UTTARAKHAND TECHNICAL UNIVERSITY, DEHRADUN

M TECH (Digital Communications)

2018

M. Tech. (Electronics and Telecommunication)

Curriculum Structure

Specialization: Digital Communications

Semester-I

Sr. No.	Course Type/Code	Course Name	Teaching Scheme			Credits
			L	T	P	
1	Core 1/ MDCT-101	Advanced Digital Communication Systems	3	0	0	3
2	Core 2/ MDCT-102	Advanced Signal processing	3	0	0	3
3	Prog. Specific Elective PE1	Elective I	3	0	0	3
	MDCT-111	(1)Optical Fiber Communication System				
	MDCT-112	(2)Computer Communication networks				
	MDCT-113	(3)Digital System Design Using VERILOG				
	MDCT-114	(4)Signal theory				
4	Prog. Specific Elective PE2	Elective II	3	0	0	3
	MDCT-121	(1) Telecommunication system modelling and simulation				
	MDCT-122	(2) Microwave theory and circuit				
	MDCT-123	(3) Radar system				
	MDCT-124	(4) Computational Techniques Using MATLAB				
5	LAB 1/ MDCP-101	Advanced Digital Communication System	0	0	4	2
6	LAB 2/ MDCP-102	Advanced Signal Processing	0	0	4	2
7		Research Methodology and IPR	2	0	0	2
8	Aud 1	Audit course 1	2	0	0	0
9		**Total**	16	0	8	18

Semester-II

Sr. No.	Course Type/Code	Course Name	Teaching Scheme			Credits
			L	T	P	
1	Core 3/ MDCT-201	Advanced Information Theory & Coding	3	0	0	3
2	Core 4/ MDCT-202	Detection and Estimation Theory	3	0	0	3
3	Prog. Specific Elective PE3	Elective III	3	0	0	3
	MDCT-231	(1) Fading Channels				
	MDCT-232	(2) Satellite Communication				
	MDCT-233	(3) Fuzzy Logic & Design				
	MDCT-234	(4) Digital Mobile Radio Systems				
4	Prog. Specific Elective PE2	Elective IV	3	0	0	3
	MDCT-241	(1) Antenna Theory And Practice				
	MDCT-242	(2) RF System Design				
	MDCT-243	(3) Digital Image Processing				
	MDCT-244	(4) Wavelet Transform For Signal And Image Processing				
5	LAB 3/ MDCP-201	Advanced Information Theory & Coding Lab	0	0	4	2
6	LAB 4/ MDCP-202	Detection and Estimation Theory Lab	0	0	4	2
7	MDCP-203	Seminar	0	0	4	2
8	Aud 2	Audit course 2	2	0	0	0
9		**Total**	14	0	12	18

Semester-III

Sr. No.	Course Type/Code	Course Name	Teaching Scheme			Credits
			L	T	P	
1	Prog. Specific Elective PE5	Elective V	3	0	0	3
	MDCT-531	1)Advanced mobile Computing				
	MDCT-532	(2)Broadband communication Systems and Networks				
	MDCT-533	(3)Spread Spectrum Technique				
	MDCT-534	(4) ADHOC Sensor Networks				
2	Open Elective / MDCT-391	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	3
3	Dissertation / MDCP-301	Dissertation Phase – I	0	0	20	10
		Total	6	0	20	16

Semester-IV

Sr. No.	Course Type/Code	Course Name	Teaching Scheme			Credits
			L	T	P	
1	Dissertation / MDCP-401	Dissertation Phase – II	--	--	32	16
		Total	--	--	32	16

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.
[T2] Tomasi: Advanced Electronics Communication Systems, 6th Edition, PHI

References:

[R1] Taub & Schilling, Principles of Communication system, TMH.
[R2] Lathi B.P., Modern Analog and Digital Communication systems, Oxford Uni. Press.
[R3] Haykin Simon, Digital Communication, Wiley Publication.
[R4] Proakis, Digital communication, McGraw Hill
[R5] Schaum"s Outline series, Analog and Digital Communication.
[R6] Singh and Sapre: Communication System, TMH
[R7] Couch: Digital and Analog Communication, Pearson Education

