M. Tech.

(Electronics and Communication Engineering)

Curriculum Structure

Program Outcomes (POs)

Students are expected to demonstrate

a. Ability to apply the knowledge of science, mathematics, and engineering principles for developing problem solving attitude

b. Ability to identify, formulate and solve engineering problems in the broad areas like Systems Design using communication and networking platforms and tools. Explore recent developments in areas like optical communication, satellite communication, wireless communication, networking, RF-microwave, antennas, measurements and standards in communication.

c. Ability to understand and use different software tools for Design, Analysis and Verification in the domain of communication and networking. System results are obtained through progressive steps such as Design entry, Synthesis, Functional and Timing Simulation.

d. Ability to design and conduct experiments, analyze and interpret data, imbibe programming skills for development of simulation experiments.

e. Ability to function as a member of a multidisciplinary team with sense of ethics, integrity and social responsibility.
FIRST SEMESTER

M. Tech
Electronics & Communication Engineering

IK Gujral Punjab Technical University
Jalandhar-Kapurthala Highway, Kapurthala-144603 (PB)
# SEMESTER-1ST

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(2) Optical Networks  
(3) Statistical Information Processing | 3 | 0 | 0 | 40  | 60  | 100   | 3       |
| 4      | MTEC-PE2Y-18| Programme Elective – II  
(1) Cognitive Radios  
(2) RF and Microwave Circuit Design  
(3) Information Theory and Coding  
(4) Fuzzy Logic & Systems  
(5) Optical Communication Systems | 3 | 0 | 0 | 40  | 60  | 100   | 3       |
| 5      | MTEC-111-18| Advanced Communication Networks Lab             | 0 | 0 | 4 | 60  | 40  | 100   | 2       |
| 6      | MTEC-112-18| Wireless and Mobile Communication Lab            | 0 | 0 | 4 | 60  | 40  | 100   | 2       |
| 7      | MTRM-101-18| Research Methodology and IPR                     | 2 | 0 | 0 | 40  | 60  | 100   | 2       |
| 8      | MTAXX-18   | Audit Course I                                   | 2 | 0 | 0 | S/US* | S/US* | 100 | Non-credit |

**Total**

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*S/US - SATISFACTORY/UNSATISFACTORY
**Course Objective:** This course targets to have complete knowledge of networking concepts and functioning of all networking layers and have knowledge of various protocols associated with them.

**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 (int Serv). 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 Identification-Grid 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 (Diff Serv). DiffServ architecture and frame work.

**Unit 6:** IPV4, IPV6, IP tunnelling, IP switching 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:**
Course Objective: Keeping into mind basic need for communication this course targets on various multiplexing concepts and communication mechanisms for 3G, 4G technologies.

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 mobile communication 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 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:
Course Objective: The objective of this course is to have good knowledge and understanding about various adhoc and Manets. Besides that students will learn about operating tools associated with these.

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, bnode, 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 at least 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:
**Course Objective:** This course is the core domain for optical communication systems. It covers various architectures, configurations switching mechanisms for this domain.

**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:**
**Course Objective:** This course targets to in depth knowledge about various random variables, theories, models and possible statistical theories for better analysis of information transfer.

**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, Tchebychef inequality theorem, Central Limit theorem, Discrete &Continuous Random Variables.

**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 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:
Cognitive Radios

Course Objective: This course targets to impart complete knowledge about cognitive radio concept, various spectrum sensing techniques and various challenges associated with these.

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).

References:
**Course Objective:** This course deals with high frequency communication systems. It also explains the various components used their details operation of working and designing for different applications.

**Course Outcomes:**
- 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 Variance Inter-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:**
Course objectives:
The aims of this course are to introduce the principles and applications of information theory. The course will study how information is measured in terms of probability and entropy, and the relationships among conditional and joint entropies; how these are used to calculate the capacity of a communication channel, with and without noise; coding schemes, including error correcting codes.

Course Outcomes:
At the end of this course, students will be able to
Characterize and apply probabilistic techniques in modern digital communication 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 error coding and modulating techniques.

