# M.Tech, ECE

## Curriculum & Syllabus for M.Tech under AEC Autonomy Electronics and Communication Engineering (Effective from 2025-26 Admission Batch)

# MTECH, ECE, AEC_2025-2026

| Curriculum Structure | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Semester-I** | | | | | | | |
| Sl No. | Category | Subject Code | Subject Name | **Total Number of contact hours** | | | Credits |
| | | | | L | T | P | |
| **Theory** | | | | | | | |
| 1 | Program Core I | MCE101 | Advanced Communication Networks | 3 | 0 | 0 | 3 |
| 2 | Program Core II | MCE 102 | Wireless and Mobile Communication | 3 | 0 | 0 | 3 |
| 3 | Program Elective-I | MCE 103 | Program Elective-I | 3 | 0 | 0 | 3 |
| 4 | Program Elective-II | MCE 104 | Program Elective-II | 3 | 0 | 0 | 3 |
| 5 | Mandatory Learning Course | MCE105 | Research Methodology and IPR | 2 | 0 | 0 | 2 |
| 6 | Audit Course 1 | MCE 106 | Audit Course 1 | 2 | 0 | 0 | 0 |
| | | | *Total Theory* | **16** | **0** | **0** | **14** |
| **Practical** | | | | | | | |
| 1 | Laboratory I | MCE 191 | Advanced Communication Networks Lab | 0 | 0 | 4 | 2 |
| 2 | Laboratory II | MCE 192 | Wireless and Mobile Communication Lab | 0 | 0 | 4 | 2 |
| | | | *Total Practical* | **0** | **0** | **8** | **4** |
| | | | **Total of Semester-I** | **16** | **0** | **8** | **18** |
| **Semester-II** | | | | | | | |
| **Theory** | | | | | | | |
| 1 | Program Core III | MCE 201 | Antennas and Radiating Systems | 3 | 0 | 0 | 3 |
| 2 | Program Core IV | MCE 202 | Advanced Digital Signal Processing | 3 | 0 | 0 | 3 |
| 3 | Program Elective-III | MCE 203 | Program Elective-III | 3 | 0 | 0 | 3 |
| 4 | Program Elective-IV | MCE 204 | Program Elective-IV | 3 | 0 | 0 | 3 |
| 5 | Audit Course 2 | MCE 205 | Audit Course 2 | 2 | 0 | 0 | 0 |
| | | | *Total Theory* | **14** | **0** | **0** | **12** |
| **Practical** | | | | | | | |
| 1 | Laboratory III | MCE 291 | Antennas and Radiating Systems lab | 0 | 0 | 4 | 2 |
| 2 | Laboratory IV | MCE 292 | Advanced Digital Signal Processing Lab | 0 | 0 | 4 | 2 |
| | | | *Total Practical* | **0** | **0** | **8** | **4** |
| **Sessional** | | | | | | | |
| 1 | Mini Project | MCE 281 | Mini Project with Seminar | **0** | **0** | **3** | **2** |
| | | | **Total of Semester-II** | **14** | **0** | **11** | **18** |
| **Semester-III** | | | | | | | |
| **Theory*** | | | | | | | |
| 1 | Program Elective-V | MCE 301 | Program Elective-V | 3 | 0 | 0 | 3 |
| 2 | Open Elective | MCE 302 | Open Elective | 3 | 0 | 0 | 3 |
| | | | *Total Theory* | **6** | **0** | **0** | **6** |
| **Sessional** | | | | | | | |

| 1 | Major Project | MCE 381 | Dissertation –I | 0 | 0 | 20 | 10 |
|---|---------------|---------|-----------------|---|---|----|----|
|   |               |         | **Total of Semester-III** | **6** | **0** | **0** | **16** |
| **Semester-IV** | | | | | | | |
| **Sessional** | | | | | | | |
| 1 | Major Project | MCE 481 | Dissertation -II | 0 | 0 | 32 | 16 |
|   |               |         | **Total of Semester-IV** | **0** | **0** | **32** | **16** |
| **Total Credits for the programme** | | | | | | | **68** |

## List of Program Electives

❖ **Program Elective – I**     **MCE 103**
  A. Wireless Sensor Networks
  B. Optical Networks
  C. Statistical Information Processing

❖ **Program Elective – II**     **MCE 104**
  A. Cognitive Radio
  B. RF and Microwave Circuit Design
  C. DSP Architecture

❖ **Program Elective – III**     **MCE 203**
  A. Satellite Communication
  B. Internet of Things
  C. Voice and data networks

❖ **Program Elective – IV**     **MCE 204**
  A. Markov Chain and Queuing System
  B. MIMO System
  C. Programmable Networks –SDN, NFV

❖ **Program Elective – V**     **MCE 301**
  A. High Performance Networks
  B. Pattern Recognition and Machine Learning
  C. Remote Sensing

**List of Open Electives** *(as per AICTE Model Curriculum for Postgraduate Degree Courses in Engineering & Technology- January 2018)*     **MCE 302**

  A. Business Analytics
  B. Operations Research
  C. Cost Management of Engineering Projects
  D. Industrial Safety
  E. Composite Materials
  F. Waste to Energy

**Audit course 1 & 2** *(as per AICTE Model Curriculum for Postgraduate Degree Courses in Engineering & Technology-January 2018)*

**MCE 106**

  A. English for Research Paper Writing

B. Pedagogy Studies

C. Value Education

D. Stress Management by Yoga

**MCE 205**

A. Personality Development through Life Enlightenment Skills.

B. Sanskrit for Technical Knowledge

C. Constitution of India

D. Disaster Management

**Subject Code : MCE 101**
**Category : Program Core I**
**Subject Name : Advanced Communication Network**
**Semester : I**
**L-T-P : 3-0-0**
**Credit: 3**
**Course Outcomes:**
At the end of this course, students will be able to
☐ Understand advanced concepts in Communication Networking.
☐ Design and develop protocols for Communication Networks.
☐ Understand the mechanisms in Quality of Service in networking.
☐ Optimise the Network Design

**Syllabus Contents:**
Unit 1: 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 2: 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 3: 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 4: IP address lookup-challenges. Packet classification algorithms and Flow IdentificationGrid of Tries, Cross producting and controlled prefix expansion algorithms.
Unit 5: Admission control in Internet. Concept of Effective bandwidth. Measurement based admission control. Differentiated Services in Internet (DiffServ). DiffServ architecture and framework. Unit 6: 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.

**References:**
☐ Jean Wairand and Pravin Varaiya, "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.

**Subject Code : MCE 102**
**Category : Program Core II**
**Subject Name : Wireless and Mobile Communication**
**Semester : I**
**L-T-P : 3-0-0 Credit: 3**
**Course Outcomes:**
At the end of this course, students will be able to
 Design appropriate mobile communication systems.
 Apply frequency-reuse concept in mobile communications, and to analyze its effects on
interference, system capacity, handoff techniques
 Distinguish various multiple-access techniques for mobile communications e.g. FDMA,
TDMA, CDMA, and their advantages and disadvantages.
 Analyze path loss and interference for wireless telephony and their influences on a
mobilecommunication system's performance.
 Analyze and design CDMA system functioning with knowledge of forward and reverse
channel details, advantages and disadvantages of using the technology
 Understanding upcoming technologies like 3G, 4G etc.

**Syllabus Contents:**
Unit 1: Cellular Communication Fundamentals:Cellular system design, Frequency reuse, cell splitting, handover concepts, Co channel and adjacent channel interference, interference reduction techniques and methods to improve cell coverage, Frequency management and channel assignment.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 2:Spectral efficiency analysis based on calculations for Multiple access technologies:TDMA FDMA and CDMA,Comparison of these technologies based on their signal separation techniques, advantages, disadvantages and application areas.Wireless network planning (Link budget and power spectrum calculations)
Unit 3: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 4:Equalization, Diversity:Equalizers in a communications receiver, Algorithms for adaptive equalization, diversity techniques, space, polarization, frequency diversity, Interleaving.
Unit 5: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 6: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

**References:**

□ V.K.Garg, J.E.Wilkes, "Principle and Application of GSM", Pearson Education, 5th edition, 2008.
□ V.K.Garg, "IS-95 CDMA & CDMA 2000", Pearson Education, 4th edition, 2009.
□ 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.
□ Asha Mehrotra, "A GSM system Engineering" Artech House Publishers Bosten, London,1997.

**Subject Code : MCE 103**
**Category : Program Elective-I**
**Subject Name : Wireless Sensor Networks**
**Semester : I**
**L-T-P : 3-0-0 Credit: 3**
**Course Outcomes:**
At the end of this course, students will be able to
□ Design wireless sensor network system for different applications under consideration.
□ Understand the hardware details of different types of sensors and select right type of sensor for various applications.
□ Understand radio standards and communication protocols to be used for wireless sensor network based systems and application.
□ Use operating systems and programming languages for wireless sensor nodes, performance of wireless sensor networks systems and platforms.
□ Handle special issues related to sensors like energy conservation and security challenges.

