**M.Tech. (Electronics & Communication Engineering)**
**Specialization: Digital Electronics & Communication Systems**

**I M.Tech -I Sem**

| S.No | Course Code | Course Name | L | T | P | Credits |
|---|---|---|---|---|---|---|
| 1 | 18EC4001 | Advanced Digital System Design | 3 | - | - | 3 |
| 2 | 18EC4002 | Advanced Digital Signal Processing | 3 | - | - | 3 |
| **Program Elective I** | | | | | | |
| 3 | 18EC4003 | Antenna and Radiating Systems | 3 | - | - | 3 |
| | 18EC4004 | Digital Communication Techniques | | | | |
| | 18EC4005 | DSP Processors & Architectures | | | | |
| **Program Elective II** | | | | | | |
| 4 | 18EC4006 | High Speed Networks | 3 | - | - | 3 |
| | 18EC4007 | Voice and Data Networks | | | | |
| | 18EC4008 | Wireless Sensor Networks | | | | |
| 5 | 18EC4009 | Advanced Digital Signal Processing Lab(Virtual Lab) | - | - | 4 | 2 |
| 6 | 18EC4010 | Advanced Digital System Design Lab | - | - | 4 | 2 |
| 7 | 18HS0823 | Research Methodology and IPR | 2 | - | - | 2 |
| **Audit Course –I** | | | | | | |
| 8 | 18HS0818 | English for Research Paper Writing | 2 | - | - | - |
| | 18CE1029 | Disaster Management | | | | |
| | 18HS0825 | Sanskrit for Technical Knowledge | | | | |
| | 18HS0826 | Value Education | | | | |
| Contact Periods / Week | | | 16 | - | 8 | 18 |
| | | | Total/Week: 24 | | | |

**I M.Tech -II Sem**

| S.No | Course Code | Course Name | L | T | P | Credits |
|---|---|---|---|---|---|---|
| 1 | 18EC4011 | Wireless Communications | 3 | - | - | 3 |
| 2 | 18EC4012 | Coding Theory & Techniques | 3 | - | - | 3 |
| **Program Elective III** | | | | | | |
| 3 | 18EC4109 | Introduction to IoT | 3 | - | - | 3 |
| | 18EC4013 | Adaptive Signal Processing | | | | |
| | 18EC4014 | Cognitive Radio | | | | |
| **Program Elective IV** | | | | | | |
| 4 | 18EC4015 | Image & Video Processing | 3 | - | - | 3 |
| | 18EC4016 | Pattern Recognition and Machine learning | | | | |
| | 18EC4017 | Detection & Estimation of Signals | | | | |
| 5 | 18EC4018 | Advanced Communications Lab (Virtual Lab) | - | - | 4 | 2 |
| 6 | 18EC4019 | Image & Video Processing Lab | - | - | 4 | 2 |
| 7 | 18EC4020 | Mini Project | - | - | 4 | 2 |
| **Audit Course – II** | | | | | | |
| 8 | 18HS0829 | Constitution of India | 2 | - | - | - |
| | 18HS0827 | Pedagogy Studies | | | | |
| | 18HS0828 | Stress Management by Yoga | | | | |
| | 18HS0819 | Personality Development Through Life Enlightenment Skills. | | | | |
| Contact Periods / Week | | | 14 | - | 12 | 18 |
| | | | Total/Week:26 | | | |

## II M.Tech -I Sem

| S.No | Course Code | Course Name | L | T | P | Credits |
|---|---|---|---|---|---|---|
| **Program Elective V** | | | | | | |
| 1 | 18EC4021 | Optical Networks | 3 | - | - | 3 |
| | 18EC4213 | Testing & Testability | | | | |
| | 18EC4022 | RF and Microwave Circuit Design | | | | |
| **Open Elective** | | | | | | |
| 2 | 18HS0824 | Business Analytics | 3 | - | - | 3 |
| | 18ME3121 | Industrial Safety | | | | |
| | 18ME3122 | Advanced Operations Research | | | | |
| | 18CE1028 | Cost Management of Engineering Projects | | | | |
| | 18ME3123 | Composite Materials | | | | |
| | 18EE2128 | Waste to Energy | | | | |
| 3 | 18EC4023 | Dissertation-I | - | - | 20 | 10 |
| Contact periods / Week | | | 6 | - | 20 | 16 |
| | | | Total/Week:26 | | | |

## II M.Tech -II Sem

| S.No | Course Code | Course Name | L | T | P | Credits |
|---|---|---|---|---|---|---|
| 1 | 18EC4024 | Dissertation –II | - | - | 32 | 16 |
| Contact periods / Week | | | Total/Week:32 | | | 16 |

# List of Subjects

| S.No | Course Code | Course Name |
|---|---|---|
| 1. | 18EC4001 | Advanced Digital System Design |
| 2. | 18EC4002 | Advanced Digital Signal Processing |
| 3. | 18EC4003 | Antenna and Radiating Systems |
| 4. | 18EC4004 | Digital Communication Techniques |
| 5. | 18EC4005 | DSP Processors & Architectures |
| 6. | 18EC4006 | High Speed Networks |
| 7. | 18EC4007 | Voice and Data Networks |
| 8. | 18EC4008 | Wireless Sensor Networks |
| 9. | 18EC4009 | Advanced Digital Signal Processing Lab (Virtual Lab) |
| 10. | 18EC4010 | Advanced Digital System Design Lab |
| 11. | 18HS0823 | Research Methodology and IPR |
| 12. | 18HS0818 | English for Research Paper Writing |
| 13. | 18CE1029 | Disaster Management |
| 14. | 18HS0825 | Sanskrit for Technical Knowledge |
| 15. | 18HS0826 | Value Education |
| 16. | 18EC4011 | Wireless Communications |
| 17. | 18EC4012 | Coding Theory & Techniques |
| 18. | 18EC4109 | Introduction to IoT |
| 19. | 18EC4013 | Adaptive Signal Processing |
| 20. | 18EC4014 | Cognitive Radio |
| 21. | 18EC4015 | Image & Video Processing |
| 22. | 18EC4016 | Pattern Recognition and Machine learning |
| 23. | 18EC4017 | Detection & Estimation of Signals |
| 24. | 18EC4018 | Advanced Communications Lab (Virtual Lab) |
| 25. | 18EC4019 | Image & Video Processing Lab |
| 26. | 18EC4020 | Mini Project |
| 27. | 18HS0829 | Constitution of India |
| 28. | 18HS0827 | Pedagogy Studies |
| 29. | 18HS0828 | Stress Management by Yoga |
| 30. | 18HS0819 | Personality Development through Life Enlightenment Skills. |
| 31. | 18EC4021 | Optical Networks |
| 32. | 18EC4213 | Testing & Testability |
| 33. | 18EC4022 | RF and Microwave Circuit Design |
| 34. | 18HS0824 | Business Analytics |
| 35. | 18HS0824 | Business Analytics |
| 36. | 18ME3121 | Industrial Safety |
| 37. | 18ME3122 | Advanced Operations Research |
| 38. | 18CE1028 | Cost Management of Engineering Projects |
| 39. | 18ME3123 | Composite Materials |
| 40. | 18EC4023 | Dissertation-I |
| 41. | 18EC4024 | Dissertation –II |

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## (18EC4001) ADVANCED DIGITAL SYSTEM DESIGN

**(Common to DECS & VLSI)**

| **I M.Tech -I Sem. (E.C.E) (DECS)** | **L** | **T** | **C** |
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| | **3** | **-** | **3** |

**UNIT I**

**Design of Digital Systems:** ASM charts, Hardware description language and control sequence method, Reduction of state tables, state assignments.

**Sequential Circuit Design:** Design of Iterative circuits, Design of sequential circuits using ROMs, PLAs, CPLD and FPGAs.

**UNIT II**

**Fault Modeling:** Fault classes and models – Stuck at faults, Bridging faults, Transition and Intermittent faults.

**Test Generation:** Fault diagnosis of Combinational circuits by conventional methods–Path Sensitization technique, Boolean difference method, Kohavi algorithm.

**UNIT III**

**Test Pattern Generation:** D – Algorithm, PODEM, Random testing, Transition count testing, Signature Analysis and Testing for bridging faults.

**UNIT IV**

**Programming Logic Arrays:** Introduction, Design using PLA's, PLA minimization and PLA folding.

**Fault Diagnosis in Sequential Circuits:** State identification and Fault detection experiment. Machine identification, Design of fault detection experiment.

**UNIT V**

**PLA Testing:** Fault models, Test generation and Testable PLA design.

**Asynchronous Sequential Machine:** Fundamental mode model, Flow table, State reduction, Minimal closed covers, Races, Cycles and Hazards.

**TEXTBOOKS:**


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


**REFERENCES:**


1. *Digital System Testing and Testable Design,* M. Abramovici, M.A. Breues, A. D. Friedman, Jaico Publications.
2. *Fundamentals of Logic Design*, Charles H. Roth Jr.
3. *Computer Aided Logic Design*, Frederick. J. Hill & Peterson, Wiley 4th Edition.

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## (18EC4002) ADVANCED DIGITAL SIGNAL PROCESSING

**(Common to DECS & ES)**

| **I M.Tech -I Sem. (E.C.E) (DECS)** | **L** | **T** | **C** |
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| | **3** | **-** | **3** |

**UNIT I**

**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.

**LTI Systems:** Types of Linear-Phase transfer functions, Simple Digital Filters, Complementary Transfer Function, Inverse Systems, System Identification, Digital Two-Pairs, and Algebraic Stability Test.

**UNIT II**

**Digital Filter Structure and Design:** All Pass Filters, Tunable IIR Digital Filter, IIR Tapped Cascade Lattice Structures, FIR Cascaded Lattice Structures, Parallel All Pass Realization of IIR Transfer Functions, State Space Structures, Polyphase Structures, Digital Sine-Cosine Generator, Computational Complexity of Digital Filter Structures, Design of IIR Filter using pade approximation, Least Square Design Methods, Design of Computationally Efficient FIR Filters.

**UNIT III**

**FFT Algorithms:** Fast DFT algorithms based on Index mapping, Sliding Discrete Fourier Transform, DFT Computation Over a narrow Frequency Band, Split Radix FFT, Linear filtering approach to Computation of DFT using Chirp Z-Transform.

**Multi Rate Signal Processing:** Decimation by a factor D, Interpolation by a factor I, Sampling rate conversion by a rational factor I/D, Filter design & Implementation for sampling rate conversion.

**UNIT IV**

**Power Spectral Estimation:** Estimation of spectra from finite duration observation of signals, Non-parametric methods: Bartlett, Welch & Blackmann & Tukey methods.

