M TECH (Digital Communications)
2018
### M. Tech. (Electronics and Telecommunication)

#### Curriculum Structure

**Specialization: Digital Communications**

#### Semester-I

<table>
<thead>
<tr>
<th>Sr. No.</th>
<th>Course Type/Code</th>
<th>Course Name</th>
<th>Teaching Scheme</th>
<th>Credits</th>
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</thead>
<tbody>
<tr>
<td>1</td>
<td>Core 1/ MDCT-101</td>
<td>Advanced Digital Communication Systems</td>
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<td>2</td>
<td>Core 2/ MDCT-102</td>
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<td>(2) Computer Communication networks</td>
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<td>(3) Digital System Design Using VERILOG</td>
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<td>(4) Signal theory</td>
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<td>(2) Microwave theory and circuit</td>
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<td>(3) Radar system</td>
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<td>MDCT-123</td>
<td>(4) Computational Techniques Using MATLAB</td>
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<td>(2) Satellite Communication</td>
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### Semester-III

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### Audit course 1 & 2

- English for Research Paper Writing
- Disaster Management
- Sanskrit for Technical Knowledge
- Value Education
- Constitution of India
- Pedagogy Studies
- Stress Management by Yoga
- Personality Development through Life Enlightenment Skills.
SEMESTER I

Paper Code : MDCT-101

Paper: Advance Digital Communication System

Unit 1: Modulation Techniques
Digital Modulation Techniques :- Analysis, Generation and Detection (Block Diagram), Spectrum and Bandwidth of Amplitude Shift Keying (ASK), Binary Phase Shift Keying (BPSK), Differential Phase Shift Keying (DPSK), Offset and Non-offset Quadrature Phase Shift Keying (QPSK), M-ary PSK, Binary Frequency Shift Keying (BFSK), M-ary FSK, Minimum Shift Keying, Quadrature Amplitude Modulation (QAM), Comparison of digital modulation techniques on the basis of probability of error, Matched Filter.

Unit 2: Pulse Modulation
Sampling of Signal, Sampling Theorem for Low Pass and Band Pass Signals, Aliasing, Pulse Amplitude Modulation (PAM), Time Division Multiplexing (TDM), Channel Bandwidth for PAM-TDM Signal, Types of Sampling, Instantaneous, Natural and Flat Top Sampling, Aperture Effect, PPM and PDM techniques, Pulse Code Modulation (PCM), Signal-to-Noise Ratio in PCM, Companding, Data Rate and Bandwidth of Multiplexed PCM Signal, Inter-symbol Interference, Eye Diagram, Line Coding NRZ, RZ, Biphase,, Differential PCM (DPCM), Delta Modulation (DM), and Adaptive Delta Modulation (ADM), Slope Overload Error ,Granular Noise ,Comparison of various system in terms of Bandwidth and Signal-to-Noise Ratio.

Unit 3: Random Processes
Concept of Probability, Relative Frequency and Probability Conditional Probability and Independent Events, Random Variables, Discrete Random Variables, Cumulative Distribution Function(CDF), Probability Density Function(PDF), Statistical Averages (Means), Chebyshevs Inequality, Central Limit Theorem

Unit 4: Spread Spectrum Modulation
Pseudo noise sequences, notion of spread spectrum, direct sequence spread spectrum with coherent binary phase shift keying, signal space dimensionality and processing gain, probability of error, frequency hop spread spectrum, maximum length and Golay codes.

Text Books:
[T1] B. Sklar, Digital Communication, Pearson Education.

References:
[R1] Taub & Schilling, Principles of Communication system, TMH.
[R5] Schaum’s Outline series, Analog and Digital Communication.
[R7] Couch: Digital and Analog Communication, Pearson Education
UNIT I
Introduction Signals and signal Processing, characterization & classification of signals, Review of passive circuits and filters, Filter Approximation theory (Maximally flat and Chebeychev), of magnitude and/or delay, Ladder design and Leapfrog filter design, Practical design considerations, effect of op-amp non-idealities.

UNIT II
Linear and non-linear applications of op-amps and OTAs, Active filter (Single amplifier biquads, Multiple feedback filters, Integrator loop Multiple amplifier filters employing opamp and OTA), oscillator design using op-amps and OTAs. Use of computers in filter design, IC timers.

UNIT III

UNIT-IV

Text Books:
Design of Analog Filters: Passive, Active-RC and Switched Capacitor By Laker, Ghausi and Schaumann Publisher: Prentice Hall.
Passive, active and digital filters By Wai-Kai Chen, Taylor and Francis.

References:
Continuous-time active filter design By Deliyanis, Sun and Fidler, Wiley.
Selected research papers from Journals
PROGRAM ELECTIVE 1
Paper code: MDCT-111
Paper: Optical Fiber Communication Systems

UNIT-I
Introduction to optical fibers, Modes of propagation, Attenuation, Dispersion in single mode and multimode fibers, Non-linear optical effects.

UNIT-II
Optical sources and transmitters: LEDs, Laser diodes, Line codes (RZ, NRZ, Manchester, AMI codes), Receivers: p-i-n photodiodes, APDs, Noise sources, Signal-to Noise Ratio, Bit-error rate (BER), Optical Pre-amplifier design.

UNIT-III
Optical amplifiers: Semiconductor optical amplifier, EDFA, Dispersion Compensation: Pre-post compensation, Dispersion Compensating Fiber (DCF), Dispersion Compensating Grating (DCG) (Simulation Exercises on OptiSystem/OptiSim).