Paper code: MDCT-102

Paper: Advanced Signal Processing

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

Linear constant coefficient difference equations, Frequency domain representation of discrete-time systems, symmetry properties of the Fourier transform, Sampling of continuous-time systems.Z-transforms, Inverse Z-transform, properties of Z-transform, & its applications in system analysis & design. Discrete Fourier Transform (DFT) & its properties, computation of the DFT of real sequences, Linear Convolution using the DFT. Computation of Discrete Fourier Transform: Complexity of the DFT computation by direct method, Goertzel algorithm, Decimation –in-time FFT algorithms, Decimation-in frequency FFT algorithms.

UNIT-IV

Digital Filter Structure: Signal Flow Graph Representation, Basic FIR Digital Filter Structures: Direct forms, Transposed forms, Cascaded forms, Poly phase realization and Linear phase FIR structures. Basic IIR Filter Structures: Direct forms, Transposed forms, Cascaded realizations and Parallel realizations. All pass filters, Digital Sine-Cosine Generator.

Digital Filter Design: Design of IIR Digital filters from analog filters, Properties of FIR digital filters, Desgin of FIR filters using Windows, Computer aided design of FIR filters, Comparison of IIR and FIR digital filters.

Text Books:

Modern filter theory and design, edited By G. C. Temes and S. K. Mitra, Wiley, New York. 1973

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.

Alan V. Oppenheim & Ronald W. Schafer, " Digital Signal Processing" PHI, 2002

Sanjit K. Mitra, "Digital Signal Processing: A computer based approach" TMH, Second Edition, 2003

Selected research papers from Journals

hi-Tsong Chen, "Digital Signal Processing, Spectral Computation and Filter Design" Oxford University Press, 2001

Monson H. Hayes, " Schaum's Outline of Digital Signal Processing", Mcgraw Hill, 1999

Richard W. Hammming, "Digital Filters", Dover Pubns, 1998

Lars Wanhammar, "DSP Integrated Circuits", Academic Press, First edition, 1999.

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 Mynbev - John Wiley & Sons/Pearson.
Fiber-Optic Communication Systems - by GP Aggarwal - John Wiley & Sons

Reference Books:

Optical Fiber Communications, Principles & Practice by John M. Senior , PHI, 2nd Edition.
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:

Data and Computer Communications By William Stallings, PHI,6th Edition,2002.
Computer Networks By Larry Peterson, Bruce Davie

Reference Books:

Computer Networks by Tananbaum .A.S., PHI, 3rd Edition, 1999.
Introduction to Data Communication & Networking by Wayne Tomasi, Pearson ,2007.
TCP/IP Protocol suit by Behrouz A. Forouzan, TMH, 2000.

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:
[1] Verilog HDL by Samir Palnitkar, Pearson Pub.
[2] M. Ercegovac, T. Lang and L.J. Moreno, "Introduction to Digital Systems", Wiley,2000

Reference Books:
Digital Design by Frank Vahid, Wiley, 20063.
Introduction to Digital Systems by M. Ercegovac, T. Lang and L.J. Moreno, Wiley,2000.
Fundamental of digital Logic with Verilog design by S. Brown & Z. Vransesic, TMH.
Design through Verilog HDL by T.R. Padmanabhan& B. Bala Tripura Sundari, Wiley Pub. 2007

PROGRAM ELECTIVE 1
Paper code: MDCT-114
Paper: Signal Theory

UNIT I
Representation of deterministic signal: Orthogonal representation of signals, Dimensionality of signal spaces, Construction of orthogonal basis functions. Time-bandwidth relationship: RMS duration and bandwidth, uncertainty relations.

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

UNIT III
Transformations of random processes by linear systems, Representation of random processes (via sampling, K-L expansion and narrow band representations), special random processes (white Gaussian noise, Wiener-Levy processes, shot-noise processes, Markov processes).

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.
Probability, Random Variables, and Random Processes, (Schaum's Outline Series) By H. Hsu, McGraw Hill.