**Parametric Methods for Power Spectrum Estimation:** Relation between auto correlation & model parameters, Yule-Waker & Burg Methods, MA & ARMA models for power spectrum estimation.

**UNIT V**

**Analysis of Finite Word length Effects in Fixed-Point DSP Systems:** Fixed, Floating Point Arithmetic – ADC quantization noise & signal quality-Finite word length effect in IIR digital Filters – Finite word-length effects in FFT algorithms.

**Applications of Digital Signal Processing:** Dual Tone Multi-frequency Signal Detection, Spectral Analysis of Sinusoidal Signals, Spectral Analysis of Non- stationary Signals,

Musial Sound Processing, Over Sampling A/D Converter, Over Sampling D/A Converter, Discrete-Time Analytic Signal Generation.

**TEXTBOOKS:**

1. *Digital Signal Processing*, 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*, 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*, S. M .Kay, PHI, 1997

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## (18EC4003) ANTENNAS AND RADIATING SYSTEMS
**(Program Elective -I)**

| **I M. Tech. – I Sem. (E.C.E) (DECS)** | **L** | **T** | **C** |
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**UNIT I**

**Antenna Fundamentals:** Types of Antennas: Wire antennas, Aperture antennas, Micro strip antennas, Array antennas Reflector antennas, Lens antennas, Radiation Mechanism, Current distribution on thin wire antenna. Fundamental Parameters of Antennas: Radiation Pattern, Radiation Power Density, Radiation Intensity, Directivity, Gain, Antenna efficiency, Beam efficiency, Bandwidth, Polarization, Input Impedance, radiation efficiency, Antenna Vector effective length, Friis Transmission equation, Antenna Temperature.

**UNIT II**

**Linear Wire and Loop Antennas:** Linear Wire Antennas: Infinitesimal dipole, Small dipole, Region separation, Finite length dipole, Half wave dipole, Ground effects.
Loop Antennas: Small Circular loop, Circular Loop of constant current, Circular loop with non-uniform current.

**UNIT III**

**Linear Arrays:** Two element array, N- Element array: Uniform Amplitude and spacing, Broadside and End fire array, Super directivity, planar array, and Design consideration.

**UNIT IV**

**Aperture Antennas and Horn Antennas:** Aperture Antennas: Huygen's Field Equivalence principle, radiation equations, Rectangular Aperture, Circular Aperture. Horn Antennas: E-Plane, H-plane Sectoral horns, Pyramidal and Conical horns.

**UNIT V**

**Microstrip Antennas and Reflector Antennas:** Micro strip Antennas: Basic Characteristics, Feeding mechanisms, Method of analysis, Rectangular Patch, Circular Patch. Reflector Antennas: Plane reflector, parabolic reflector, Cassegrain reflectors, Introduction to MIMO.

**TEXT BOOKS:**


1. *Antenna Theory Analysis and Design,* Constantine A. Balanis, John Wiley & Sons, 4th edition, 2016.
2. *Antennas for All Applications,* John D Kraus, Ronald J Marhefka, Ahmad S Khan, Tata McGraw-Hill, 2002.


**REFERENCES:**


1. *Antenna Engineering hand book,* R.C.Johnson and H.Jasik, Mc-Graw Hill, 1984.
2. *Micro-strip antennas,* I.J.Bhal and P.Bhartia, Artech house, 1980.

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**(18EC4004) DIGITAL COMMUNICATION TECHNIQUES**
**(Program Elective -I)**

| **I M.Tech -I Sem. (E.C.E) (DECS)** | **L** | **T** | **C** |
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**UNIT I**

**Review of Random Variables and Processes:** Random variable – Moment generating function – Markov's inequality – Chebyshev's inequality – Central limit theorem– Chi-square, Rayleigh, and Ricean distributions – Correlation – Covariance matrix Stationary processes – Wide sense stationary processes – Ergodic process – Cross correlation – Autocorrelation functions – Gaussian process.

**Characterization of Communication Signals and Systems:** Signal space representations-Vector Space Concepts, Signal Space Concepts, Orthogonal Expansion of Signals. Representation of Digitally Modulated Signals-Memory less Modulation Methods.

**UNIT II**

**Communication Over Additive Gaussian Noise Channels :** Optimum receiver for signals corrupted by additive white Gaussian noise (AWGN)- Cross correlation demodulation, matched filter demodulator and error probabilities, Optimum receiver for signals with random phase in AWGN channels, Optimum receiver for binary signals, Optimum receiver for M-array orthogonal signals, Probability of error for envelope detection of M-array orthogonal signals. Optimum waveform receiver for colored Gaussian noise channels, Karhunen-Loeve expansion approach, and Whitening.

**UNIT III**

**Fading Channels:** Characterization of fading multipath channels, Statistical Models for fading channels, Time varying Channel impulse response, narrow and wide band fading models, channel correlation functions, Key multipath parameters, Rayleigh and Ricean fading channels, Simulation methodology of fading channels.

**UNIT IV**

**Digital Communication Over Fading Channels:** Optimum coherent and non-coherent receiver in random amplitude, random phase channels- Performance of Rayleigh and Ricean channels, Performance of digital Modulation schemes such as BPSK, QPSK, FSK, DPSK, MSK etc. over wireless channels.

**UNIT V**

**Communication Over Band Limited Channels:** Communication over band Limited Channels- Optimum pulse shaping- Nyquist criterion for zero ISI, partial response Signalling- Equalization Techniques, Zero forcing linear Equalization- Decision feedback equalization.

**Orthogonal Frequency Division Multiplexing (OFDM):** Carrier Synchronization, Timing synchronization, Multichannel and Multicarrier Systems.

**TEXT BOOKS:**

1. *Digital Communications*, J. Proakis, McGraw Hill, 2000
2. *Principles of Digital Communications and Coding*, J. Viterbi and J. K. Omura, McGraw Hill,1979
3. *Spread Spectrum Communications*, Marvin K. Simon, Jim K Omura, Robert A. Scholtz, Barry K.Levit, 1995.
4. *CDMA Principles of Spread Spectrum Communications*, Andrew J Viterbi, Addison Wesley, 1995.

**REFERENCES:**

1. *Multi-carrier Digital Communications Theory and Applications of OFDM*, Ahmad R S Bahai, Burton R Saltzberg Mustafa Ergen, Springer Publications.
2. *Digital Communication*, J.S.Chitode, Technical Publications.
3. *Digital Communication,* Edward. A. Lee and David. G. Messerschmitt, 2/e, Allied Publishers.
4. *Digital Communication Techniques* J Marvin.K.Simon, Sami. M. Hinedi and William. C. Lindsey, PHI.
5. *An introduction to Probability Theory and its applications*, William Feller, Vol 11, Wiley2000.

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## (18EC4005) DSP PROCESSORS & ARCHITECTURES
**(Program Elective -I)**

| **I M.Tech -I Sem. (E.C.E) (DECS)** | **L** | **T** | **C** |
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**UNIT I**

**Introduction to Digital Signal Processi**ng**:** Introduction, A Digital signal-processing system, the sampling process, discrete time sequences. Discrete Fourier Transform (DFT) and Fast Fourier Transform (FFT), Linear time-invariant systems, Digital filters, Decimation and interpolation, Analysis and Design tool for DSP Systems MATLAB, DSP using MATLAB.

**Computational Accuracy in DSP Implementations:** Number formats for signals and coefficients in DSP systems, Dynamic Range and Precision, Sources of error in DSP implementations, A/D Conversion errors, DSP Computational errors, D/A Conversion Errors, Compensating filter.

**UNIT II**

**Architectures for Programmable DSP Devices:** Basic Architectural features, DSP Computational Building Blocks, Bus Architecture and Memory, Data Addressing Capabilities, Address Generation Unit, Programmability and Program Execution, Speed Issues, Features for External interfacing.

**Execution Control and Pipelining:** Hardware looping, Interrupts, Stacks, Relative Branch support Pipelining and Performance, Pipeline Depth, Interlocking, Branching effects, Interrupt effects, Pipeline Programming models.

**UNIT III**

**Programmable Digital Signal Processors:** Commercial Digital signal processing Devices, Data Addressing modes of TMS320C54XX DSPs, Data Addressing modes of TMS320C54XX Processors, Memory space of TMS320C54XX Processors, Program Control, TMS320C54XX instructions and Programming, On-Chip Peripherals, Interrupts of TMS320C54XX Processors, Pipeline Operation of TMS320C54XX Processors.

**UNIT IV**

**Implementation of Basic DSP Algorithms:** The Q-notation, FIR Filters, IIR Filters, Interpolation Filters, Decimation Filters, PID Controller, Adaptive Filters, 2-D Signal Processing.

**Implementation of FFT Algorithms:** An FFT Algorithm for DFT Computation, A Butterfly Computation, Overflow and scaling, Bit-Reversed index generation, An 8-Point FFT implementation on the TMS320C54XX, Computation of the signal spectrum.

**UNIT V**

**Interfacing Memory and I/O Peripherals to Programmable DSP Devices:** Memory space organization, External bus interfacing signals, Memory interface, Parallel I/O interface, Programmed I/O, Interrupts and I/O, Direct Memory Access (DMA). A Multichannel buffered serial port (McBSP), McBSP Programming, a CODEC interface circuit, CODEC programming, A CODEC-DSP interface example.

**TEXT BOOKS:**

1. *Digital Signal Processing*, Avtar Singh and S. Srinivasan, Thomson Publications, 2004.
2. *DSP Processor Fundamentals, Architectures & Features*, Lapsley, S.Chand & Co, 2000.

**REFERENCES:**

1. *Digital Signal Processors, Architecture, Programming and Applications*, B.Venkata Ramani and M. Bhaskar, TMH, 2004.
2. *Digital Signal Processing*, Jonatham Stein, John Wiley, 2005.

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## (18EC4006) HI-SPEED NETWORKS
**(Program Elective -II)**

| **I M.Tech -I Sem. (E.C.E) (DECS)** | **L** | **T** | **C** |
|---|---|---|---|
| | **3** | **-** | **3** |

**UNIT I**

**Network Services & Layered Architecture:** Traffic characterization and quality of service, Network services, High performance networks, Network elements, Basic network mechanisms, layered architecture.

**UNIT II**

**ISDN & B-ISDN:** Over view of ISDN, ISDN channels, User access, ISDN protocols, Brief history of B-ISDN and ATM, ATM based services and applications, principles and building block of B-ISDN, general architecture of B-ISDN, frame relay.

**UNIT III**

**ATM Networks:** Network layering, Switching of virtual channels and virtual paths, applications of virtual channels and connections. QOS parameters, traffic descriptors, ATM service categories, ATM cell header, ATM layer, ATM adaptation layer.