UNIT-IV
Research Directions: Wavelength Division Multiplexing (WDM) systems, Orthogonal Frequency Division Multiplexing (OFDM), Optical Code Division Multiple Access (OCDMA), Optical Time Division Multiplexing (OTDM), Solitons (Exercises on OptiSystem/OptiSim).

Text Books:
Fiber-Optic Communication Systems - by GP Aggarwal - John Wiley & Sons

Reference Books:
Related IEEE/IEE publications
PROGRAM ELECTIVE 1

Paper code: MDCT-112
Paper: Computer Communication Networks

UNIT I
Review of data communication techniques, Data transmission, line coding, error control coding, Data switching, circuit switching, message and packet switching.

UNIT II
Network model ISO-OSI model, primitives and services, Elements of queuing. Data link control Simplex, pipelined and sliding window protocols, simplex performance analysis, X 25 data link layer, Random access techniques, Pure, slotted and finite population ALOHAs, Stability in ALOHAs.

UNIT III
Routing and congestion control static, adaptive, centralized and distributed routing procedures, congestion control, Local Area Networks LAN topologies and protocols, IEEE 802.x protocols, implementation and performance issues, High speed LANs. Switching and Bridging, Basic Internetworking (IP), Routing, Implementation and Performance.

UNIT IV
Advanced Internetworking - The Global Internet, Routing Areas, Interdomain Routing (BGP), IP version 6 (IPv6), Multicast, Multicast Addresses, Multicast Routing (DVMRP, PIM, MSDP), Multiprotocol Label Switching (MPLS), Destination-Based Forwarding, Explicit Routing, Virtual Private Networks and Tunnels, Routing among mobile devices, Challenges for Mobile Networking, Routing to Mobile Hosts (Mobile IP).

Text Books:
- Computer Networks By Larry Peterson, Bruce Davie

Reference Books:
PROGRAM ELECTIVE 1
Paper Code: MDCT-113
Paper: Digital System Design with Verilog

Unit-1
ASIC Design Flow, Architecture and configuration of (Xilinx)Virtex series FPGA, Principles Hardware Description Languages, Y-Chart, Review of Synchronous and Asynchronous Design, Types of HDLs, Introduction to Verilog, Language Constructs ,Modeling style, Assignment Structures, Delays and Continuous Assignments, Assignment to Vectors, Operators,

Unit-2
Design of Adder, Subtractor, Decoders, Encoders, Multiplexer, code Converter. Behavioral Modeling: Functional Bifurcation, Initial & Always Construct, multiple always blocks, Program flow control and looping, Parallel blocks, force-release construct, design of sequential circuits using verilog: Register, Counters, Timing and Delays model, path delay modeling, timing check

Unit 3
Introduction of behavioral modelling, functional bifurcation, initial & always construct, procedural assignment statement, Delay in Procedural statements, Timing Control Statements, If and If-else, case statement assign-deassign, repeat construct, loop construct: repeat, for, while & forever, sequential and parallel blocks, force-release construct, design of flip flop, shift register and counters using Verilog

Unit-4
Data Subsystems, Storage Modules, Functional Modules, Data paths, Control Subsystems, Micro programmed Controller, Structure of a micro programmed controller, Micro instruction Format, Micro instruction sequencing, Micro instruction Timing, Basic component of a micro system, memory subsystem design.

Text Books:

Reference Books:
Digital Design by Frank Vahid, Wiley, 20063.
Fundamental of digital Logic with Verilog design by S. Brown & Z. Vransesic, TMH.
UNIT I

UNIT II
Random Processes: Concept of random variables, functions on joint-PDF, joint-CDF of random variables, 1st and 2nd characteristic function, Definition and classification, stochastic integrals, WSS processes, Fourier transforms of random processes, correlation functions, Ergodicity, power spectral density.

UNIT III

UNIT IV
Optimum Filtering: Matched filters for deterministic signals in white and coloured Gaussian noise. Wiener filters for random signals in white and coloured Gaussian noise. Discrete and continuous time filters.

Text books:

Probability, Random Variables and Stochastic Processes By A. Papoulis, S. Pillai, McGraw-Hill.

Reference Book
PROGRAM ELECTIVE 2
Paper Code: MDCT-121
Paper: Telecommunication System Modeling and Simulation

Objective: To model the random variables and random process applied to telecommunications system and to learn
the methods of system simulation and performance evaluation.

UNIT – I
SIMULATION OF RANDOM VARIABLES RANDOM PROCESS
Generation of Random numbers and Sequence, Gaussian and Uniform random numbers Correlated random
sequences, testing of random numbers generators, Stationary and Uncorrelated Noise, Goodness of fit test.

UNIT – II
MODELING OF COMMUNICATION SYSTEMS
Radio frequency and Optical sources, Analog and Digital signals, Communication channel and Models, Free Space
channels, Multipath channel and discrete channel noise and interference.

UNIT – III
ESTIMATION OF PERFORMANCE MEASURE FOR SIMULATION
Quality of Estimator, Estimation of SNR, Probability density function and Bit Error Rate, Monte Carlo method,
Importance Sampling method, Extreme Value Theory.

UNIT – IV
SIMULATION AND MODELING METHODOLOGY
Simulation Environment, Modeling considerations, Performance Evaluation techniques, Error Source Simulation,
Validation. Case Studies: Simulations of QAM Digital Radio link in environment, Light wave communication link
and Satellite system.