Reference Book

Probability, Random Processes, and Estimation Theory for Engineers (Second Edition) By H Stark, J. Woods, Prentice Hall.

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, Methodology and Techniques", Plenum Press, New York, 2001.

REFERENCES

Averill.M.Law and W.David Kelton, "Simulation Modeling and Analysis", McGraw-Hill, 2000.

Geoffrey Garden, "System Simulation", Prentice Hall of India, 2nd Edition, 1992.

W.Turin, "Performance Analysis of Digital Communication Systems", Computer Science Press, New York, 1990.

Jery Banks and John S.Carson, "Discrete Event System Simulation", Prentice Hall of India, 1984.

PROGRAM ELECTIVE 2
Paper code: MDCT-122
Paper: Microwave Theory and Circuits

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:
Microwave Engineering By D.M.Pozar, John Wiley & Sons, 3rd Edition.
Reference Books:
Microwave Devices and Circuits By Samuel Y. Liao, Prentice Hall of India,3rd Edition.

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.

Probability of False Alarms, Probability of Detection, Minimum detection signal , Pulse Compression Techniques , Matched Filter receiver. MTI Radar, Coherent MTI Radar, radar adaptability and anti-clutter device.

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

Radar Handbook by M.I.Skolonik , Tata Mc-Graw-Hill**,** 3rd Edition.

Reference Books

Modern Radar Systems Analysis by David K. Barton,Artech House, 1998.
Radar Systems Principles by Harold R. Raemer, CRC Press, 1996.
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

Nonlinear Equations: Bisection Method, Regula Falsi Method, Newton Raphson Method, Secant Method, Newton Method for a System of Nonlinear Equations

Unit-III

Numerical Differentiation/Integration: Difference Approximation for First Derivative, Approximation Error of First Derivative, Numerical Integration and Quadrature, Trapezoidal Method and Simpson Method, Romberg Integration,Adaptive and Gauss Quadrature.

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

Unit-IV

Optimization: Unconstrained Optimization, Constrained Optimization, MATLAB Built-In Routines for Optimization, Matrices and Eigenvalues: Eigenvalues and Eigenvectors, Power Method, Jacobi Method Partial Differential Equations: Elliptic , Hyperbolic, and Parabolic PDE, Finite Element Method (FEM) for solving PDE,

Text Books

"Applied Numerical methods using MATLAB", By W. Y. Yang, Wiley Publications, 2005

"Applied Numerical Methods with MATLAB," Steven C. Chapra, McGraw-Hill, 2005

Reference Books

"Numerical Methods using MATLAB", John H. Mathews, Prentice Hall

"Introduction to MATLAB® for Engineers", W.J Palm, McGraw-Hill

Paper Code:
Paper: Research Methodologies

Unit 1: 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:
[R1]Research Methodologies, R. Panneerselvam, Prentice Hall, 2007.
[R2] Research in Education, Best John V. and James V Kahn, Wiley eastern, 2005.
[R3] Elements of Educational Research, Sukhia, S.P., P.V. Mehrotra, and R.N. Mehrotra, PHI publication, 2003.
[R4] Methodology of Research Education, K. Setia, EEE publication, 2004.
[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, Repitition 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:
Information Theory, Coding and Cryptography By Ranjan Bose, Tata McGraw Hill, 2002.
Introduction to Error Control Codes by Salvatore Gravano, Oxford University Press

Reference Books:
1, Information Theory, Inference, and Learning Algorithms By David J.C. MacKay, Cambridge University Press, 2003.
2, Entropy & Information Theory by Robert M Gray, Springer-Verlag, Newyork, INC, 1990.

Paper code: MDCT-201

Paper: Detection and Estimation Theory

UNIT I

Classical Detection and Estimation Theory, Karhunen-Loeuve Transform and its application to Detection of signals in Gaussian noise, Waveform estimation, Linear estimation problems, Wiener filtering, Kalman filtering.

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:

Detection, Estimation and Modulation Theory vol-I By Harry.L.Van Trees, John Wiley & Sons Inc.

