Applications of OFDM." Springer Publications.
2. J.S.Chitode, "Digital Communication", Technical Publications.
3. Edward. A. Lee and David. G. Messerschmitt, "Digital Communication", Allied Publishers (second edition).
4. J Marvin.K.Simon, Sami. M. Hinedi and William. C. Lindsey, "Digital Communication Techniques", PHI.
5. William Feller, "An introduction to Probability Theory and its applications", Vol 11, Wiley 2000

**M.Tech I Sem.**

## PSE1: Analog and Digital CMOS VLSI Design

### Course Objectives:

1. To analyze, design, optimize and simulate analog and digital circuits using CMOS

constrained by the design metrics.

2. To Connect the individual gates to form the building blocks of a system.

3. To understand how to use EDA tools like Cadence, Mentor Graphics and other open source software tools like Ngspice.

### Course Outcomes:

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

1. Analyze, design, optimize and simulate analog and digital circuits using CMOS constrained by the design metrics.
2. Connect the individual gates to form the building blocks of a system.
3. Use EDA tools like Cadence, Mentor Graphics and other open source software tools like Ngspice.

### Digital CMOS Design:

#### Unit 1

Review: Basic MOS structure and its static behaviour, Dynamic Behavior, Stick diagram and Layout, Wire delay models. Inverter: Static CMOS inverter, Switching threshold and noise margin concepts and their evaluation, Power consumption.

#### Unit 2

Physical design flow: Floor planning, Placement, Routing, CTS, Power analysis.Combinational logic: Static CMOS design, Complementary CMOS, Ratioed logic, Pass transistor logic, Dynamic logic, Speed and power dissipation in dynamic logic, Cascading dynamic gates.

#### Unit 3

Sequential logic: Static latches and registers, Bi-stability principle, MUX based latches, Static SR flip-flops, Master-slave edge-triggered register, Dynamic latches and registers, Concept of pipelining, Pulse registers, Non-bistable sequential circuit.

### Analog CMOS Design:

#### Unit 4

Single Stage Amplifier: CS stage with resistance load, Diode connected load, Current source load, CS stage with source degeneration, Common gate stage, CG Stage With Biasing Source follower, Source Follower With Biasing.

## Unit 5

Passive and active current mirrors: Basic current mirrors, Cascode Stage, Cascode as a Current Source, Cascode as an Amplifier , Active current mirrors, Bipolar Current Mirror, MOS Current Mirror.

**References:**


1. J P Rabaey, A P Chandrakasan, B Nikolic, "Digital Integrated circuits: A design
    a. perspective", Prentice Hall electronics and VLSI series, 2nd Edition.
2. Baker, Li, Boyce, "CMOS Circuit Design, Layout, and Simulation", Wiley, 2nd Edition.
3. BehzadRazavi , "Design of Analog CMOS Integrated Circuits", TMH, 2007.
4. Phillip E. Allen and Douglas R. Holberg, "CMOS Analog Circuit Design", Oxford, 3rd Edition.
5. R J Baker, "CMOS circuit Design, Layout and Simulation", IEEE Inc., 2008.
6. Kang, S. and Leblebici, Y., "CMOS Digital Integrated Circuits, Analysis and Design"

TMH, 3rdEdition.

7. Pucknell, D.A. and Eshraghian, K., "Basic VLSI Design", PHI, 3rd Edition.

**M.Tech I Sem.**

## PSE 1: Low Power VLSI Design

**Course objectives:**

1. To understand the sources of power dissipation in digital IC systems & the impact of power on system performance and reliability.
2. ToCharacterize and model power consumption & understand the basic analysismethods.
3. To get the knowledge on the leakage sources and reduction techniques.

**Course Outcomes:**

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

1. Identify the sources of power dissipation in digital IC systems & understand the impact of power on system performance and reliability.
2. Characterize and model power consumption & understand the basic analysis methods.
3. Understand leakage sources and reduction techniques.

**Syllabus Contents:**

### Unit 1

Technology & Circuit Design Levels: Sources of power dissipation in digital ICs, degree of freedom, recurring themes in low-power, emerging low power approaches, dynamic dissipation in CMOS, effects of Vdd&Vt on speed, constraints on Vt reduction, transistor sizing & optimal gate oxide thickness, impact of technology scaling, technologyinnovations.

### Unit 2

Low Power Circuit Techniques: Power consumption in circuits, flip-flops & latches, high capacitance nodes, energy recovery, reversible pipelines, high performance approaches.

### Unit 3

Low Power Clock Distribution: Power dissipation in clock distribution, single driver

Versus distributed buffers, buffers & device sizing under process variations, zero skew Vs.

Tolerable skew, chip & package co-design of clock network.

### Unit 4

Logic Synthesis for Low Power estimation techniques: Power minimization techniques, low power arithmetic components- circuit design styles, adders, multipliers.

### Unit 5

Low Power Memory Design: Sources & reduction of power dissipation in memory

subsystem, sources of power dissipation in DRAM & SRAM, low power DRAM circuits, low power SRAM circuits.

**References:**


1. P. Rashinkar, Paterson and L. Singh, “Low Power Design Methodologies”, Kluwer
    a. Academic, 2002
2. Kaushik Roy, Sharat Prasad, “Low power CMOS VLSI circuit design”, John Wiley sonsInc.,2000.
3. J.B.Kulo and J.H Lou, “Low voltage CMOS VLSI Circuits”, Wiley, 1999.
4. A.P.Chandrasekaran and R.W.Broadersen, “Low power digital CMOS design”,
    a. Kluwer,1995
5. Gary Yeap, “Practical low power digital VLSI design”, Kluwer, 1998.

**M.Tech I Sem.**

## PSE 1: SoC Design

**Course objectives:**

1. To identify and formulate a given problem in the framework of SoC based design approaches
2. To understand the Designing of SoC based system for engineering applications
3. To Realize impact of SoC on electronic design philosophy and Macro-electronics thereby incline towards entrepreneurship & skill development.

**Course Outcomes:**

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

4. Identify and formulate a given problem in the framework of SoC based design approaches
5. Design SoC based system for engineering applications
6. Realize impact of SoC on electronic design philosophy and Macro-electronics thereby incline towards entrepreneurship & skill development.

**Syllabus Contents:**

### Unit 1

ASIC :Overview of ASIC types, design strategies, CISC, RISC and NISC approaches for SOC architectural issues and its impact on SoC design methodologies, Application Specific Instruction Processor (ASIP) concepts.

### Unit 2

NISCControl Words methodology, NISC Applications and Advantages, Architecture Description Languages (ADL) for design and verification of Application Specific Instructionset Processors (ASIP), No-Instruction-Set-computer (NISC)- design flow, modeling NISC architectures and systems.

### Unit 3

Simulation:Different simulation modes, behavioural, functional, static timing, gate level, switch level,transistor/circuit simulation, design of verification vectors, Low power FPGA, configurablesystems, SoC related modeling of data path design and control logic, Minimization ofinterconnects impact, clock tree design issues.

### Unit 4

Low power SoC design / Digital system,Design synergy, Low power system perspective- power gating, clock gating, adaptive voltagescaling (AVS), Static voltage scaling, Dynamic clock

frequency and voltage scaling (DCFS),building block optimization, building block memory, power down techniques, powerconsumption verification.

## Unit 5

Synthesis: Role and Concept of graph theory and its relevance to synthesizable constructs, Walks, trailspaths, connectivity, components, mapping/visualization, nodal and admittance graph.Technology independent and technology dependent approaches for synthesis, optimizationconstraints, Synthesis report analysis.

**References:**


1. Hubert Kaeslin, "Digital Integrated Circuit Design: From VLSI Architectures to CMOS
2. Fabrication", Cambridge University Press, 2008.
3. B. Al Hashimi, "System on chip-Next generation electronics", The IET, 2006
4. RochitRajsuman, "System-on- a-chip: Design and test", Advantest America R & D Center,2000
5. P Mishra and N Dutt, "Processor Description Languages", Morgan Kaufmann, 2008
6. Michael J. Flynn and Wayne Luk, "Computer System Design: System-on-Chip". Wiley,2011

**M.Tech I Sem.**

## PSE 2: Digital Image and Video Processing

**Course Objectives:**

1. To provide an introduction to the basic concepts and techniques used in digital image and videoprocessing.
2. To give an understanding of the two-dimensional sampling and quantization
3. To study Edge detection and Image Enhancement Algorithms
4. To Understand techniques for video sampling and motion estimation
5. To Study techniques for image and video compression and object recognition

**Course outcomes: At the end of the course, students will be able to**

1. Have the knowledge on basic concepts and techniques used in digital image and videoprocessing.
2. Do the two-dimensional sampling and quantization
3. Analyze Edge detection and Image Enhancement Algorithms
4. Know the techniques for video sampling and motion estimation
5. Use the techniques for image and video compression and object recognition

### UNIT I

Fundamentals of Image Processing: Digital image fundamentals, Applications of image processing, Image Sampling and Quantization, relationship between pixels.