TEXTBOOKS
MC.Jeruchim, P.Balaban and Sam K Shanmugam, “Simulation of communication systems: Modeling,

REFERENCES
1990.
Unit I:
Review of EM Theory: Maxwell’s equations, fields in media and boundary conditions, wave equation and basic plane wave solutions, plane waves in dielectric and conducting media, energy and power.

Unit II:
Transmission lines and waveguides: field analysis of transmission lines, terminated lossless terminated line, quarter wave transformer, lossy transmission lines closed and dielectric guides, planar transmission lines.

Unit III:
Microwave Network analysis: Impedance and equivalent voltages and currents, scattering matrix and other parameters, signal flow graphs and network representation. Impedance matching and tuning.

Unit IV:
Analysis of planar transmission lines. Analysis of Coupled Transmission Line Structures, microwave resonators.

Text Books:

Reference Books:
PROGRAM ELECTIVE 2
Paper code: MDCT-123
Paper: Radar Systems

UNIT-I
Introduction to radar systems: History, Radar modalities, Electromagnetic spectrum, basic operating principles (detection, ranging, Doppler, importance of phase), radar system components
Radar Equation and Radar Cross Section: The Decibel, term analysis and relation to basic radar components, system temperature, hard target versus distributed target, radar cross section and scattering basics

UNIT-II
Pulse, MTI and ATC Radar: Basic Elements of Pulse Radar, Radar Coverage, radar Parameters, determination of fundamental parameters of pulse radar.

UNIT-III
Function of ATC Radar, Receiver, Transmitter, Indicator unit, Phased Array Radar and Applications.
Fundamentals of Radar signal processing: Superheterodyne reception, I and Q demodulation, Pulsed-Doppler analysis, Matched Filtering, Ambiguity function, Pulse compression, Hard target (detection of signals in noise), Synthetic Aperture Radar (SAR), Doppler weather radar, Ionospheric sounding, Incoherent scatter radar

UNIT-IV
High resolution Radar: radar system target and surface imaging. Concepts and definitions, modern radar design, wideband waveforms and signal processing, synthetic high resolution radar, and synthetic aperture radar concepts.
Applications

Text Books

Reference Books
Radar System Analysis & Modelling by David K. Barton, Artech House
PROGRAM ELECTIVE 2

Paper Code: MDCT-124

Paper: Computational Techniques using MATLAB

Unit-I

MATLAB Usage and Computational Errors: Introduction to MATLAB, Types of Computer Errors, IEEE 64-bit Floating-Point Number Representation, Vectors in MATLAB, Efficient programming techniques System of Linear Equations: Solution for a System of Linear Equations, Solving a System of Linear Equations, Inverse Matrix, Decomposition (Factorization), Iterative Methods to Solve Equations

Unit-II

Interpolation and Curve Fitting: Interpolation by Lagrange, Newton, and Chebyshev Polynomial, Hermite Interpolating Polynomial, Cubic Spline interpolation, Straight Line, Polynomial Curve, and Exponential Curve Fit, Fourier transform

Unit-III

Ordinary Differential Equations: Euler’s Method, Runge-Kutta Method, PredMEor-Corrector Method, Vector Differential Equations, Boundary Value Problem (BVP)

Unit-IV


Text Books
Reference Books
"Introduction to MATLAB® for Engineers”, WJ Palm, McGraw-Hill
Paper Code:
Paper: Research Methodologies

Unit I: Introduction to Research Methodology
Meaning of research, objectives of research, meaning of research, motivation in research, types of research, scope of educational research, characteristics and prerequisites of educational research, types of educational research, research approaches, significance of research, research methods versus methodology, research and scientific method, importance of knowing how research is done, research process, criteria of good research, necessity of defining the problem.

Unit II: Techniques for Research Methodology
Defining research problems, hypothesis formulation, developing a research plan, research design, features of a good design, different research designs, and important concepts related to research design, methods for data collection.

Unit III: Data Analysis and Statistical Techniques
Data and their analyses, quantitative methods and techniques, Measure of central tendency, measures of variation, frequency distribution, analysis of variance methods, identifying the distribution with data, parameter estimation, Goodness-of-Fit tests-Chi-Square test, K-S Goodness-of-Fit test, Correlation analysis, Regression analysis, time series and forecasting, Introduction to discriminate analysis, factor analysis, cluster analysis, conjoint analysis. Sampling methods, test of hypothesis

Unit IV: Algorithmic Research and Simulation
Algorithmic research problems, types of algorithmic research, types of solution procedure, steps of development of algorithm, steps of algorithmic research, design of experiments, steps of modeling, operations research models, application of models. Need for simulation, types of simulation, simulation language, fitting the problem to simulation study, simulation models, output analysis.

Books:
[R5] Research methodology, Methods and Techniques, Kothari, C.R., 2000
SEMESTER II

Paper code: MDCT-201
Paper: Advanced Information Theory & Coding

UNIT I
Measure of Information, Information contents of discrete memoryless sources, Entropy & Mutual Information, Source coding theorem: Huffman coding, Shannon-Fano coding, Lempel-Ziv algorithm, Prefix codes,

UNIT II
Channel Coding theorem, Channel capacity theorem, Channel models, BSC, DMC, Lossless, Noiseless channels, Linear Block codes, Systematic & Non-Systematic codes, Repetition codes, Hamming codes, Cyclic codes, Cyclic Redundancy check (CRC) codes, Golay codes, BCH Codes, Read-Solomon codes.