Signal Detection and Estimation By Mourad Barkat, Artech House London.

PROGRAM ELECTIVE 3
Paper code: MDCT-231
Paper: Fading Channels

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:

Digital Communication. over Fading Channels By Marvin .K. Simon, Mohamed-Slim Alouini, John Wiley &Sons,2005.
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

PROGRAM ELECTIVE 3
Paper code: MDCT-232
Paper: Satellite Communication

UNIT-I

ORBITAL MECHANICS: Orbits, Orbit Equations, Orbital Elements-Look Angle Determination and Visibility - Orbital Perturbations, Orbit Determination, Launch Vehicles, Orbital Effects in Communication System - Performance Attitude control; Satellite launch vehicles. spectrum allocations for satellite systems.

UNIT-II

SPACECRAFT SUB SYSTEMS AND EARTH STATION: Altitude and Orbit Control, Telemetry and Tracking, Power Systems, Communication Subsystems, Transponders, Antennas, Equipment Reliability, Earth Stations, Example of payloads of operating and planned systems.

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:

1 Dennis Roddy, “Satellite Communications”, Third Edition, Mc Graw Hill International Editions, 2001
Timothy Pratt, “Satellite Communication”, Addison Wesley.

Reference Books:

Bruce R.Elbert, "The Satellite Communication Applications Hand Book, Artech House Boston,1997.

PROGRAM ELECTIVE 3

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

Unit-I
Fuzzy Arithmetic: Fuzzy Numbers, Linguistic Variables, Arithmetic Operations on intervals & Numbers, Lattice of Fuzzy Numbers, Fuzzy Equations.

Unit-II
Fuzzy Relations: Crisp & Fuzzy Relations, Projections & Cylindric Extensions, Binary Fuzzy Relations, Binary Relations on single set, Equivalence, Compatibility & Ordering Relations, Morphisms, Fuzzy Relation Equations.

Unit-III
Possibility Theory: Fuzzy Measures, Evidence & Possibility Theory, Possibility versus Probability Theory.

Fuzzy Logic: Classical Logic, Multivalued Logics, Fuzzy Propositions, Fuzzy Qualifiers, Linguistic Hedges.

Unit-IV
Uncertainty based Information: Information & Uncertainty, Nonspecificity of Fuzzy & Crisp sets, Fuzziness of Fuzzy Sets.

Applications of Fuzzy Logic:

Text Book:

G.J.Klir , Yuan,"Fuzzy Sets and fuzzy logic, Theory and applications", Prentice Hall India, 1995.

Reference Books:

John Yen, Reza Langari, "Fuzzy Logic Intelligence, Control and Information", Pearson Education, 2006.
Ross, "Fuzzy Logic with Engineering Applications", 2nd Edition, John Wiley, 2004.
H. Zimmermann, "Fuzzy Set Theory and its application

PROGRAM ELECTIVE 3

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

Unit-I
Overview & Classification of Mobile Communication Systems, Mobile Communication channel. Modeling of Propagation Loss, Diversity reception, Cellular System Concepts, Ways of increasing system capacity, First Generation Cellular Telephony.

Unit-II
GSM Cellular Telephony. GSM Architecture. Radio Transmission Parameters of GSM. GSM Logical Channels. GSM Burst Structures. Call setup Procedures & Handover in GSM System.
Data Transmission in GSM. HSCSD, GPRS, EDGE.

Unit-III
CDMA in Mobile Communication Systems. Spreading Sequences. Basic Transmitter & Receiver Schemes in CDMA Systems. RAKE Receiver. Multi Carrier CDMA. IS- 95 systems. Digital Cordless telephony. Wire Less Local Loops.

Unit-IV
Third Generation Mobile Communication Systems. IMT 2000. Concepts of UMTS. UTRA FDD Mode, UTRA TDD Mode.WCDMA. CDMA 2000. Application of Smart Antennas in Cellular Telephony. Satellite Mobile Communication Systems. Iridium, Global Start, ICO Systems.