**Syllabus Contents:**
Unit 1:Introduction and overview of sensor network architecture and its applications, sensor network comparison with Ad Hoc Networks, Sensor node architecture with hardware and software details.
Unit 2:Hardware: Examples like mica2, micaZ, telosB, cricket, Imote2, tmote, btnode, and Sun SPOT, Software (Operating Systems): tinyOS, MANTIS, Contiki, and RetOS.
Unit 3:Programming tools: C, nesC. Performance comparison of wireless sensor networks simulation and experimental platforms like open source (ns-2) and commercial (QualNet, Opnet)
Unit 4: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 5:Data dissemination and processing; differences compared with other database management systems, data storage; query processing.
Unit 6: Specialized features: Energy preservation and efficiency; security challenges; faulttolerance, 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.

**References:**
□ H. Karl and A. Willig, "Protocols and Architectures for Wireless Sensor Networks", John Wiley & Sons, India, 2012.
□ C. S. Raghavendra, K. M. Sivalingam, and T. Znati, Editors, "Wireless Sensor Networks", Springer Verlag, 1st Indian reprint, 2010.
□ F. Zhao and L. Guibas, "Wireless Sensor Networks: An Information Processing Approach", Morgan Kaufmann, 1st Indian reprint, 2013.
□ YingshuLi, MyT. Thai, Weili Wu, "Wireless sensor Network and Applications", Springer series on signals and communication technology, 2008.

**Subject Code : MCE 103**
**Category : Program Elective-I**
**Subject Name : Optical Networks**
**Semester : I , L-T-P : 3-0-0**
**Credit: 3**

**Course Outcomes:**
At the end of this course, students will be able to
☐ Contribute in the areas of optical network and WDM network design.
☐ Implement simple optical network and understand further technology developments for future enhanced network.

**Syllabus Contents:**
Unit 1:SONET/SDH: optical transport network, IP, routing and forwarding, multiprotocol label switching.
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, optical safety.
Unit 4:Network Survivability: protection in SONET/SDH & client layer, optical layer protection schemes
Unit 5:WDM network design: LTD and RWA problems, dimensioning wavelength routing networks, statistical dimensioning models.
Unit 6:Access networks: Optical time division multiplexing, synchronization, header processing, buffering, burst switching, test beds, Introduction to PON, GPON, AON.
References:
☐ Rajiv Ramaswami, Sivarajan, Sasaki, "Optical Networks: A Practical Perspective", MK, Elsevier, 3 rd edition, 2010.
☐ C. Siva Ram Murthy and Mohan Gurusamy, "WDM Optical Networks: Concepts Design, and Algorithms", PHI, EEE, 2001.

**Subject Code : MCE 103**
**Category : Program Elective-I**
**Subject Name : Statistical Information Processing**
**Semester : I, L-T-P : 3-0-0**
**Credit: 3**

**Course Outcomes:**
At the end of this course, students will be able to
☐ Characterize and apply probabilistic techniques in modern decision systems, such as information systems, receivers, filtering and statistical operations.
☐ Demonstrate mathematical modelling and problem solving using such models.
☐ Comparatively evolve key results developed in this course for applications to signal processing, communications systems.
☐ Develop frameworks based in probabilistic and stochastic themes for modelling and analysis of various systems involving functionalities in decision making, statistical inference, estimation and detection.

**Syllabus Contents:**
Unit 1: Review of random variables: Probability Concepts, distribution and density functions, moments, independent, uncorrelated and orthogonal random variables; Vector-space representation of Random

variables, Vector quantization, Tchebaychef inequality theorem, Central Limit theorem, Discrete &Continuous Random Variables. Random process: Expectations, Moments,Ergodicity, Discrete-Time Random Processes Stationary process, autocorrelation and auto covariance functions, Spectral representation of random signals, Properties of power spectral density, Gaussian Process and White noise process.

Unit 2: Random signal modelling: MA(q), AR(p), ARMA(p,q) models, Hidden Markov Model & its applications ,Linear System with random input , Forward and Backward Predictions, Levinson Durbin Algorithm.

Unit 3: Statistical Decision Theory: Bayes' Criterion, Binary Hypothesis Testing, M-ary Hypothesis Testing, Minimax Criterion, Neyman-Pearson Criterion, Composite Hypothesis Testing. Parameter Estimation Theory: Maximum Likelihood Estimation, Generalized Likelihood Ratio Test ,Some Criteria for Good Estimators, Bayes' Estimation Minimum Mean-Square Error Estimate, Minimum, Mean Absolute Value of Error Estimate Maximum A Posteriori Estimate , Multiple Parameter Estimation Best Linear Unbiased Estimator ,Least-Square Estimation Recursive Least-Square Estimator.

Unit 4: Spectral analysis: Estimated autocorrelation function, Periodogram, Averaging the periodogram (Bartlett Method), Welch modification, Parametric method, AR(p) spectral estimation and detection of Harmonic signals.

Unit 5:Information Theory and Source Coding: Introduction, Uncertainty, Information and Entropy, Source coding theorem, Huffman, Shanon Fano , Arithmetic , Adaptive coding , RLE , LZW Data compaction, , LZ-77, LZ-78. Discrete Memory less channels, Mutual information, channel capacity, Channel coding theorem, Differential entropy and mutual information for continuous ensembles.

Unit 6:Application of Information Theory: Group, Ring & Field, Vector, GF addition, multiplication rules. Introduction to BCH codes, Primitive elements ,Minimal polynomials, Generator polynomials in terms of Minimal polynomials, Some examples of BCH codes,& Decoder, Reed- Solomon codes & Decoder, Implementation of Reed Solomon encoders and decoders.

**References:**
 Papoulis and S.U. Pillai, "Probability, Random Variables and Stochastic Processes",4th
Edition, McGraw-Hill, 2002.
 D.G. Manolakis, V.K. Ingle and S.M. Kogon, "Statistical and Adaptive Signal
Processing", McGraw Hill, 2000.
 Mourad Barkat , "Signal Detection and Estimation", Artech House, 2nd Edition, 2005.
 R G. Gallager, "Information theory and reliable communication", Wiley, 1st edition, 1968.
 F. J. MacWilliams and N. J. A. Sloane, "The Theory of Error-Correcting Codes", New
York, North-Holland, 1977.
 Rosen K.H, "Elementary Number Theory", Addison-Wesley, 6th edition, 2010.

**Subject Code : MCE 104**
**Category : Program Elective-II**
**Subject Name : Cognitive Radio**
**Semester : I, L-T-P : 3-0-0**
**Credit: 3**

**Course Outcomes:**
At the end of this course, students will be able to
 Understand the fundamental concepts of cognitive radio networks.
 Develop the cognitive radio, as well as techniques for spectrum holes detection that cognitive radio takes advantages in order to exploit it.
 Understand technologies to allow an efficient use of TVWS for radio communications based on two spectrum sharing business models/policies.
 Understand fundamental issues regarding dynamic spectrum access, the radio-resource management and trading, as well as a number of optimisation techniques for better

spectrum exploitation.

**Syllabus Contents:**
Unit 1:Introduction to Cognitive Radios: 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 2: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 3:Optimization Techniques of Dynamic Spectrum Allocation: Linear programming, convex programming, non-linear programming, integer programming, dynamic programming, stochastic programming.
Unit 4:Dynamic Spectrum Access and Management: Spectrum broker, cognitive radio architectures, centralized dynamic spectrum access, distributed dynamic spectrum access, learning algorithms and protocols.
Unit 5: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).
Unit 6: Research Challenges in Cognitive Radio: Network layer and transport layer issues, crosslayer
design for cognitive radio networks.

**References:**
 Ekram Hossain, Dusit Niyato, Zhu Han, "Dynamic Spectrum Access and Management in
Cognitive Radio Networks", Cambridge University Press, 2009.
 Kwang-Cheng Chen, Ramjee Prasad, "Cognitive radio networks", John Wiley & Sons
Ltd., 2009.
 Bruce Fette, "Cognitive radio technology", Elsevier, 2nd edition, 2009.
 Huseyin Arslan, "Cognitive Radio, Software Defined Radio, and Adaptive Wireless
Systems", Springer, 2007.
 Francisco Rodrigo Porto Cavalcanti, Soren Andersson, "Optimizing Wireless
Communication Systems" Springer, 2009.
 Linda Doyle, "Essentials of Cognitive Radio", Cambridge University Press, 2009.


**Subject Code : MCE 104**
**Category : Program Elective-II**
**Subject Name : RF and Microwave Circuit Design**
**Semester : I, L-T-P : 3-0-0**
**Credit: 3**

**Course Outcomes:**
At the end of this course, students will be able to
 Understand the behaviour of RF passive components and model active components.
 Perform transmission line analysis.
 Demonstrate use of Smith Chart for high frequency circuit design.
 Justify the choice/selection of components from the design aspects.
 Contribute in the areas of RF circuit design.

**Syllabus Contents**:
Unit 1: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 2: Microwave Network Analysis:Impedance and equivalent voltage and current, Impedance and admittance matrix, The scattering matrix, transmission matrix, Signal flow graph.