UNIT III
Convolutional codes, Polynomial representation of Convolutional codes, Tree, State and Trellis diagrams, Maximum-likelihood/Viterbi Decoding of Convolutional codes, Concept of Interleaving, Turbo Codes, Turbo decoding,

UNIT IV
Combined coding and Modulation, Trellis Coded Modulation (TCM), Mapping by set partitioning, TCM decoder, TCM for fading channels, Concept of Space time Trellis Codes.

Text Books:
Introduction to Error Control Codes by Salvatore Gravano, Oxford University Press

Reference Books:
Paper code: MDCT-201

Paper: Detection and Estimation Theory

UNIT I

UNIT II
Classical detection Theory: Binary and m-ry hypothesis testing, Bayes’ criterion, NP test, the general Gaussian problem, min-max test, erasure decision problem;

UNIT III
Classical estimation theory: random parameter estimation; MMSE absolute error cost function, uniform error cost function estimators, CRLB for random parameter case, non-random parameter estimation; ML estimator, CRLB.

UNIT IV
Composite and non-parametric hypothesis testing: Sign test, Wilcoxon test.

Text Books/References:
UNIT I
Concept of fading, factors influencing fading, types of fading and characteristics of fading channels, fading margin, statistical models for multipath fading channels, optimum receivers for fading channels.

UNIT II
Radio propagation over wireless channel: General considerations about radio waves and wireless channels, propagation mechanism, free space propagation model, ground wave propagation, ionospheric propagation, channel noise and losses, satellite link, influence of multipath effect on signal propagation, fading effects to signals & frequency components, shadowing, signal outages in fading channels.

UNIT III
Introduction to channel modeling, representation of discrete channel by filter, Rayleigh fading model, Rician fading model, Nakagami fading model, comparison of Rayleigh, Rician and Nakagami Fading models.

UNIT IV
Performance of single channel receivers over fading channels, Trellis Coded Modulation (TCM), coded communications over fading channels.

Text Books:
Mobile Fading Channels by Matthias Patzold, John wiley & sons, 2002.

Reference Books:
Mobile Communication Systems by Wesolowshi.
Wireless Communications Principles & Practices BY Theodore S. Rappaport, second edition
Wireless Communications by Upena Dalal
UNIT-I

UNIT-II

UNIT-III
SPACE LINKS: Satellite Link Design - Satellite uplink -down link power Budget, Basic Transmission Theory, System Noise Temperature, G/T Ratio, Noise Figure. Design of Down links, Domestic Satellite Systems Using Small Earth stations, Uplink Design, Design of Satellite Link for Specified (C/N).

UNIT-IV
MULTIPLE ACCESS TECHNIQUES AND NETWORK ASPECTS: Single access vs. multiple access, FDMA, TDMA, Single channel per carrier (SCPC) access - Code division multiple access (CDMA). Demand assignment techniques, Mobile satellite network design, ATM via satellite, TCP/IP via satellite - Call control, Hybrid satellite-terrestrial networks. VSATs.
SERVICES AND APPLICATIONS: Fixed and mobile services, Multimedia satellite services, advanced applications based on satellite platforms.

Text Books:

Reference Books:
PROGRAM ELECTIVE 3

Paper Code: MDCT-233
Paper: Fuzzy Logic & Design

Unit-I

Unit-II

Unit-III


Unit-IV

Applications of Fuzzy Logic:

Text Book:

Reference Books:
H. Zimmermann, “Fuzzy Set Theory and its application
PROGRAM ELECTIVE 3

Paper code: MDCT-234
Paper: Digital Mobile Radio Systems

Unit-I

Unit-II

Unit-III

Unit-IV

Text Books:
Theodore S. Rappaport, Wireless Communications Principles & Practice, Pearson Education
Jochen Schiller, Mobile Communications, Pearson Education.

Reference books:
Raj Pandya, Mobile & Personal Communication Systems And Service, PHI.
PROGRAM ELECTIVE 4  
Paper code: MDCT-241  
Paper: Antenna Theory and Practice

Unit I:  
Review of electromagnetic theory, Antenna and their different types, Radiation Mechanism and Current Distribution, Fundamental Parameters related to antenna (Radiation Pattern, Radiation Power Density, Directivity, Gain, Beamwidth, Antenna Efficiency, Bandwidth, Polarization, Radiation Efficiency, Antenna Factor) Radiation Integrals, Auxiliary Potential Functions and Construction of Solution, Solution of the inhomogeneous vector Potential Wave Equation, Far Field Radiation

Unit II:  
Infinitesimal dipole, Small Dipole, Finite length and Half-Wavelength Dipole – Analysis using assumed current Distribution Small Circular loop, Circular Loop with constant current, Two Element Array N-Element Linear Array with uniform amplitude and spacing, Broadside and End-Fire Array, N-Element Linear Array: Three Dimensional Characteristic

Unit III:  
Pyramidal Horn

Unit IV:  
Basic of Microstrip Antenna, Designing of Rectangular Microstrip Antenna, Antenna Ranges, Gain Measurement, Radiation Pattern Measurement, Anechoic Chamber

TEXT BOOK  

REFERENCE BOOK  
Antenna Theory and Design by W.L.Stutzman and G.A.Thiele, Wiley Publication
PROGRAM ELECTIVE 4

Paper code: MDCT-242
Paper: RF System Design

UNIT-I
Introduction: Radio receivers. Radiometers, Active and Passive Sensors, Noise emission for Passive Radiometers, Rx and Tx System Design, Receiver Noise Figure and Dynamic Range, Noise figure, Noise Temperature, Noise Figure in Cascaded Circuits, Noise Figure of a Mixer Circuit, Dynamic Range, 1 dB Compression Point, Minimum Detectable Signal, Inter-modulation and Intercept Points.

