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.

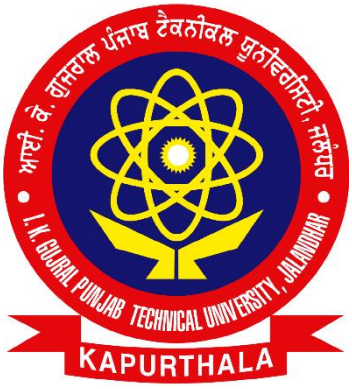
d. Ability to design and conduct experiments, analyze and interpret data, imbibe programming skills for development of simulation experiments.

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

S. No.	Code	Course Name	L	T	P	Int	Ext	Total	Credits
1	MTEC-101-18	Advanced Communication Networks	3	0	0	40	60	100	3
2	MTEC-102-18	Wireless and Mobile Communication	3	0	0	40	60	100	3
3	MTEC-PE1X-18	Programme Elective I (1) Wireless Sensor Networks (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			**16**	**0**	**8**	**320**	**380**	**800**	**18**

*S/US - SATISFACTORY/UNSATISFACTORY

MTEC-101-18	Credits	L	T	P	Int	Ext
Advanced Communication Networks	3	3	0	0	40	60

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:

- 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.

MTEC-102-18	Credits	L	T	P	Int	Ext
Wireless and Mobile Communication	3	3	0	0	40	60

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 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

MTEC-PE1A-18	Credits	L	T	P	Int	Ext
Wireless Sensor Networks	3	3	0	0	40	60

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, 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, 1stIndian reprint, 2013.
- YingshuLi, MyT. Thai, Weili Wu, “Wireless sensor Network and Applications”, Springer series on signals and communication technology, 2008.

MTEC-PE1B-18	Credits	L	T	P	Int	Ext
Optical Networks	3	3	0	0	40	60

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:

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

MTEC-PE1C-18	Credits	L	T	P	Int	Ext
Statistical Information Processing	3	3	0	0	40	60

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 mathematic al 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, “TheTheory of Error-Correcting Codes”, New
- York, North-Holland, 1977.
- Rosen K.H, “Elementary Number Theory”, Addison-Wesley, 6th edition, 2010.

MTEC-PE2A-18	Credits	L	T	P	Int	Ext
Cognitive Radios	3	3	0	0	40	60

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).

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, 2ndedition, 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.

MTEC-PE2B-18	Credits	L	T	P	Int	Ext
RF and Microwave Circuit Design	3	3	0	0	40	60

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:

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 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:

- 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.

MTEC-PE2C-18	Credits	L	T	P	Int	Ext
Information Theory and coding	3	3	0	0	40	60

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 mathematic al 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:

1. J. Dass. , S.K. Malik & P.K. Chatterjee, ,"Principles of digitals communication:,Wiley-Blackwel, 1991.

2. Vera Pless," Introduction to the theory of Error correcting codes",Edition3July 2, 1998

3. Robert G. Gallanger,"Information Theory and Reliable Communication",McGraw Hill, 1992

MTEC-PE2D-18	Credits	L	T	P	Int	Ext
Fuzzy Logic & Systems	3	3	0	0	40	60

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 mathematic al 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)

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

Fuzzy rule base system: Fuzzy propositions, formation, decomposition & aggregation of fuzzy rules, fuzzy reasoning, Fuzzy Inference Systems (FIS) – Mamdani Fuzzy Models – Sugeno Fuzzy Models – Tsukamoto Fuzzy Models, Fuzzification and Defuzzification, fuzzy decision making & Applications of fuzzy logic.