Image Transforms: General approach for operating in the linear transform domain, 2-D DFT and Properties, Walsh transform, Hadamard Transform, Discrete cosine Transform, Haar transform, KL Transform or Hotelling transform.

### UNIT II

Image Enhancement: Spatial domain methods: Spatial domain methods: Point processing, Histogram processing, Fundamentals of spatial filtering, smoothing spatial filters, sharpening spatial filters.

Frequency domain methods: Basics of filtering in frequency domain, image smoothing, image sharpening, Homomorphic filtering, LOG filters.

Colour image processing: Colour fundamentals, colour models, Pseudo color image processing.

### UNIT III

Image Segmentation: Point, Line and Edge detection, Edge linking and boundary detection, Thresholding, Region based segmentation – Region growing, Region splitting and merging. Region Based segmentation.

Image Restoration: Degradation model, Noise models, Restoration in the presence of noise only – spatial filtering, Periodic noise reduction by frequency domain filtering, linear position-Invariant degradation, restoration using inverse filtering, Wiener filtering, Constrained Least Squares filtering.

### UNIT IV

Image Compression: Redundancies in images, Fidelity criteria, Image compression models, Error free compression – Variable length coding, Huffman coding, Arithmetic coding, LZW coding, Bit-plane coding, loss less and lossy predictive coding, Transform coding, Image Compression standards- JPEG, JPEG 2000.

## UNIT V

Video Processing: Definition of video signal, Analog and digital video, digital video applications, 3-D sampling and filtering, motion estimation and compensation signals, Transform coding, Predictive coding, Motion estimation algorithms, Search algorithms for Block Matching in motion estimation, video compression standards- MPEG-2/4, H.264, SVC.

**Text Books:**

1. Digital Image Processing – Gonzaleze and Woods, 3rd Ed., Pearson.

2. Digital Image Processing – S.Jayaraman, S.Esakkirajan, T.Veera Kumar–TMH, 2009.

3. J. W. Woods, "Multidimensional Signal, Image and Video Processing and Coding",2nd Edition, Academic Press, 2011.

**Reference Books:**

1. Digital Image Processing and Analysis-Human and Computer Vision Application with CVIP Tools –
1. ScotteUmbaugh, 2nd Ed, CRC Press, 2011.
2. Digital Video Processing – M. Tekalp, Prentice Hall International
3. Ed. Al Bovik ,"Handbook of Image and Video Processing", 2nd Edition, Academic
4. Press, 2000.
5. Digital Image Processing with MATLAB and LabView – Vipula Singh, Elsevier.

**M.Tech I Sem.**

## PSE 2: Wireless and Mobile Communication

**Course Objectives**:

1. To understand the designing mobile communication systems.
2. To understand the various multiple-access techniques for mobile communications e.g. FDMA, TDMA, CDMA, and their advantages and disadvantages.
3. To analyze path loss and interference for wireless telephony and their influences on a mobile communication system's performance.
4. To Analyze and design CDMA system functioning with knowledge of forward and reverse channel details, advantages and disadvantages of using the technology
5. To Understand the upcoming technologies like 3G, 4G etc.

**Course Outcomes:**

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

1. Design appropriate mobile communication systems.

2. Distinguish various multiple-access techniques for mobile communications e.g. FDMA,

TDMA, CDMA, and their advantages and disadvantages.

3. Analyze path loss and interference for wireless telephony and their influences on a mobile communication system's performance.

4. Analyze and design CDMA system functioning with knowledge of forward and reverse channel details, advantages and disadvantages of using the technology

5. Understand the upcoming technologies like 3G, 4G etc.

### UNIT I

**Introduction to Wireless Communications Systems:** Evolution, Examples of Wireless Communication systems, Comparison, Second Generation Cellular Networks, WLL, Bluetooth and Personal Area Networks.

**GSM Fundamentals:** GSM architecture and interfaces, GSM architecture details, GSM subsystems, GSM Logical Channels, Data Encryption in GSM, Mobility Management, Call Flows in GSM.2.5 G Standards: High speed Circuit Switched Data (HSCSD), General Packet Radio Service (GPRS), 2.75 G Standards: EDGE

### UNIT II

**Mobile Radio Propagation:** Large Scale Path Loss, Free Space Propagation Model, Reflection, Ground Reflection (Two-Ray) Model, Diffraction, Scattering, Practical Link Budget Design using Path Loss Models, Outdoor Propagation Models, Indoor Propagation Models, Signal Penetration into Buildings. Small Scale Fading and Multipath Propagation, Impulse Response Model, Multipath Measurements, Parameters of Multipath channels, Types of Small Scale Fading: Time Delay Spread; Flat, Frequency selective, Doppler Spread; Fast and Slow fading.

### UNIT III

**Multiple access technologies:** TDMA, FDMA and CDMA, Comparison of these technologies based on their signal separation techniques, advantages, disadvantages and application areas.

**Code Division Multiple Access:** Introduction to CDMA technology, IS 95 system Architecture, Air Interface, Physical and logical channels of IS 95, Forward Link and Reverse link operation, Physical and Logical channels of IS 95 CDMA, IS 95 CDMA Call Processing, soft Handoff, Evolution of IS 95 (CDMA One) to CDMA 2000, CDMA 2000 layering structure and channels.

## UNIT IV

**Equalization and Diversity:** Equalizers in a communications receiver, Algorithms for adaptive equalization, diversity techniques, space, polarization, frequency diversity, Interleaving.

## UNIT V

**Higher Generation Cellular Standards:** 3G Standards: evolved EDGE, enhancements in 4G standard, Architecture and representative protocols, call flow for LTE, VoLTE, UMTS, introduction to 5G.

**Text Books**


1. V.K.Garg, J.E.Wilkes, "Principle and Application of GSM", Pearson Education, 5th edition, 2008.
2. V.K.Garg, "IS-95 CDMA & CDMA 2000", Pearson Education, 4th edition, 2009.
3. T.S.Rappaport, "Wireless Communications Principles and Practice", 2nd edition, PHI, 2002. William C.Y.Lee, "Mobile Cellular Telecommunications Analog and Digital Systems", 2nd edition, TMH, 1995.
4. AshaMehrotra, "A GSM system Engineering" Artech House Publishers Bosten, London, 1997.

**M.Tech I Sem.**

# PSE 2: Advanced Communication Network

## Course objectives:

1. To Understandthe advanced concepts in Communication Networking.
2. To Design and develop protocols for Communication Networks.
3. To Knowthe mechanisms in Quality of Service in networking.
4. To Optimize the Network Design.

## Course Outcomes:

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

5. Understand advanced concepts in Communication Networking.
6. Design and develop protocols for Communication Networks.
7. Understand the mechanisms in Quality of Service in networking.
8. Optimize the Network Design.

### UNIT I

**Overview of Internet-Concepts, challenges and history:**Overview of -ATM. TCP/IP Congestion and Flow Control in Internet-Throughput analysis of TCP congestion control. TCP for high bandwidth delay networks. Fairness issues in TCP.

### UNIT II

**Real Time Communications over Internet. Adaptive applications:**Latency and throughput Issues, Integrated Services Model (intServ). Resource reservation in Internet.RSVP, Characterization of Traffic by Linearly Bounded Arrival Processes (LBAP). Leaky bucket algorithm and its properties.

### UNIT III

**Packet Scheduling Algorithms-requirements and choices:**Scheduling guaranteed service connections. GPS, WFQ and Rate proportional algorithms.High speed scheduler design.Theory of Latency Rate servers and delay bounds in packet switched networks for LBAP traffic, Active Queue Management - RED, WRED and Virtual clock. Control theoretic analysis of active queue management.

### UNIT IV

**IP address lookup-challenges:**Packet classification algorithms and Flow Identification-Grid of Tries, Cross producting and controlled prefix expansion algorithms.

**Admission control in Internet:** Concept of Effective bandwidth, Measurement based admission control, Differentiated Services in Internet (DiffServ), DiffServ architecture and framework.

## UNIT V

**IPV4, IPV6, IP tunnelling, IPswitching and MPLS:**Overview of IP over ATM and its evolution to IP switching, MPLS architecture and framework, MPLS Protocols, Traffic engineering issues in MPLS.

**Text Books**


- Jean Wairand and PravinVaraiya, "High Performance Communications Networks", 2nd edition, 2000.
- Jean Le Boudec and Patrick Thiran, "Network Calculus A Theory of Deterministic Queueing Systems for the Internet", Springer Veriag, 2001.
- Zhang Wang, "Internet QoS", Morgan Kaufman, 2001.
- Anurag Kumar, D. Manjunath and Joy Kuri, "Communication Networking: An Analytical Approach" , Morgan Kaufman Publishers, 2004.
- George Kesidis, "ATM Network Performance", Kluwer Academic, Research Papers, 2005.