Unit 3: Microwave Components: Microwave resonators, Microwave filters, power dividers and directional couplers, Ferromagnetic devices and components.

Unit 4: Nonlinearity And Time VarianceInter-symbol interference, random process & noise, definition of sensitivity and dynamic range, conversion gain and distortion.

Unit 5: 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 6: 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.


**References:**

☐ Matthew M. Radmanesh, "Advanced RF & Microwave Circuit Design: The Ultimate
Guide to Superior Design", AuthorHouse, 2009.

☐ D.M.Pozar, " Microwave engineering" ,Wiley, 4th edition, 2011.

☐ R.Ludwig and P.Bretchko, "R. F. Circuit Design", Pearson Education Inc, 2009.

☐ G.D. Vendelin, A.M. Pavoi, U. L. Rohde, "Microwave Circuit Design Using Linear And
Non Linear Techniques", John Wiley 1990.

☐ S.Y. Liao, "Microwave circuit Analysis and Amplifier Design", Prentice Hall 1987.

☐ Radmanesh, "RF and Microwave Electronics Illustrated" , Pearson Education, 2004.


**Subject Code : MCE 104**
**Category : Program Elective-II**
**Subject Name : DSP Architecture**
**Semester : I, L-T-P : 3-0-0**
**Credit: 3**


**Course Outcomes:**
At the end of this course, students will be able to
☐ Identify and formalize architectural level characterization of P-DSP hardware
☐ Ability to design, programming (assembly and C), and testing code using Code Composer
Studio environment
☐ Deployment of DSP hardware for Control, Audio and Video Signal processing
applications
☐ Understanding of major areas and challenges in DSP based embedded systems


**Syllabus Contents:**
Unit 1: Programmable DSP Hardware: Processing Architectures (von Neumann, Harvard), DSP core algorithms (FIR, IIR, Convolution, Correlation, FFT), IEEE standard for Fixed and Floating Point Computations, Special Architectures Modules used in Digital Signal Processors (like MAC unit, Barrel shifters), On-Chip peripherals, DSP benchmarking.

Unit 2: Structural and Architectural Considerations: Parallelism in DSP processing, Texas Instruments TMS320 Digital Signal Processor Families, Fixed Point TI DSP Processors: TMS320C1X and TMS320C2X Family,TMS320C25 –Internal Architecture, Arithmetic and Logic Unit, Auxiliary Registers, Addressing Modes (Immediate, Direct and Indirect, Bit-reverse Addressing), Basics of TMS320C54x and C55x Families in respect of Architecture improvements and new applications fields, TMS320C5416 DSP Architecture, Memory Map, Interrupt System, Peripheral Devices, Illustrative Examples for assembly coding.

Unit 3: VLIW Architecture: Current DSP Architectures, GPUs as an alternative to DSP Processors, TMS320C6X Family, Addressing Modes, Replacement of MAC unit by ILP, Detailed study of ISA,

Assembly Language Programming, Code Composer Studio, Mixed Cand Assembly Language programming, On-chip peripherals, Simple applications developments as an embedded environment.

Unit 4: Multi-core DSPs: Introduction to Multi-core computing and applicability for DSP hardware, Concept of threads, introduction to P-thread, mutex and similar concepts, heterogeneous and homogenous multi-core systems, Shared Memory parallel programming –OpenMP approach of parallel programming, PRAGMA directives, OpenMP Constructs for work sharing like for loop, sections, TI TMS320C6678 (Eight Core subsystem).

Unit 5: FPGA based DSP Systems: Limitations of P-DSPs, Requirements of Signal processing for Cognitive Radio (SDR), FPGA based signal processing design-case study of a complete design of DSP processor.

Unit 6: High Performance Computing using P-DSP: Preliminaries of HPC, MPI, OpenMP, multicore DSP as HPC infrastructure.

**References:**

☐ M. Sasikumar, D. Shikhare, Ravi Prakash, "Introduction to Parallel Processing", 1st Edition, PHI, 2006.
☐ Fayez Gebali, "Algorithms and Parallel Computing",1st Edition, John Wiley & Sons, 2011
☐ Rohit Chandra, Ramesh Menon, Leo Dagum, David Kohr, DrorMaydan, Jeff McDonald,"Parallel Programming in OpenMP", 1st Edition, Morgan Kaufman,2000.
☐ Ann Melnichuk,Long Talk, "Multicore Embedded systems", 1st Edition, CRC Press,2010.
☐ Wayne Wolf, "High Performance Embedded Computing: Architectures, Applications and Methodologies", 1st Edition, Morgan Kaufman, 2006.
☐ E.S.Gopi, "Algorithmic Collections for Digital Signal Processing Applications Using MATLAB", 1st Edition, Springer Netherlands,2007.


**Subject Code : MCE 191**
**Category : Lab-I**
**Subject Name : Advanced Communication Networks Lab**
**Semester : I, L-T-P : 0-0-4**
**Credit: 2**

**Course Outcomes:**
At the end of this course, students will be able to
☐ Identify the different types of network devices and their functions within a network.
☐ Understand and build the skills of sub-netting and routing mechanisms.
☐ Understand basic protocols of computer networks, and how they can be used to assist in network design and implementation.

**List of Assignments:**
1. Study of Networking Commands (Ping, Tracert, TELNET, nslookup, netstat, ARP, RARP) and Network Configuration Files.
2. Linux Network Configuration.
a. Configuring NIC's IP Address.
b. Determining IP Address and MAC Address using if-config command.
c. Changing IP Address using if-config.
d. Static IP Address and Configuration by Editing.
e. Determining IP Address using DHCP.
f. Configuring Hostname in /etc/hosts file.
3. Design TCP iterative Client and Server application to reverse the given input sentence.
4. Design a TCP concurrent Server to convert a given text into upper case using multiplexing system call "select".

5. Design UDP Client Server to transfer a file.
6. Configure a DHCP Server to serve contiguous IP addresses to a pool of four IP devices with a default gateway and a default DNS address. Integrate the DHCP server with a BOOTP demon to automatically serve Windows and Linux OS Binaries based on client MAC address.
a. Configure DNS: Make a caching DNS client, and a DNS Proxy; implement reverse DNS and forward DNS, using TCP dump/Wireshark characterise traffic when the DNS server is up and when it is down.
7. Configure a mail server for IMAP/POP protocols and write a simple SMTP client in C/C++/Java client to send and receive mails.
8. Configure FTP Server on a Linux/Windows machine using a FTP client/SFTP client characterise file transfer rate for a cluster of small files 100k each and a video file of 700mb.Use a TFTP client and repeat the experiment.
9. Signaling and QoS of labeled paths using RSVP in MPLS.
10. Find shortest paths through provider network for RSVP and BGP.
11. Understand configuration, forwarding tables, and debugging of MPLS.


**Subject Code : MCE 192**
**Category : Lab-II**
**Subject Name : Wireless and Mobile Communication Lab**
**Semester : I, L-T-P : 0-0-4**
**Credit: 2**

**Course Outcomes:**
At the end of this course, students will be able to
 Understanding Cellular concepts, GSM and CDMA networks
 To study GSM handset by experimentation and fault insertion techniques
 Understating of 3G communication system by means of various AT commands usage in GSM
 Understanding CDMA concept using DSSS kit
 To learn, understand and develop concepts of Software Radio in real time environment

**List of Assignments:**
1. Understanding Cellular Fundamentals like Frequency Reuse, Interference, cell splitting, multi path environment, Coverage and Capacity issues using communication software.
2. Knowing GSM and CDMA architecture, network concepts, call management, call setup, call release,Security and Power Control, Handoff Process and types, Rake Receiver etc.
3. Study of GSM handset for various signalling and fault insertion techniques (Major GSM handset sections: clock, SIM card, charging, LCD module, Keyboard, User interface).
4. To study transmitters and receiver section in mobile handset and measure frequency band signal and GMSK modulating signal.
5. To study various GSM AT Commands their use and developing new application using it. Understating of 3G Communication System with features like; transmission of voice and videocalls, SMS, MMS, TCP/IP, HTTP, GPS and File system by AT Commands in 3G network.
6. Study of DSSS technique for CDMA, observe effect of variation of types of PN codes, chip rate, spreading factor, processing gain on performance.
7. To learn and develop concepts of Software Radio in real time environment by studying the building blocks like Base band and RF section, convolution encoder, Interleaver and DeInterleaver. 8. To study and analyze different modulation techniques in time and frequency domain using SDR kit.

**Subject Code : MCE 105**
**Category : Mandatory Learning Course**
**Subject Name : Research Methodology and IPR Semester : I**
**L-T-P : 2-0-0 Credit: 2**

**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.

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


**Audit course 1 & 2**
1. English for Research Paper Writing
2. Disaster Management

3. Sanskrit for Technical Knowledge
4. Value Education
5. Constitution of India
6. Pedagogy Studies
7. Stress Management by Yoga
8. Personality Development through Life Enlightenment Skills.