UNIT1 (11 Hrs) Elements of information theory Source coding theorem, Huffman coding, Channel coding theorem, channel capacity theorem, Shannon fanon theorem, entropy

UNIT2 (11 Hrs) Sampling Process Base band and band pass sampling theorems reconstruction from samples, Practical aspects of sampling and signal recovery TDM

UNIT3 (11 Hrs) Waveform Coding Techniques PCM Channel noise and error probability DPCM and DM Coding speech at low bit rates Prediction and adaptive filters. Base band shaping for data transmission, PAM signals and their power spectra Nyquist criterion ISI and eye pattern Equalization.

UNIT 4 (12 Hrs) Digital Modulation Techniques Binary and M-ary modulation techniques, Coherent and non-coherent detection, Bit Vs symbol error probability and bandwidth efficiency. Bit error analysis, using orthogonal Signaling. Error Control Coding Rationale for coding Linbear block codes, cyclic codes and convolution codes Viterbi decoding algorithm and trellis codes.

Books Recommended:
**Fuzzy Logic & Systems**

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**Course Objective:** This course targets to fuzzy modelling and their applications to our daily life. Also deals with genetic algorithms and soft computing techniques.

**Course Outcomes:**

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

- Characterize and apply fuzzy logics in modern digital communication 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.
- Explains the different structures of neural networks
- Explains various genetic algorithms and soft computing techniques.

**UNIT – I (12 Hrs)**

**Fuzzy Logic:** Fuzzy set versus crisp set, basic concepts of fuzzy sets, membership functions, basic operations on fuzzy sets and its properties. Fuzzy relations versus Crisp relation,


**UNIT – II (13 Hrs)**


**UNIT – III (12 Hrs)**

**Genetic algorithm:** Fundamentals, basic concepts, working principle, encoding, fitness function, reproduction, Genetic modeling: selection operator, cross over, mutation operator, Stopping Condition and GA flow, Constraints in GA, Applications of GA, Classification of GA.

**UNIT – IV (8 Hrs)**

**Hybrid Soft Computing Techniques:** An Introduction, Neuro-Fuzzy Hybrid Systems, Genetic Neuro-Hybrid systems, Genetic fuzzy Hybrid and fuzzy genetic hybrid systems

**Text Books**

Reference Books
Course Objectives
This Course provides knowledge about various types of optical sources and detectors available at receivers. It also imparts knowledge about communication system based on optical fiber and various techniques of multiplexing. Apart from this, various networking models for optical communication taught to complete all aspects of this subject.

Course Outcomes: At the end of this course, students will be able to
- Students will attain various skills to develop different optical networks for single user and multiuser and can also attain the maximum benefit of this domain w. r. t. maximum data rate and available bandwidth.
- Contribute in the areas of optical network and various optical sources, fibres.
- Implement simple optical network and understand further technology developments for future enhanced network.

Syllabus Contents:

UNIT I (11 hrs)
Nature of light and basic fiber optic communication system, principle of light transmission through a fiber, Classification of optical fibers: Single Mode and Multi-Mode Fibers, Step Index and Graded Index Fibers, Losses in Optical Fibers; Absorption, Scattering and Dispersion, Optical Windows for Fiber Optic Transmission system.

UNIT II (13 hrs)

UNIT III (12 hrs)

UNIT IV (12 hrs)
Optical OFDM: Need of OFDM, Differentiate between optical and RF OFDM, problems associated with optical OFDM, Peak to Average power ratio, various applications associated with OFDM

References:
Course Objective: This Lab course will provide in depth knowledge about networking concepts and students will be familiar with all various protocols.

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, ns lookup, net stat, 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.
Course Objective: Aim of this lab course to impart complete knowledge to students about all communication concepts i.e. about cell interferences, frequency reuse for GSM systems.

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
- Understanding 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 De-Interleaver.
8. To study and analyze different modulation techniques in time and frequency domain using SDR kit.
Course Objective: Aim of this subject is impart knowledge to research students about the facts that how to choose the problem, go through the literature associated with that, how to frame objectives and various problems associated during research, along with how to get benefit from that.

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 I Overview of Research: Meaning of Research, Objectives of research, Types of research, Research approaches, Significance of research, Criteria of good research. Defining the research problem: research problem, Necessity of defining the problem, Technique involve in defining a problem.