**UNIT IV**

**Interconnection Networks:** Introduction, Banyan Networks, Routing algorithm & blocking phenomenon, Batcher-Banyan networks, Crossbar switch, three stage class networks.

**Rearrangeable Networks:** Re-arrangeable class networks, Folding algorithm, Bens network, looping algorithm.

**UNIT V**

**ATM Signalling, Routing and Traffic Control:** ATM addressing, UNI signalling, PNNI signalling, PNNI routing, ABR Traffic management.

**TCP/IP Networks:** History of TCP/IP, TCP application and Services, Motivation, TCP, UDP, IP services and Header formats, Internetworking, TCP congestion control.

**Queue Management**: Passive & active, QOS in IP networks-Differentiated and integrated services.

**TEXT BOOKS:**


1. *ISDN & B-ISDN with Frame Relay*, William Stallings, PHI.
2. *Communication Networks*, Leon Garcia widjaja, TMH, 2000.
3. *ATM Fundamentals*, N. N. Biswas, Adventure books publishers, 1998.


**REFERENCES:**


1. *High Performance TCP/IP Networking*, Mahbub Hassan, Raj Jain, PHI, 2005.
2. *ATM Networks*, Rainer Handel, Manfred N.Hubber, Stefan Schroder, Pearson Edu, 2002
3. *High Speed Networks and Internets*, William Stallings, Pearson edu., 2002

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## (18EC4007) VOICE AND DATA NETWORKS
**(Program Elective -II)**

| **I M. Tech. - I Sem. (E.C.E) (DECS)** | **L** | **T** | **C** |
|---|---|---|---|
| | **3** | **-** | **3** |

**UNIT I**

Network Design Issues, Network Performance Issues, Network Terminology, centralized and distributed approaches for networks design, Issues in design of voice and data networks. Layered and Layer less Communication, Cross layer design of Networks, Voice Networks (wired and wireless) and Switching, Circuit Switching and Packet Switching, Statistical Multiplexing.

**UNIT II**

Data Networks and their Design, Link layer design- Link adaptation, Link Layer Protocols, Retransmission. Mechanisms (ARQ), Hybrid ARQ (HARQ), Go Back N, Selective Repeat protocols and their analysis.

**UNIT III**

Queuing Models of Networks, Traffic Models, Little's Theorem, Markov chains, M/M/1 and other Markov systems, Multiple Access Protocols, Aloha System, Carrier Sensing, Examples of Local area networks.

**UNIT IV**

Inter-networking, Bridging, Global Internet, IP protocol and addressing, Sub netting, Classless Inter Domain Routing (CIDR), IP address lookup, Routing in Internet, End to End Protocols, TCP and UDP, Congestion Control, Additive Increase/Multiplicative Decrease, Slow Start, Fast Retransmit/ Fast Recovery.

**UNIT V**

Congestion avoidance, RED TCP Throughput Analysis, Quality of Service in Packet Networks, Network Calculus, Packet Scheduling Algorithms.

**TEXT BOOKS:**


1. *Data Networks*, D. Bertsekas and R. Gallager, 2nd Edition, Prentice Hall, 1992.
2. *Computer Networks: A Systems Approach*, L. Peterson and B. S. Davie, 5th Edition, Morgan Kaufman, 2011.
3. *Communication Networking: An analytical approach*, Kumar, D. Manjunath and J. Kuri, 1st Edition, Morgan Kaufman, 2004.


**REFERENCES:**


1. *Communications Network: A First Course*, Walrand, 2nd Edition, McGraw Hill, 2002.
2. *Queuing Systems, Volume I: Theory*, Leonard Kleinrock, 1st Edition, John Wiley and Sons, 1975.
3. *Telecommunication Network Design Algorithms,* Aaron Kershenbaum, McGraw Hill, 1993.
4. *Design and Analysis of Computer Communication Networks*, Vijay Ahuja, McGraw Hill, 1987.

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## (18EC4008) WIRELESS SENSOR NETWORKS

**(Common to DECS, ES & VLSI)**

**(Program Elective -II)**

| **I M. Tech. -I Sem. (E.C.E) (DECS)** | **L** | **T** | **C** |
|---|---|---|---|
| | **3** | **-** | **3** |

**UNIT I**

Introduction and overview of sensor network architecture and its applications, sensor network comparison with Adhoc Networks, Sensor node architecture with hardware and software details.

**UNIT II**

Hardware, Examples like mica2, micaZ, telosB, cricket, Imote2, tmote, btnode, and Sun SPOT, Software (Operating Systems): tinyOS, MANTIS, Contiki, and RetOS. Programming tools: C, nesC. Performance comparison of wireless sensor networks simulation and experimental platforms like open source (ns-2) and commercial (QualNet, Opnet)

**UNIT III**

Overview of sensor network protocols (details of atleast 2 important protocol per layer), Physical, MAC and routing/ Network layer protocols, node discovery protocols, multi-hop and cluster based protocols, Fundamentals of 802.15.4, Bluetooth, BLE (Bluetooth low energy), UWB.

**UNIT IV**

Data dissemination and processing, differences compared with other database management systems, data storage, query processing.

**UNIT V**

Specialized features, Energy preservation and efficiency, security challenges, fault tolerance, Issues related to Localization, connectivity and topology, Sensor deployment mechanisms, coverage issues, sensor Web, sensor Grid, Open issues for future research, and Enabling technologies in wireless sensor network.

**TEXT BOOKS:**


1. *Protocols and Architectures for Wireless Sensor Networks,* H. Karl and A.Willig, John Wiley & Sons, India, 2012.
2. *Wireless Sensor Networks,* C.S. Raghavendra, K.M. Sivalingam, and T.Znati, Editors, Springer Verlag, 1st Indian reprint, 2010.


**REFERENCES:**


1. *Wireless Sensor Networks:An Information Processing Approach,* F. Zhao and L. Guibas,Morgan Kaufmann, 1st Indian reprint, 2013.
2. *Wireless sensor Network and Applications,* YingshuLi, MyT. Thai, Weili Wu,Springer series on signals and communication technology, 2008.

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## (18EC4009) ADVANCED DIGITAL SIGNAL PROCESSING LAB (Virtual Lab)

| **I M.Tech -I Sem. (E.C.E) (DECS)** | **P** | **C** |
|---|---|---|
| | **4** | **2** |

**List of Experiments:**

1. Study of sampling theorem, effect of under-sampling.
2. Study of Quantization of continuous-amplitude, discrete-time Analog signals.
3. Study of different types of Companding Techniques.
4. Study of properties of linear time-invariant system.
5. Study of convolution: series and parallel system.
6. Study of Discrete Fourier Transform (DFT) and its inverse.
7. Study of Transform domain properties and its use. .
8. Study of FIR filter design using window method: Low pass and high pass filter.
9. Study of FIR filter design using window method: Band pass and Band stop filter.
10. Study of Infinite Impulse Response (IIR) filter.

**Tools Required:**
**MATLAB**

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## (18EC4010) ADVANCED DIGITAL SYSTEM DESIGN LAB

| **I M.Tech -I Sem. (E.C.E) (DECS)** | **P** | **C** |
|---|---|---|
| | **4** | **2** |

**List of Experiments:**

**CYCLE I:**

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 Modelling Styles.
4. Modelling 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 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.

**CYCLE II:**

**Digital Circuit Description Using Verilog / VHDL.**

1. Verification of the Functionality of the circuit using function Simulators.
2. Timing Simulator for Critical Path time Calculation.
3. Synthesis of Digital Circuit.
4. Place and Router Techniques for FPGA‟s like Xilinx, Altera, Cypress, etc.
5. Implementation of Design using FPGA and CPLD Devices.

**Tools Required:**

**VHDL or VERILOG**

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## (18HS0823) RESEARCH METHODOLOGY AND IPR

**I M.Tech -I Sem. (E.C.E) (DECS)**

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**Course outcomes:**

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

- Understand research problem formulation. Analyze research related information
- Follow research ethics
- Understand that today's world is controlled by Computer, Information Technology, but tomorrow world will be ruled by ideas, concept, and creativity.
- 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 Right to be promoted among students in general & engineering in particular.
- 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.

**UNIT I**

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 II**

Effective Literature Studies Approaches, Analysis Plagiarism, Research Ethics,

**UNIT III**

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 IV**

Nature of Intellectual Property: Patents, Designs, Trade 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 V**

Patent Rights: Scope of Patent Rights. Licensing and Transfer of Technology. Patent Information and Databases. Geographical Indications. 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.

**TEXT BOOKS:**


1. *Research methodology: an introduction for science & engineering students*, Stuart Melville and Wayne Goddard.
2. *Research Methodology: An Introduction*, Wayne Goddard and Stuart Melville.
3. *Resisting Intellectual Property*, Ranjit Kumar, 2nd Edition, Research Methodology: A Step by Step Guide for beginners, Halbert,, Taylor & Francis Ltd ,2007.
4. *Industrial Design*, Mayall , McGraw Hill, 1992. Niebel ,"*Product Design*", McGraw Hill, 1974.
5. *Introduction to Design*, Asimov , Prentice Hall, 1962.
6. *Intellectual Property in New Technological Age,* Robert P. Merges, Peter S. Menell, Mark A. Lemley, 2016.
7. *Intellectual Property Rights Under WTO,* T. Ramappa, S. Chand, 2008

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## (18HS0818) ENGLISH FOR RESEARCH PAPER WRITING

**I M.Tech -I Sem. (E.C.E) (DECS)**

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**Course objectives:**

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.

**UNIT I**

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

**UNIT II**

Clarifying Who Did What, Highlighting Your Findings, Hedging and Criticising, Paraphrasing and Plagiarism, Sections of a Paper, Abstracts and Introduction.

**UNIT III**

Review of the Literature, Methods, Results, Discussion, Conclusions, The Final Check.

**UNIT IV**

Key Skills Needed When Writing a Title, Key Skills Needed When Writing Abstract, Key Skills Needed When Writing an Introduction, Skills When Writing a Review of the Literature.

**UNIT V**

Skills Needed When Writing the Methods, Skills Needed When Writing the Results, Skills Needed When Writing the Discussion, Skills Needed When Writing the Conclusions.

**TEXT BOOKS:**


1. *Writing for Science,* Goldbort R (2006), Yale University Press.
2. Day R (2006) *How to Write and Publish a Scientific Paper*, Cambridge University Press.
3. *Handbook of Writing for the Mathematical Sciences,* SIAM, Highman's Books, HighmanN (1998).
4. *English for Writing Research Papers*, Springer New York Dordrecht Heidelberg London, Adrian Wallwork, 2011.