## AUDIT 1 and 2: ENGLISH FOR RESEARCH PAPER WRITING
**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
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 4
Unit 2 Clarifying Who Did What, Highlighting Your Findings, Hedging and Criticising, Paraphrasing and Plagiarism, Sections of a Paper, Abstracts. Introduction 4
Unit 3 Review of the Literature, Methods, Results, Discussion, Conclusions, The Final Check 4
Unit 4 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 4
Unit 5 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 4
Unit 6 useful phrases, how to ensure paper is as good as it could possibly be the first- time submission 4

**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
3. Highman N (1998), Handbook of Writing for the Mathematical Sciences, SIAM. Highman's book .
4. Adrian Wallwork , English for Writing Research Papers, Springer New York Dordrecht Heidelberg London, 2011

## AUDIT 1 and 2: DISASTER MANAGEMENT
**Course Objectives:**
Students will be able to:
1. learn to demonstrate a critical understanding of key concepts in disaster risk reduction and humanitarian response.
2. critically evaluate disaster risk reduction and humanitarian response policy and practice from multiple perspectives.
3. develop an understanding of standards of humanitarian response and practical relevance in specific types of disasters and conflict situations.
4. critically understand the strengths and weaknesses of disaster management approaches, planning and programming in different countries, particularly their home country or the countries they work in

**Syllabus:**
Unit1 Introduction
Disaster: Definition, Factors And Significance; Difference Between Hazard And Disaster; Natural And Manmade Disasters: Difference, Nature, Types And Magnitude.
Unit 2 Repercussions Of Disasters And Hazards:

Economic Damage, Loss Of Human And Animal Life, Destruction Of Ecosystem. Natural Disasters: Earthquakes, Volcanisms, Cyclones, Tsunamis, Floods, Droughts And Famines, Landslides And Avalanches, Man-made disaster: Nuclear Reactor Meltdown, Industrial Accidents, Oil Slicks And Spills, Outbreaks Of Disease And Epidemics, War And Conflicts.

Unit 3 Disaster Prone Areas In India Study Of Seismic Zones;

Areas Prone To Floods And Droughts, Landslides And Avalanches; Areas Prone To Cyclonic And Coastal Hazards With Special Reference To Tsunami; Post-Disaster Diseases And Epidemics

Unit 4 Disaster Preparedness And Management Preparedness:

Monitoring Of Phenomena Triggering A Disaster Or Hazard; Evaluation Of Risk: Application Of Remote Sensing, Data From Meteorological And Other Agencies, Media Reports: Governmental And Community Preparedness.

Unit 5 Risk Assessment Disaster Risk:

Concept And Elements, Disaster Risk Reduction, Global And National Disaster Risk Situation. Techniques Of Risk Assessment, Global Co-Operation In Risk Assessment And Warning, People's Participation In Risk Assessment. Strategies for Survival.

Unit 6 Disaster Mitigation

Meaning, Concept And Strategies Of Disaster Mitigation, Emerging Trends In Mitigation. Structural Mitigation And Non-Structural Mitigation, Programs Of Disaster Mitigation In India

**SUGGESTED READINGS:**

1. R. Nishith, Singh AK, "Disaster Management in India: Perspectives, issues and strategies "'New Royal book Company.
2. Sahni, Pardeep Et.Al. (Eds.)," Disaster Mitigation Experiences And Reflections", Prentice Hall Of India, New Delhi.
3. Goel S. L. , Disaster Administration And Management Text And Case Studies" ,Deep &Deep Publication Pvt. Ltd., New Delhi.

**AUDIT 1 and 2: SANSKRIT FOR TECHNICAL KNOWLEDGE**
**Course Objectives:**
1. To get a working knowledge in illustrious Sanskrit, the scientific language in the world
2. Learning of Sanskrit to improve brain functioning
3. Learning of Sanskrit to develop the logic in mathematics, science & other subjects enhancing the memory power
4. The engineering scholars equipped with Sanskrit will be able to explore the huge knowledge from ancient literature
**Course Output:**
Students will be able to
1. Understanding basic Sanskrit language
2. Ancient Sanskrit literature about science & technology can be understood
3. Being a logical language will help to develop logic in students

**Syllabus:**
Units
1 Alphabets in Sanskrit,
Past/Present/Future Tense,
Simple Sentences                                                        8

2 Order
Introduction of roots
Technical information about Sanskrit Literature                          8

3 Technical concepts of Engineering-Electrical, Mechanical, Architecture, Mathematics 8

**Suggested Reading:**
1. "Abhyaspustakam" – 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.

## AUDIT 1 and 2: VALUE EDUCATION

**Course Objectives:**
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
**Course outcomes:**
Students will be able to
1.Knowledge of self-development
2.Learn the importance of Human values
3.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                                                         4
Unit 2 ☐ Importance of cultivation of values.
☐ Sense of duty. Devotion, Self-reliance. Confidence, Concentration.
Truthfulness, Cleanliness.
☐ Honesty, Humanity. Power of faith, National Unity.                      6
☐ Patriotism.Love for nature ,Discipline
Unit 3 ☐ Personality and Behavior 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.                                            6
☐ Doing best for saving nature
Unit 4 ☐ 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                                          6

**Suggested Reading:**

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


**AUDIT 1 and 2: CONSTITUTION OF INDIA**
**Course Objectives:**
Students will be able to:
1. Understand the premises informing the twin themes of liberty and freedom from a civil rights perspective.
2. 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.
3. 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.
**Course Outcomes:**
Students will be able to:
1. Discuss the growth of the demand for civil rights in India for the bulk of Indians before the arrival of Gandhi in Indian politics.
2. Discuss the intellectual origins of the framework of argument that informed the conceptualization of social reforms leading to revolution in India.
3. Discuss the circumstances surrounding the foundation of the Congress Socialist Party [CSP] under the leadership of Jawaharlal Nehru and the eventual failure of the proposal of direct elections through adult suffrage in the Indian Constitution.
4. Discuss the passage of the Hindu Code Bill of 1956.


**Syllabus:**
Unit 1 History of Making of the Indian Constitution:                      4
History
Drafting Committee, ( Composition & Working)
Unit 2 Philosophy of the Indian Constitution:                      4
Preamble
Salient Features
Unit 3 Contours of Constitutional Rights & Duties:                      4
 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 4 Organs of Governance:                      4
 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 5 Local Administration:                                                4
 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 Zila Pachayat: Position and role.
 Block level: Organizational Hierarchy (Different departments),
 Village level: Role of Elected and Appointed officials,
 Importance of grass root democracy
Unit 6 Election Commission:                                                 4
 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.

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


**8AUDIT 1 and 2: PEDAGOGY STUDIES**

**Course Objectives:**
Students will be able to:
1. Review existing evidence on the review topic to inform programme design and policy making
undertaken by the DfID, other agencies and researchers.
2. Identify critical evidence gaps to guide the development.
**Course Outcomes:**
Students will be able to understand:
1. What pedagogical practices are being used by teachers in formal and informal classrooms in
developing countries?
2. What is the evidence on the effectiveness of these pedagogical practices, in what conditions, and
with what population of learners?
3. How can teacher education (curriculum and practicum) and the school curriculum and guidance
materials best support effective pedagogy?

**Syllabus:**
Unit 1 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.                                     4
Unit 2  Thematic overview: Pedagogical practices are being used by teachers in formal and informal
classrooms in developing countries.
 Curriculum, Teacher education.                                             2
Unit 3 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.                                   4
Unit 4 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                               4
Unit 5 Research gaps and future directions
 Research design
 Contexts
 Pedagogy
 Teacher education
 Curriculum and assessment
 Dissemination and research impact.                                                          2

### Suggested reading:

1. Ackers J, Hardman F (2001) Classroom interaction in Kenyan primary schools, Compare, 31 (2): 245-261.
2. Agrawal M (2004) Curricular reform in schools: The importance of evaluation, Journal of Curriculum Studies, 36 (3): 361-379.
3. Akyeampong K (2003) Teacher training in Ghana - does it count? Multi-site teacher education research project (MUSTER) country report 1. London: DFID.
4. Akyeampong K, Lussier K, Pryor J, Westbrook J (2013) Improving teaching and learning of basic maths and reading in Africa: Does teacher preparation count? International Journal Educational Development, 33 (3): 272–282.
5. Alexander RJ (2001) Culture and pedagogy: International comparisons in primary education. Oxford and Boston: Blackwell.
6. Chavan M (2003) Read India: A mass scale, rapid, 'learning to read' campaign.
7. www.pratham.org/images/resource%20working%20paper%202.pdf.