UNIT-II

UNIT-III
Amplifiers and power supplies: Power Gain, Power Gain for Unilateral Transistors, Stability Considerations, Constant Gain Circles for the Unilateral Case, Constant Noise Figure Circles, Amplifier specifications-gain, bandwidth and impedance, stability, amplifier design, noise considerations, class C class D amplifiers, Low Noise Amplifiers, High power amplifiers. Bandwidth Considerations, Broad Band Amplifiers, DC Bias Techniques.

UNIT-IV

TEXT BOOKS:

REFERENCE BOOKS:
UNIT I
Introduction to 2-D Signals and Systems, Image Digitization, Image Transforms, Image Data Compression: Transform Domain Coding, Predictive Coding, JPEG. Image Enhancement:

UNIT II

UNIT III

UNIT IV
Thresholding, Region-Oriented Segmentation, Selected Topics of Current Interest (for example multi-resolution analysis, morphological processing etc.).

Text books/ References:
Digital Image Processing and Computer vision By Milan Sonka, CL-Engineering Publisher.
PROGRAM ELECTIVE 4

Paper code MDCT-244
Paper: Wavelet Transforms for Signal and Image Processing

UNIT I
Basics of functional Analysis; Basics of Fourier Analysis; Spectral Theory; Time-Frequency representations;

UNIT II
Non-stationary Processes; Continuous Wavelet Transforms; Discrete Time-Frequency Transforms;

UNIT III
Multi resolution Analysis; Time-Frequency Localization; Signal Processing Applications;

UNIT IV
Image Processing Applications

Text Books/References:
Wavelet Transforms & Time-Frequency Signal Analysis (Hardcover) By Lokenath Debnath, Birkhauser (USA).
3) A Wavelet Tour of Signal Processing By Stephane Mallat, Elsevier.
UNIT I

UNIT II

UNIT III

UNIT IV
Wireless Loop Technologies, WLL Architecture Model, Mobile AD HOC Networks, AD HOC Routing Protocols, DSDV, DSR and AODV Routing Techniques, Quality of service in Mobile Ad hoc Networks.

TEXT BOOKS:

REFERENCE BOOKS:
1) Raj Pandya, Mobile & Personal Communication Systems And Service, PHI.
3) Jochen Schiller, Mobile Communication, Pearson education
UNIT I

UNIT II

UNIT III

UNIT IV

TEXT BOOKS:
1) Broadband Communication Systems by Cajetan Akujuobi and Matthew Sadiku, Scitech Publishing.
2) Introduction to broadband Communication Systems By Cajetan M. Akujuobi and MNO Sadiku, Chapman & Hall.

REFERENCE BOOKS:
2) Optical Networks A Practical Perspective by Rajiv Ramaswami, Kumar N. Sivarajan, Galen H. Sasaki.
PROGRAM ELECTIVE 5

Paper code: MDCT-353

UNIT I

UNIT II
CODE GENERATION: Coding – Maximal sequences – Linear Code Generator – Auto Correlation and Cross Correlation of codes – Composite codes – Chip rate and code length – Choosing a linear code – Generating high rate codes – Code selection and Signal spectra – Initial Synchronization – Tracking

UNIT III

UNIT IV

TEXT BOOKS:

REFERENCE BOOKS:
PROGRAM ELECTIVE 5

Paper Code: MDCT-354
Paper: Adhoc Sensor Networks

Unit I

Unit II
Transport layer & Security protocols

Unit III
Wire Sensor Networks: Introduction and overview of WSN, Applications of Sensor Networks, Sensor network architecture, Architecture of WSNs Hardware components, Energy consumption of sensor nodes, Operating systems and execution environments, some examples of sensor nodes, Network Architecture: Sensor networks scenarios, Optimization goals and figures of merit, Design principles for WSNs, Service interfaces of WSNs, Gateway concepts.

Unit IV
Communication Protocols:

Text Book:
Ad HOC Wireless Networks: Architectures & Protocols, By C Siva Ram Murty & BS Manoj 2nd Ed, Pearson Education.

Reference:
Handbook of Ad Hoc Wireless Network, By Mohmad Illayas, CRC press
### (Dissertation) Dissertation Phase – I (MVLP031) and Phase – II (MVLP041)

<table>
<thead>
<tr>
<th>Teaching Scheme: Lab</th>
</tr>
</thead>
<tbody>
<tr>
<td>20 and 30 Hrs/Week</td>
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</tbody>
</table>

**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

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.


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/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
OPEN ELECTIVES
Business Analytics

Teaching scheme
Lecture: - 3 h/week

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Name</th>
<th>Credits</th>
<th>Prerequisites</th>
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<tbody>
<tr>
<td></td>
<td>Business Analytics</td>
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</table>

Total Number of Lectures: 48

**Course objective**

Understand the role of business analytics within an organization.

Analyze data using statistical and data mining techniques and understand relationships between the underlying business processes of an organization.

To gain an understanding of how managers use business analytics to formulate and solve business problems and to support managerial decision making.

To become familiar with processes needed to develop, report, and analyze business data.

Use decision-making tools/Operations research techniques.

Manage business process using analytical and management tools.