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## (18CE1029) DISASTER MANAGEMENT

**I M.TECH - I SEM. (E.C.E) (DECS)**

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**Course *Objective:***

The objective of this subject is to give the basic knowledge of Environmental Hazards and disasters. The syllabus includes the basics of Endogenous and Exogenous hazards and gives a suitable picture on the different types of hazard and disaster mitigation methods.

**Course Outcomes:**

On completion of the course the students will have knowledge on

1. Types of disasters and their effects on environment
2. Causes of disasters
3. Disaster management through engineering applications

**UNIT I**

Environmental Hazards & Disasters: Meaning of Environmental Hazards, Environmental Disasters and Environmental Stress. Concept of Environmental Hazards, Environmental Stress & Environmental Disasters. Different Approaches & Relation With Human Ecology - Landscape Approach - Ecosystem Approach - Perception Approach - Human Ecology & its Application in Geographical Researches.

**UNIT II**

Types of Environmental Hazards & Disasters: Natural Hazards and Disasters – Man Induced Hazards & Disasters - Natural Hazards- Planetary Hazards/ Disasters – Extra Planetary Hazards/ Disasters - Planetary Hazards- Endogenous Hazards – Exogenous Hazards

**UNIT III**

Endogenous Hazards - Volcanic Eruption – Earthquakes – Landslides – Volcanic Hazards/ Disasters - Causes and Distribution of Volcanoes - Hazardous Effects of Volcanic Eruptions - Environmental Impacts of Volcanic Eruptions – Earthquake Hazards/ Disasters - Causes of Earthquakes - Distribution of Earthquakes – Hazardous Effects of - Earthquakes - Earthquake Hazards in India - - Human Adjustment, Perception & Mitigation of Earthquake.

**UNIT IV**

Exogenous Hazards/ Disasters - Infrequent Events- Cumulative Atmospheric Hazards/ Disasters Infrequent Events: Cyclones – Lightning – Hailstorms Cyclones: Tropical Cyclones & Local Storms - Destruction by Tropical Cyclones & Local Storms (Causes, Distribution Human Adjustment, Perception & Mitigation) Cumulative Atmospheric Hazards/ Disasters: - Floods- Droughts- Cold Waves- Heat Waves. Floods:- Causes of Floods- Flood Hazards India- Flood Control Measures ( Human Adjustment, Perception & Mitigation).Droughts:- Impacts of Droughts- Drought Hazards in India- Drought Control Measures- Extra Planetary Hazards/ Disasters- Man Induced Hazards /Disasters- Physical Hazards/ Disasters-Soil Erosion Soil Erosion:-- Mechanics & Forms of Soil Erosion- Factors & Causes of Soil Erosion- Conservation Measures of Soil Erosion. Chemical Hazards/

Disasters: Release of Toxic Chemicals, Nuclear Explosion- Sedimentation Processes. Sedimentation Processes: - Global Sedimentation Problems- Regional Sedimentation Problems- Sedimentation & Environmental Problems- Corrective Measures of Erosion & Sedimentation. Biological Hazards/ Disasters: - Population Explosion.

**UNIT V**

Emerging Approaches In Disaster Management- Three Stages

1. Pre- Disaster Stage (Preparedness)
2. Emergency Stage
3. Post Disaster Stage-Rehabilitation

**TEXT BOOKS:**


1. *Disaster Management,* Rajib Shah, Universities Press, India, 2003.
2. *Disaster Science and Management,* Tushar Bhattacharya, TMH Publications.
3. *Disaster Mitigation: Experiences and Reflections,* Pardeep Sahni.
4. *Natural Hazards & Disasters,* Donald Hyndman & David Hyndman – Cengage Learning


**REFERENCES:**


1. *The Environment as Hazards,* Kates, B.I & White, G.F, Oxford Publishers, New York, 1978
2. *Disaster Management,* R.B. Singh (Ed), Rawat Publication, New Delhi, 2000
3. *Disaster Management,* H.K. Gupta (Ed), Universiters Press, India, 2003
4. *Space Technology for Disaster Mitigation in India (INCED),* R.B. Singh, University of Tokyo, 1994.

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## (18HS0825) SANSKRIT FOR TECHNICAL KNOWLEDGE

| **I M.Tech -I Sem. (E.C.E) (DECS)** | **L** | **T** | **C** |
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**Course Objectives:**

- To get a working knowledge in illustrious Sanskrit, the scientific language in the world.
- Learning of Sanskrit to improve brain functioning.
- Learning of Sanskrit to develop the logic in mathematics, science & other subjects
- Enhancing the memory power.
- The engineering scholars equipped with Sanskrit will be able to explore the huge knowledge from ancient literature.

**Course Outcomes:**

- Students will be able to
- Understanding basic Sanskrit language
- Ancient Sanskrit literature about science & technology can be understood
- Being a logical language will help to develop logic in students

**UNIT-I**

Alphabets in Sanskrit, Past/Present/Future Tenses, Simple Sentences

**UNIT-II**

Order, Introduction of Roots, Technical Information about Sanskrit Literature

**UNIT-III**

Technical Concepts of Engineering-Electrical, Mechanical, Architecture, Mathematics

**TEXT BOOKS:**

1. *Abhyaspustaka*, Dr.Vishwas, Samskrita-Bharti Publication, New Delhi
2. *Teach Yourself Sanskrit*, Prathama Deeksha-Vempati Kutumbshastri, Rashtriya Sanskrit Sansthanam, New Delhi Publication
3. *India's Glorious Scientific Tradition*, Suresh Soni, Ocean books (P) Ltd., New Delhi.

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## (18HS0826) VALUE EDUCATION

| **I M. Tech. - I Sem. (E.C.E) (DECS)** | **L** | **T** | **C** |
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***Course Objectives:***

Students will be able to

- Understand value of education and self- development
- Imbibe good values in students
- Let the should know about the importance of character

***Course outcomes:***

Students will be able to

- Knowledge of self-development.
- Learn the importance of Human values.
- Developing the overall personality.

**UNIT I**

Values and Self-Development – Social Values and Individual Attitudes. Work Ethics and Indian Vision of Humanism. Moral and Non-Moral Valuation. Standards and Principles. Value Judgements.

**UNIT II**

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 and Discipline.

**UNIT III**

- Personality and Behaviour Development - Soul and Scientific Attitude. Positive Thinking. Integrity and Discipline
- Punctuality, Love and Kindness.
- Avoid Fault Thinking.
- Free From Anger, Dignity of Labour.
- 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 IV**

- 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.

**TEXT BOOKS:**

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

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## (18EC4011) WIRELESS COMMUNICATIONS

**(Common to DECS & ES)**

| **I M.Tech -II Sem. (E.C.E) (DECS)** | **L** | **T** | **C** |
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**UNIT I**

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

**UNIT II**

**Mobile Radio Propagation:** Large-Scale Path Loss, Introduction to Radio Wave Propagation, Free Space Propagation Model, Propagation Mechanisms, Reflection, Ground Reflection (Two-Ray) Model, Diffraction, Scattering. Small-Scale Fading and Multipath, Impulse Response Model of a Multipath Channel, Small- Scale Multipath Measurements, Parameters of Mobile Multipath Channels, Types of Small-Scale Fading, Rayleigh and Ricean Distributions, Statistical Models for Multipath Fading Channels, Theory of Multipath Shape Factors for Small-Scale Fading Wireless Channels.

**UNIT III**

**Diversity Techniques:** Repetition coding and Time Diversity- Frequency and Space Diversity, Receive Diversity- Concept of diversity branches and signal paths- Combining methods- Selective diversity combining - Switched combining- maximal ratio combining- Equal gain combining- performance analysis for Rayleigh fading channels.

**Cellular Communication:** Cellular Networks, Multiple Access: FDM/TDM/FDMA/TDMA, Spatial reuse, Co-channel interference Analysis, Hand over Analysis, Erlang Capacity Analysis, Spectral efficiency and Grade of Service- Improving capacity – Cell splitting and sectorization.

**UNIT IV**

**Spread Spectrum and CDMA:** Motivation- Direct sequence spread spectrum- Frequency Hopping systems, Time Hopping., Anti-jamming- Pseudo Random (PN) sequence, Maximal length sequences, Gold sequences, and Generation of PN sequences.

**Diversity in DS-SS Systems:** Rake Receiver- Performance analysis. Spread Spectrum Multiple Access, CDMA Systems- Interference Analysis for Broadcast and Multiple Access Channels, Capacity of cellular CDMA networks- Reverse link power control, Hard and Soft hand off strategies.

**UNIT V**

**Fading Channel Capacity:** Capacity of Wireless Channels- Capacity of flat and frequency selective fading channels, Multiple Input Multiple output (MIMO) systems- Narrow band multiple antenna system model, Parallel Decomposition of MIMO Channels- Capacity of MIMO Channels.

**Cellular Wireless Communication Standards:** GSM specifications and Air Interface, specifications, IS 95 CDMA- 3G systems: UMTS & CDMA 2000 standards and specifications.

**TEXT BOOKS:**


1. *Wireless Communications*, Andrea Goldsmith, Cambridge University press.
2. *Modern Wireless Communications*, Simon Haykin and Michael Moher,Person Education.
3. *Wireless Communications, principles & practice*, T.S. Rappaport, PHI, 2001.


**REFERENCES:**


1. *Principles of Mobile Communications*, G.L Stuber, 2nd edition, Kluwer Academic Publishers.
2. *Wireless digital communication*, Kamilo Feher, PHI, 1995.
3. *Introduction to Spread Spectrum Communication*, R.L Peterson, R.E. Ziemer and David E. Borth, Pearson Education.
4. *CDMA- Principles of Spread Spectrum*, A.J.Viterbi, Addison Wesley, 1995.

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## (18EC4012) CODING THEORY & TECHNIQUES

| **I M.Tech -II Sem. (E.C.E) (DECS)** | **L** | **T** | **C** |
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**UNIT I**

**Source Coding:** Mathematical model of Information, A Logarithmic Measure of Information, Average and Mutual Information and Entropy, coding for Discrete less sources, Source coding theorem, fixed length and variable length coding, properties of prefix codes.

**UNIT II**

**Coding Techniques:** Shannon-Fano coding, Huffman code, Huffman code applied for pair of symbols, efficiency calculations, Lempel-Ziv codes.

**Linear Block Codes:** Introduction to Linear block codes, Generator Matrix, Systematic Linear Block codes, Encoder Implementation of Linear Block Codes, Parity Check Matrix, Syndrome testing, Error Detecting and correcting capability of Linear Block codes.

**UNIT III**

Hamming Codes, Probability of an undetected error for linear codes over a Binary Symmetric Channel, Weight Enumerators and Mac-Williams identities, Perfect codes, Application of Block codes for error control in data storage Systems.