**M.Tech I Sem.**

## Lab 1: DIGITAL SYSTEM DESIGN LAB

### Course objectives:

1. To Identify, formulate, solve and implement problems in Adders, multipliers, Flip-Flops, Counters etc using RTL design tools.
2. To use EDA tools like Mentor Graphics and Xilinx.

### Course Outcomes:

At the end of the laboratory work, students will be able to:

1. Identify, formulate, solve and implement problems in Adders, multipliers, Flip-Flops, Counters etc using RTL design tools.

2.Use EDA tools like Mentor Graphics and Xilinx.

List of experiments:

1. Simulation and Verification of Logic Gates.
2. Design and Simulation of Half adder, Serial Binary Adder, Multi Precession Adder, Carry Look Ahead Adder and Full Adder.
3. Simulation and Verification of Decoder, MUXs, Encoder using all Modeling Styles.
4. Modeling of Flip-Flops with Synchronous and Asynchronous reset.
5. Design and Simulation of Counters-Ring Counter, Johnson Counter, and Up-Down Counter, Ripple Counter.
6. Design of a N-bit Register of Serial-in Serial-out, Serial in Parallel out, Parallel in serial out and Parallel in Parallel Out.
7. Design of Sequence Detector (Finite State Machine-Mealy and Moore Machines).
8. 4-Bit Multiplier, Divider. (for 4-Bit Operand)
9. Design ALU to Perform –ADD, SUB, AND-OR, 1‟s and 2‟s COMPLIMENT, Multiplication, Division.
10. Design of Shift register.

**M.Tech I Sem.**

## Lab 2: Digital Communication Techniques Lab

### Course objectives:

1. To Identify, formulate, solve and implement problems in communication systems.
2. To know how to use simulation like Matlab / COM SIM .

### Course Outcomes:

At the end of the laboratory work, students will be able to:

1. Identify, formulate, solve and implement problems in communication systems.
2. Use simulation like Matlab / COM SIM .

**Experiments:**

1. Simulate generation and detection of ASK Signal
2. Simulate generation and detection of FSK Signal
3. Simulate generation and demodulation of BPSK Signal
4. Simulate Rayleigh Fading Channel Using Either Clarke's Model or Jake's Model for different Doppler Spreads (Ex. 50 Hz and 100 Hz)
5. Generation of Maximal Sequences and Gold Sequences.
6. Performance Evaluation of QPSK System over Gaussian AWGN Channel.
7. Performance Evaluation of QPSK System over Rayleigh Fading Channel.
8. M-ary QAM with AWGN fading
9. Equalization of Multipath Channel using LMS or RLS Algorithms.
10. Performance Evaluation of RAKE Receiver over Slow Fading Channel.
11. Error detection and correction using CRC method.
12. Generation of Hamming code sequence.
13. Correlation: Auto And Cross.

**M.Tech I Sem.**

## Research Methodology and IPR

**Course objectives:**

1. To understand research problem formulation.
2. To analyze research related information
3. To know how to Follow research ethics
4. To understand that today's world is controlled by Computer, Information Technology, buttomorrow world will be ruled by ideas, concept, and creativity.
5. To Understand that when IPR would take such important place in growth of individuals & nation, it is needless to emphasis the need of information about Intellectual Property
6. To know the Right to be promoted among students in general & engineering in particular.
7. To understand that IPR protection provides an incentive to inventors for further research work and investment in R & D, which leads to creation of new and better products, and in turn brings about, economic growth and social benefits.

**Course Outcomes:**

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

1 Understand research problem formulation.

2 Analyze research related information

3. Follow research ethics

4. Understand that today's world is controlled by Computer, Information Technology, but tomorrow world will be ruled by ideas, concept, and creativity.

5. Understanding that when IPR would take such important place in growth of individuals & nation, it is needless to emphasis the need of information about Intellectual Property

6 Right to be promoted among students in general & engineering in particular.

7. Understand that IPR protection provides an incentive to inventors for further research work and investment in R & D, which leads to creation of new and better products, and in turn brings about, economic growth and social benefits.

**Syllabus Contents:**

### Unit 1

Meaning of research problem, Sources of research problem, Criteria Characteristics of a good research problem, Errors in selecting a research problem, Scope and objectives of research problem. Approaches of investigation of solutions for research problem, data collection, analysis, interpretation, Necessary instrumentations

### Unit 2

Effective literature studies approaches, analysis Plagiarism , Research ethics,

### Unit 3

Effective technical writing, how to write report, Paper Developing a Research Proposal, Format of research proposal, a presentation and assessment by a review committee

**Unit 4**

Nature of Intellectual Property: Patents, Designs, Trademarks and Copyright. Process of Patenting and Development: technological research, innovation, patenting, development. International Scenario: International cooperation on Intellectual Property. Procedure for grants of patents, Patenting under PCT.

**Unit 5**

Patent Rights: Scope of Patent Rights. Licensing and transfer of technology.Patent information and databases.Geographical Indications.

**Unit 6**

New Developments in IPR: Administration of Patent System. New developments in IPR; IPR of Biological Systems, Computer Software etc.Traditional knowledge Case Studies, IPR and IITs.

**References:**


1. Stuart Melville and Wayne Goddard, "Research methodology: an introduction for science & engineering students'"
2. Wayne Goddard and Stuart Melville, "Research Methodology: An Introduction"
3. Ranjit Kumar, 2nd Edition , "Research Methodology: A Step by Step Guide for beginners"
4. Halbert, "Resisting Intellectual Property", Taylor & Francis Ltd ,2007.
5. Mayall , "Industrial Design", McGraw Hill, 1992.
6. Niebel , "Product Design", McGraw Hill, 1974.
7. Asimov , "Introduction to Design", Prentice Hall, 1962.
8. Robert P. Merges, Peter S. Menell, Mark A. Lemley, " Intellectual Property in New Technological Age", 2016.
9. T. Ramappa, "Intellectual Property Rights Under WTO", S. Chand, 2008

**M.Tech I Sem.**

## Audit 1: VALUE EDUCATION

**Course objectives:**

1. To Understand value of education and self- development
2. To Imbibe good values in students
3. To know about the importance of character
4. To acquire the knowledge of self-development
5. To Learn the importance of Human values

**Course Outcomes**

Students will be able to

1. Understand value of education and self- development
2. Imbibe good values in students
3. Let the should know about the importance of character
4. Knowledge of self-development
5. Learn the importance of Human values
6. Developing the overall personality

***Syllabus***

**Unit** 1

Values and self-development –Social values and individual attitudes, Work ethics, Indian vision of humanism, Moral and non- moral valuation, Standards and principles, Value judgements.

**Unit 2**

Importance of cultivation of values, Sense of duty. Devotion, Self-reliance, Confidence, Concentration, Truthfulness, Cleanliness, Honesty, Humanity,Power of faith, National Unity,Patriotism, Love for nature ,Discipline

**Unit 3**

Personality and Behavior Development - Soul and Scientific attitude,PositiveThinking,Integrity and discipline, Punctuality, Love and Kindness, Avoid fault Thinking, Free from anger, Dignity of labour.

**Unit 4**

Universal brotherhood and religious tolerance, True friendship, Happiness Vs suffering, love for truth, Aware of self-destructive habits, Association and Cooperation,Doing best for saving nature.

**Unit 5**

Character and Competence ,Holy books vs Blind faith, Self-management and Good health, Science of reincarnation, Equality, Nonviolence ,Humility, Role of Women,All religions and same message,Mind your Mind, Self-control, Honesty, Studying effectively.

***Suggested reading***

1 Chakroborty, S.K. "Values and Ethics for organizations Theory and practice", Oxford University Press, New Delhi

1.

**M.Tech II Sem.**

## Core 3: Microcontrollers and Programmable Digital Signal Processors

**Course objectives:**

1. To understand how toCompare and select ARM processor core based SoC with several features/peripherals based on requirements of embedded applications.

2. To identify and characterize architecture of Programmable DSP Processors.

3. To understand the development of small applications by utilizing the ARM processor core and DSP processor based platform

**Course Outcomes:**

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

1. Compare and select ARM processor core based SoC with several features/peripherals based on requirements of embedded applications.
2. Identify and characterize architecture of Programmable DSP Processors.
3. Develop small applications by utilizing the ARM processor core and DSP processor based platform.

**Syllabus Contents:**

### Unit 1

ARM Cortex-M3 processor: Applications, Programming model – Registers, Operation modes, Exceptions and Interrupts, Reset Sequence Instruction Set, Unified Assembler Language, Memory Maps, Memory Access Attributes, Permissions, Bit-Band Operations, Unaligned and Exclusive Transfers, Pipeline, Bus Interfaces.