Analyze and solve problems from different industries such as manufacturing, service, retail, software, banking and finance, sports, pharmaceutical, aerospace etc.

**LECTURE WITH BREAKUP**

<table>
<thead>
<tr>
<th>LECTURE WITH BREAKUP</th>
<th>NO. OF LECTURES</th>
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</thead>
<tbody>
<tr>
<td><strong>Unit 1:</strong></td>
<td></td>
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<tr>
<td>Business analytics:</td>
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<tr>
<td>Overview of Business</td>
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<td>analytics, Scope of</td>
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<td>Business analytics,</td>
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<td>Business Analytics</td>
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<td>Process, Relationship</td>
<td>9</td>
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<tr>
<td>of Business Analytics</td>
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<tr>
<td>Process and organisation, competitive advantages of Business Analytics.</td>
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<tr>
<td>Statistical Tools:</td>
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<tr>
<td>Statistical Notation,</td>
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<tr>
<td>Descriptive Statistical methods, Review of probability distribution and data modelling, sampling and estimation methods overview.</td>
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<tr>
<td><strong>Unit 2:</strong></td>
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<tr>
<td>Trendiness and Regression Analysis: Modelling Relationships and Trends in Data, simple Linear Regression.</td>
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<tr>
<td>Important Resources, Business Analytics Personnel, Data and models for Business analytics, problem solving, Visualizing and Exploring Data, Business Analytics Technology.</td>
<td>8</td>
</tr>
<tr>
<td><strong>Unit 3:</strong></td>
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<tr>
<td>Organization Structures of Business analytics, Team management, Management Issues, Designing Information Policy, Outsourcing, Ensuring Data Quality, Measuring contribution of Business analytics, Managing Changes.</td>
<td>9</td>
</tr>
<tr>
<td>Descriptive Analytics, predictive analytics, predicative Modelling,</td>
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</tbody>
</table>
Predictive analytics analysis, Data Mining, Data Mining Methodologies, Prescriptive analytics and its step in the business analytics Process, Prescriptive Modelling, nonlinear Optimization.

Unit 4:

Unit 5:

Unit 6:
Recent Trends in : Embedded and collaborative business intelligence, 4 Visual data recovery, Data Storytelling and Data journalism.

COURSE OUTCOMES

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

Reference:
Business Analytics by James Evans, persons Education.

OPEN ELECTIVES

Industrial Safety

Teaching scheme
Lecture: - 3 h/week

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

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

Unit-IV: Fault tracing: Fault tracing-concept and importance, decision tree concept, need and applications, sequence of fault finding activities, show as decision tree, draw decision tree for problems in machine tools, hydraulic, pneumatic, automotive, thermal and electrical equipment’s like, i. Any one machine tool, ii. Pump iii. Air compressor, iv. Internal combustion engine, v. Boiler, vi. Electrical motors, Types of faults in machine tools and their general causes.

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

Reference:
- Pump-hydraulic Compressors, Audels, Mcgrew Hill Publication.

OPEN ELECTIVES
Operations Research

Teaching Scheme
Lectures: 3 hrs/week

Course Outcomes: At the end of the course, the student should be able to
- Students should able to apply the dynamic programming to solve problems of discreet and continuous variables.
- Students should able to apply the concept of non-linear programming
- Students should able to carry out sensitivity analysis
- 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

[34]
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:
J.C. Pant, Introduction to Optimisation: Operations Research, Jain Brothers, Delhi, 2008
Pannerselvam, Operations Research: Prentice Hall of India 2010

Open Elective
Cost Management of Engineering Projects

Teaching scheme
Lecture: - 3 h/week

Introduction and Overview of the Strategic Cost Management Process

Cost concepts in decision-making; Relevant cost, Differential cost, Incremental cost and Opportunity cost. Objectives of a Costing System; Inventory valuation; Creation of a Database for operational control; Provision of data for Decision-Making.

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


References:
Cost Accounting A Managerial Emphasis, Prentice Hall of India, New Delhi
Charles T. Horngren and George Foster, Advanced Management Accounting
Robert S. Kaplan and Anthony A. Alkinson, Management & Cost Accounting
Ashish K. Bhattacharya, Principles & Practices of Cost Accounting A. H. Wheeler publisher
N.D. Vohra, Quantitative Techniques in Management, Tata McGraw Hill Book Co. Ltd.
Open Elective
Composite Materials

Teaching scheme
Lecture: - 3 h/week


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:

References:

Open Elective
Waste to Energy

Teaching scheme
Lecture: - 3 h/week

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


Unit-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:

AUDIT 1 and 2: ENGLISH FOR RESEARCH PAPER WRITING

Course objectives:
Students will be able to:
- Understand that how to improve your writing skills and level of readability
- Learn about what to write in each section
- Understand the skills needed when writing a Title

<table>
<thead>
<tr>
<th>Units</th>
<th>CONTENTS</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Planning and Preparation, Word Order, Breaking up long sentences, Structuring Paragraphs and Sentences, Being Concise and Removing Redundancy, Avoiding Ambiguity and Vagueness</td>
<td>4</td>
</tr>
<tr>
<td>3</td>
<td>Review of the Literature, Methods, Results, Discussion, Conclusions, The Final Check.</td>
<td>4</td>
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<tr>
<td>4</td>
<td>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, skills are needed when writing the Methods, skills needed when 4 writing the Results, skills are needed when writing the Discussion, skills are needed when writing the Conclusions</td>
<td>4</td>
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<tr>
<td>6</td>
<td>useful phrases, how to ensure paper is as good as it could possibly be the first- time submission</td>
<td>4</td>
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</tbody>
</table>