UNIT – II (13 Hrs)

Structure and Function of a single neuron: Biological neuron, artificial neuron,definition of ANN and its applications. Neural Network architecture: Single layer and multilayer feed forward networks and recurrent networks. Learning rules and equations: Perceptron, Hebb's, Delta, winner take all and out-star learning rules. Supervised Learning Network: Perceptron Networks, Adaptive Linear Neuron, Multiple Adaptive Linear Neuron, Back Propagation Network, Associative memory networks, Unsupervised Learning Networks: Competitive networks, Adaptive Resonance Theory, Kohnen Self Organizing Map

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

1. S, Rajasekaran& G.A. VijayalakshmiPai, "Neural Networks, Fuzzy Logic & Genetic Algorithms, Synthesis & applications", PHI Publication,2011
2. S.N. Sivanandam& S.N. Deepa, "Principles of Soft Computing", Wiley Publications,2007

Reference Books

1. Michael Negnevitsky, “Artificial Intelligence”, Pearson Education, New Delhi, 2008.
2. Timothy J. Ross, “Fuzzy Logic with Engineering Applications”, Wiley, 2010

MTEC-PE2E-18	Credits	L	T	P	Int	Ext
Optical Communication Systems	3	3	0	0	40	60

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-ModeFibers, Step Index and Graded Index Fibers, Losses in Optical Fibers; Absorption, Scattering and Dispersion, Optical Windows for Fiber Optic Transmission system.

Fiber Materials: Glass Fibers and Plastic Glass Fibers, Fiber Fabrication Methods:Outside Vapor Phase Oxidation & Vapor Phase Axial Deposition and Double Crucible Method, Optical Fiber Cables.

UNIT II (13 hrs)

Optical Sources: PN junction Diode Theory, Light Emitting Diode& Laser Diode: Structure, Materials, Quantum Efficiency and Modulation. Optical Detectors: Semiconductor Photodiodes &Avalanche Photodiodes and their characteristics, responsivity and quantum efficiency.

UNIT III (12 hrs)

Optical Fiber Splices & Amplifiers: Fusion and Mechanical Splicing Technique and Fiber Connectors, Working Principle of OTDR and Applications of OTDR, Optical Fiber Measurements: Attenuation, Absorption, Dispersion and Scattering, Fiber Cut-Off Wavelength and Numerical Aperture Measurement. Semiconductor and Erbium Doped Fiber Amplifiers, Optical communication Techniques and Network Topologies: Wavelength division Multiplexing and SONET/SDH.

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:

1. Optical Fiber Communications by Gerd Keiser, 3rd Edition, McGraw-Hill International.
2. Optical Fiber Communications, Principles &Practice by John M. Senior, 3rd edition, Pearson Publishers.

MTEC-111-18	Credits	L	T	P	Int	Ext
Advanced Communication Networks Lab	2	0	0	4	60	40

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.

MTEC-112-18	Credits	L	T	P	Int	Ext
Wireless and Mobile Communication Lab	2	0	0	4	60	40

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
- 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 De-Interleaver.
8. To study and analyze different modulation techniques in time and frequency domain using SDR kit.

MTRM-101-18	Credits	L	T	P	Int	Ext
Research Methodology and IPR	2	2	0	0	40	60

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.

Unit IV Overview of Intellectual Property: Introduction and the need for intellectual property right (IPR), Patents, Patent Law, Copyright, Trademarks, Geographical Indications, Industrial Design, Unfair Competition, Protection of IPR, Basic steps to write a research paper/ report writing, Introduction to Latex report writing, Introduction to Plagiarism.

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
- Halbert, Resisting Intellectual Property, Taylor & Francis Ltd ,2007.
- Niebel, Product Design, McGraw Hill.
- Asimov, Introduction to Design, Prentice Hall.
- Robert P. Merges, Peter S. Menell, Mark A. Lemley, Intellectual Property in New Technological Age.
- T. Ramappa, Intellectual Property Rights Under WT, S. Chand
- J.F.Kaiser, "Richard Hamming-You and Your Research", Transcription of Bell Communications Research Colloquium Seminar, 1986.