### Unit 2

Exceptions, Types, Priority, Vector Tables, Interrupt Inputs and Pending behaviour, Fault Exceptions, Supervisor and Pendable Service Call, Nested Vectored Interrupt Controller, Basic Configuration, SYSTICK Timer, Interrupt Sequences, Exits, Tail Chaining, Interrupt Latency.

### Unit 3

LPC 17xx microcontroller- Internal memory, GPIOs, Timers, ADC, UART and other serial interfaces, PWM, RTC, WDT

### Unit 4

Programmable DSP (P-DSP) Processors: Harvard architecture, Multi port memory, architectural structure of P-DSP- MAC unit, Barrel shifters, VLIW architecture, Introduction to TI DSP processor family, TMS320C6000 series, architecture study, data paths, cross paths.

## Unit 5

Introduction to Instruction level architecture of C6000 family, Assembly Instructions memory addressing, for arithmetic, logical operations, Code Composer Studio for application development for digital signal processing, On chip peripherals , Processor benchmarking.

**References:**


1. Joseph Yiu, “The definitive guide to ARM Cortex-M3”, Elsevier, 2nd Edition
2. Venkatramani B. and Bhaskar M. “Digital Signal Processors: Architecture, Programming and Applications” , TMH , 2nd Edition
3. Sloss Andrew N, Symes Dominic, Wright Chris, “ARM System Developer's Guide: Designing and Optimizing”, Morgan Kaufman Publication
4. Steve furber, “ARM System-on-Chip Architecture”, Pearson Education
5. Frank Vahid and Tony Givargis, “Embedded System Design”, Wiley
6. Technical references and user manuals on www.arm.com, NXP Semiconductor www.nxp.com and Texas Instruments www.ti.com

**M.Tech. II Sem.**

## Advanced Digital Signal Processing

### Objectives:

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

1. To understand theory of different filters and algorithms
2. To understand theory of multirate DSP, solve numerical problems and write algorithms
3. To understand theory of prediction and solution of normal equations
4. To know applications of DSP at block level.

### Outcome:

Upon completion of the course, the student will be able to :

1. Comprehend the DFTs and FFTs.
2. Design and analyze the digital filters.
3. Acquire the basics of Multirate digital signal processing.
4. Analyze the power spectrum estimation.
5. Comprehend the finite word length effects in fixed point DSP systems.

### Syllabus Contents:

**Unit 1**

Overview **:**Discrete-Time Signals, Sequences and sequence Representation, Discrete-Time Systems, Time-Domain Characterization and Classification of LTI Discrete-Time Systems. The Continuous-Time Fourier Transform, The discrete-Time Fourier Transform, energy Density Spectrum of a Discrete-Time Sequence, Band-Limited Discrete-Time signals, The Frequency Response of LTI Discrete-Time System.

**Unit 2**

Multi rate DSP, Decimators and Interpolators, Sampling rate conversion, multistage decimator & interpolator, poly phase filters, QMF, digital filter banks, Applications in Multi rate systems.

**Unit 3**

Linear prediction & optimum linear filters, stationary random process, forward-backward linear prediction filters, solution of normal equations, AR Lattice and ARMA Lattice-Ladder Filters, Wiener Filters for Filtering and Prediction.

**Unit 4**

Estimation of Spectra from Finite-Duration Observations of Signals. Nonparametric Methods for Power Spectrum Estimation,Parametric Methods for Power Spectrum Estimation, Minimum-Variance Spectral Estimation, Eigenanalysis Algorithms for Spectrum Estimation.

## Unit 5

Application of DSP: Dual-Tone Multifrequency Signal Design, Spectral analysis of Sinusoidal Signals, Spectral analysis of nonstationary signals, Musical sound processing, Discrete-time analytic signal generation, Subband coding of speech and audio signals, transmultiplexers and Oversampling A/D and D/C converters.

**TEXTBOOKS:**

1. Digital Signal Processing by Sanjit K Mitra, Tata MCgraw Hill Publications.

2. Digital Signal Processing Principles, Algorithms, Applications by J G Proakis, D G Manolokis,

PHI.

**REFERENCES:**

1. Discrete-Time Signal Processing by A V Oppenhiem, R W Schafer, Pearson Education.

2. DSP- A Practical Approach- Emmanuel C Ifeacher Barrie. W. Jervis, Pearson Education.

3. Modern spectral Estimation techniques by S. M .Kay, PHI, 1997

**M.Tech. II sem. (DECS)**

## PSE 3: Advanced Computer Architecture

**Course objectives:**

**1.** To Learn the advanced concepts related to computer architecture and storage systems.

2. To Understand parallelism and pipelining concepts, the design aspects and challenges.

3. To Study and analyze the high performance scalable Multithreaded and multiprocessor systems.

**Course Outcomes:**

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

1. Learn the advanced concepts related to computer architecture and storage systems.
2. Understand parallelism and pipelining concepts, the design aspects and challenges.
3. Study and analyze the high performance scalable Multithreaded and multiprocessor systems.

### UNIT I

**Fundamentals of Computer Design:** Technology trends, cost- measuring and reporting performancequantitative principles of computer design.

**Instruction Set Principles and Examples: c**lassifying instruction set- memory addressing- type and sizeof operands- addressing modes for signal processing operations in the instruction set, instructions for control flow, encoding an instruction set, the role of compiler

### UNIT II

**Instruction Level Parallelism (ILP):** overcoming data hazards reducing branch costs, high performanceinstruction delivery, hardware based speculation, limitation of ILP

**ILP Software Approach**:compiler techniques- static branch protection, VLIW approach, H.W support formore ILP at compile time- H.W verses S.W solutions

### UNIT III

**Memory Hierarchy Design**:cache performance, reducing cache misses penalty and miss rate, virtualmemory, protection and examples of VM.

### UNIT IV

**Multiprocessors and Thread Level Parallelism**:Symmetric shared memory architectures, distributedshared memory, Synchronization, multi threading.

### UNIT V

**Storage Systems**-Types, Buses, RAID, errors and failures, bench marking a storage device, designing a I/Osystem.

**Interconnection Networks and Clusters**:Interconnection network media, practical issues ininterconnecting networks- examples, clusters, designing a Cluster

**Text Books:**

1. Computer Architecture A quantitative approach 3rd edition John L. Hennessy & David A. Patterson Morgan Kufmann (An Imprint of Elsevier)

**References:**


1. Kai Hwang and A.Briggs "Computer Architecture and parallel processing", International Edition McGraw-Hill.
2. Kai Hwang, "Advanced Computer Architecture", McGraw Hill Education,1993.
3. DezsoSima, Terence Fountain, Peter Kacsuk, "Advanced Computer Architectures", Pearson.

**M.Tech. II sem. (DECS)**

## PSE 3: IOT and Applications

**Course objectives:**

1. To know and understand the concept of IOT and M2M
2. To get the knowledge on IOT architecture and applications in various fields
3. To analyze the security and privacy issues in IOT.

**Course Outcomes:**

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

1. Understand the concept of IOT and M2M

2. Study IOT architecture and applications in various fields

3. Study the security and privacy issues in IOT.

**Syllabus Contents:**

### Unit 1

IoT& Web Technology The Internet of Things Today, Time for Convergence, Towards the IoT Universe, Internet of Things Vision, IoT Strategic Research and Innovation Directions, IoT Applications, Future Internet Technologies, Infrastructure, Networks and Communication, Processes, Data Management, Security, Privacy & Trust, Device Level Energy Issues, IoT Related Standardization, Recommendations on Research Topics.

### Unit 2

M2M to IoT – A Basic Perspective– Introduction, Some Definitions, M2M Value Chains, IoT Value Chains, An emerging industrial structure for IoT, The international driven global value chain and global information monopolies. M2M to IoT-An Architectural Overview– Building an architecture, Main design principles and needed capabilities, An IoT architecture outline, standards considerations.

### Unit 3

IoT Architecture -State of the Art – Introduction, State of the art, Architecture Reference ModelIntroduction, Reference Model and architecture, IoT reference Model, IoT Reference Architecture- Introduction, Functional View, Information View, Deployment and Operational View, Other Relevant architectural views.

### Unit 4

IoT Applications for Value Creations Introduction, IoT applications for industry: Future Factory Concepts, Brownfield IoT, Smart Objects, Smart Applications, Four Aspects in your Business to Master IoT, Value Creation from Big Data and Serialization, IoT for Retailing Industry, IoT For Oil and Gas Industry, Opinions on IoT Application and Value for Industry, Home Management,

eHealth.

## Unit 5

Internet of Things Privacy, Security and Governance Introduction, Overview of Governance,

Privacy and Security Issues, Contribution from FP7 Projects, Security, Privacy and Trust in IoT-Data-Platforms for Smart Cities, First Steps Towards a Secure Platform, Smartie Approach. Data Aggregation for the IoT in Smart Cities, Security.