Text Books :

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

Reference books:

Hazysztof Wesolowski, Mobile Communication Systems, Wiley.
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:

Long Wire – Designing, V and Rhombic Antenna – Designing, Helical Antenna –

Designing of normal and axial mode, Rectangular apertures with different configurations-

--With analysis Circular Apertures, E-Plane Sectoral Horn – Analysis and Design, H-Plane Sectoral Horn – Analysis and Design

Pyramidal Horn

Unit IV:

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

TEXT BOOK

1. Antenna Theory Analysis and Design by C.A.Balanis , 3rd Edition Wiley Publication.

REFERENCE BOOK

Antenna Theory and Design by R.S.Elliot, Revised Edition, Wiley Publication(IEEE Press).
Antenna by J.D. Kraus, 3rdEdition , McGraw Hill.
Electromagnetic Waves and Radiating Systems By Jordan and Balmain, Prentice Hall, 2ndEdition.
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

Mixer and Detector circuits. Mixers and Down-converters-Operating Theory, Single ended Mixers, Single balanced Mixers and double balanced Mixers. Harmonic and Sub-harmonic Mixers, Up-converters, FET Mixers, Non Linear Analysis Techniques, Detector Operating Theory, Detector Sensitivity, Detector Circuits, Rectennas, RF Switches, Rotary vane Switches, PIN Diode, Ferrite Switches, ABCD Matrices for Circuit Building Blocks, Modulators and Attenuators, Biasing Techniques, Ferrite Phase shifters, PIN Diode Phase Shifters-Transmission and Reflection Type Phase Shifters, Phased Arrays, Power Combiners, Feed Networks, Transistor Switches and Phase Shifters.

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

Oscillators, General Theory of Oscillators, General Theory of Reflection Amplifiers, Injection Locked Amplifiers. PLL: Relaxation oscillators, series resonant oscillators, negative resonant oscillators, oscillator dynamics, stability, oscillator noise, design examples, phase locked loops-loop dynamics, analysis, frequency synthesizers.

TEXT BOOKS:

Microwave Receiver with Electronic Warfare Application, James Bao-Yen Tsui, John Wiley & Sons, 2nd Edition.
Microwave Solid-State Circuits & Applications, Kai Chang, John Wiley & Sons,2nd Edition.
RF System Design of Transceivers for Wireless Communication by Qizheng Gu, Springer-Verlag New York, May 2006

REFERENCE BOOKS:

Practical RF System Design by William F.Egan,Wiley-IEEE Press,April 2003.
RF MicroElectronics by Behzad Razavi, Prentice Hall,1998.

PROGRAM ELECTIVE 4

Paper code: MDCT-243
Paper: Digital Image Processing

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
Image Restoration: Inverse Filtering, Algebraic Approach to Restoration, Wiener (LMS) approach, Constrained Least Squares Restoration, Interactive and other methods for restoration.

UNIT III
Image Reconstruction: The Filtered Back-Projection Algorithm, Algebraic reconstruction Method. Image Segmentation: Detection of Discontinuities, Edge Linking and Boundary Detection,

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 By R. C. Gonzalez and R. E. Woods, Prentice-Hall.
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).

2) Wavelet Transforms: Introduction to Theory and Applications By Raghuveer M. Rao, Ajit S. Bopardikar, Rochester Institute of Tech Addison-Wesley.

3) A Wavelet Tour of Signal Processing By Stephane Mallat, Elsevier.

SEMESTER III

PROGRAM ELECTIVE 5

Paper code: MDCT-351

Paper: Advanced Mobile Computing

Unit -1

Introduction to Personal Communication Systems, PCS Architecture. Medium Access Techniques,GSM Overview, Packet Switched Data, 2.5/3G Mobile Wireless Systems. GPRS, EDGE Systems, WCDMA & CDMA 2000 Systems.

Unit-II

Wireless Local Area Networks. IEEE 802.11, System Architecture and Protocol Architecture of IEEE 802.11. HIPERLAN Architecture, Bluetooth Networks , Mobile Internet Protocol. IP packet Delivery. Tunneling and Encapsulation. Reverse Tunneling. IPv6.