Suggested Studies:
AUDIT 1 and 2: DISASTER MANAGEMENT

**Course Objectives:** Students will be able to:
- learn to demonstrate a critical understanding of key concepts in disaster risk reduction and humanitarian response.
- critically evaluate disaster risk reduction and humanitarian response policy and practice from multiple perspectives.
- develop an understanding of standards of humanitarian response and practical relevance in specific types of disasters and conflict situations.
- 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**

<table>
<thead>
<tr>
<th>Units</th>
<th>CONTENTS</th>
<th>Hours</th>
</tr>
</thead>
</table>
| 1     | Introduction  
Disaster: Definition, Factors And Significance; Difference Between Hazard And Disaster; Natural And Manmade Disasters: Difference, Nature, Types And Magnitude. | 4 |
| 3     | 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. 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. | 4 |
| 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. | 4 |
| 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. | 4 |
| 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. | 4 |
SUGGESTED READINGS:
Sahni, Pardeep Et.Al. (Eds.),” Disaster Mitigation Experiences And Reflections”, Prentice Hall Of India, New Delhi.

AUDIT 1 and 2: SANSKRIT FOR TECHNICAL KNOWLEDGE

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

Syllabus

<table>
<thead>
<tr>
<th>Unit</th>
<th>Content</th>
<th>Hours</th>
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<tbody>
<tr>
<td>1</td>
<td>Alphabets in Sanskrit, Past/Present/Future Tense, Simple Sentences</td>
<td>8</td>
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<tr>
<td>2</td>
<td>Order</td>
<td>8</td>
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<td></td>
<td>Introduction of roots</td>
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<td></td>
<td>Technical information about Sanskrit Literature</td>
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<tr>
<td>3</td>
<td>Technical concepts of Engineering-Electrical, Mechanical, Architecture, Mathematics</td>
<td>8</td>
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</tbody>
</table>

Suggested reading
“Abhyaspustakam” – Dr.Vishwas, Samskrita-Bharti Publication, New Delhi
“Teach Yourself Sanskrit” PrathamaDeeksha-VempatiKutumbshastri, Rashtriya Sanskrit Sansthanam, New Delhi Publication
“India’s Glorious Scientific Tradition” Suresh Soni, Ocean books (P) Ltd., New Delhi.

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

AUDIT 1 and 2: VALUE EDUCATION

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

**Syllabus**

<table>
<thead>
<tr>
<th>Unit</th>
<th>Content</th>
<th>Hours</th>
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<tbody>
<tr>
<td>1</td>
<td>Values and self-development –Social values and individual attitudes.</td>
<td>4</td>
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<td></td>
<td>Work ethics, Indian vision of humanism.</td>
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<td></td>
<td>Moral and non- moral valuation. Standards and principles.</td>
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<tr>
<td></td>
<td>Value judgements</td>
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<td>2</td>
<td>Importance of cultivation of values.</td>
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<tr>
<td></td>
<td>Truthfulness, Cleanliness.</td>
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<td>Honesty, Humanity. Power of faith, National Unity.</td>
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<td>Patriotism. Love for nature, Discipline</td>
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<td>3</td>
<td>Personality and Behavior Development - Soul and Scientific attitude.</td>
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<td></td>
<td>Positive Thinking, Integrity and discipline.</td>
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<td></td>
<td>Punctuality, Love and Kindness.</td>
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<td></td>
<td>Avoid fault Thinking.</td>
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<td></td>
<td>Free from anger, Dignity of labour.</td>
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<td>Universal brotherhood and religious tolerance.</td>
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<td></td>
<td>True friendship.</td>
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<td></td>
<td>Happiness Vs suffering, love for truth.</td>
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<td></td>
<td>Aware of self-destructive habits.</td>
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<td></td>
<td>Association and Cooperation.</td>
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<td>Doing best for saving nature.</td>
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<td>4</td>
<td>Character and Competence –Holy books vs Blind faith.</td>
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<td></td>
<td>Self-management and Good health.</td>
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<td></td>
<td>Science of reincarnation.</td>
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<td></td>
<td>Equality, Nonviolence, Humility, Role of Women.</td>
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<td></td>
<td>All religions and same message.</td>
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<td>Mind your Mind, Self-control.</td>
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<td></td>
<td>Honesty, Studying effectively.</td>
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</table>

**Suggested reading**


**Course outcomes**

Students will be able to

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

**AUDIT 1 and 2: CONSTITUTION OF INDIA**
Course Objectives:
Students will be able to:
Understand the premises informing the twin themes of liberty and freedom from a civil rights perspective.
To address the growth of Indian opinion regarding modern Indian intellectuals' constitutional role and entitlement to civil and economic rights as well as the emergence of nationhood in the early years of Indian nationalism.
To address the role of socialism in India after the commencement of the Bolshevik Revolution in 1917 and its impact on the initial drafting of the Indian Constitution.