**References:**


1. Vijay Madisetti and ArshdeepBahga, "Internet of Things (A Hands-on-Approach)", 1st
2. Edition, VPT, 2014.
3. Francis daCosta, "Rethinking the Internet of Things: A Scalable Approach to Connecting
4. Everything", 1stEdition, Apress Publications, 2013.
5. CunoPfister, "Getting Started with the Internet of Things", OReilly Media, 2011.
6. Dr. OvidiuVermesan, Dr. Peter Friess, Internet of Things: Converging Technologies for Smart Environments and Integrated Ecosystems, River Publishers, 2013.
7. Catherine Mulligan, David Boyle, Jan Holler, StamatisKarnouskos, and VlasiosTsiatsis, "From Machine-to-Machine to the Internet of Things: Introduction to a New Age of Intelligence", Elsevier, 2014.

**M.Tech. II sem. (DECS)**

## PSE 3: VLSI SIGNAL PROCESSING

**Course objectives:**

1. To acquire the knowledge about DSP algorithms, its DFG representation, pipelining and parallel processing approaches.
2. To understand about the retiming techniques, folding and register minimization path problems.
3. To get about algorithmic strength reduction techniques and parallel processing of FIR and IIR digital filters.
4. To understand the knowledge about finite word-length effects and round off noise computation in DSP systems.

**Course Outcomes:**

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

1. Acquired knowledge about DSP algorithms, its DFG representation, pipelining and parallel processing approaches.
2. Ability to acquire knowledge about retiming techniques, folding and register minimization path problems.
3. Ability to have knowledge about algorithmic strength reduction techniques and parallel processing of FIR and IIR digital filters.
4. Acquired knowledge about finite word-length effects and round off noise computation in DSP systems.

**Syllabus Contents:**

### Unit 1

Introduction to DSP systems, Pipelined and parallel processing.

### Unit 2

Iteration Bound, Retiming, unfolding, algorithmic strength reduction in filters and Transforms.

### Unit 3

Systolic architecture design, fast convolution, pipelined and parallel recursive and adaptive filters, Scaling and round off noise.

### Unit 4

Digital lattice filter structures, bit level arithmetic, architecture, redundant arithmetic.

## Unit 5

Numerical strength reduction, synchronous, wave and asynchronous pipe lines, low power design.

**References:**


1. Keshab K. Parthi , VLSI Digital signal processing systems, design and implementation , Wiley, Inter Science, 1999.
2. Mohammad Isamail and Terri Fiez, Analog VLSI signal and information processing, McGraw Hill, 1994
3. S.Y. Kung, H.J. White House, T. Kailath, VLSI and Modern Signal Processing, Prentice Hall, 1985.

**M.Tech. II sem. (DECS)**

## PSE 4: Detection and Estimation of Signals

**Course Objectives:**

1. To provide knowledge about various estimation techniques like parametric and non parametric estimation techniques.
2. To provide knowledge for finding good estimators.
3. To provide enough knowledge for detection of signal in noise and estimate the signals in the presence of noise.

**Course outcomes:**

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

1. Get the knowledge about various estimation techniques like parametric and non parametric estimation techniques.
2. Find good estimators.
3. Have the enough knowledge for detection of signal in noise and estimate the signals in the presence of noise.

### UNIT-I

**Introduction to Discrete-Ttime Signals:** Fourier Transform of a discrete time signal. Amplitude and phase spectrum.Frequency content and sampling rates. Transfer function. Frequency response.

**Random – Discrete-time signals:** Review of probability – Random data –Filtered signals – Autocorrelation and power spectral density.

### UNIT-II

**Statistics:** Measurements, Nonparametric Estimators of Probability Distribution and Density Functions, Point Estimators of Parameters, Measures of the Quality of Estimators, Introduction to Interval Estimates, Distribution of Estimators, Tests of Hypotheses, Simple Linear Regression, Multiple Linear Regression.

### UNIT-III

**Detection of Signals in Noise:** Minimum probability of Error criterion, Neyman-Pearson criterion for Radar detection of constant and variable, amplitude signals, Matched Filters, optimum formulation, detection of random signals, simple problems thereon with multisample cases.

### UNIT-IV

**Estimation of signals in Noise:** Linear mean squared estimation, non-linear estimates, MAP and ML estimates, maximum likelihood estimate of parameters of linear system, simple problems theoreon.

## UNIT- V

**Recursive Linear Mean Squared Estimation:** Estimation of a signal parameter. Estimation of time-varying signals, Kalman filtering, Filtering signals in noise, Treatment restricted to two variable case only, Simple problems.

**Text Books:**


1. Signal processing: Discrete Spectral analysis, Detection and Estimation, Mischa Schwartz and Leonard Shaw, Mc-Graw Hill Book Company, 1975.
2. Shanmugam and Breipohl, 'Detection of signals in noise and estimation', John Wiley &Sons, New York, 1985.


**Reference Books:**


1. E.L. Van Trees, Detection, Estimation and Modulation Theory, Wiley, New York, 1968.
2. Srinath, Rajasekaran&Viswanathan, Introduction to statistical Signal processing with Applications, Prentice Hall of India, New Delhi, 110 001,1989.

**M.Tech. II sem. (DECS)**

## PSE 4: OPTICAL NETWORKS

**Course Objectives:**

1. To acquire the knowledge how to contribute in the areas of optical network and WDM network design.
2. To understand the implementation of simple optical network and understand further technology developments forfuture enhanced network

**Course Outcomes:**

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

1. Contribute in the areas of optical network and WDM network design.
2. Implement simple optical network and understand further technology developments for future enhanced network.

### Unit 1

**Client Layers of the Optical Layer**: SONET/SDH, Multiplexing, SONET/SDHLayers, SONETFrame Structure, SONET/SDHPhysicalLayer, Elements of a SONET/SDH Infrastructure optical transport network, Frame Structure, Multiplexing, IP- routing and forwarding, multiprotocol label switching - Labels and Forwarding, Quality of Service, Signaling andRouting

### Unit 2

**WDM network elements:** optical line terminals and amplifiers, optical add/drop multiplexers, OADM architectures, reconfigurable OADM, optical cross connects.

### Unit 3

**Control and management:** network management functions, optical layer services and interfacing, performance and fault management, configuration management.

### Unit 4

**Network Survivability:** protection in SONET/SDH & client layer.

**WDM network design:** LTD and RWA problems, dimensioning wavelength routing networks, statistical dimensioning models.

### Unit 5

**Photonic packet switching:** Optical time division multiplexing, synchronization, header processing, buffering, burst switching, test beds.

Text Books**:**


1. Rajiv Ramaswami, Sivarajan, Sasaki, “Optical Networks: A Practical Perspective”, MK, Elsevier, 3 rd edition, 2010.
2. C. Siva Ram Murthy and Mohan Gurusamy, “WDM Optical Networks: Concepts Design, and Algorithms”, PHI, EEE, 2001.

**M.Tech. II sem. (DECS)**

## PSE 4: Biomedical Signal Processing

**Course objectives:**

1. To understand the different types of biomedical signal.
2. To Identify and analyze different biomedical signals.
3. To know the applications related to biomedical signal processing

**Course Outcomes:**

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

1. Understand different types of biomedical signal.
2. Identify and analyze different biomedical signals.
3. Find applications related to biomedical signal processing

### Unit I

**Introduction:** Acquisition, Generation of Bio-signals, Origin of bio-signals, Types of bio-signals, Study of diagnostically significant bio-signal parameters

### UNIT -II

**Data Compression Techniques:** Lossy and Lossless data reduction Algorithms. ECG data compression using Turning point, AZTEC, CORTES, Huffman coding, vector quantization, DICOM Standards

### UNIT -III

**Cardiological Signal Processing:** Pre-processing, QRS Detection Methods, Rhythm analysis, Arrhythmia Detection Algorithms, Automated ECG Analysis, ECG Pattern Recognition.
**Adaptive Noise Cancelling:** Principles of Adaptive Noise Cancelling, Adaptive Noise Cancelling with the LMS Adaptation Algorithm, Noise Cancelling Method to Enhance ECG Monitoring, Fetal ECG Monitoring.

### UNIT -IV

**Signal Averaging, Polishing** : Mean and trend removal, Prony's method, Prony's Method based on the Least Squares Estimate, Linear prediction, Yule – Walker (Y –W) equations, Analysis of Evoked Potentials.

### UNIT -V

**Neurological Signal Processing:** Modeling of EEG Signals, Detection of spikes and spindles Detection of Alpha, Beta and Gamma Waves. Auto Regressive (A.R.) modeling of seizure EEG. Sleep Stage analysis, Inverse Filtering, Least squares and polynomial modeling.