Unit II Research Design: Need for research design, Features of a good design, Basic principles of Experimental design Data Collection: Methods of Data Collection; Primary data and Secondary Data.

Unit III Data preparation: Data preparation process, designing questionnaires and schedules. Descriptive statistics: Measures of central tendency, Mean, Median, Mode etc. Sampling and non-sampling errors, Testing of Hypotheses: Parametric (t, z and F) Chi Square, ANOVA, and non-parametric tests.


Suggested Readings/Books:
- Krishnaswami K. N., Sivakumar A. I., Mathirajan M., Management Research Methodology, Pearson Education, New Delhi
• Kothari C. R., Research Methodology Methods and Techniques, 2nd Edition, New Age International Publishers
• Niebel, Product Design, McGraw Hill.
• Asimov, Introduction to Design, Prentice Hall.
• T. Ramappa, Intellectual Property Rights Under WT, S. Chand
### SEMESTER-2ND

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*S/US - Satisfactory/Unsatisfactory*
Course Objective: This theory course explains different antennas systems, about their transmission and reception concepts, their structures and various structures / accessories associated with that.

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

- Compute the far field distance, radiation pattern and gain of an antenna for given current distribution.
- Estimate the input impedance, efficiency and ease of match for antennas.
- Compute the array factor for an array of identical antennas.
- Design antennas and antenna arrays for various desired radiation pattern characteristics.

Syllabus Contents:

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, Broadsidae and End fire array, Super directivity, Planar array, Design consideration.


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.

References:

Course Objectives:
The Digital Signal Processing is a fundamental and immensely important signal processing course keeping in view the modern day technological advancements. The objective of this course is to provide fundamental background for digital signal processing which later on becomes basic building block of new upcoming technologies.

Course Outcomes:
The students will have knowledge to work in Time as well as frequency domain systems. They also can design high speed systems with the help of FFT/IFFT.

At the end of this course, students will be able to:
- To understand theory of different filters and algorithms
- To understand theory of multirate DSP, solve numerical problems and write algorithms
- To understand theory of prediction and solution of normal equations
- To know applications of DSP at block level.

Syllabus Contents:
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 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.

References:
Course Objectives
This course provides an introduction to the fundamentals of orbital mechanics and launchers, link budgets, modulation, coding, multiple access techniques, propagation effects, and earth terminals. This course provides an understanding how analog and digital technologies are used for satellite communications networks. They will gain skills for performance improvement for different available satellites by calculating power budgets.

Course Outcomes:
At the end of this course, students will be able to
- Visualize the architecture of satellite systems as a means of high speed, high range communication system.
- State various aspects related to satellite systems such as orbital equations, sub-systems in a satellite, link budget, modulation and multiple access schemes.
- Solve numerical problems related to orbital motion and design of link budget for the given parameters and conditions.

Syllabus Contents:
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.

References:
**Course Objective:** Keeping into mind the present scenario which completely depends upon networking, this theory subject designed to acquire knowledge about internet of things, about various hardware and software’s associated with theses.

**Course Outcomes:**
- Understand what IoT technologies are used for today, and what is required in certain scenarios.
- Understand the types of technologies that are available and in use today and can be utilized to implement IoT solutions.
- Apply these technologies to tackle scenarios in teams of using an experimental platform for implementing prototypes and testing them as running applications.

**Syllabus Contents:**

**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.

**References:**

**Web resources:**
- https://developer.mbed.org/handbook/AnalogIn
- http://www.libelium.com/50_sensor_applications/
- M2MLabs Mainspring http://www.m2mlabs.com/framework
- Node-RED http://nodered.org/
Course Objective: The principal objective of this subject is to introduce students to neural networks and fuzzy theory from an engineering perspective. In the identification and control of dynamic systems, neural networks and fuzzy systems can be implemented as model-free estimators and/or controllers.