SEMESTER-2ND

S. No.	Code	Course Name	L	T	P	Int	Ext	Total	Credits
1	MTEC-103-18	Antennas and Radiating Systems	3	0	0	40	60	100	3
2	MTEC-104-18	Advanced Digital Signal Processing	3	0	0	40	60	100	3
3	MTEC-PE3X-18	Programme Elective – III (1) Satellite Communication (2) Internet of Things (3) Neural networks (3) Voice and data networks	3	0	0	40	60	100	3
4	MTEC-PE4Y-18	Programme Elective – IV (1)Nano-Electronics (2)MIMO System (3)Programmable Networks – SDN, NFV (4)Evolutionary Algorithms (5) Queuing Theory	3	0	0	40	60	100	3
5	MTEC-113-18	Antennas and Radiating Systems lab	0	0	4	60	40	100	2
6	MTEC-114-18	Advanced Digital Signal Processing Lab	0	0	4	60	40	100	2
7	MTEC-MP1-18	Mini Project	0	0	4	60	40	100	2
8	MTAXX-18	Audit course II	2	0	0	S/US*	S/US*	100	Non-credit
Total			**14**	**0**	**12**	**340**	**360**	**800**	**18**

*S/US - SATISFACTORY/UNSATISFACTORY

MTEC-103-18	Credits	L	T	P	Int	Ext
Antennas and Radiating Systems	3	3	0	0	40	60

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 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: LinearArrays: Two element array, N Element array: Uniform Amplitude and spacing, Broadside and End fire array, Super directivity, Planar array, 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.

References:

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

MTEC-104-18	Credits	L	T	P	Int	Ext
Advanced Digital Signal Processing	3	3	0	0	40	60

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 sub band 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

References:

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

MTEC-PE3A-18	Credits	L	T	P	Int	Ext
Satellite Communication	3	3	0	0	40	60

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:

- Timothy Pratt and Others, "Satellite Communications", Wiley India, 2nd
- edition,2010.
- S. K. Raman, "Fundamentals of Satellite Communication", PearsonEducation India, 2011.
- Tri T. Ha, "Digital Satellite Communications", Tata McGraw Hill, 2009.
- Dennis Roddy, "Satellite Communication", McGraw Hill, 4th Edition, 2008.

MTEC-PE3B-18	Credits	L	T	P	Int	Ext
Internet of Things	3	3	0	0	40	60

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:

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

- 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:

- A Bahaga, V. Madisetti, "Internet of Things- Hands on approach", VPT publisher, 2014.
- McEwen, H. Cassimally, "Designing the Internet of Things", Wiley, 2013.
- CunoPfister, "Getting started with Internet of Things", Maker Media, 1st
- edition, 2011.
- Samuel Greenguard, "Internet of things", MIT Press, 2015.

Web resources :

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

MTEC-PE3C-18	Credits	L	T	P	Int	Ext
Neural Networks	3	3	0	0	40	60

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)

Neural Networks: History, overview of biological Neuro-system, Mathematical Models of Neurons, ANN architecture, Learning rules, Learning Paradigms-Supervised, Unsupervised and reinforcement Learning, ANN training Algorithms-perceptions, Training rules, Delta, Back Propagation Algorithm, Multilayer Perception Model, Hopfield Networks, Associative Memories, Applications of Artificial Neural Networks.

UNIT II (13hrs)

Fuzzy Logic: Introduction to Fuzzy Logic, Classical and Fuzzy Sets: Overview of Classical Sets, Membership Function, Fuzzy rule generation.

Operations on Fuzzy Sets: Compliment, Intersections, Unions, Combinations of Operations, AggregationOperations.

Fuzzy Arithmetic: Fuzzy Numbers, Linguistic Variables, Arithmetic Operations on Intervals & Numbers, Lattice of Fuzzy Numbers, Fuzzy Equations.

UNIT III(12 hrs)

Fuzzy Logic: Classical Logic, Multi valued Logics, Fuzzy Propositions, Fuzzy Qualifiers, Linguistic Hedges, Uncertainty based Information: Information & Uncertainty, Non specificity of Fuzzy & Crisp Sets, Fuzziness of Fuzzy Sets.