**UNIT IV**

**Cyclic Codes:** Algebraic structure of cyclic codes, Binary Cyclic code properties, Encoding in systematic and non-systematic form, Encoder using (n-k) bit shift register, Syndrome Computation and Error detection, Decoding of Cyclic Codes.

**Convolutional Codes:** Encoding of Convolutional codes, Structural properties of Convolutional codes, state diagram, Tree diagram, Trellis Diagram, Maximum Likelihood decoding of Convolutional codes.

**UNIT V**

Viterbi Algorithm, Fano and Stack Sequential decoding algorithms, Application of Viterbi and sequential decoding.

**BCH Codes:** Groups, fields, binary Fields arithmetic, construction of galois fields GF (2m), Basic properties of galois Fields, Computation using galois Field GF (2m) arithmetic, Description of BCH codes, Decoding procedure for BCH codes.

**TEXT BOOKS**:


1. *Error Control Coding-Fundamentals and Applications*, SHU LIN and Daniel J. Costello, Jr.Prentice Hall Inc.
2. *Digital Communications-Fundamental and Application,* Bernard sklar, Pearson Education, Asia.
3. *Error Control Coding Theory*, Man Young Rhee, McGraw Hill Publications.


**REFERENCES:**


1. *Digital Communications,* John G. Proakis, Mc. Graw Hill Publication.
2. *Digital and Analog Communication Systems*, K. Sam Shanmugam, Wisley Publications.

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## (18EC4109) INTRODUCTION TO IoT

**(Common to DECS & ES)**
**(Program Elective -III)**

| **I M.Tech -II Sem. (E.C.E) (DECS)** | **L** | **T** | **C** |
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**UNIT I**

**Introduction & Concepts:** Introduction to Internet of Things, Physical Design of IoT, Logical Design of IoT, IoT Enabling Technologies, IoT Levels.

**UNIT II**

**Domain Specific IoTs:** Home Automation, Cities, Environment, Energy, Retail, Logistics, Agriculture, Industry, Health & Life Style.

**UNIT III**

**M2M & System Management with Netconf-Yang:** M2M, Difference between IoT and M2M, SDN and NFV for IoT, Software defined Networking, Network Function Virtualization, Need for IoT Systems Management, Simple Network Management Protocol, Limitations of SNMP, Network Operator Requirements, NETCONF, YANG, IoT Systems management with NETCONF-YANG.

**UNIT IV**

**Developing Internet of Things & Logical Design using Python:** Introduction, IoT Design Methodology, Installing Python, Python Data Types & Data Structures, Control Flow, Functions, Modules, Packages, File Handling, Date/ Time Operations, Classes, Python Packages.

**UNIT V**

**IoT Physical Devices & Endpoints:** What is an IoT Device, Exemplary Device, Board, and Linux on Raspberry Pi, Interfaces, and Programming& IoT Devices.

**TEXT BOOKS:**

1. *Internet of Things A Hands-On- Approach*, VijayMadisetti, Arshdeep Bahga, 2014.

**REFERENCES:**

1. *Designing the Internet of Things,* Adrian McEwen, Wiley Publishers, 2013.
*2. The Silent Intelligence: The Internet of Things,* Daniel Kell mereit. 2013.

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## (18EC4013) ADAPTIVE SIGNAL PROCESSING
**(Program Elective -III)**

| **I M.Tech -II Sem. (E.C.E) (DECS)** | **L** | **T** | **C** |
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**UNIT I**

**Eigen Analysis:** Eigen Value Problem, Properties of Eigen values and Eigen vectors, Eigen Filters, Eigen Value computations.

**Introduction to Adaptive Systems:** Definitions, Characteristics, Applications, Example of an Adaptive System. The Adaptive Linear Combiner - Description, Weight Vectors, Desired Response Performance function, Gradient & Mean Square Error.

**UNIT II**

**Development of Adaptive Filter Theory & Searching the Performance Surface:** Introduction to Filtering, Smoothing and Prediction, Linear Optimum Filtering, Problem statement, Principle of Orthogonality - Minimum Mean Square Error, Wiener- Hopf equations, Error Performance - Minimum Mean Square Error.

**Searching the Performance Surface:** Methods & Ideas of Gradient Search methods, Gradient Searching Algorithm & its Solution, Stability & Rate of convergence -Learning Curves.

**UNIT III**

**Steepest Descent Algorithms:** Gradient Search by Newton's Method, Method of Steepest Descent, Comparison of Learning Curves.

**LMS Algorithm & Applications:** Overview - LMS Adaptation algorithms, Stability & Performance analysis of LMS Algorithms - LMS Gradient & Stochastic algorithms, Convergence of LMS algorithm.

**Applications:** Noise cancellation, Cancellation of Echoes in long distance telephone circuits, Adaptive Beam forming.

**UNIT IV**

**RLS Algorithm:** Matrix Inversion lemma, Exponentially weighted recursive least square algorithm, update recursion for the sum of weighted error squares, convergence analysis of RLS Algorithm, Application of RLS algorithm on Adaptive Equalization.

**UNIT V**

**Kalman Filtering:** Introduction, Recursive Mean Square Estimation Random variables, Statement of Kalman filtering problem, Filtering, Initial conditions, Variants of Kalman filtering, Extend Kalman filtering.

**Non Linear Adaptive Filtering:** Theoretical and Practical considerations of Blind Deconvolution, Buss Gang Algorithm for blind Equalization of real baseband Channels.

**TEXT BOOKS:**

1. *Adaptive Signal Processing*, Bernard Widrow, Samuel D.Strearns, 2005, PE.
2. *Adaptive Filter Theory*, Simon Haykin, 4 ed., 2002, PE Asia.

**REFERENCES:**

1. *Optimum signal processing: An introduction*, Sophocles.J.Orfamadis, 2 ed., 1988, MGH
2. *Adaptive signal processing-Theory and Applications*, S.Thomas Alexander, 1986, Springer

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## (18EC4014) COGNITIVE RADIO
**(Program Elective -III)**

| **I M.Tech -II Sem. (E.C.E) (DECS)** | **L** | **T** | **C** |
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**UNIT I**

**Introduction to Cognitive Radio:** Digital Dividend, Cognitive Radio (CR) Architecture, Functions of Cognitive Radio, Dynamic Spectrum Access (DSA), Components of Cognitive Radio, Spectrum Sensing, Spectrum Analysis and Decision, Potential Applications of Cognitive Radio.

**UNIT II**

**Spectrum Sensing:** Spectrum Sensing, Detection of Spectrum Holes (TVWS), Collaborative Sensing, Geo-Location Database and Spectrum Sharing Business Models (Spectrum of Commons, Real Time Secondary Spectrum Market).

**UNIT III**

**Optimization Techniques of Dynamic Spectrum Allocation**: Linear Programming, Convex Programming, Non-Linear Programming, Integer Programming, Dynamic Programming, Stochastic Programming.

**UNIT IV**

**Dynamic Spectrum Access and Management:** Spectrum Broker, Cognitive Radio Architectures, Centralized Dynamic Spectrum Access, Distributed Dynamic Spectrum Access, Learning Algorithms and Protocols.

**UNIT V**

**Spectrum Trading:** Introduction to Spectrum Trading, Classification to Spectrum Trading, Radio Resource Pricing, Brief Discussion on Economics Theories in DSA (Utility, Auction Theory), Classification of Auctions (Single Auctions, Double Auctions, Concurrent, Sequential).

**Research Challenges in Cognitive Radio:** Network Layer and Transport Layer Issues, Cross Layer Design for Cognitive Radio Networks.

**TEXT BOOKS:**


1. *Dynamic Spectrum Access and Management in Cognitive Radio Networks*, Ekram Hossain, Dusit Niyato, Zhu Han, Cambridge University Press, 2009.
2. *Cognitive radio networks*, Kwang-Cheng Chen, Ramjee Prasad, John Wiley & Sons Ltd., 2009.
3. *Cognitive radio technology*, Bruce Fette, Elsevier, 2nd edition, 2009.


**REFERENCES:**


1. *Cognitive Radio, Software Defined Radio, and Adaptive Wireless Systems*, Huseyin Arslan, Springer, 2007.
2. *Optimizing Wireless Communication Systems*, Francisco Rodrigo Porto Cavalcanti, Soren Andersson, Springer, 2009.
3. *Essentials of Cognitive Radio*, Linda Doyle, Cambridge University Press, 2009.

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## (18EC4015) IMAGE & VIDEO PROCESSING

**(Common to DECS & VLSI)**
**(Program Elective -IV)**

| **I M.Tech -II Sem. (E.C.E) (DECS)** | **L** | **T** | **C** |
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**UNIT I**

**Image Representation:** Gray scale and Color Images, image sampling and quantization. Two dimensional orthogonal transforms: DFT, WT, Haar transform, KLT, DCT.

**UNIT II**

**Image Enhancement:** Filters in Spatial and Frequency domains, Histogram-based processing, and Homomorphic filtering. Edge detection, Non-parametric and Model based approaches, LOG filters, Localization problem.

**UNIT III**

**Image Restoration:** Degradation Models, PSF, Circulant and Block–Circulant matrices, De-convolution, Restoration using inverse filtering, Wiener filtering and Maximum entropy-based methods ,Morphological operations.

**Image Segmentation:** Pixel classification, Bi-level Thresholding, Multi-level Thresholding, P-tile method, Adaptive Thresholding, Spectral & Spatial classification, Hough transform, Region growing.

**UNIT IV**

**Image Compression:** Compression models, Information theoretic perspective, Fundamental coding theorem.

**Lossless Compression:** Huffman Coding, Arithmetic coding, Bit plane coding, Run length coding, Lossy compression: Transform coding, Image compression standards.

**UNIT V**

**Video Processing:** Representation of Digital Video, Spatio-temporal sampling, Motion Estimation, Motion compensation, Video Filtering, Video Compression, Video coding standards.

**TEXT BOOKS:**


1. *Digital Image Processing*, R. C. Gonzalez, R. E. Woods, Pearson Education. 2nd edition, 2002
2. *Digital image processing,* W. K. Pratt, Prentice Hall, 1989
3. *Digital image processing,* A. Rosenfold and A. C. Kak, Vols. 1 and 2, PH, 1986.


**REFERENCES:**


1. *Digital image restoration* H. C. Andrew and B. R. Hunt, Prentice Hall, 1977
2. *Machine Vision*, R. Jain, R.Kasturi and B.G.Schunck, MGH International Edition, 1995.

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## (18EC4016) PATTERN RECOGNITION AND MACHINE LEARNING
**(Program Elective -IV)**

| **I M.Tech -II Sem. (E.C.E) (DECS)** | **L** | **T** | **C** |
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**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:** Linear Models for Regression, Linear Regression, Logistic Regression Linear Models for Classification.