Course Outcomes: This subject is helpful to explore the functional components of neural network classifiers or controllers, and the functional components of fuzzy logic classifiers or controllers. This course will also discuss to develop and implement a basic trainable neural network or a fuzzy logic system for VLSI, computing application or biomedical application

UNIT I (11hrs)

UNIT II (13hrs)

UNIT III(12 hrs)

UNIT IV(12 hrs)

References:

1. AI & Expert system by Janki Raman &MacMillen.
5. Artificial Intelligence, by Nilsson, Morgon, &Kufmann Pub.
Course Objectives: This course provides an In-depth knowledge on computer networks and provides a good background for advanced studies in communication networks. The students will be able to design different networks based on different Internet protocols and also able to work for different OSI layers.

Course Outcomes:
At the end of this course, students will be able to
- Protocol, algorithms, trade-offs rationale.
- Routing, transport, DNS resolutions
- Network extensions and next generation architectures.

Syllabus Contents:
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.

References:
**Course Objectives:**
The main aim of this course is to introduce the students about Nano sciences. Actual chemistry involved in semiconductor physics will be discussed. How this will be helpful for Designing of different circuits.

**Course Outcomes:**
Students learn skills for handling basic concepts of Nano sciences for different applications for various fields.

**UNIT I (10 hrs)**
**BASICS AND SCALE OF NANOTECHNOLOGY:** Introduction – Scientific revolutions – Time and length scale in structures, Definition of a nano-system, Top down and bottom up approaches – Evolution of band structures and Fermi surface – introduction to semi conducting Nanoparticles, introduction to quantum Dots, wells, wires, Dimensionality and size dependent phenomena – Fraction of surface atoms – Surface energy and surface stress, Misconceptions of Nanotechnology.

**UNIT II (13 hrs)**
**The carbon age and nanotubes:** New forms of carbon, Types of nanotubes, Formation of nanotubes, methods and reactants- Arcing in the presence of cobalt, Laser method, Chemical vapor deposition method, ball milling, properties of Nanotubes Electrical properties, vibrational properties, Mechanical properties, applications of Nanotubes in electronics, hydrogen storage, materials, space elevators.

**UNIT III (12 hrs)**
**Characterization Techniques in Nano-electronics:**
Principle, construction and working: Electron microscopy (SEM and TEM), Infrared and Raman Spectroscopy, Photoemission and X-RD spectroscopy, AFMs, Magnetic force microscope.

**UNIT IV (12 hrs)**
**Nano-scale Devices:**

**References:**

Course Objectives: The purpose of this course is to teach students how it is different from conventional wire line and wireless communications systems? Development of mathematical models and performance analysis of wireless systems. Understand the key wireless technologies such as CDMA, OFDM, MIMO etc.

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

- 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.
- Understand cooperative and coordinated multi-cell MIMO, introduction to MIMO in 4G (LTE, LTE-Advanced, WiMAX).
- Perform Mathematical modelling and analysis of MIMO systems.

Syllabus Contents:

Unit 1: Introduction to Multi-antenna Systems, Motivation, Types of multi-antenna systems, MIMO vs. multi-antenna 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, Beamforming, Beamforming principles, Increased spectrum efficiency, Interference cancellation, Switched beamformer, Adaptive beamformer, Narrowband beamformer, Wideband beamformer

Unit 5: Case study: MIMO in LTE, Codewords to layers mapping, Pre-coding for spatial multiplexing, Pre-coding for transmit diversity, Beamforming 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.

References:
Course Objectives: This course provides an In-depth knowledge on Software Defined Networking (SDN), and provides a good background for advanced control strategies in communication networks.

Course Outcomes:
At the end of this course, students will be able to
- Understand advanced concepts in Programmable Networks.
- Understand Software Defined Networking, an emerging Internet architectural framework.
- Implement the main concepts, architectures, algorithms, protocols and applications in SDN and NFV.

Syllabus Contents:
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 OpenFlow protocol.
Unit 6: Data Center Networks: Packet, Optical and Wireless Architectures, Network Topologies. Use Cases of SDNs: Data Centers, Internet Exchange Points, Backbone Networks, Home Networks, Traffic Engineering.

References:
Evolutionary Algorithms

Course objectives: Evolutionary algorithms are very powerful techniques used to find solutions to many real-world search and optimization problems. Many of these problems have multiple objectives, which leads to the need to obtain a set of optimal solutions, known as effective solutions. It has been found that using evolutionary algorithms is a highly effective way of finding multiple effective solutions in a single simulation run.