**TEXT BOOKS:**


1. Rangaraj M. Rangayyan – Biomedical Signal Analysis. IEEE Press, 2001.
2. D. C. Reddy, Biomedical Signal Processing- principles, and techniques, Tata McGraw-Hill, 2005.
3. Biomedical Digital Signal Processing, Willis J. Tompkins, PHI.

**M.Tech II Sem.**

## Lab 3:Microcontrollers and Programmable Digital Signal Processors Lab

**Course objectives:**

1. To know how to install, configure and utilize tool sets for developing applications based on ARM processor core SoC and DSP processor.
2. To Develop prototype codes using commonly available on and off chip peripherals on the Cortex M3 and DSP development boards.

**Course Outcomes:**

At the end of the laboratory work, students will be able to:

1. Install, configure and utilize tool sets for developing applications based on ARM processorcore SoC and DSP processor.
2. Develop prototype codes using commonly available on and off chip peripherals on the Cortex M3 and DSP development boards.

**List of Assignments:**

Part A) Experiments to be carried out on Cortex-M3 development boards and using GNU toolchain

1. Blink an LED with software delay, delay generated using the SysTick timer.
2. System clock real time alteration using the PLL modules.
3. Control intensity of an LED using PWM implemented in software and hardware.
4. Control an LED using switch by polling method, by interrupt method and flash the LED once every five switch presses.
5. UART Echo Test.
6. Take analog readings on rotation of rotary potentiometer connected to an ADC channel.
7. Temperature indication on an RGB LED.
8. Mimic light intensity sensed by the light sensor by varying the blinking rate of an LED.
9. Evaluate the various sleep modes by putting core in sleep and deep sleep modes.
10. System reset using watchdog timer in case something goes wrong.
11. Sample sound using a microphone and display sound levels on LEDs.

Part B) Experiments to be carried out on DSP C6713 evaluation kits and using Code Composer Studio (CCS)

1. To develop an assembly code and C code to compute Euclidian distance between any two points
2. To develop assembly code and study the impact of parallel, serial and mixed execution
3. To develop assembly and C code for implementation of convolution operation
4. To design and implement filters in C to enhance the features of given input sequence/signal

**M.Tech II Sem.**

## Lab 4: Advanced Digital Signal Processing lab

### Course objectives:

1. To understand the designing of different digital filters in software
2. To apply various transforms in time and frequency
3. To Perform decimation and interpolation

### Course Outcomes:

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

1. Design different digital filters in software
2. Apply various transforms in time and frequency
3. Perform decimation and interpolation

### List of Assignments:

1. Basic Signal Representation
2. Auto Correlation And Cross Correlation
3. Stability Using Hurwitz Routh Criteria
4. Sampling FFT Of Input Sequence
5. Butterworth Low pass And High pass Filter Design
6. Chebychev Type I,II Filter
7. Normal Equation Using Levinson Durbin
8. Decimation And Interpolation Using Rationale Factors
9. Maximally Decimated Analysis DFT Filter
10. Cascade Digital IIR Filter Realization
11. Convolution And M Fold Decimation &PSD Estimator
12. Estimation Of PSD
13. Separation Of T/F
14. Parallel Realization of IIR filter

**M.Tech II Sem.**

## Audit 2: ENGLISH FOR RESEARCH PAPER WRITING

**Course objectives:**

1. To understand that how to improve your writing skills and level of readability
2. To learn about what to write in each section
3. To understand the skills needed when writing a Title
4. To ensure the good quality of paper at very first-time submission

**Course outcomes:**

Students will be able to:

1. Understand that how to improve your writing skills and level of readability
2. Learn about what to write in each section
3. Understand the skills needed when writing a Title
4. Ensure the good quality of paper at very first-time submission

**Syllabus**

**Unit** 1

Planning and Preparation, Word Order, Breaking up long sentences, Structuring Paragraphs and Sentences, Being Concise and Removing Redundancy, Avoiding Ambiguity and Vagueness

Unit 2

Clarifying Who Did What, Highlighting Your Findings, Hedging and Criticising, Paraphrasing and Plagiarism, Sections of a Paper, Abstracts. Introduction, Review of the Literature, Methods, Results, Discussion, Conclusions, The Final Check.

Unit 3

key skills are needed when writing a Title, key skills are needed when writing an Abstract, key skills are needed when writing an Introduction, skills needed when writing a Review of the Literature,

Unit 4

Skills are needed when writing the Methods, skills needed when writing the Results, skills are needed when writing the Discussion, skills are needed when writing the Conclusions

Unit 5

Useful phrases, how to ensure paper is as good as it could possibly be the first- time submission

**Suggested Studies:**

1. Goldbort R (2006) Writing for Science, Yale University Press (available on Google Books)

2. Day R (2006) How to Write and Publish a Scientific Paper, Cambridge University Press.

**M.Tech III Sem.**

## PSE 5:Microcomputer System Design

**Course objectives:**

1. To familiar with 8086, 80X86, Pentium & Pentium IV Microprocessor Architecture, Instructions, Operating Modes, and Programming.
2. To Study I/O, Multi programming and Arithmetic Coprocessor.

**Course Outcomes:**

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

1. Become familiar with 8086, 80X86, Pentium & Pentium IV Microprocessor Architecture, Instructions, Operating Modes, and Programming.
2. Study I/O, Multi programming and Arithmetic Coprocessor.

### UNIT I

**Review of 8086 Processor:** Architecture, Register organization, Addressing Modes and Instruction Set (Brieftreatment only), Difference between 8086 and 8088 with rest to pin structures.

**The 80286 Microprocessors:** Architecture, Register Organization, Addressing Modes and instruction sets of80286 (brief treatment only)

### UNIT II

**The 80386, and 80486 Microprocessors:** Architectural features, Register Organization, Memorymanagement, Virtual 8086 mode, The Memory Paging Mechanism, Pin Definitions of 80386 and 80486 (brief treatment).

### UNIT III

**The Pentium and Pentium Pro-processors:** The Memory System, Input/output system, Branch PredictionLogic, Cache Structure, Pentium Registers, Serial Pentium pro features.

**The Pentium IV and Dual Core Microprocessors:** Architecture, Special Registers and Pin Structures(brief treatment only)

### UNIT IV

**I/O Programming:** Fundamentals of I/O Considerations Programmed I/O, Interrupt I/O, Block Transfers andDMA, I/O Design Example.

**Introduction to Multiprogramming:** Process Management, Semaphores Operations, Common ProcedureSharing, Memory Management, Virtual Memory Concept of 80286 and other advanced Processors.

### UNIT V

**Arithmetic Coprocessor, MMX and SIMD Technologies:** Data formats for Arithmetic Coprocessor, Internal Structure of 8087 and Advanced Coprocessors. Instruction Set (brief treatment).

**Text Books:**


1. Barry, B. Brey, “The Intel Microprocessors,”8th Edition Pearson Education, 2009.
2. A.K. Ray and K.M. Bhurchandi,”Advanced Microprocessor and Peripherals,” TMH.
3. YU-Chang, Glenn A. Gibson, “Micro Computer Systems: The 8086/8088 Family Architecture, Programming and Design” 2nd Edition, Pearson Education, 2007.


**Reference Books:**


1. The 8088 and 8086 Microprocessors: Programming, Interfacing, Software, Hardware, and Applications : Including the 80286, 80386, 80486, and Pentium Processors Walter A. Triebel, Avtar SinghPrentice Hall, 2000
2. Douglas V. Hall, “Microprocessors and Interfacing,” Special Indian Edition, 2006

**M.Tech III Sem.**

## PSE 5: Joint Time Frequency Analysis & Multi Resolution Analysis

### Course objectives:

1. To understand the introduction of Transforms in signal processing
2. To understand Time -Frequency Analysis &Multiresolution Analysis
3. To Study the Wavelets and its Applications

### Course Outcomes:

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

1. Introduction to Transforms in signal processing

2. Have the knowledge on Time -Frequency Analysis &Multiresolution Analysis

3. Know the Wavelets and its Applications

**Syllabus Contents:**

**Unit 1**

Introduction: Review of Fourier Transform, Parseval Theorem and need for joint time-frequency Analysis. Concept of non-stationary signals, Short-time Fourier transforms (STFT), Uncertainty Principle, and Localization/Isolation in time and frequency, Hilbert Spaces, Banach Spaces, and Fundamentals of Hilbert Transform.

**Unit 2**

Bases for Time-Frequency Analysis: Wavelet Bases and filter Banks, Tiling's of Wavelet Packet and Local Cosine Bases, Wavelet Transform, Real Wavelets, Analytic Wavelets, Discrete Wavelets, Instantaneous Frequency, Quadratic time-frequency energy, Wavelet Frames, Dyadic wavelet Transform, Construction of Haar and Roof scaling function using dilation equation and graphical method.