### AUDIT 1 and 2: STRESS MANAGEMENT BY YOGA
### Course Objectives:
1. To achieve overall health of body and mind
2. To overcome stress
### Course Outcomes:
Students will be able to:
1. Develop healthy mind in a healthy body thus improving social health also
2. Improve efficiency

### Syllabus:
Units CONTENTS Hours
Unit 1  Definitions of Eight parts of yog. ( Ashtanga )              8
Unit 2  Yam and Niyam.
Do`s and Don't's in life.                                           8
i) Ahinsa, satya, astheya, bramhacharya and aparigraha
ii) Shaucha, santosh, tapa, swadhyay, ishwarpranidhan
Unit 3  Asan and Pranayam                                           8

i) Various yog poses and their benefits for mind & body
ii)Regularization of breathing techniques and its effects-Types of pranayam
**Suggested reading:**
1. 'Yogic Asanas for Group Tarining-Part-I" : Janardan Swami Yogabhyasi Mandal, Nagpur
2. "Rajayoga or conquering the Internal Nature" by Swami Vivekananda, Advaita Ashrama
(Publication Department), Kolkata


## AUDIT 1 and 2: PERSONALITY DEVELOPMENT THROUGH LIFE ENLIGHTENMENT SKILLS

**Course Objectives:**
1. To learn to achieve the highest goal happily
2. To become a person with stable mind, pleasing personality and determination
3. To awaken wisdom in students

**Course Outcomes:**
Students will be able to
1. Study of Shrimad-Bhagwad-Geeta will help the student in developing his personality and achieve the highest goal in life
2. The person who has studied Geeta will lead the nation and mankind to peace and prosperity
3. Study of Neetishatakam will help in developing versatile personality
**Syllabus:**
Unit 1 Neetisatakam-Holistic development of personality                    8
  ☐ 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 2 Approach to day to day work and duties.                    8
  ☐ Shrimad Bhagwad Geeta : 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 3 Statements of basic knowledge.                    8
  ☐ Shrimad Bhagwad Geeta: Chapter2-Verses 56, 62, 68
  ☐ Chapter 12 -Verses 13, 14, 15, 16,17, 18
  ☐ Personality of Role model. Shrimad Bhagwad Geeta: Chapter2-Verses 17, Chapter 3-Verses 36,37,42,
  ☐ Chapter 4-Verses 18, 38,39
  ☐ Chapter18 – Verses 37,38,63

**Suggested Readings:**
1. "Srimad Bhagavad Gita" by Swami Swarupananda Advaita Ashram (Publication
Department), Kolkata
2. Bhartrihari's Three Satakam (Niti-sringar-vairagya) by P.Gopinath, Rashtriya Sanskrit
Sansthanam, New Delhi.


**Code : MCE 201 Category : Program Core III**
**Subject Name : Antennas and Radiating Systems Semester : II**
**L-T-P : 3-0-0 Credit: 3**
**Course Outcomes:**

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

1. Compute the far field distance, radiation pattern and gain of an antenna for given current distribution.
2. Estimate the input impedance, efficiency and ease of match for antennas.
3. Compute the array factor for an array of identical antennas.

4. Design antennas and antenna arrays for various desired radiation pattern characteristics.

**Course Outline:**

Unit 1

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 2

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 3

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 4

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 5

Micro strip Antennas: Basic Characteristics, Feeding mechanisms, Method of analysis, Rectangular Patch, Circular Patch.

Unit 6

Reflector Antennas: Plane reflector, parabolic reflector, Cassegrain reflectors, Introduction to MIMO.

Learning Recourses:

1. Constantine A. Balanis, "Antenna Theory Analysis and Design", John Wiley & Sons, 4th edition, 2016.
2. John D Kraus, Ronald J Marhefka, Ahmad S Khan, "Antennas for All Applications", Tata McGraw- Hill, 2002.
3. R.C.Johnson and H.Jasik, "Antenna Engineering hand book", Mc-Graw Hill, 1984.
4. I.J.Bhal and P.Bhartia, "Micro-strip antennas", Artech house, 1980.

**Code : MCE 202 Category : Program Core IV**
**Subject Name : Advanced Digital Signal Processing Semester : II**
**L-T-P : 3-0-0 Credit: 3**
**Course Outcomes:**
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.


**Course Outline:**

Unit 1

Overview of DSP, Characterization in time and frequency, FFT Algorithms, Digital filter design and structures: Basic FIR/IIR filter design &structures, design techniques of linear phase FIR filters,IIR filters by impulse invariance, bilinear transformation, FIR/IIR Cascaded lattice structures, parallel realization of IIR.

Unit 2

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

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

Adaptive Filters, Applications, Gradient Adaptive Lattice, Minimum mean square criterion, LMS algorithm, Recursive Least Square algorithm.

Unit 5

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, Eigen analysis Algorithms for Spectrum Estimation.

Unit 6

Application of DSP & Multi rate DSP, Application to Radar, introduction to wavelets, application to image processing, design of phase shifters, DSP in speech processing & other applications.


**Learning Recourses:**

1. 1. J.G.Proakis and D.G.Manolakis"Digital signal processing: Principles, Algorithm and
Applications", 4th Edition, Prentice Hall, 2007.
2. N. J. Fliege, "Multirate Digital Signal Processing: Multirate Systems -Filter Banks – Wavelets",
1st Edition, John Wiley and Sons Ltd, 1999.
3. Bruce W. Suter, "Multirate and Wavelet Signal Processing", 1st Edition, Academic Press, 1997.
4. M. H. Hayes, "Statistical Digital Signal Processing and Modeling", John Wiley & Sons Inc., 2002.
5. S.Haykin, "Adaptive Filter Theory", 4th Edition, Prentice Hall, 2001.
6. 6. D.G.Manolakis, V.K. Ingle and S.M.Kogon, "Statistical and Adaptive Signal Processing",
McGraw Hill, 2000


**Subject Code : MCE 203 Category : Program Elective-III**
**Subject Name : Satellite Communication Semester : II**
**L-T-P : 3-0-0 Credit: 3**
**Course Outcomes:**
At the end of this course, students will be able to:

1. Visualize the architecture of satellite systems as a means of high speed, high range communication system.
2. State various aspects related to satellite systems such as orbital equations, sub-systems in a satellite, link budget, modulation and multiple access schemes.
3. Solve numerical problems related to orbital motion and design of link budget for the given parameters and conditions.

**Course Outline:**
Unit 1
Architecture of Satellite Communication System: Principles and architecture of satellite Communication, Brief history of Satellite systems, advantages, disadvantages, applications, and frequency bands used for satellite communication and their advantages/drawbacks.
Unit 2
Orbital Analysis: Orbital equations, Kepler's laws of planetary motion, Apogee and Perigee for an elliptical orbit, evaluation of velocity, orbital period, angular velocity etc. of a satellite, concepts of Solar day and Sidereal day.
Unit 3
Satellite sub-systems: Architecture and Roles of various sub-systems of a satellite system such as Telemetry, tracking, command and monitoring (TTC & M), Attitude and orbit control system (AOCS), Communication sub-system, power sub-systems, antenna sub-system.
Unit 4
Typical Phenomena in Satellite Communication: Solar Eclipse on satellite, its effects, remedies for Eclipse, Sun Transit Outage phenomena, its effects and remedies, Doppler frequency shift phenomena and expression for Doppler shift.
Unit 5
Satellite link budget: Flux density and received signal power equations, Calculation of System noise temperature for satellite receiver, noise power calculation, Drafting of satellite link budget and C/N ratio calculations in clear air and rainy conditions, Case study of Personal Communication system (satellite telephony) using LEO.
Unit 6
Modulation and Multiple Access Schemes used in satellite communication. Typical case studies of VSAT, DBS-TV satellites and few recent communication satellites launched by NASA/ ISRO. GPS.
**Learning Recourses:**
1. Timothy Pratt and Others, "Satellite Communications", Wiley India, 2nd edition, 2010.
2. S. K. Raman, "Fundamentals of Satellite Communication", Pearson Education India, 2011.
3. Tri T. Ha, "Digital Satellite Communications", Tata McGraw Hill, 2009.
4. Dennis Roddy, "Satellite Communication", McGraw Hill, 4th Edition, 2008

**Subject Code : MCE 203 Category : Program Elective-III**
**Subject Name : Internet of things Semester : II**
**L-T-P : 3-0-0 Credit: 3**
**Course Outcomes:**
At the end of this course, students will be able to:
1. Understand what IOT technologies are used for today and what is required in certain scenarios.

2. Understand the types of technologies that are available and in use today and can be utilized to implement IOT solutions.

3. Apply these technologies to tackle scenarios in teams of using an experimental platform for implementing prototypes and testing them as running applications.

**Course Outline:**

Unit 1

Smart cities and IOT revolution, Fractal cities, From IT to IOT, M2M and peer networking concepts, Ipv4 and IPV6.

Unit 2

Software Defined Networks SDN, From Cloud to Fog and MIST networking for IOT communications, Principles of Edge/P2P networking, Protocols to support IOT communications, modular design and abstraction, security and privacy in fog.

Unit 3

Wireless sensor networks: introduction, IOT networks (PAN, LAN and WAN), Edge resource pooling and caching, client side control and configuration.

Unit 4

Smart objects as building blocks for IOT, Open source hardware and Embedded systems platforms for IOT, Edge/gateway, IO drivers, C Programming, multithreading concepts.

Unit 5

Operating systems requirement of IOT environment, study of mbed, RIOT, and Contiki operating systems, introductory concepts of big data for IOT applications.