UNIT IV(12 hrs)

Introduction of Neuro-Fuzzy Systems, Architecture of Neuro Fuzzy Networks, **Applications of Fuzzy Logic:** Medicine, Economics etc. Genetic Algorithm: An Overview, GA in problem solving, Implementation of GA

References:

1. AI & Expert system by Janki Raman &MacMillen.
2. Artificial Intelligence, by Knight, TMH, 1991.
3. Artificial Intelligence by G.F luger, Pearson education, 2003.
4. Artificial Intelligence, by Patricks henry & Winston, Pearson education, 2001.
5. Artificial Intelligence, by Nilsson, Morgon, &Kufmann Pub.

MTEC-PE3D-18	Credits	L	T	P	Int	Ext
Voice and Data Networks	3	3	0	0	40	60

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 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.

References:

- D. Bertsekas and R. Gallager, “Data Networks”, 2ndEdition, Prentice Hall, 1992.
- L. Peterson and B. S. Davie, “Computer Networks: A Systems Approach”,5th Edition, Morgan Kaufman, 2011.
- Kumar, D. Manjunath and J. Kuri, “Communication Networking: An analytical approach”, 1stmEdition, Morgan Kaufman, 2004.
- Walrand, “Communications Network: A First Course”, 2nd,Edition, McGraw Hill, 2002.
- Leonard Kleinrock, “Queueing Systems, Volume I: Theory”, 1stEdition, John Wiley and Sons, 1975.
- Aaron Kershenbaum, “Telecommunication Network Design Algorithms”, McGraw Hill, 1993.
- Vijay Ahuja, “Design and Analysis of Computer Communication Networks”, McGraw Hill, 1987

MTEC-PE4A-18	Credits	L	T	P	Int	Ext
Nano Electronics	3	3	0	0	40	60

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:
Introduction: Quantum Electron Devices; High Electron Mobility Transistor, Quantum Interference Transistor, Single Electron Transistor and Carbon Nanotube Transistor, DNA Computing; Structure of DNA, Basic Operation on DNA and DNA Computer.

References:

1. C.P.Polle and F.J.Owens, “Introduction to Nanotechnology” Willey India Pvt. Ltd, Edition 2011.
2. Daniel Minoli ‘Nanotechnology Applications to Telecommunications and Networking” Willey India Pvt. Ltd, Edition 2011.

MTEC-PE4B-18	Credits	L	T	P	Int	Ext
MIMO Systems	3	3	0	0	40	60

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:

- Claude Oestges, Bruno Clerckx, "MIMO Wireless Communications : From Real-world Propagation to Space-time Code Design",Academic Press, 1stedition, 2010.
- Mohinder Janakiraman, “Space - Time Codes and MIMO Systems”, Artech House Publishers, 2004.

MTEC-PE4C-18	Credits	L	T	P	Int	Ext
Programmable Networks - SDN, NFV	3	3	0	0	40	60

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 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 Hadrware-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 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:

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

MTEC-PE4D-18	Credits	L	T	P	Int	Ext
Evolutionary Algorithms	3	3	0	0	40	60

Course objectives: Evolutionary algorithms are very powerful techniques used to find solutions too 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

1. Kalyanmoy Deb, “Multi Objective Optimization using Evolutionary Algorithms”, John Wiley and Sons, 2001.
2. David A Coley, “An introduction to Genetic Algorithms for Scientists and Engineers”, World Scientific Publishing Company, 1997.
3. Mitsuo Gen, Runwei Cheng, “Genetic Algorithms and Engineering Design”, WileyInterscience, 1997.
4. Thomas Back, “Evolutionary Algorithms in Theory and Practice: Evolution Strategies, Evolutionary Programming, Genetic Algorithms”, Oxford University Press, 1996.