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<thead>
<tr>
<th>Units</th>
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<th>Hours</th>
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<tbody>
<tr>
<td>History</td>
<td>History of Making of the Indian Constitution:</td>
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<td></td>
<td>Drafting Committee, (Composition &amp; Working)</td>
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<td>Philosophy of</td>
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<td>the Indian Constitution:</td>
<td>Salient Features</td>
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<td>Contours of</td>
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<td>Constitutional Rights &amp; Duties:</td>
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<td>Right to Equality</td>
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<td>Right to Freedom of Religion</td>
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<td>Cultural and Educational Rights</td>
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<td>Right to Constitutional Remedies</td>
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<td>Directive Principles of State Policy</td>
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<td>Fundamental Duties.</td>
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<td>Organs of Governance:</td>
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<td>Parliament</td>
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<td>Qualifications and Disqualifications</td>
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<td>Powers and Functions</td>
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<td>Council of Ministers</td>
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<td>Judiciary, Appointment and Transfer of Judges, Qualifications</td>
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<td>Powers and Functions</td>
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</tbody>
</table>
Local Administration:
District’s Administration head: Role and Importance,
Municipalities: Introduction, Mayor and role of Elected Representative, CEO of Municipal Corporation.
Elected officials and their roles, CEO ZilaPachayat: Position and role.
Block level: Organizational Hierarchy (Different departments),
Village level: Role of Elected and Appointed officials,
Importance of grass root democracy

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

Suggested reading
The Constitution of India, 1950 (Bare Act), Government Publication.

Course Outcomes:
Students will be able to:
Discuss the growth of the demand for civil rights in India for the bulk of Indians before the arrival of Gandhi in Indian politics.
Discuss the intellectual origins of the framework of argument that informed the conceptualization of social reforms leading to revolution in India.
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.
Discuss the passage of the Hindu Code Bill of 1956.

AUDIT 1 and 2: PEDAGOGY STUDIES

Course Objectives:
Students will be able to:
Review existing evidence on the review topic to inform programme design and policy making undertaken by the DfID, other agencies and researchers.
Identify critical evidence gaps to guide the development.

Syllabus

<table>
<thead>
<tr>
<th>Units</th>
<th>Content</th>
<th>Hours</th>
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</thead>
<tbody>
<tr>
<td>1</td>
<td>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.</td>
<td>4</td>
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<tr>
<td>Thematic overview: Pedagogical practices are being used by teachers in formal and informal classrooms in developing countries. <strong>Curriculum, Teacher education.</strong></td>
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<tr>
<td>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.</td>
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<td><strong>Research gaps and future directions</strong></td>
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**Suggested reading**

**Course Outcomes:**

Students will be able to understand:
- What pedagogical practices are being used by teachers in formal and informal classrooms in developing countries?
What is the evidence on the effectiveness of these pedagogical practices, in what conditions, and with what population of learners?

How can teacher education (curriculum and practicum) and the school curriculum and guidance materials best support effective pedagogy?

**AUDIT 1 and 2: STRESS MANAGEMENT BY YOGA**

**Course Objectives**
- To achieve overall health of body and mind
- To overcome stress

**Syllabus**

<table>
<thead>
<tr>
<th>Unit</th>
<th>Content</th>
<th>Hours</th>
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<tbody>
<tr>
<td>1</td>
<td>Definitions of Eight parts of yog. (Ashtanga)</td>
<td>8</td>
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<tr>
<td>2</td>
<td>Yam and Niyam. Do’s and Don'ts in life. i) Ahinsa, satya, astheya, bramhacharya and aparigraha ii) Shaucha, santosh, tapa, swadhyay, ishwarpriyanidhan</td>
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<td>3</td>
<td>Asan and Pranayam i) Various yog poses and their benefits for mind &amp; body ii) Regularization of breathing techniques and its effects - Types of pranayam</td>
<td>8</td>
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</tbody>
</table>

**Suggested reading**
- ‘Yogic Asanas for Group Training-Part-I” : Janardan Swami YogabhyasiMandal, Nagpur
- “Rajayoga or conquering the Internal Nature” by Swami Vivekananda, AdvaitaAshrama (Publication Department), Kolkata

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

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

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

**Syllabus**

<table>
<thead>
<tr>
<th>Unit</th>
<th>Content</th>
<th>Hours</th>
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<tbody>
<tr>
<td>1</td>
<td>Neetisatakam-Holistic development of personality Verse- 19,20,21,22 (wisdom) Verse- 29,31,32 (pride &amp; heroism) Verse- 26,28,63,65 (virtue) Verse- 52,53,59 (dnt’s) Verse- 71,73,75,78 (do’s)</td>
<td>8</td>
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</tbody>
</table>
| 2 | Approach to day to day work and duties.  
ShrimadBhagwadGeeta: 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. | 8 |
|---|---|
| 3 | Statements of basic knowledge.  
ShrimadBhagwadGeeta: Chapter 2-Verses 56, 62, 68  
Chapter 12-Verses 13, 14, 15, 16, 17, 18  
Personality of Role model. ShrimadBhagwadGeeta:  
Chapter 2-Verses 17, Chapter 3-Verses 36, 37, 42,  
Chapter 4-Verses 18, 38, 39  
Chapter 18 – Verses 37, 38, 63 | 8 |

**Suggested reading**

“Srimad Bhagavad Gita” by Swami Swarupananda Advaita Ashram  
/Publication Department, Kolkata  
Bhartrihari’s Three Satakam (Niti-sringar-vairagya) by  
P.Gopinath, Rashtriya Sanskrit Sansthanam, New Delhi.

**Course Outcomes**

Students will be able to  
Study of Shrimad-Bhagwad-Geeta will help the student in developing his personality and achieve the highest goal in life  
The person who has studied Geeta will lead the nation and mankind to peace and prosperity  
Study of Neetishatakam will help in developing versatile personality of students.