Unit-III

Wireless Application Protocol. Networks for WAP. WAP Layered Architecture and Protocol Stack. WAP Gateways. Wireless Markup Language(WML). Programming in WML. WML Script. Voice over Internet Protocol and Convergence Technologies.

Unit-IV

Wireless Local 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 :

Yi-Bing and Imrich Chlamtac, "Wirelwss and Mobile Networks Architectures", John Wiley & Sons,2001.

Asoke k Talukder , Roopa R Yavagal, "Mobile Computing", Tata Mc Graw Hill

Reference Books:

1) Raj Pandya, Mobile & Personal Communication Systems And Service, PHI.
2) Jon W.Mark , Weihua Zhuang, " Wirelwss Communication and Networking", PHI.
3) Jochen Schiller, Mobile Communication, Pearson education

PROGRAM ELECTIVE 5

Paper code: MDCT-352
Paper: Broadband Communication Systems and Networks

UNIT I
Components of Broadband Communication Systems, Network Architecture, Cable Broadband, Data Network Architecture, Importance of Broadband Network, Future of Broadband Telecommunications. X.25 Technology & Frame Relay.

UNIT II
DIGITAL SUBSCRIBER LINE: DSL Technology, ADSL, HDSL, SDSL, SHDSL. Cable - Modem Technology, Cable Internet Access, Comparison Between Broadband DSL and Cable Modem Technologies, Future of DSL and Broadband Systems – XDSL.
ISDN & BISDN, ISDN Standards, ISDN Applications. ATM Technology, ATM Network, ATM Service Class, ATM Standards, ATM LAN Emulation, ATM Applications.

UNIT III
SYCHRONOUS OPTICAL NETWORK (SONET): SONET Signal, SONET Frame, SONET Components, SONET Topologies, Advantages and Disadvantages of SONET & SDH, SONET and SDH Standards.
WDM Network Elements- Optical Line Terminals, Optical Line Amplifiers, Optical Add/Drop Multiplexers, OADM Architectures, Reconfigurable OADMs, Optical Crossconnects, All-Optical OXC Configurations.

UNIT IV
NETWORK MANAGEMENT: Network Management Architecture - Network Management Protocols - Simple Management Information Protocol (SNMP) Management - Information Base (MIB) - Structure of Management Information (SMI) - Remote Network Monitoring (RMON). Network Security Requirements, Network Threats, Access Control Methods.

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:
1) Fixed Broadband Wireless System Design: The Creation of Global Mobile Communications By Harry R. Anderson; Wiley Blackwell.
2) Optical Networks A Practical Perspective by Rajiv Ramaswami, Kumar N. Sivarajan, Galen H. Sasaki.

PROGRAM ELECTIVE 5

Paper code: MDCT-353
Paper: Spread Spectrum Techniques.

UNIT I
INTRODUCTION: Origin of Spread Spectrum – Spreading the Spectrum – Progress Gain – Jamming Margin – Direct Sequence System – Direct Sequence Signal Characteristics – Direct Sequence Code – Spectrum relationship – Frequency Hopping Signal Characteristics – Frequency Hopping Rate and No. of frequencies – Time Hopping – Chirp System – Hybrid Forms

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
MODULATION – CORRELATION AND DEMODULATION: Modulation – Balanced Modulation – Frequency Synthesis – Sending the Information – Remapping the Spread Spectrum – Effect of non synchronous input signal – Base band recovery.

UNIT IV
SYNCHRONISATION: Noise figure and Cochannel users - Dynamic range and AGC - Propagation Medium - Overall Receiver-Transmitter Design – Ranging Techniques – Direction finding – Special Antennas. APPLICATIONS OF SPREAD SPECTRUM METHODS: Space Systems – Avionics Systems – Test Systems and Equipment – Message Protection – Position Location – Test and Evaluation of Spread Spectrum Systems – Sensitivity, Selectivity, Jamming Margin, Synchronous acquisition, loss of Synchronization – Signal to noise ratio Vs Interference level – Process gain – FCC Method – Cross Correlation – Transmitter Measurements.