MTEC-PE4E-18	Credits	L	T	P	Int	Ext
Queuing Theory	3	3	0	0	40	60

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

- Wiley: Fundamentals of Queueing Theory, 4th Edition Queueing Systems, Volume I
- Introduction to Queueing Theory and Stochastic Teletraffic Models, Moshe ,Copyright M. Zukerman 2000–2018.
- Fundamentals of Queueing Theory, Fourth Edition, Donald Gross George Mason University Fairfax, Virginia John F. Shortie George Mason University Fairfax, Virginia James M. Thompson Freddie Mac Corporation McLean, Virginia Carl M. Harris ~ WILEY A JOHN WILEY & SONS, INC., PUBLICATION

MTEC-113-18	Credits	L	T	P	Int	Ext
Antennas and Radiating Systems Lab	2	0	0	4	60	40

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.
9. Case study.

MTEC-114-18	Credits	L	T	P	Int	Ext
Advanced Digital Signal Processing lab	2	0	0	4	60	40

Course Objectives: This lab course will targets 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. 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. Seperation Of T/F
17. Parallel Realization of IIR filter

MTEC-MP1-18	Credits	L	T	P	Int	Ext
Mini Project	2	0	0	4	60	40

Course Objectives: This course will targets 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:

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

- 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

S. No.	Code	Course Name	L	T	P	Int	Ext	Total	Credits
1	MTEC-PE5X-18	Elective – V (1) MEMS and NEMS (2) Pattern Recognition and Machine learning (3) Remote Sensing	3	0	0	40	60	100	3
2	MTOE-O301X-18	1. Business Analytics 2. Industrial Safety 3. Operations Research 4. Cost Management of Engineering Projects 5. Composite Materials 6. Waste to Energy	3	0	0	40	60	100	3
3	MTEC-DS1-18	Dissertation Phase –I	0	0	20	60	40	100	10
Total			**06**	**0**	**20**	**140**	**160**	**300**	**16**

SEMESTER-4TH

S. No.	Code	Course Name	L	T	P	Int	Ext	Total	Credits
1	MTEC-DS2-18	Dissertation Phase – II	6	--	20	60	40	100	16
Grand Total of all semesters						**860**	**940**	**2000**	**68**

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

MTEC-PE5A-18	Credits	L	T	P	Int	Ext
Micro& Nano Electro Mechanical System (MEMS & NEMS)	3	3	0	0	40	60

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 1(12Hrs): Introduction: Micro Electro Mechanical System (MEMS) Origins.MEMS Impetus / Motivation. Material for MEMS. The toolbox: Processes for Micro machining.

Unit II (12hrs): MEMS Fabrication Technologies. Fundamental MEMS Device Physics: Actuation.

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:
1. Micro-electromechanical (MEM) Microwave Systems by Hector J.De Los Santos, Artechhouse.
2. An Introduction to Micro-electromechanical System by NadimMaluf, Artechhouse

MTEC-PE5B-18	Credits	L	T	P	Int	Ext
Pattern Recognition and Machine Learning	3	3	0	0	40	60

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:

- 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.

MTEC-PE5C-18	Credits	L	T	P	Int	Ext
Remote Sensing	3	3	0	0	40	60

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 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 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-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 borne sensors -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, 6th Edition
- 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.
- Charles Elachi and Jakob J. van Zyl , Introduction To The Physics and Techniques of Remote Sensing , Wiley Series in Remote Sensing and Image Processing, 2006.

MTOE-301A-18	Credits	L	T	P	Int	Ext
OPEN ELECTIVE (Business Analytics)	3	3	0	0	40	60

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. Mange 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.

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 Statistical methods, Review of probability distribution and data modelling, sampling and estimation methods overview.

Unit 2: 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.

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 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.

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 Principles, Concepts, and Applications by Marc J. Schniederjans, Dara G. Schniederjans, Christopher M. Starkey, Pearson FT Press.
- Business Analytics by James Evans, persons Education.