Unit 6

Applications of IOT, Connected cars IOT Transportation, Smart Grid and Healthcare sectors using IOT, Security and legal considerations, IT Act 2000 and scope for IOT legislation.

**Learning Recourses:**

1. A Bahaga, V. Madisetti, "Internet of Things- Hands on approach", VPT publisher, 2014.

2. A. McEwen, H. Cassimally, "Designing the Internet of Things", Wiley, 2013.

3. CunoPfister, "Getting started with Internet of Things", Maker Media, 1st edition, 2011.

4. Samuel Greenguard, "Internet of things", MIT Press, 2015.

**Web Recourses:**

1. http://www.datamation.com/open-source/35-open-source-tools-for-the-internet-ofthings1. html

2. https://developer.mbed.org/handbook/AnalogIn

3. http://www.libelium.com/50_sensor_applications/

4. M2MLabs Mainspring http://www.m2mlabs.com/framework

5. Node-RED http://nodered.org/

**Subject Code : MCE 203 Category : Program Elective-III**
**Subject Name : Voice and Data Networks Semester : II**
**L-T-P : 3-0-0 Credit: 3**
**Course Outcomes:**
At the end of this course, students will be able to:
1. Protocol, algorithms, trade-offs rationale.
2. Routing, transport, DNS resolutions

3. Network extensions and next generation architectures.

**Course Outline:**
Unit 1
Network Design Issues, Network Performance Issues, Network Terminology, centralized and distributed approaches for networks design, Issues in design of voice and data networks.
Unit 2
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 3
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 4
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 5
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 6
Congestion avoidance, RED TCP Throughput Analysis, Quality of Service in Packet Networks. Network Calculus, Packet Scheduling Algorithms.

Learning Recourses:
1. D. Bertsekas and R. Gallager, "Data Networks", 2nd Edition, Prentice Hall, 1992.
2. L. Peterson and B. S. Davie, "Computer Networks: A Systems Approach", 5th Edition, Morgan Kaufman, 2011.
3. Kumar, D. Manjunath and J. Kuri, "Communication Networking: An analytical approach", 1$^{st}$ Edition, Morgan Kaufman, 2004.
4. Walrand, "Communications Network: A First Course", 2nd Edition, McGraw Hill, 2002.
5. Leonard Kleinrock, "Queueing Systems, Volume I: Theory", 1st Edition, John Wiley and Sons, 1975.
6. Aaron Kershenbaum, "Telecommunication Network Design Algorithms", McGraw Hill, 1993.
7. Vijay Ahuja, "Design and Analysis of Computer Communication Networks", McGraw Hill, 1987

**Subject Code : MCE 204 Category : Program Elective-IV**
**Subject Name : Markov Chains and Queuing Systems Semester : II**
**L-T-P : 3-0-0 Credit: 3**
**Course Outcomes:**
At the end of this course, students will be able to:
1. Understand Markov Chains and regenerative processes used in modelling a wide variety of systems and phenomena.
2. Model a system as queuing system with some aspect of the queue governed by a random process.
3. Understand telecommunication systems modelling using Markov chains with special emphasis
on developing queuing models.
**Course Outline:**

Unit 1

Introduction: Review of basic probability, properties of nonnegative random variables, laws of large numbers and the Central Limit Theorem.

Unit 2

Renewal Processes: Basic definitions, recurrence times, rewards and renewal reward theorem, point processes, Poisson process, Walds equation, Blackwell's theorem.

Unit 3

Discrete time Markov chains: definitions and properties, matrix representation, Perron-Frobenius theory.

Unit 4

Continuous time Markov chains: basic definitions, Q-matrix, birth-death processes, quasi birth death processes; Embedded Markov processes, semi Markov processes, reversible Markov chains, Random walks.

Unit 5

Fundamental queuing results: Little's theorem, invariance of the mean delay, Conservation law. Markovian queues: Jackson and BCMP networks, numerical Algorithms. M/G/1 & G/M/1 queues and G/G/1 queues.

Unit 6

Advanced queuing models: priority, vacation and retrials in queues.

**Learning Recourses:**

1. Cliffs, "Stochastic Modelling and the Theory Queues", Prentice Hall, 1989.
2. P.Bremaud, "Markov Chains", Springer-Verlag, 1999.
3. E.Seneta, "Non Negative Matrices and Markov Chains", Springer Series in Statistics, Springer, 1981.
4. R.Gallager, "Discrete Stochastic Processes", Kluwer Academic Press, 1996.
5. L.Kleinrock, "Queuing Systems", vols I and II, John Wiley and Sons 1976.

**Subject Code : MCE 204 Category : Program Elective-IV**
**Subject Name : MIMO Systems Semester : II**
**L-T-P : 3-0-0 Credit: 3**
**Course Outcomes:**
At the end of this course, students will be able to:

1. Understand channel modelling and propagation, MIMO Capacity, space-time coding, MIMO receivers, MIMO for multi-carrier systems (e.g. MIMO-OFDM), multi-user communications, multi-user MIMO.
2. Understand cooperative and coordinated multi-cell MIMO, introduction to MIMO in 4G (LTE, LTE-Advanced, WiMAX).
3. Perform Mathematical modelling and analysis of MIMO systems.

**Course Outline:**
Unit 1

Introduction to Multi-antenna Systems, Motivation, Types of multi-antenna systems, MIMO vs. multiantenna
systems.

Unit 2

Diversity, Exploiting multipath diversity, Transmit diversity, Space-time codes, The Alamouti scheme, Delay diversity, Cyclic delay diversity, Space-frequency codes, Receive diversity, The rake receiver,

Combining techniques, Spatial Multiplexing, Spectral efficiency and capacity, Transmitting independent streams in parallel, Mathematical notation.

Unit 3

The generic MIMO problem, Singular Value Decomposition, Eigenvalues and eigenvectors, Equalising MIMO systems, Disadvantages of equalising MIMO systems, Predistortion in MIMO systems, Disadvantages of pre-distortion in MIMO systems, Pre-coding and combining in MIMO systems, Advantages of pre-coding and combining, Disadvantages of precoding and combining, Channel state information.

Unit 4

Codebooks for MIMO, Beam forming, Beam forming principles, increased spectrum efficiency, Interference cancellation, Switched beam former, Adaptive beam former, Narrowband beam former, Wideband beam former.

Unit 5

Case study: MIMO in LTE, Code words to layers mapping, Pre-coding for spatial multiplexing, Pre-coding for transmit diversity, Beam forming in LTE, Cyclic delay diversity based pre-coding, Pre-coding codebooks, Propagation Channels, Time & frequency channel dispersion, AWGN and multipath propagation channels, Delay spread values and time variations, Fast and slow fading environments, Complex baseband multipath channels, Narrowband and wideband channels, MIMO channel models.

Unit 6

Channel Estimation, Channel estimation techniques, Estimation and tracking, Training based channel estimation, Blind channel estimation, Channel estimation architectures, Iterative channel estimation, MMSE channel estimation, Correlative channel sounding, Channel estimation in single carrier systems, Channel estimation for CDMA, Channel estimation for OFDM.

Learning Recourses:

1. Claude Oestges, Bruno Clerckx, "MIMO Wireless Communications: From Real-world Propagation to Space-time Code Design",Academic Press, 1st edition, 2010.

2. Mohinder Janakiraman, "Space - Time Codes and MIMO Systems", Artech House Publishers,


**Subject Code : MCE 204 Category : Program Elective-IV**
**Subject Name : Programmable Networks - SDN, NFV Semester : II**
**L-T-P : 3-0-0 Credit:3**
**Course Outcomes:**
At the end of this course, students will be able to:
1. Understand advanced concepts in Programmable Networks.
2. Understand Software Defined Networking, an emerging Internet architectural framework.
3. Implement the main concepts, architectures, algorithms, protocols and applications in SDN and NFV.


**Course Outline:**
Unit 1

Introduction to Programmable Networks, History and Evolution of Software Defined Networking (SDN), Fundamental Characteristics of SDN, Separation of Control Plane and Data Plane, Active Networking.

Unit 2

Control and Data Plane Separation: Concepts, Advantages and Disadvantages, the basics of Open Flow protocol.

Unit 3

Network Virtualization: Concepts, Applications, Existing Network Virtualization Framework, Mininet A simulation environment for SDN.

Unit 4

Control Plane: Overview, Existing SDN Controllers including Floodlight and Open Daylight projects.Customization of Control Plane: Switching and Firewall Implementation using SDN Concepts. Data Plane: Software-based and Hardware-based; Programmable Network Hardware.

Unit 5

Programming SDNs: Northbound Application Programming Interface, Current Languages and Tools, Composition of SDNs. Network Functions Virtualization (NFV) and Software Defined Networks: Concepts, Implementation and Applications.

Unit 6

Data Centre Networks: Packet, Optical and Wireless Architectures, Network Topologies. Use Cases of SDNs: Data Centres, Internet Exchange Points, Backbone Networks, Home Networks, Traffic Engineering.