TEXT BOOKS:

R.C. Dixon, “Spread Spectrum Systems with commercial appications”, Wiley Interscience, 3rd Edition,1994

George Cooper & Clare. D. Mc Gillen, “Modern Communications and Spread Spectrum”, Mc Graw Hill, 1985.

REFERENCE BOOKS:

M.K. Simon, J.K. Omura, R.A. Scholtz , “Spread Spectrum Communications Handbook, Elctronic Edition”, McGraw Hill, 1st Edition, 2001.

Rodger E. Ziemer, Roger L. Peterson, David E. Borth, “Introduction to Spread Spectrum Communications”, Prentice Hall Inc., 1995.

PROGRAM ELECTIVE 5

Paper Code: MDCT-354
Paper: Adhoc Sensor Networks

Unit I
Introduction to Mobile Ad Hoc Networks, Technologies for Ad Hoc Network, Issues in Ad hoc wireless Networks, Ad Hoc network applications, Fundamentals of WLANs, IEEE 802.11 Architecture , protocols ,performance and open issues. Introduction to IEEE 802.15.4, MAC Protocols for Ad Hoc Wireless Networks:
Issues, design goals and classification of MAC protocol, MACA and MACAW, Routing Protocols for Ad hoc wireless networks: Issues and classifications of routing protocols, AODV, DSR, DSDV, Multicasting Routing: Issues, Architecture reference model, and classifications of multicasting routing protocols.

Unit II
Transport layer & Security protocols
Issues and design goals in designing transport layer protocols, TCP over Ad Hoc Wireless Networks: Traditional TCP, Feedback-Based TCP, TCP-BuS, Ad Hoc and Split TCP, Security in Ad hoc wireless networks: Network security requirements, Issues and challenges, Types of Network Security Attacks, and Key management, Secure routing in Ad hoc wireless networks.

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:
Physical Layer and Transceiver design considerations in WSNs, Fundamentals of (wireless) MAC protocol: Low duty cycle protocols and wakeup concepts, Contention-based protocols, Schedule-based protocols, The IEEE 802.15.4 MAC protocol, Address and name management in wireless sensor networks, Localization and positioning, Routing protocols: Data Dissemination and Gathering, Routing Challenges and Design Issues in WSN, QoS in wireless sensor networks, Coverage and deployment, Advanced Application Support.

Text Book:

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

Protocols and Architectures for Wireless Sensor Networks, By Holger Karl and Andreas Willig Wiley Publisher (2014).

Reference:

Wireless Sensor Networks Technology, Protocols, and applications by Kazem Sohraby, Daniel Minoli, Taieb Znati, John Wiley & Sons.

Handbook of Ad Hoc Wireless Network, By Mohmad Illayas, CRC press

(Dissertation) Dissertation Phase – I (MVLP031) and Phase – II (MVLP041)	
Teaching Scheme: Lab 20 and 30 Hrs/Week	

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.

Guidelines for Dissertation Phase – I and II at M. Tech. (Electronics):

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

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OPEN ELECTIVES

Business Analytics

Teaching scheme

Lecture: - 3 h/week

Course Code	
Course Name	**Business Analytics**
Credits **Prerequisites**	

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. Mange 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	**NO. OF LECTURES**
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.	9
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.	8
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,	9

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, 10 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 8 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, 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 Principles, Concepts, and Applications by Marc J. Schniederjans, Dara G. Schniederjans, Christopher M. Starkey, Pearson FT Press.

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 electricalhazards, 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 reductionmethods, 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 andapplications, 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:

Maintenance Engineering Handbook, Higgins & Morrow, Da Information Services.
Maintenance Engineering, H. P. Garg, S. Chand and Company.
Pump-hydraulic Compressors, Audels, Mcgrew Hill Publication.
Foundation Engineering Handbook, Winterkorn, Hans, Chapman & Hall London.

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

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:

H.A. Taha, Operations Research, An Introduction, PHI, 2008

H.M. Wagner, Principles of Operations Research, PHI, Delhi, 1982.