**UNIT III**

**Neural Network:** Perceptron, Multi-Layer Perceptron, Back propagation Algorithm, Error Surfaces, Practical Techniques for Improving Back propagation, Additional Networks and Training Methods, Adaboost, Deep Learning.

**UNIT IV**

**Linear Discriminant Functions:** Decision Surfaces, Two-Category, Multi-Category, Minimum Squared Error Procedures, 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, Combining Classifiers.

**Unsupervised Learning and Clustering:** K-Means Clustering, Fuzzy K-Means Clustering, Hierarchical Clustering.

**TEXTBOOKS:**


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

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## (18EC4017) DETECTION & ESTIMATION OF SIGNALS
**(Program Elective -IV)**

| **I M.Tech -II Sem. (E.C.E) (DECS)** | **L** | **T** | **C** |
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**UNIT I**

**Detection Theory:** Binary decisions - Single observation**,** Maximum likelihood decision criterion, Neymann-Pearson criterion, Probability of error criterion, Bayes risk criterion, Min-max criterion, Robust detection, Receiver operating characteristics.

**UNIT II**

**Binary Decisions - Multiple Observations:** Vector observations, the general Gaussian Problem, Waveform Observation in Additive Gaussian Noise, The Integrating Optimum Receiver; Matched Filter Receiver.

**UNIT III**

**Estimation Theory:** Methods**,** Maximum likelihood estimation; Bayes cost method Bayes estimation criterion - Mean square error criterion; Uniform cost function; absolute value cost function; Linear minimum variance - Least squares method; Estimation in the presence of Gaussian noise - Linear observation; Non-linear estimation.

**UNIT IV**

**Properties of Estimators:** Bias, Efficiency, Cramer-Rao bound asymptotic properties, Sensitivity and error analysis.

**State Estimation:** Prediction, Kalman filter.

**UNIT V**

**Sufficient Statistics and Statistical Estimation of Parameters:** Concept of sufficient statistics, Exponential families of Distributions, Exponential families and Maximum likelihood estimation, uniformly minimum variance unbiased estimation.

**TEXT BOOKS:**


1. *Decision and Estimation Theory*, James L. Melsa and David L. Cohn, McGraw Hill, 1978.
2. *Detection and Estimation,* Dimitri Kazakos, P. Papantoni Kazakos, Computer Science Press, 1990.
3. *Statistical Signal Processing and Detection Theory*, Steven M. Kay, Prentice Hall Inc., 1998.


**REFERENCES:**


1. *Detection, Estimation and Modulation Theory, Part 1*, Harry L. Van Trees, John Wiley & Sons Inc. 1968.
2. *Lessons in Estimation Theory for Signal Processing, Communication and Control*, Jerry M. Mendel, Prentice Hall Inc., 1995.

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## (18EC4018) ADVANCED COMMUNICATIONS LAB (Virtual Lab)

| **I M.Tech -II Sem. (E.C.E) (DECS)** | **P** | **C** |
|---|---|---|
| | **4** | **2** |

**List of Experiments:**

1. Understanding of Path loss.
2. Path loss with Shadowing.
3. Horizontal and Vertical Beam Pattern.
4. Calculation of Boundary Coverage Probability.
5. Calculation of SINR including Beam Tilt.
   A: Downlink
   B: Uplink
6. Frequency Reuse
   A: Co-Channel Cells.
   B: Cell Cluster.
7. Sectoring.
8. Handoff.
9. Flat Fading.
10. Frequency Selective Fading.

**Tools Required:**
**MATLAB**

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## (18EC4019) IMAGE & VIDEO PROCESSING LAB

| **I M.Tech -II Sem. (E.C.E) (DECS)** | **P** | **C** |
|---|---|---|
| | **4** | **2** |

**List of Experiments:**

1. Perform basic operations on images like addition, subtraction etc.
2. Plot the histogram of an image and perform histogram equalization.
3. Implement segmentation algorithms.
4. Perform video enhancement.
5. Perform video segmentation.
6. Perform image compression using lossy technique.
7. Perform image compression using lossless technique.
8. Perform image restoration.
9. Convert a colour model into another.
10. Calculate boundary features of an image.
11. Calculate regional features of an image.
12. Detect an object in an image/video using template matching/Bayes classifier.

**Tools Required:**
**MATLAB**

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## (18HS0829) CONSTITUTION OF INDIA

| **I M.Tech -II Sem. (E.C.E) (DECS)** | **L** | **T** | **C** |
|---|---|---|---|
| | **2** | **-** | **-** |

**Course Objectives:**

Students will be able to

- Understand the premises informing the twin themes of liberty and freedom from a civil rights perspective.
- To address the growth of Indian opinion regarding modern Indian intellectuals 'constitutional role and entitlement to civil and economic rights as well as the emergence of nationhood in the early years of Indian nationalism.
- To address the role of socialism in India after the commencement of the Bolshevik Revolution in 1917 and its impact on the initial drafting of the Indian Constitution.

**UNIT I**

**History of Making of the Indian Constitution:**

History, Drafting Committee, (Composition & Working)

**UNIT II**

**Philosophy of the Indian Constitution:** Preamble, Salient Features.

**UNIT III**

**Contours of Constitutional Rights & Duties:**

- Fundamental Rights
- Right to Equality
- Right to Freedom
- Right Against Exploitation
- Right to Freedom of Religion
- Cultural and Educational Rights
- Right to Constitutional Remedies
- Directive Principles of State Policy
- Fundamental Duties.

**UNIT IV**

**Organs of Governance:**

- Parliament
- Composition
- Qualifications And Disqualifications
- Powers And Functions
- Executive
- President
- Governor
- Council of Ministers

- Judiciary, Appointment and Transfer of Judges, Qualifications
- Powers and Functions

**UNIT V**

**Local Administration:**

- District's Administration Head: Role and Importance,
- Municipalities: Introduction, Mayor and Role of Elected Representative, CEO of Municipal Corporation.
- Pachayati Raj: Introduction, PRI: Zila Pachayat.
- Elected Officials and Their Roles, CEO Zilapachayat: Position and Role.
- Block Level: Organizational Hierarchy (Different Departments),
- Village Level: Role of Elected and Appointed Officials,
- Importance of Grass Root Democracy.

**Election Commission:**

- Election Commission: Role and Functioning.
- Chief Election Commissioner and Election Commissioners.
- State Election Commission: Role and Functioning.
- Institute and Bodies for the Welfare of SC/ST/OBC and Women.

**TEXT BOOKS:**

1. *The Constitution of India*, 1950 (Bare Act), Government Publication.
2. F*raming of Indian Constitution,* Dr. S. N. Busi, Dr. B. R. Ambedkar, 1st Edition, 2015.
3. *Indian Constitution Law,* M. P. Jain, 7th Edn., Lexis Nexis, 2014.
4. *Introduction to the Constitution of India,* D.D. Basu, Lexis Nexis, 2015.

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## (18HS0827) PEDAGOGY STUDIES

| **I M.Tech -II Sem. (E.C.E) (DECS)** | **L** | **T** | **C** |
|---|---|---|---|
| | **2** | **-** | **-** |

**Course Objectives:**

Students Will Be Able To

- Review Existing Evidence On The Review Topic To Inform Programme Design And Policy
  Making Undertaken By the Dfid, Other Agencies and Researchers.
- Identify Critical Evidence Gaps To Guide The Development.

**Course Outcomes**

Students Will Be Able To Understand

- What Pedagogical Practices Are Being Used By Teachers In Formal And Informal Classrooms In Developing Countries?
- What Is The Evidence On The Effectiveness Of These Pedagogical Practices, In What Conditions, And With What Population Of Learners?
- How Can Teacher Education (Curriculum And Practicum) And The School Curriculum And Guidance Materials Best Support Effective Pedagogy?

**UNIT I**

**Introduction and Methodology:**

- Aims and Rationale, Policy Background, Conceptual Framework and Terminology.
- Theories of Learning, Curriculum, Teacher Education.
- Conceptual Framework, Research Questions**.**
- Overview of Methodology and Searching.

**UNIT II**

- Thematic Overview: Pedagogical Practices are Being Used by Teachers in Formal and Informal Classrooms in Developing Countries.
- Curriculum, Teacher Education.

**UNIT III**

- Evidence on the Effectiveness of Pedagogical Practices.
- Methodology for the in Depth Stage: Quality Assessment of Included Studies.
- How Can Teacher Education (Curriculum and Practicum) and the School Curriculum and Guidance Materials Best Support Effective Pedagogy?
- Theory of Change.
- Strength and Nature of the Body of Evidence for Effective Pedagogical Practices.
- Pedagogic Theory and Pedagogical Approaches.
- Teachers' Attitudes and Beliefs and Pedagogic Strategies.

**UNIT IV**

- Professional Development: Alignment with Classroom Practices and Follow-Up Support.
- Peer Support
- Support from the Head Teacher and the Community.
- Curriculum and Assessment
- Barriers to Learning: Limited Resources and Large Class Sizes

**UNIT V**

**Research Gaps and Future Directions**

- Research Design
- Contexts
- Pedagogy
- Teacher Education
- Curriculum and Assessment
- Dissemination and Research Impact.

**TEXT BOOKS:**


1. *Classroom Interaction In Kenyan Primary Schools,* Ackers J, Hardman F (2001) Compare, 31 (2): 245-261.
2. *The Importance Of Evaluation,* Agrawal M (2004) Curricular Reform In Schools: Journal Of Curriculum Studies, 36 (3): 361-379.
3. *Teacher Training In Ghana - Does It Count? Multi-Site Teacher Education Research Project (Muster) Country Report 1,* Akyeampong K (2003). London: Dfid.
4. *Improving Teaching And Learning Of Basic Maths And Reading In Africa: Does Teacher Preparation Count?,* Akyeampong K, Lussier K, Pryor J, Westbrook J (2013) International Journal Educational Development, 33 (3): 272–282.
5. *International Comparisons In Primary Education. Oxford And Boston,* Alexander Rj (2001) Culture And Pedagogy, Blackwell.
6. *Learning To Read,* Chavan M (2003) Read India: A Mass Scale, Rapid, Campaign.
7. Www.Pratham.Org/Images/Resource%20working%20paper%202.Pdf.

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## (18HS0828) STRESS MANAGEMENT BY YOGA

| **I M.Tech -II Sem. (E.C.E) (DECS)** | **L** | **T** | **C** |
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| | **2** | **-** | **-** |

**Course Objectives:**

- To Achieve Overall Health Of Body And Mind
- To Overcome Stress

**Course Outcomes:**

Students Will Be Able To

- Develop Healthy Mind In A Healthy Body Thus Improving Social Health Also
- Improve Efficiency.