**Learning Recourses:**

1. Thomas D. Nadeau, Ken Gray, "SDN: Software Defined Networks, An Authoritative Review of Network Programmability Technologies", O'Reilly Media, August 2013.
2. Paul Goransson, Chuck Black, Timothy Culver. "Software Defined Networks: A Comprehensive Approach", Morgan Kaufmann Publishers, 2016.
3. Fei Hu, "Network Innovation through Open Flow and SDN: Principles and Design", CRC Press, 2014.
4. Vivek Tiwari, "SDN and Open Flow for Beginners", Amazon Digital Services, Inc., ASIN: 2013.
5. Nick Feamster, Jennifer Rexford and Ellen Zegura, "The Road to SDN: An Intellectual History of Programmable Networks" ACM CCR April 2014.
6. Open Networking Foundation (ONF) Documents, https://www.opennetworking.org, 2015.
7. Open Flow standards, http://www.openflow.org, 2015.

**Subject Code : MCE 291 Category : Lab-III**
**Subject Name : Antennas and Radiating Systems Lab Semester : II**
**L-T-P : 0-0-4 Credit: 2**
**Course Outcomes:**
At the end of this course, students will be able to:
1. Determine specifications, design, construct and test antenna.
2. Explore and use tools for designing, analysing and testing antennas. These tools include Antenna design and analysis software, network analysers, spectrum analysers, and antenna pattern measurement techniques.

**List of Assignments:**
1. Simulation of half wave dipole antenna.
2. Simulation of change of the radius and length of dipole wire on frequency of resonance of antenna.
3. Simulation of quarter wave, full wave antenna and comparison of their parameters.
4. Simulation of monopole antenna with and without ground plane.
5. Study the effect of the height of the monopole antenna on the radiation characteristics of the antenna.

6. Simulation of a half wave dipole antenna array.

7. Study the effect of change in distance between elements of array on radiation pattern of dipole array.

8. Study the effect of the variation of phase difference 'beta' between the elements of the array on the radiation pattern of the dipole array.

9. Case study.

**Subject Code : MCE 292 Category : Lab-IV**
**Subject Name : Advanced Digital Signal Processing lab Semester : II**
**L-T-P : 0-0-4 Credit: 2**
**List of Assignments:**
1. Basic Signal Representation
2. Correlation Auto And Cross
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. State Space Matrix from Differential Equation
8. Normal Equation Using Levinson Durbin
9. Decimation And Interpolation Using Rationale Factors
10. Maximally Decimated Analysis DFT Filter
11. Cascade Digital IIR Filter Realization
12. Convolution And M Fold Decimation &PSD Estimator
13. Estimation Of PSD
14. Inverse Z Transform
15. Group Delay Calculation
16. Separation Of T/F
17. Parallel Realization of IIR filter
**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

**Subject Code : MCE 301A**

**Category : Program Elective-V**

**Subject Name :High Performance Networks**

**Semester :III  L-T-P : 3-0-0**

**Credit: 3**

**Course Outcomes:**

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

⬜Apply knowledge of mathematics, probability, and statistics to model and analyze some networking protocols.

⬜Design, implement, and analyze computer networks.

⬜Identify, formulate, and solve network engineering problems.

⬜Show knowledge of contemporary issues in high performance computer networks.Use techniques, skills, and modern networking tools necessary for engineering practice.

**Syllabus Contents:**

Unit 1: Types of Networks, Network design issues, Data in support of network design. Network design tools, protocols and architecture. Streaming stored Audio and Video, Best effort service, protocols for real time interactive applications, Beyond best effort, scheduling and policing mechanism, integrated services, and RSVP-differentiated services.

Unit 2: VoIP system architecture, protocol hierarchy, Structure of a voice endpoint, Protocols for the transport of voice media over IP networks. Providing IP quality of service for voice,signalingprotocols for VoIP, PSTN gateways, VoIP applications.

Unit 3: VPN-Remote-Access VPN, site-to-site VPN, Tunneling to PPP, Security in VPN. MPLS operation, Routing, Tunneling and use of FEC, Traffic Engineering, MPLS based VPN, overlay networks-P2P connections.

Unit 4:Traffic Modeling: Little's theorem, Need for modeling, Poisson modeling, Non-poisson models, Network performance evaluation.

Unit 5: Network Security and Management: Principles of cryptography, Authentication,integrity, key distribution and certification, Access control and fire walls, attacks and counter measures, security in many layers. Unit 6: Infrastructure for network management, The internet standard management framework – SMI, MIB, SNMP, Security and administration, ASN.1.

**References:**

⬜Kershenbaum A., "Telecommunications Network Design Algorithms", Tata McGraw Hill, 1993. ⬜Larry Peterson & Bruce David, "Computer Networks: A System Approach", Morgan Kaufmann,2003.
⬜Douskalis B., "IP Telephony: The Integration of Robust VoIP Services", Pearson Ed. Asia, 2000.
⬜Warland J., Varaiya P., "High-Performance Communication Networks", Morgan Kaufmann, 1996.
•Stallings W., "High-Speed Networks: TCP/IP and ATM Design Principles", Prentice Hall, 1998.
⬜Leon Garcia, Widjaja, "Communication networks", TMH 7threprint 2002.
⬜William Stalling, "Network security, essentials", Pearson education Asia publication, 4th Edition, 2011.

**Pattern Recognition and Machine Learning (MCE 301B)**

**Subject Code: MCE 301B**
**Category: Program Elective-V**
**Subject Name: Pattern Recognition and Machine Learning**
**Semester: III**
**L-T-P: 3-0-0**
**Credit: 3**

**Course Outcome**

- Study the parametric and linear models for classification

- Design neural network and SVM for classification
- Develop machine independent and unsupervised learning techniques.
- Students will demonstrate knowledge of data analytics.

**Syllabus Contents:**

**Unit 1** 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 2** Linear models: Linear Models for Regression, linear regression, logistic regression Linear Models for Classification

**Unit 3** Neural Network: perceptron, multi-layer perceptron, backpropagation algorithm, error surfaces, practical techniques for improving backpropagation, additional networks and training methods, Adaboost, Deep Learning

**Unit 4** Linear discriminant functions - decision surfaces, two-category, multi-category, minimum squared error procedures, the Ho-Kashyap procedures, linear programming algorithms, Support vector machine **Unit 5** Algorithm independent machine learning – lack of inherent superiority of any classifier, bias and variance, re-sampling for classifier design, combining classifiers

**Unit 6** Unsupervised learning and clustering – k-means clustering, fuzzy k-means clustering, hierarchical clustering

**References:**

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

**Subject Code : MCE 301C**
**Category : Program Elective-V**
**Subject Name :Remote Sensing**
**Semester :III  L-T-P : 3-0-0**
**Credit: 3**
Course Outcomes:
At the end of this course, students shall be able to
☐Understand basic concepts, principles and applications of remote sensing, particularly the geometric and radiometric principles;
☐Provide examples of applications of principles to a variety of topics in remote sensing, particularly related to data collection, radiation, resolution, and sampling.

Syllabus Contents:
Unit 1: Physics Of Remote Sensing: Electro Magnetic Spectrum, Physics of Remote Sensing Effects of Atmosphere-Scattering–Different types–Absorption-Atmospheric window-Energy interaction with surface

features –Spectral reflectance of vegetation, soil and water atmospheric influence on spectral response patterns-multi concept in Remote sensing.

Unit 2: Data Acquisition: Types of Platforms–different types of aircrafts-Manned and Unmannedspacecrafts–sun synchronous and geo synchronous satellites –Types and characteristics of different platforms –LANDSAT,SPOT,IRS,INSAT,IKONOS,QUICKBIRDetc

Unit 3: Photographic products, B/W, color, color IR film and their characteristics –resolving power of lens and film -Opto mechanical electro optical sensors –across track and along track scanners-multispectral scanners and thermal scanners–geometric characteristics of scanner imagery -calibration of thermal scanners.

Unit 4: Scattering System: Microwave scatterometry, types of RADAR –SLAR –resolution – range and azimuth –real aperture and synthetic aperture RADAR. Characteristics of Microwave images topographic effect-different types of Remote Sensing platforms –airborne and space bornesensors -ERS, JERS, RADARSAT, RISAT -Scatterometer, Altimeter-LiDAR remote sensing,principles, applications.

Unit 5: Thermal And Hyper Spectral Remote Sensing: Sensors characteristics-principle of spectroscopy-imaging spectroscopy–field conditions, compound spectral curve, Spectral library, radiative models, processing procedures, derivative spectrometry, thermal remote sensing – thermal sensors, principles, thermal data processing, applications.

Unit 6: Data Analysis: Resolution–Spatial, Spectral, Radiometric and temporal resolution-signal to noise ratio-data products and their characteristics-visual and digital interpretation–Basic principles of data processing –Radiometric correction–Image enhancement–Image classification–Principles of LiDAR, Aerial Laser Terrain Mapping.