**Unit 3**

Multiresolution Analysis: HaarMultiresolution Analysis, MRA Axioms, Spanning Linear Subspaces, nested subspaces, Orthogonal Wavelets Bases, Scaling Functions, Conjugate Mirror Filters, Haar 2-band filter Banks, Study of up samplers and down samplers, Conditions for alias cancellation and perfect reconstruction, Discrete wavelet transform and relationship with filter Banks, Frequency analysis of Haar 2-band filter banks, scaling and wavelet dilation equations in time and frequency domains, case study of decomposition and reconstruction of given signal using orthogonal framework of Haar 2band filter bank.

## Unit 4

Wavelets: Daubechies Wavelet Bases, Daubechies compactly supported family of wavelets;

Daubechies filter coefficient calculations, Case study of Daub-4 filter design, Connection between Haar and Daub-4, Concept of Regularity, Vanishing moments. Other classes of wavelets like Shannon, Meyer, and Battle-Lamarie.

## Unit 5

Bi-orthogonal wavelets and Applications: Construction and design. Case studies of biorthogonal

5/3 tap design and its use in JPEG 2000. Lifting schemes for generating orthogonalbases

of second generation wavelets.

JTFA Applications:Speech, audio, image and video compression; signal denoising, feature

extraction, inverse problem.

**References:**


1. S. Mallat, "A Wavelet Tour of Signal Processing," 2nd Edition, Academic Press, 1999.
2. L. Cohen, “Time-frequency analysis”, 1st Edition, Prentice Hall, 1995.
3. G.Strang and T. Q. Nguyen, “Wavelets and Filter Banks",2nd Edition, Wellesley
4. Cambridge Press, 1998.
5. I. Daubechies, "Ten Lectures on Wavelets", SIAM, 1992.
6. P. P. Vaidyanathan, "Multirate Systems and Filter Banks", Prentice Hall, 1993.
7. M. Vetterli and J. Kovacevic, "Wavelets and Subband Coding", Prentice Hall, 1995

**M.Tech III Sem.**

## PSE 5: Pattern Recognition and Machine Learning

**Course objectives:**

1. To Study the parametric and linear models for classification
2. To Design neural network and SVM for classification
3. To Develop machine independent and unsupervised learning techniques.

**Course Outcomes:**

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

1. Know the parametric and linear models for classification
2. Design neural network and SVM for classification
3. Develop machine independent and unsupervised learning techniques.

UNIT I

**Introduction to Pattern Recognition**: Problems, applications, design cycle, learning and adaptation, examples, Probability Distributions, Parametric Learning - Maximum likelihood and Bayesian Decision Theory- Bayes rule, discriminant functions, loss functions and Bayesian error analysis

UNIT II

**Linear models for classification:** Discriminant functions, Two and multiple classes, Fisher's linear discriminant, Fisher's discriminant for multiple classes, The perceptron algorithm.

UNIT III

**Neural Network**: perceptron, multi-layer perceptron, backpropagation algorithm, error surfaces, practical techniques for improving backpropagation, additional networks and training methods.

UNIT IV

**Linear discriminant functions -** decision surfaces, two-category, multi-category, minimumsquared error procedures, the Ho-Kashyap procedures, linear programming algorithms, Support vector machine

UNIT V

**Algorithm independent machine learning** – lack of inherent superiority of any classifier, bias and variance, re-sampling for classifier design.

**Unsupervised learning and clustering –** k-means clustering, fuzzy k-means clustering,hierarchical clustering

Text Books:


1. Richard O. Duda, Peter E. Hart, David G. Stork, "Pattern Classification", 2nd Edition John Wiley & Sons, 2001.
2. Trevor Hastie, Robert Tibshirani, Jerome H. Friedman, "The Elements of Statistical Learning", 2nd Edition, Springer, 2009.
3. C. Bishop, "Pattern Recognition and Machine Learning", Springer, 2006.

## OPEN ELECTIVES

### Business Analytics

**Course objective**

1. Understand the role of business analytics within anorganization.
2. Analyze data using statistical and data mining techniques and understand relationships between the underlying business processes of anorganization.
3. To gain an understanding of how managers use business analytics to formulate and solve business problems and to support managerial decisionmaking.
4. To become familiar with processes needed to develop, report, and analyze businessdata.Use decision-making tools/Operations researchtechniques.
5. Mange business process using analytical and managementtools.
6. Analyze and solve problems from different industries such as manufacturing, service, retail, software, banking and finance, sports, pharmaceutical, aerospaceetc.

**Course outcomes**

1. Students will demonstrate knowledge of data analytics.
2. Students will demonstrate the ability of think critically in making decisions based on data and deep analytics.
3. Students will demonstrate the ability to use technical skills in predicative and prescriptive modeling to support business decision-making.
4. Students will demonstrate the ability to translate data into clear, actionable insights.

| LECTURE WITH BREAKUP | NO. OF LECTURES |
|---|---|
| **Unit1:**<br>Business analytics: Overview of Business analytics, Scope of Business analytics, Business Analytics Process, Relationship of Business Analytics Process and organisation, competitive advantages of Business Analytics. Statistical Tools: Statistical Notation, Descriptive Statistical methods, Review of probability distribution and data modeling, sampling and estimation methods overview. | 9 |
| **Unit 2:**<br>Trendiness and Regression Analysis: Modeling Relationships and Trends in Data, simple Linear Regression.<br>Important Resources, Business Analytics Personnel, Data and models for Business analytics, problem solving, Visualizing and Exploring Data, Business Analytics Technology. | 8 |
| **Unit 3:**<br>Organization Structures of Business analytics, Team management, | |

| | |
|---|---|
| Management Issues, Designing Information Policy, Outsourcing, Ensuring Data Quality, Measuring contribution of Business analytics, Managing Changes.<br>Descriptive Analytics, predictive analytics, predicative Modelling, Predictive analytics analysis, Data Mining, Data Mining Methodologies, Prescriptive analytics and its step in the business analytics Process, Prescriptive Modelling, nonlinear Optimization. | 9 |
| **Unit 4:**<br>Forecasting Techniques: Qualitative and Judgmental Forecasting, Statistical Forecasting Models, Forecasting Models for Stationary Time Series, Forecasting Models for Time Series with a Linear Trend, Forecasting Time Series with Seasonality, Regression Forecasting with Casual Variables, Selecting Appropriate Forecasting Models.<br>Monte Carlo Simulation and Risk Analysis: Monte Carle Simulation Using Analytic Solver Platform, New-Product Development Model, Newsvendor Model,<br>Overbooking Model, Cash Budget Model. | 10 |
| **Unit 5:**<br>Decision Analysis: Formulating Decision Problems, Decision Strategies with the without Outcome Probabilities, Decision Trees, The Value of Information, Utility and Decision Making. Recent Trends in : Embedded and collaborative business intelligence, Visual data recovery, Data Storytelling and Data journalism. | 12 |

**Reference:**


1. Business analytics Principles, Concepts, and Applications by Marc J. Schniederjans, Dara G. Schniederjans, Christopher M. Starkey, Pearson FTPress.
2. Business Analytics by James Evans, personsEducation.


## Industrial Safety

**Teaching Scheme**

Lectures: 3 hrs/week

**Unit-I:** Industrial safety: Accident, causes, types, results and control, mechanical and electrical hazards, types, causes and preventive steps/procedure, describe salient points of factories act 1948 for health and safety, wash rooms, drinking water layouts, light, cleanliness, fire, guarding, pressure vessels, etc, Safety color codes. Fire prevention and firefighting, equipment andmethods.

**Unit-II:** Fundamentals of maintenance engineering: Definition and aim of maintenance engineering, Primary and secondary functions and responsibility of maintenance department, Types of maintenance, Types and applications of tools used for

maintenance, Maintenance cost & its relation with replacement economy, Service life of equipment.

**Unit-III:** Wear and Corrosion and their prevention: Wear- types, causes, effects, wear reduction methods, lubricants-types and applications, Lubrication methods, general sketch, working and applications, i. Screw down grease cup, ii. Pressure grease gun, iii. Splash lubrication, iv. Gravity lubrication, v. Wick feed lubrication vi. Side feed lubrication, vii. Ring lubrication, Definition, principle and factors affecting the corrosion. Types of corrosion, corrosion prevention methods

**Unit-IV:** Fault tracing: Fault tracing-concept and importance, decision treeconcept, need and applications, sequence of fault finding activities, show as decision tree, draw decision tree for problems in machine tools, hydraulic, pneumatic,automotive, thermal and electrical equipment's like, I. Any one machine tool, ii. Pump iii. Air compressor, iv. Internalcombustion engine, v. Boiler,

Electrical motors, Types of faults in machine tools and their generalcauses

**Unit-V:** Periodic and preventive maintenance: Periodic inspection-concept and need, degreasing, cleaning and repairing schemes, overhauling of mechanical components, overhauling of electrical motor, common troubles and remedies of electric motor, repair complexities and its use, definition, need, steps and advantages of preventive maintenance. Steps/procedure for periodic and preventive maintenance of: I. Machine tools, ii. Pumps, iii. Air compressors, iv. Diesel generating (DG) sets, Program and schedule of preventive maintenance of mechanical and electrical equipment, advantages of preventive maintenance. Repair cycle concept andimportance

**Reference:**


1. Maintenance Engineering Handbook, Higgins & Morrow, Da InformationServices.
2. Maintenance Engineering, H. P. Garg, S. Chand andCompany.
3. Pump-hydraulic Compressors, Audels, Mcgrew HillPublication.
4. Foundation Engineering Handbook, Winterkorn, Hans, Chapman & HallLondon.