**UNIT I**

Definitions of Eight Parts of Yoga ( Ashtanga )

**UNIT II**

Yam and Niyam. Do`S and Don'ts in Life:
Ahinsa, Satya, Astheya, Bramhacharya and Aparigraha.
Shaucha, Santosh, Tapa, Swadhyay, Ishwarpranidhan.

**UNIT III**

Asan and Pranayam:
Various Yog Poses and Their Benefits for Mind & Body.
Regularization of Breathing Techniques and its Effects-Type of Pranayam.

**TEXT BOOKS:**

1. *Yogic Asanas For Group Tarining-Part-I*", Janardan Swami Yogabhyasi Mandal, Nagpur Model Curriculum Of Engineering & Technology Pg Courses [Volume-I] [47 ].
2. *Rajayoga Or Conquering The Internal Nature*, Swami Vivekananda, Advaitaashrama (Publication Department) Kolkata.

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## (18HS0819) PERSONALITY DEVELOPMENT THROUGH LIFE ENLIGHTENMENT SKILLS

| **I M.Tech -II Sem. (E.C.E) (DECS)** | **L** | **T** | **C** |
|---|---|---|---|
| | **2** | **-** | **-** |

***Course Objectives:***

- To Learn To Achieve The Highest Goal Happily.
- To Become A Person With Stable Mind, Pleasing Personality And Determination.
- To Awaken Wisdom In Students.

***Course Outcomes***

Students Will Be Able To

- Study Of Shrimad-Bhagwad-Geeta Will Help The Student In Developing His Personality And Achieve The Highest Goal In Life.
- The Person Who Has Studied Geeta Will Lead The Nation And Mankind To Peace And Prosperity.
- Study Of Neetishatakam Will Help In Developing Versatile Personality Of Students.

**UNIT I**

Neetisatakam-Holistic Development Of Personality

- Verses- 19,20,21,22 (Wisdom)
- Verses- 29,31,32 (Pride & Heroism)
- Verses- 26,28,63,65 (Virtue)
- Verses- 52,53,59 (Dont's)
- Verses- 71,73,75,78 (Do's)
-

**UNIT II**

- Approach to Day to Day Work and Duties.
- Shrimad Bhagwadgeeta : Chapter 2-Verses 41, 47,48,
- Chapter 3-Verses 13, 21, 27, 35, Chapter 6-Verses 5,13,17, 23, 35,
- Chapter 18-Verses 45, 46, 48.

**UNIT III**

- Statements of Basic Knowledge.
- Shrimad Bhagwadgeeta: Chapter2-Verses 56, 62, 68
- Chapter 12 -Verses 13, 14, 15, 16,17, 18
- Personality Of Role Model. Shrimad Bhagwadgeeta: Chapter2-Verses 17, Chapter 3-Verses 36,37,42,
- Chapter 4-Verses 18, 38,39
- Chapter18 – Verses 37,38,63

**TEXT BOOKS:**


1. *Srimad Bhagavad Gita,* Swami Swarupanandaadvaita Ashram (Publication Department), Kolkata.
2. *Bhartrihari's Three Satakam (Niti-Sringar-Vairagya),* P.Gopinath, 4. Rashtriya Sanskrit Sansthanam, New Delhi.

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## (18EC4021) OPTICAL NETWORKS
**(Program Elective -V)**

| **II M.Tech -I Sem. (E.C.E) (DECS)** | **L** | **T** | **C** |
|---|---|---|---|
| | **3** | **-** | **3** |

**UNIT I**

**Optical Fiber Components:** Couplers, Isolators and Circulators, Multiplexers, Bragg grating, Fabry-perot Filters, Mach zender interferometers, Arrayed waveguide grating, Tunable filters, Hi-channel count multiplexer architectures, Optical amplifiers, Direct and External modulation transmitters, Pump sources for amplifiers, Optical switching and Wave length converters.

**UNIT II**

**Client Layers of Optical Networks:** SONET / SDH – Multiplexing, Frame Structure, Physical Layer, Infrastructure, ATM – Functions, Adaptation layers, QoS, Flow Control Signaling and Routing, IP – Routing, QoS, MPLS, Storage Area Networks – ESCON, Fiber Channel, HIPPI.

**UNIT III**

**WDM Network Elements and Design:** Optical Line Terminals and Amplifiers, Add/Drop Multiplexers, Optical Cross Connects, Cost trade-offs in Network Design, LTD and RWA Problems, Dimensioning – Wavelength Routing Networks.

**UNIT IV**

**Network Control, Management and Survivability:** Network Management Functions, Optical Layer Services and Interfacing, Layers within Optical Layer, Multivendor Interoperability, Performance and Fault Management.

Basic Concepts of Survivability, Protection in SONET/SDH Links and Rings, Protection in IP Networks, Optical Layer Protection – Service Classes, Protection Schemes, Interworking between Layers.

**UNIT V**

**Access Networks and Photonic Packet Switching:** Network Architecture, Enhanced HFC, FTTC, Photonic Packet Switching – OTDM, Synchronization, Header Processing, Buffering, Burst Switching.

**TEXT BOOKS:**


1. *Optical Networks:* A Practical Perspective, Rajiv Ramaswami and Kumar N. Sivarajan, 2nd edition 2004, Elsevier Morgan Kaufmann Publishers (An Imprint of Elsevier).
2. *WDM Optical Networks: Concepts, Design and Algorithms,* C. Siva Rama Murthy and Mohan Guruswamy 2nd edition, 2003, PEI.


**REFERENCE BOOKS:**


1. *Optical Fiber Communications: Principles and Practice*- John.M.Senior, 2nd edition, 2000, PE.
2. *Fiber Optics Communication*, Harold Kolimbris, 2nd Ed., 2004, PEI.

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**(18EC4213) TESTING & TESTABILITY**
**(Common to DECS, ES & VLSI)**
**(Program Elective -V)**

| **II M.Tech -I Sem. (E.C.E) (DECS)** | **L** | **T** | **C** |
|---|---|---|---|
| | **3** | **-** | **3** |

**UNIT I**

**Introduction to Test and Design for Testability (DFT) Fundamentals:** Modelling: Modelling Digital Circuits at Logic Level, Register Level and Structural Models, Levels of Modelling, Logic Simulation: Types of Simulation, Delay Models, Element Evaluation, Hazard Detection, Gate Level Event Driven Simulation.

**UNIT II**

**Fault Modelling:** Logic Fault Models, Fault Detection and Redundancy, Fault Equivalence and Fault Location. Single Stuck and Multiple Stuck – Fault Models. Fault Simulation Applications, General Techniques for Combinational Circuits.

**Testing for Single Stuck Faults (SSF):** Automated Test Pattern Generation (ATPG/ATG) for SSFs in Combinational and Sequential Circuits, Functional Testing with Specific Fault Models.

**UNIT III**

**Design for Testability:** Testability Trade-Offs, Techniques, Scan Architectures and Testing – Controllability and Absorbability, Generic Boundary Scan, Full Integrated Scan, Storage Cells for Scan Design, Board Level and System Level DFT Approaches, Boundary Scans Standards, Compression Techniques – Different Techniques, Syndrome Test and Signature Analysis.

**UNIT IV**

**Built-In Self-Test (BIST):** BIST Concepts and Test Pattern Generation. Specific BIST Architectures – CSBL, BEST, RTS, LOCST, STUMPS, CBIST, CEBS, RTD, SST, CATS, CSTP, BILBO. Brief Ideas on Some Advanced BIST Concepts and Design for Self-Test at Board Level.

**UNIT V**

**Memory BIST (MBIST):** Memory Test Architectures and Techniques – Introduction to Memory Test, Types of Memories and Integration, Embedded Memory Testing Model. Memory Test Requirements for MBIST.

**Brief Ideas on Embedded Core Testing:** Introduction to Automatic in Circuit Testing (ICT), JTAG Testing Features.

**TEXT BOOKS:**

1. *Digital Systems Testing and Testable Design*, Miron Abramovici, Melvin A. Breur, Arthur D.Friedman, Jaico Publishing House, 2001.

**REFERENCES:**

1. *Design for Test for Digital ICs & Embedded Core Systems*, Alfred Crouch, PH.
2. *Introduction to VLSI Testing, Prentice Hall,* 1998. Robert J.Feugate, Jr., Steven M.Mentyn,

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## (18EC4022) RF AND MICROWAVE CIRCUIT DESIGN
**(Program Elective -V)**

| **II M.Tech -I Sem. (E.C.E) (DECS)** | **L** | **T** | **C** |
|---|---|---|---|
| | **3** | **-** | **3** |

**UNIT I**

**Transmission Line Theory:** Lumped Element Circuit Model for Transmission Line, Field Analysis, Smith Chart, Quarter Wave Transformer, Generator and Load Mismatch, Impedance Matching and Tuning.

**UNIT II**

**Microwave Network Analysis:** Impedance and Equivalent Voltage and Current, Impedance and Admittance Matrix, the Scattering Matrix, Transmission Matrix, Signal Flow Graph.

**UNIT III**

**Microwave Components:** Microwave Resonators, Microwave Filters, Power Dividers and Directional Couplers, Ferromagnetic Devices and Components. Nonlinearity and Time Variance, Inter-Symbol Interference, Random Process & Noise, Definition of Sensitivity and Dynamic Range, Conversion Gain and Distortion.

**UNIT IV**

**Microwave Semiconductor Devices and Modeling:** PIN Diode, Tunnel Diodes, Varactor Diode, Schottky Diode, IMPATT And TRAPATT Devices, Transferred Electron Devices, Microwave Bjts, GaAs Fets, Low Noise and Power GaAs Fets, MESFET, MOSFET, HEMT.

**UNIT V**

**Amplifiers Design:** Power Gain Equations, Stability, Impedance Matching, Constant Gain and Noise Figure Circles, Small Signal, Low Noise, High Power and Broadband Amplifier, Oscillators, Mixers Design.

**TEXT BOOKS:**


1. *Advanced RF & Microwave Circuit Design: The Ultimate Guide to Superior Design,* Matthew M. Radmanesh, AuthorHouse, 2009.
2. *Microwave engineering,* D.M.Pozar, Wiley, 4th edition, 2011.
3. *R. F. Circuit Design, R.Ludwig and P.Bretchk,* Pearson Education Inc, 2009.


**REFERENCES:**


1. *Microwave Circuit Design Using Linear and Non-Linear Techniques,* G.D. Vendelin, A.M. Pavoi, U. L. Rohde, John Wiley 1990.
2. *Microwave circuit Analysis and Amplifier Design,* S.Y. Liao, Prentice Hall 1987.
3. *RF and Microwave Electronics Illustrated Radmanesh,* Pearson Education, 2004.