**References:**
☐Lillesand T.M., and Kiefer,R.W. Remote Sensing and Image interpretation, John Wiley & Sons-2000, 6thEdition
☐John R. Jensen, Introductory Digital Image Processing: A Remote Sensing Perspective, 2nd Edition, 1995.
☐John A.Richards, Springer –Verlag, Remote Sensing Digital Image Analysis,1999.
☐Paul Curran P.J. Principles of Remote Sensing, ELBS; 1995.

**Subject Code: MCE 302 A**
**Category: Open Elective**
**Subject Name: Business Analytics**
**Semester: III**
**L-T-P: 3-0-0**
**Credit: 3**
**Course Outcome**

Students will demonstrate knowledge of data analytics.

Students will demonstrate the ability of think critically in making decisions based on data and deep analytics.

Students will demonstrate the ability to use technical skills in predicative and prescriptive modeling to support business decision-making.

Students will demonstrate the ability to translate data into clear, actionable insights.

**Syllabus Contents:**

**Unit1:** 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 Statisticalmethods, Review of probability distribution and data modelling, sampling and estimation methods overview.

**Unit2:** Trendiness and Regression Analysis: Modelling Relationships and Trends in Data, simple Linear Regression. Important Resources, Business Analytics Personnel, Data and models for Business analytics, problem solving, Visualizing and Exploring Data, Business Analytics Technology

**Unit3:** Organization Structures of Business analytics, Team management, Management Issues, Designing Information Policy, Outsourcing, Ensuring Data Quality, measuring contribution of Business analytics, Managing Changes. 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.

**Unit 4:** 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. Monte Carlo Simulation and Risk Analysis: Monte Carle Simulation Using Analytic Solver Platform, New-Product Development Model, Newsvendor Model, Overbooking Model, Cash Budget Model.

**Unit 5:** Decision Analysis: Formulating Decision Problems, Decision Strategies with the without Outcome Probabilities, Decision Trees, The Value of Information, Utility and Decision Making.

**Unit 6:** Recent Trends in : Embedded and collaborative business intelligence, Visual data recovery, Data Storytelling and Data journalism.

**References:**

1. Business analytics Principles, Concepts, and Applications by Marc J. Schniederjans, Dara G. Schniederjans, Christopher M. Starkey, Pearson FT Press.

2. Business Analytics by James Evans, persons Education.


**Subject Code : MCE 302B**

**Category : Open Elective**

**Subject Name :Operations Research**

**Semester :III  L-T-P : 3-0-0**

**Credit: 3**

**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-linear programming.

3. Students should able to carry out sensitivity analysis.

4. Student should able to model the real world problem and simulate it.


**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 India 2010

6. Harvey M Wagner, Principles of Operations Research: Prentice Hall of India 2010


**Subject Code : MCE 302 C**

**Category : Open Elective**

**Subject Name :Cost Management of  Engineering Projects**

**Semester :III  L-T-P : 3-0-0**

**Credit: 3**

Syllabus Contents:

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.

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 nontechnical 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.

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.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 ValueChain Analysis.Budgetary Control; Flexible Budgets; Performance budgets; Zero-based budgets.Measurement of Divisional profitability pricing decisions including transfer pricing.

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, New Delhi

2. Charles T. Horngren and George Foster, Advanced Management Accounting

3. Robert S Kaplan Anthony A. Alkinson, Management & Cost Accounting

4.Ashish K. Bhattacharya, Principles & Practices of Cost Accounting A. H. Wheeler publisher

5.N.D. Vohra, Quantitative Techniques in Management, Tata McGraw Hill Book Co. Ltd.

**Subject Code : MCE 302 D**

**Category : Open Elective**

**Subject Name :Industrial Safety**

**Semester :III  L-T-P : 3-0-0**

**Credit: 3**


**Syllabus Contents:**

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 1948for health and safety, wash rooms, drinking water layouts, light, cleanliness, fire, guarding, pressurevessels, 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 ofmaintenance, Types and applications of tools used for maintenance, Maintenance cost & its relationwith 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. Internal combustion engine, v. Boiler,vi. 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 electricalmotor, 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 and importance

**Reference:**

1. Maintenance Engineering Handbook, Higgins & Morrow, Da Information Services.

2. Maintenance Engineering, H. P. Garg, S. Chand and Company.

3. Pump-hydraulic Compressors, Audels, Mcgrew Hill Publication.

4. Foundation Engineering Handbook, Winterkorn, Hans, Chapman & Hall London.

**Subject Code : MCE 302E**

**Category : Open Elective**

**Subject Name :Composite Materials**

**Semester :III  L-T-P : 3-0-0**

**Credit: 3**

**Syllabus Contents:**

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, particlereinforcements. 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 MatrixComposites: Liquid Metal Infiltration – Liquid phase sintering. Manufacturing of Carbon – Carboncomposites: Knitting, Braiding, Weaving. Properties and applications.

UNIT–IV: Manufacturing of Polymer Matrix Composites: Preparation of Moulding compounds andprepregs – hand layup method – Autoclave method – Filament winding method – Compressionmoulding – 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 usingcaplet plots; stress concentrations.

**TEXT BOOKS:**

1. Material Science and Technology – Vol 13 – Composites by R.W.Cahn – VCH, WestGermany.

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 Composite Materials-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.


**Subject Code : MCE 302F**

**Category : Open Elective**

**Subject Name :Waste to Energy**

**Semester :III  L-T-P : 3-0-0**

**Credit: 3**

**Syllabus Contents:**

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 technologyand status - Bio energy system - Design and constructional features - Biomass resources and theirclassification - 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, 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.


**Subject Code: MCE 381**
**Category: Major Project**
**Subject Name: Dissertation –I**

**Semester: III**
**L-T-P: 0-0-20**
**Credit: 10**

### Course Outcome
- Ability to synthesize knowledge and skills previously gained and applied to an in-depth study and execution of new technical problem.
- Capable to select from different methodologies, methods and forms of analysis to produce a suitable research design, and justify their design.

### Syllabus Contents:

The dissertation / project topic should be selected / chosen to ensure the satisfaction of the urgent need to establish a direct link between education, national development and productivity and thus reduce the gap between the world of work and the world of study. The dissertation should have the following Relevance to social needs of society

- Relevance to value addition to existing facilities in the institute
- Relevance to industry need
- Problems of national importance
- Research and development in various domain

The student should complete the following:

- Literature survey Problem Definition
- Motivation for study and Objectives
- Preliminary design / feasibility / modular approaches
- Partial implementation and Verification
- Report and presentation

**Subject Code: MCE 481**
**Category: Major Project**
**Subject Name: Dissertation –II**
**Semester: IV**
**L-T-P: 0-0-32**
**Credit: 16**

### Course Outcome
- Ability to synthesize knowledge and skills previously gained and applied to an in-depth study and execution of new technical problem.
- Capable to select from different methodologies, methods and forms of analysis to produce a suitable research design, and justify their design.
- Ability to present the findings of their technical solution in a written report.
- Presenting the work in International/ National conference or reputed journals.

### Syllabus Contents:

The dissertation stage II is based on a report prepared by the students on dissertation allotted to them. It may be based on:

- Experimental verification / Proof of concept.
- Design, fabrication, testing of Communication System.
- The viva-voce examination will be based on the above report and work.  Guidelines for Dissertation Phase-I and Phase II
- As per the AICTE directives, the dissertation is a yearlong activity, to be carried out and evaluated in two phases i.e. Phase – I: July to December and Phase – II: January to June.
- The dissertation may be carried out preferably in-house i.e. department's laboratories and centers OR in industry allotted through department's T & P coordinator.
- After multiple interactions with guide and based on comprehensive literature survey, the student shall identify the domain and define dissertation objectives. The referred literature should preferably include IEEE/IET/IETE/Springer/Science Direct/ACM journals in the areas of Computing and Processing (Hardware and Software), Circuits Devices and Systems, Communication-Networking and Security, Robotics and Control Systems, Signal Processing and Analysis and any other related domain. In case of Industry sponsored projects, the relevant application notes, white papers, product catalogues should be referred and reported. □Student is expected to detail out specifications, methodology, resources required, critical issues involved in design and implementation and phase wise work distribution, and submit the proposal within a month from the date of registration.
- Phase – I deliverables: A document report comprising of summary of literature survey, detailed objectives, project specifications, paper and/or computer aided design, proof of concept/functionality, part results, A record of continuous progress.
- Phase – I evaluation: A committee comprising of guides of respective specialization shall assess the progress/performance of the student based on report, presentation and Q & A. In case of unsatisfactory performance, committee may recommend repeating the Phase-I work. □During phase – II, student is expected to exert on design, development and testing of the proposed work as per the schedule. Accomplished results/contributions/innovations should be published in terms of research papers in reputed journals and reviewed focused conferences OR IP/Patents.
- Phase – II deliverables: A dissertation report as per the specified format, developed system in the form of hardware and/or software, A record of continuous progress.
- Phase – II evaluation: Guide along with appointed external examiner shall assess the progress/performance of the student based on report, presentation and Q & A. In case of unsatisfactory performance, committee may recommend for extension or repeating the work