MTOE-301B-18	Credits	L	T	P	Int	Ext
OPEN ELECTIVE (Industrial Safety)	3	3	0	0	40	60

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

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

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

Unit-IV: Fault tracing: Fault tracing-concept and importance, decision 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 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

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.

MTOE-301C-18	Credits	L	T	P	Int	Ext
OPEN ELECTIVE (Operations Research)	3	3	0	0	40	60

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

MTOE-301D-18	Credits	L	T	P	Int	Ext
OPEN ELECTIVE (Cost Management of Engineering Projects)	3	3	0	0	40	60

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.

UNIT–III: **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 Value-Chain Analysis. Budgetary Control; Flexible Budgets; Performance budgets; Zero-based budgets. Measurement of Divisional profitability pricing decisions including transfer pricing.

UNIT–IV: **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.

MTOE-301E-18	Credits	L	T	P	Int	Ext
OPEN ELECTIVE (Composite Materials)	3	3	0	0	40	60

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

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

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

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

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

TEXT BOOKS:

1. Material Science and Technology – Vol 13 – Composites by R.W.Cahn – VCH, West Germany.
2. Materials Science and Engineering, An introduction. WD Callister, Jr., Adapted by R. Bala subramaniam, 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.

MTOE-301F-18	Credits	L	T	P	Int	Ext
OPEN ELECTIVE (Waste to Energy)	3	3	0	0	40	60

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

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

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

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

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

MTEC-DS1-18 (SEMESTER 3RD)	Credits	L	T	P	Int	Ext
(Dissertation) Dissertation Phase – I	10	0	0	20	60	40

MTEC-DS2-18 (SEMESTER 4TH)	Credits	L	T	P	Int	Ext
(Dissertation) Dissertation Phase - II	16	6	0	20	60	40

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

MTA101-18	Credits	L	T	P	Int	Ext
ENGLISH FOR RESEA RCH PAPER WRITING	0	2	0	0	S/US	S/US

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

Unit1: Planning and Preparation, Word Order, Breaking up long sentences, Structuring Paragraphs and Sentences, Being Concise and Removing Redundancy, Avoiding Ambiguity and Vagueness

Unit 2 : Clarifying Who Did What, Highlighting Your Findings, Hedging and Criticising, Paraphrasing and Plagiarism, Sections of a Paper, Abstracts. Introduction

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:

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

MTA102-18	Credits	L	T	P	Int	Ext
DISASTER MANAGEMENT	0	2	0	0	U/US	U/US

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:

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.

MTA103-18	Credits	L	T	P	Int	Ext
SANSKRIT FOR TECHNICAL KNOWLEDGE	Non-credit	2	0	0	S/US	S/US

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
3. "India's Glorious Scientific Tradition" Suresh Soni, Ocean books (P) Ltd., New Delhi.

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

MTA104-18	Credits	L	T	P	Int	Ext
VALUE EDUCATION	Non-credit	2	0	0	S/US	S/US

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

Syllabus

Unit1

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

Unit 2

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

Unit 3

- Personality and Behavior Development - Soul and Scientific attitude. 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

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

Course outcomes

Students will be able to

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

MTA105-18	Credits	L	T	P	Int	Ext
CONSTITUTION OF INDIA	Non-credit	2	0	0	S/US	S/US

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

Unit1

- 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.
- 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:
- 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.
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.

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.

MTA106-18	Credits	L	T	P	Int	Ext
PEDAGOGY STUDIES	Non-credit	2	0	0	S/US	S/US

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

Unit1

- 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

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

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?

MTA107-18	Credits	L	T	P	Int	Ext
STRESS MANAGEMENT BY YOGA	Non-credit	2	0	0	S/US	S/US

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

MTA108-18	Credits	L	T	P	Int	Ext
PERSONALITY DEVELOPMENT THROUGH LIFE ENLIGHTENMENT SKILLS	Non-credit	2	0	0	S/US	S/US

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

Unit1 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.