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**(18HS0824) BUSINESS ANALYTICS**
**(Open Elective)**

| **II M. Tech. - I Sem. (E.C.E) (DECS)** | **L** | **T** | **C** |
|---|---|---|---|
| | **3** | **0** | **3** |

**Course Objective:** The course is to understand the management and administration, functions of management, formal and informal organization, staffing, creativity and innovation, process of communication.

**Course Outcomes:**
CO -1: Design, device, and query relational databases for operative data.
CO - 2: Design, implement, populate and query data warehouses for informational data.
CO - 3: To integrate very large data sets to make business decisions.
CO - 4: Evaluate the use of data from acquisition through cleansing, warehousing, analytics, and visualization to the ultimate business decision.
CO - 5: Evaluate the key concepts of business analytics.
CO - 6: Determine when to implement relational versus document oriented database structures.
CO -7: Outline the relationship of the business analytics process within the organization's decision-making process.
CO - 8: Examine and apply appropriate business analytic techniques and methods.
CO–9: Execute real-time analytical methods on streaming datasets to react quickly to customer needs.
CO -10: To critically analyze the predictive analysis methods.

**UNIT I**
Introduction to Descriptive analytics, Descriptive Statistics, Probability Distributions, Inferential Statistics through hypothesis tests, Permutation & Randomization Test

**UNIT II**
Regression, ANOVA (Analysis of Variance), Machine Learning Introduction and Concepts Differentiating, algorithmic and model based frameworks, Regression: Ordinary Least Squares, Ridge Regression, Lasso Regression, K Nearest Neighbors', Regression &Classification

**UNIT III**
Supervised Learning with Regression and Classification techniques- Bias-Variance Dichotomy, Model Validation Approaches, Logistic Regression, Linear Discriminant Analysis, Quadratic Discriminant Analysis, Regression and Classification Trees, Support Vector Machines, Ensemble Methods: Random Forest, Neural Networks, Deep learning

**UNIT IV**
Unsupervised Learning and Challenges for Big Data Analytics- Clustering, Associative Rule Mining, Challenges for big data analytics

**UNIT V**
Prescriptive analytics Creating data for analytics through designed experiments, creating data for analytics through Active learning, creating data for analytics through Reinforcement learning, Graph Visualization, Data Summaries, Model Checking & Comparison

**TEXT BOOKS:**


1. *The elements of statistical learning.Vol.2.No.1*, Hastie, Trevor, et al. New York: springer, 2009.
2. *Applied statistics and probability for engineers*, Montgomery, Douglas C., and George C. Runger. John Wiley & Sons, 2010
3. *Scaling up Machine Learning*, Bekkerman et al.
4. *Hadoop: The Definitive Guide*, Tom White Third Edition, O‟reilly Media, 2012.
5. *Mining of Massive Datasets*, Anand Rajaraman and Jeffrey David Ullman, Cambridge University Press, 2012.
6. *Developing Analytic Talent: Becoming a Data Scientist*, Vincent Granville, wiley, 2014.
7. *Introduction to Data Science, Version 2.0*, Jeffrey Stanton & Robert De Graaf, 2013.

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**(18ME3121) INDUSTRIAL SAFETY**
**(Open Elective)**

| **II M.Tech -I Sem. (E.C.E) (DECS)** | **L** | **T** | **C** |
|---|---|---|---|
| | **3** | **0** | **0** |

***Course Objectives*:**

- *To learn about mechanical and electrical hazards.*
- *To learn about P mechanical and electrical hazards.*
- *To learn about Wear and Corrosion and their prevention.*
- *To learn about Periodic and preventive maintenance*

***Course Outcomes*:**

*Students undergoing this course are able to*

- *Understand the points of factories act 1948 for health and safety.*
- *Understand the cost & its relation with replacement economy.*
- *Understand the concepts of sequence of fault finding activities*
- *Understand the Program and schedule of preventive maintenance of mechanical and electrical equipment.*

**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 and methods.

**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 tree concept, 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, Any one machine tool, Pump, Air compressor, Internal combustion engine, Boiler, Electrical motors, Types of faults in machine tools and their general causes.

**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: Machine tools, Pumps, Air compressors, Diesel generating (DG) sets Program and schedule of preventive maintenance of mechanical and electrical equipment, advantages of preventive maintenance. Repair cycle concept and importance.

**Text Books:**


1. *Maintenance Engineering Handbook*, Higgins & Morrow, Da Information Services, 2002
2. *Maintenance Engineering*, H. P. Garg, S. Chand and Company, 2008


**Reference Books:**


1. *Pump-hydraulic Compressors*, Audels, Mcgrew Hill Publication, 2009
2. *Foundation Engineering Handbook*, Winterkorn, Hans, Chapman & Hall London, 2010

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## (18ME3122) ADVANCED OPERATIONS RESEARCH
**(Open Elective)**

| **II M.Tech -I Sem. (E.C.E) (DECS)** | **L** | **T** | **C** |
|---|---|---|---|
| | **3** | **0** | **0** |

***Course Objectives*:**

- *To learn about Optimization Techniques.*
- *To learn about Graphical solution revised simplex method*
- *To learn about Nonlinear programming problem.*
- *To learn about Scheduling and sequencing and Competitive Models*

***Course Outcomes*:**

*Students undergoing this course are able to*

- *Understand the Inventory Control Models*
- *Understand the Graphical solution revised simplex method*
- *Understand the concepts of Kuhn-Tucker conditions min cost flow.*
- *Understand the Probabilistic inventory control models and Dynamic Programming*

**UNIT I**

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

**UNIT II**

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

**UNIT III**

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

**UNIT IV**

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

**UNIT V**

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

**Text Books:**


1. *Operations Research, An Introduction*, H.A. Taha, PHI, 2008
2. *Principles of Operations Research*, H.M. Wagner, PHI, Delhi, 1982.
3. *Introduction to Optimization: Operations Research*, J.C. Pant, Jain Brothers, Delhi, 2008


**Reference Books:**


1. *Operations Research*: Hitler Liebermann McGraw Hill Pub. 2009
2. *Operations Research*: Pannerselvam, Prentice Hall of India 2010

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## (18CE1028) COST MANAGEMENT OF ENGINEERING PROJECTS
**(Open Elective)**

| **II M.TECH - I SEM. (E.C.E) (ES)** | **L** | **T** | **C** |
|---|---|---|---|
| | **3** | **-** | **3** |

***Course Objectives*:**

- To study fundamentals of engineering project economics
- To understand dynamics of money over time
- To understand the significance of Benefit & Cost Analysis
- To get familiarised with depreciation, inflation and taxes
- To know the procedures of equipment costing
- To understand the basic concepts of Financial Management

***Course Outcomes:***

- Student can access the present value and future value for money
- Student can apply the principals of Benefit & Cost Analysis and
- Break-Even comparison
- Student can calculate the depreciation cost for construction equipment and can estimate the cost for construction equipment
- Can prepare profit and loss, balance sheets etc.

**UNIT I**

Engineering economics : Basic principles – Time value of money, Quantifying alternatives for decision making, Cash flow diagrams, Equivalence- Single payment in the future (P/F, F/P), Present payment compared to uniform series payments (P/A, A/P), Future payment compared to uniform series payments (F/A, A/F), Arithmetic gradient, Geometric gradient.

**UNIT II**

Comparison of alternatives: Present, future and annual worth method of comparing alternatives, Rate of return, Incremental rate of return, Break-even comparisons, Capitalized cost analysis, Benefit-cost analysis.

**UNIT III**

Depreciation, Inflation and Taxes: Depreciation, Inflation, Taxes.
Equipment economics: Equipment costs, Ownership and operating costs, Buy/Rent/Lease options, Replacement analysis.

**UNIT IV**

Cost Estimating: Types of Estimates, Approximate estimates – Unit estimate, Factor estimate, Cost indexes, parametric estimate, and Life cycle cost.

**UNIT V**

Financial management: Construction accounting, Chart of Accounts, Financial statements – Profit and loss, Balance sheets, Financial ratios, Working capital management.

**TEXT BOOKS / REFERENCES**:


1. *Engineering Economy by* Blank, L. T. and Tarquin, A. Fourth Edition, WCB/McGraw-Hill, 1998.
2. *Fundamentals of Financial management by* Bose, D. C. 2nd ed., PHI, New Delhi, 2010.
3. *Fundamentals of Financial management by* Boyer, C. B. and Merzbach, U. C., 2nd ed., John Wiley & Sons, New York, 1989.

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## (18ME3123) COMPOSITE MATERIALS
**(Open Elective)**

**II M.Tech -I Sem. (E.C.E) (DECS)**

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***Course Objectives*:**

- *To learn about Classification and characteristics of Composite materials*
- *To learn about layup method and Mechanical Behavior of composites*
- *To learn about Manufacturing of Metal Matrix Composites and Manufacturing of Polymer Matrix Composites*
- *To learn about Laminar Failure Criteria and Laminate strength-ply discount truncated maximum strain criterion*

***Course Outcomes*:**

*Students undergoing this course are able to*

- *Understand the need of composite materials.*
- *Understand the Properties and applications of whiskers, particle reinforcements. Mechanical Behavior of composites.*
- *Understand the concepts of Manufacturing of Ceramic Matrix Composite and Metal Matrix Composite.*
- *Understand the various manufacturing method of composites.*

**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 isostatic pressing. 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 prepress – 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, hydro thermal 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, 2003
2. *Materials Science and Engineering*, An introduction. WD Callister, Jr., Adapted by R. Bala Subramanian, John Wiley & Sons, NY, Indian edition, 2007.


**References:**


1. *Hand Book of Composite Materials*-ed-Lubin. 2010
2. *Composite Materials* – K.K.Chawla. 2009
3. *Composite Materials Science and Applications* – Deborah D.L. Chung, 2012
4. *Composite Materials Design and Applications* – Danial Gay, Suong V. Hoa, and Stephen W. Tasi, 2012

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## (18EE2128) WASTE TO ENERGY
**(Open Elective)**

| **II M.TECH - I SEM. (E.C.E) (ES)** | **L** | **T** | **C** |
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**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 COMBUTION:** 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**

**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 in India.

**REFERENCES:**


1. *Non-Conventional Energy by* Desai, Ashok V., Wiley Eastern Ltd., 1990.
2. *Biogas Technology - A Practical Hand Book by* Khandelwal, K. C. and Mahdi, S. S., Vol. I & II, Tata McGraw Hill Publishing Co. Ltd., 1983.
3. *Food, Feed and Fuel from Biomass by* Challal, D. S., IBH Publishing Co. Pvt. Ltd., 1991.