## Operation Research

### Teaching Scheme

Lectures: 3 hrs/week

**Course Outcomes: At the end of the course,** the student should be able to

1. Students should able to apply the dynamic programming to solve problems of discreet and continuous variables.
2. Students should able to apply the concept of non-linearprogramming
3. Students should able to carry out sensitivityanalysis
4. Student should able to model the real world problem and simulateit.

**Syllabus Contents:**

**Unit 1**:

Optimization Techniques, Model Formulation, models, General L.R Formulation, Simplex Techniques, Sensitivity Analysis, Inventory Control Models

**Unit 2**

Formulation of a LPP - Graphical solution revised simplex method - duality theory - dual simplex method - sensitivity analysis - parametric programming

**Unit 3**:

Nonlinear programming problem - Kuhn-Tucker conditions min cost flow problem - max flow problem - CPM/PERT

**Unit 4**

Scheduling and sequencing - single server and multiple server models - deterministic inventory models - Probabilistic inventory control models - Geometric Programming.

**Unit 5**

Competitive Models,Single and Multi-channel Problems, Sequencing Models, Dynamic Programming, Flow in Networks, Elementary Graph Theory, Game Theory Simulation

**References**:


1. H.A. Taha, Operations Research, An Introduction, PHI,2008
2. H.M. Wagner, Principles of Operations Research, PHI, Delhi,1982.
3. J.C. Pant, Introduction to Optimisation: Operations Research, Jain Brothers, Delhi,2008
4. Hitler Libermann Operations Research: McGraw Hill Pub.2009
5. Pannerselvam, Operations Research: Prentice Hall of India2010
6. Harvey M Wagner, Principles of Operations Research: Prentice Hall of India2010


## Cost Management of Engineering Projects

### Teaching Scheme

Lectures: 3 hrs/week

**Unit-1**

Introduction and Overview of the Strategic Cost Management Process

Cost concepts in decision-making; Relevant cost, Differential cost, Incremental cost and

Opportunity cost. Objectives of a Costing System; Inventory valuation; Creation of a Database for operational control; Provision of data for Decision-Making.

**Unit-2**

Project: meaning, Different types, why to manage, cost overruns centres, various stages of project execution: conception to commissioning. Project execution as conglomeration of technical and non- technical activities. Detailed Engineering activities. Pre project execution main clearances and documents Project team: Role of each member. Importance Project site: Data required with significance. Project contracts. Types and contents. Project execution Project cost control. Bar charts and Network diagram. Project commissioning: mechanical and process

**Unit-3**

Cost Behavior and Profit Planning Marginal Costing; Distinction between Marginal Costing and Absorption Costing; Break-even Analysis, Cost-Volume-Profit Analysis. Various decision-making problems. Standard Costing and Variance Analysis. Pricing strategies: Pareto Analysis. Target costing, Life Cycle Costing. Costing of service sector.

**Unit-4**

Just-in-time approach, Material Requirement Planning, Enterprise Resource Planning, Total Quality Management and Theory of constraints. Activity-Based Cost Management, Bench Marking; Balanced Score Card and Value-Chain Analysis. Budgetary Control; Flexible Budgets; Performance budgets; Zero-based budgets. Measurement of Divisional profitability pricing decisions including transfer pricing.

**Unit-5**

Quantitative techniques for cost management, Linear Programming, PERT/CPM, Transportation problems, Assignment problems, Simulation, Learning Curve Theory.

**References:**


1. Cost Accounting A Managerial Emphasis, Prentice Hall of India, NewDelhi
2. Charles T. Horngren and George Foster, Advanced ManagementAccounting
3. Robert S Kaplan Anthony A. Alkinson, Management & CostAccounting
4. AshishK. Bhattacharya, Principles & Practices of Cost Accounting A. H. Wheelerpublisher
5. N.D. Vohra, Quantitative Techniques in Management, Tata McGraw Hill Book Co.Ltd.


## Composite Materials

### Teaching Scheme

Lectures: 3 hrs/week

**UNIT–I**: INTRODUCTION: Definition – Classification and characteristics of Composite materials. Advantages and application of composites. Functional requirements of reinforcement and matrix. Effect of reinforcement (size, shape, distribution, volume fraction) on overall composite performance.

**UNIT – II**: REINFORCEMENTS: Preparation-layup, curing, properties and applications of glass fibers, carbon fibers, Kevlar fibers and Boron fibers. Properties and applications of whiskers, particle reinforcements. Mechanical Behavior of composites: Rule of mixtures, Inverse rule of mixtures. Isostrain and Isostress conditions.

**UNIT – III:** Manufacturing of Metal Matrix Composites: Casting – Solid State diffusion technique, Cladding – Hot isostaticpressing. Properties and applications. Manufacturing of Ceramic Matrix Composites: Liquid Metal Infiltration – Liquid phase sintering. Manufacturing of Carbon – Carbon composites: Knitting, Braiding, Weaving. Properties and applications.

**UNIT–IV:** Manufacturing of Polymer Matrix Composites: Preparation of Moulding compounds and prepregs – hand layup method – Autoclave method – Filament winding method – Compression moulding – Reaction injection moulding. Properties and applications.

**UNIT – V:** Strength: Laminar Failure Criteria-strength ratio, maximum stress criteria, maximum strain criteria, interacting failure criteria, hygrothermal failure. Laminate first play failure-insight strength; Laminate strength-ply discount truncated maximum strain criterion; strength design using caplet plots; stress concentrations.

**TEXT BOOKS:**

1. Material Science and Technology – Vol 13 – Composites by R.W.Cahn – VCH, West Germany.
2. Materials Science and Engineering, An introduction. WD Callister, Jr., Adapted by R. Balasubramaniam, John Wiley & Sons, NY, Indian edition,2007.

**References:**

1. Hand Book of CompositeMaterials-ed-Lubin.
2. Composite Materials – K.K.Chawla.
3. Composite Materials Science and Applications – Deborah D.L.Chung.
4. Composite Materials Design and Applications – Danial Gay, Suong V. Hoa, and Stephen W. Tasi.

## Waste to energy

### Teaching Scheme

Lectures: 3 hrs/week

**Unit-I:** Introduction to Energy from Waste: Classification of waste as fuel – Agro based, Forest residue, Industrial waste - MSW – Conversion devices – Incinerators, gasifiers, digestors

**Unit-II:** Biomass Pyrolysis: Pyrolysis – Types, slow fast – Manufacture of charcoal – Methods - Yields and application – Manufacture of pyrolytic oils and gases, yields and applications.

**Unit-III:** Biomass Gasification: Gasifiers – Fixed bed system – Downdraft and updraft gasifiers – Fluidized bed gasifiers – Design, construction and operation – Gasifier burner arrangement for thermal heating – Gasifier engine arrangement and electrical power – Equilibrium and kinetic consideration in gasifier operation.

**Unit-IV:** Biomass Combustion: Biomass stoves – Improved chullahs, types, some exotic designs, Fixed bed combustors, Types, inclined grate combustors, Fluidized bed combustors, Design, construction and operation - Operation of all the above biomass combustors.

**Unit-V:** Biogas: Properties of biogas (Calorific value and composition) - Biogas plant technology and status - Bio energy system - Design and constructional features - Biomass resources and their classification - Biomass conversion processes - Thermo chemical conversion - Direct combustion - biomass gasification - pyrolysis and liquefaction - biochemical conversion - anaerobic digestion - Types of biogas Plants – Applications - Alcohol production from biomass - Bio diesel production - Urban waste to energy conversion - Biomass energy programme inIndia.

**References:**


1. Non Conventional Energy, Desai, Ashok V., Wiley Eastern Ltd.,1990.
2. Biogas Technology - A Practical Hand Book - Khandelwal, K. C. and Mahdi, S. S., Vol. I & II, Tata McGraw Hill Publishing Co. Ltd.,1983.
3. Food, Feed and Fuel from Biomass, Challal, D. S., IBH Publishing Co. Pvt. Ltd.,1991.
4. Biomass Conversion and Technology, C. Y. WereKo-Brobby and E. B. Hagan, John Wiley & Sons,1996.