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

- Understand concept of optimisation techniques.
- To work on some applications
- Understand various computing techniques.

Course Contents

Unit 1: Introduction to Optimization What is optimization, categories of optimization, minimum seeking algorithms.

Unit 2: Natural Optimization Methods Simulated annealing, evolutionary algorithms (GAs, EP, ES, GP, PSO, BBO etc.), a simple evolutionary algorithm, Selection Schemes, Crossovers, Mutation, Applications Muti-Objective Evolutionary Optimization Multi-Objective Optimization Problem, Principles of Multi-Objective Optimization, Difference with Single-Objective Optimization, Dominance and Pareto-Optimality, Some applications of Multi-Objective Evolutionary Algorithms

Unit 3: High Performance Computing for Evolutionary Algorithms Some HPC paradigms viz. Cluster computing, GPU computing

Unit 4: Some Case Studies for Engineering Design

Text/References

Queuing Theory

Course objectives: This theory subject imparts concepts of queuing theory for different systems and will classify its need based on some basic models.

Course outcomes: At the end of this course, students will be able to
- Examine possibilities for queuing in particular application
- Able to apply available Jackson and non Jackson models for different models.

Unit 1: Introduction.
Description of the Queuing Problem, Characteristics of Queuing processes, Notation, Measuring System Performance, Some General Results, Simple Data Bookkeeping for Queues, Poisson Process and the Exponential Distribution, Markovian Property of the Exponential Distribution, Stochastic Processes and Markov Chains.

Unit 2. Simple Markovian Queueing Models, Birth Death Processes, Single-Server Queues (M/M/1), Multi-Server Queues (M/M/c), Choosing the Number of Servers, Queues with Truncation (M/M/c/K), Erlang’s Loss Formula (M/M/c/c), Queues with Unlimited Service (M/M/1),Finite Source Queues, State-Dependent Service, Queues with Impatience, Transient Behavior, Busy-Period Analysis.

Unit 3. Networks, Series, and Cyclic Queues, Series Queues, Open Jackson Networks, Closed Jackson Networks, Cyclic Queues, Extensions of Jackson Networks, Non-Jackson Networks.

Unit 4. General Arrival or Service Patterns, General Service, Single Server (M/G/1), General Service, Multi-Server (M/G/c/ú, M/G/1), General Input (G/M/1, G/M/c).

References
**Course Objective:** The main objective to have this lab course to make aware the students about basic communication concepts with the help of various antenna systems.

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

- Determine specifications, design, construct and test antenna.
- Explore and use tools for designing, analyzing and testing antennas. These tools include
  - Antenna design and analysis software, network analyzers, spectrum analyzers, 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.
**Course Objectives:** This lab course will target to analyse and design various digital communication systems and to understand about various digital filters.

**Course Outcomes:**
At the end of this course, students will be able to
- Design different digital filters in software
- Apply various transforms in time and frequency
- Perform decimation and interpolation

**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 Lowpass And Highpass Filter Design
6. Chebyshev 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 Objectives:
This course will target to make capable to each student to design and build a project independently to understand about various Electronics circuits in a better way.

### Course Outcomes:
- Design different circuits/networks in Hardware/software
- Apply various transforms in time and frequency
- Perform decimation and interpolation
- May apply various optimisation techniques

Each student will be required to complete a Mini Project and submit a Project Report on a topic on any of the areas of modern technology related to Electronics Engineering including interdisciplinary fields. The title and objectives of the Mini Project will be chosen by the student in consultation with the Project Guide allocated to each student. The student will be required to present a talk to an audience of Faculty/Students in open defense in front of the Project Evaluation Committee having Project Guide as one of its members. The Head of Department will constitute the Project Evaluation Committee for the purpose of evaluation for internal assessment.
### Semester-3rd

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**List of Audit courses I & II**

- MTA101-18  English for Research Paper Writing
- MTA102-18  Disaster Management
- MTA103-18  Sanskrit for Technical Knowledge
- MTA104-18  Value Education
- MTA105-18  Constitution of India
- MTA106-18  Pedagogy Studies
- MTA107-18  Stress Management by Yoga
- MTA108-18  Personality Development through Life Enlightenment Skills
Course Objectives
The course aims to give the students a basic knowledge about state-of-the-art MEMS including technology, device architecture, design and modelling, scalability, figures of merit and RF IC novel functionality and performance.

Course outcomes:
Students will attain analytical and design oriented feature knowledge about NEMS and MEMS. Reliability and packaging are also considered as key issues for industrial applications.


Unit III (12Hrs): Fundamental MEMS Devices: The Cantilever Beam. Microwave MEMS Applications: MEM Switch

Unit IV (12Hrs): Design Considerations. The Micromachined Transmission Line. MEMS-Based Microwave Circuit and System.

Books:
2. An Introduction to Micro-electromechanical System by Nadim Maluf, Artechhouse
Course Objective: The principal objective of this subject is to introduce students to machine learning and pattern recognition from an engineering perspective. In the identification and control of dynamic systems, can be implemented as model-free estimators and/or controllers.

Course Outcomes:
At the end of this course, students will be able to
- Study the parametric and linear models for classification
- Design neural network and SVM for classification
- Develop machine independent and unsupervised learning techniques.

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, minimumsquared 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:
Course Objectives: The aim of this theory subject is to make aware students about remote sensing, communication, measurement and control mechanism for different thermal, hydraulic and other applications.

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 2: Data Acquisition: Types of Platforms–different types of aircrafts-Manned and Unmanned spacecrafts–sun synchronous and geo synchronous satellites –Types and characteristics of different platforms –LANDSAT, SPOT, IRS, INSAT, IKONOS, QUICKBIRD ETC

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-multiplespectral scanners and thermal scanners–geometric characteristics of scanner imagery -calibration of thermal scanners.


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.


References:
Course objective
1. Understand the role of business analytics within an organization.
2. Analyze data using statistical and data mining techniques and understand relationships between the underlying business processes of an organization.
3. To gain an understanding of how managers use business analytics to formulate and solve business problems and to support managerial decision making.
4. To become familiar with processes needed to develop, report, and analyze business data.
5. Use decision-making tools/Operations research techniques.
6. Manage business process using analytical and management tools.
7. Analyze and solve problems from different industries such as manufacturing, service, retail, software, banking and finance, sports, pharmaceutical, aerospace etc.


Unit 3: 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 6: Recent Trends in : Embedded and collaborative business intelligence, Visual data recovery, Data Storytelling and Data journalism.

COURSE OUTCOMES
1. Students will demonstrate knowledge of data analytics.
2. Students will demonstrate the ability of think critically in making decisions based on data and deep analytics.
3. Students will demonstrate the ability to use technical skills in predicative and
prescriptive modeling to support business decision-making.

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

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

**Unit-II:** Fundamentals of maintenance engineering: Definition and aim of maintenance engineering, Primary and secondary functions and responsibility of maintenance department, Types of maintenance, Types and applications of tools used for maintenance, Maintenance cost & its relation with replacement economy, Service life of equipment.


**Unit-IV:** Fault tracing: Fault tracing-concept and importance, decision tree concept, need and applications, sequence of fault finding activities, show as decision tree, draw decision tree for problems in machine tools, hydraulic, pneumatic, automotive, thermal and electrical equipment’s like, 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 electrical motor, common troubles and remedies of electric motor, repair complexities and its use, definition, need, steps and advantages of preventive maintenance. Steps/procedure for periodic and preventive maintenance of: i. Machine tools, ii. Pumps, iii. Air compressors, iv. Diesel generating (DG) sets, Program and schedule of preventive maintenance of mechanical and electrical equipment, advantages of preventive maintenance. Repair cycle concept and importance

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**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:**
UNIT–I: Introduction and Overview of the Strategic Cost Management Process
Cost concepts in decision-making; Relevant cost, Differential cost, Incremental cost and Opportunity cost. Objectives of a Costing System; Inventory valuation; Creation of a Database for operational control; Provision of data for Decision-Making.

UNIT–II: 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.


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


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

TEXT BOOKS:

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

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


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

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

**References:**
Course Objectives: Main objective of this course is to frame the unique problem which may help the society by different means.

Course Outcomes:
- At the end of this course, students will be able to
- 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 / 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
- Implementation and Verification
- Report and presentation

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 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, while 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.
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
Unit 3: Review of the Literature, Methods, Results, Discussion, Conclusions, The Final Check.
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,
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
Unit 6: useful phrases, how to ensure paper is as good as it could possibly be the first-time submission

Suggested Studies:
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
Unit 1: 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:
2. Sahni, Pardeep Et.Al. (Eds.)," Disaster Mitigation Experiences And Reflections”, Prentice Hall Of India, New Delhi.
MTA103-18

SANSKRIT FOR TECHNICAL KNOWLEDGE

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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

Syllabus

Unit 1
- Alphabets in Sanskrit,
- Past/Present/Future Tense,
- Simple Sentences

Unit 2
- Order
- Introduction of roots
- Technical information about Sanskrit Literature

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

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

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
Course Objectives
Students will be able to
1. Understand value of education and self-development
2. Imbibe good values in students
3. Let them know about the importance of character

Syllabus
Unit 1
- Values and self-development – Social values and individual attitudes. Work ethics, Indian vision of humanism.
- Value judgements

Unit 2
- Importance of cultivation of values.
- 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.
- 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

Suggested reading

Course outcomes
Students will be able to
1. Knowledge of self-development
2. Learn the importance of Human values
3. Developing the overall personality
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.

Syllabus
Unit 1
➢ History of Making of the Indian Constitution: History Drafting Committee, (Composition & Working)

Unit 2
➢ Philosophy of the Indian Constitution: Preamble, Salient Features

Unit 3
➢ Contours of Constitutional Rights & Duties:
   ➢ Fundamental Rights
   ➢ Right to Equality
   ➢ Right to Freedom
   ➢ Right against Exploitation
   ➢ Right to Freedom of Religion
   ➢ Cultural and Educational Rights
   ➢ Right to Constitutional Remedies
   ➢ Directive Principles of State Policy
   ➢ Fundamental Duties.

Unit 4
➢ Organs of Governance:
   ➢ Parliament
   ➢ Composition
   ➢ Qualifications and Disqualifications
   ➢ Powers and Functions
   ➢ Executive
   ➢ President
   ➢ Governor
   ➢ Council of Ministers
   ➢ Judiciary, Appointment and Transfer of Judges, Qualifications
   ➢ Powers and Functions

Unit 5
➢ Local Administration:
   ➢ District’s Administration head: Role and Importance,
   ➢ Municipalities: Introduction, Mayor and role of Elected Representative, CEO
   ➢ of Municipal Corporation.
- 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:
- 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 reading**
1. The Constitution of India, 1950 (Bare Act), Government Publication.

**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.
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.

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.

Unit 2
- Thematic overview: Pedagogical practices are being used by teachers in formal and informal classrooms in developing countries.
- Curriculum, Teacher education.

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.

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

Unit 5
- Research gaps and future directions
- Research design
- Contexts
- Pedagogy
- Teacher education
- Curriculum and assessment
- Dissemination and research impact.

Suggested reading

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?
Course Objectives
1. To achieve overall health of body and mind
2. To overcome stress

Syllabus
Unit 1
□ Definitions of Eight parts of yog. ( Ashtanga ) 8

Unit 2
➢ Yam and Niyam.
   Do’s and Don’t’s in life.
   i) Ahinsa, satya, astheya, bramhacharya and aparigraha
   ii) Shaucha, santosh, tapa, swadhyay, ishwarpranidhan

Unit 3
➢ Asan and Pranayam
   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

Course Outcomes:
Students will be able to:
1. Develop healthy mind in a healthy body thus improving social health also
2. Improve efficiency
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

Syllabus

Unit 1  Neetisatakam-Holistic development of personality
- Verses- 19,20,21,22 (wisdom)
- Verses- 29,31,32 (pride & heroism)
- Verses- 26,28,63,65 (virtue)
- Verses- 52,53,59 (dont’s)
- Verses- 71,73,75,78 (do’s)

Unit 2
- Approach to day to day work and duties.
- 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.
- 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 reading
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.

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 of students.