J.C. Pant, Introduction to Optimisation: Operations Research, Jain Brothers, Delhi, 2008

Hitler Libermann Operations Research: McGraw Hill Pub. 2009

Pannerselvam, Operations Research: Prentice Hall of India 2010

Harvey M Wagner, Principles of 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

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.

Quantitative techniques for cost management, Linear Programming, PERT/CPM, Transportation problems, Assignment problems, Simulation, Learning Curve Theory.

References:

Cost Accounting A Managerial Emphasis, Prentice Hall of India, New Delhi
Charles T. Horngren and George Foster, Advanced Management Accounting
Robert S Kaplan 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–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 glassfibers, 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 isostaticpressing.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 andprepregs – 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, maximumstrain 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:

Material Science and Technology – Vol 13 – Composites by R.W.Cahn – VCH, West Germany.

Materials Science and Engineering, An introduction. WD Callister, Jr., Adapted by R. Balasubramaniam, John Wiley & Sons, NY, Indian edition, 2007.

References:

Hand Book of Composite Materials-ed-Lubin.

Composite Materials – K.K.Chawla.

Composite Materials Science and Applications – Deborah D.L. Chung.

Composite Materials Design and Applications – Danial Gay, Suong V. Hoa, and Stephen W. Tasi.

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, Forestresidue, Industrial waste - MSW – Conversion devices – Incinerators, gasifiers, digestors**Unit-II:** Biomass Pyrolysis: Pyrolysis – Types, slow fast – Manufacture of charcoal – Methods -Yields and application – Manufacture of pyrolytic oils and gases, yields and applications.

Unit-III: Biomass Gasification: Gasifiers – Fixed bed system – Downdraft and updraft gasifiers – Fluidized bed gasifiers – Design, construction and operation – Gasifier burner arrangement for

thermal heating – Gasifier engine arrangement and electrical power – Equilibrium and kinetic consideration in gasifier operation.

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

Unit-V: Biogas: Properties of biogas (Calorific value and composition) - Biogas plant technologyand status - Bio energy system - Design and constructional features - Biomass resources and 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:

Non Conventional Energy, Desai, Ashok V., Wiley Eastern Ltd., 1990.

Biogas Technology - A Practical Hand Book - Khandelwal, K. C. and Mahdi, S. S., Vol. I & II, Tata McGraw Hill Publishing Co. Ltd., 1983.

Food, Feed and Fuel from Biomass, Challal, D. S., IBH Publishing Co. Pvt. Ltd., 1991.

Biomass Conversion and Technology, C. Y. WereKo-Brobby and E. B. Hagan, John Wiley & Sons, 1996.

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

Units	CONTENTS	Hours
1	Planning and Preparation, Word Order, Breaking up long sentences, Structuring Paragraphs and Sentences, Being Concise and Removing Redundancy, Avoiding Ambiguity and Vagueness	4
	Clarifying Who Did What, Highlighting Your Findings, Hedging 4 and Criticising, Paraphrasing and Plagiarism, Sections of a Paper, Abstracts. Introduction	
3	Review of the Literature, Methods, Results, Discussion, Conclusions, The Final Check.	4
4	key skills are needed when writing a Title, key skills are needed when writing an Abstract, key skills are needed when writing an Introduction, skills needed when writing a Review of the Literature,	4
	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	
6	useful phrases, how to ensure paper is as good as it could possibly 4 be the first- time submission	

Suggested Studies:

Goldbort R (2006) Writing for Science, Yale University Press (available on Google Books)

Day R (2006) How to Write and Publish a Scientific Paper, Cambridge University Press

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

AUDIT 1 and 2: DISASTER MANAGEMENT

Course Objectives: -Students will be able to:

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

Units	CONTENTS	Hours
1	**Introduction** Disaster: Definition, Factors And Significance; Difference Between Hazard And Disaster; Natural And Manmade Disasters: Difference, Nature, Types And Magnitude.	4
	Repercussions Of Disasters And Hazards: Economic Damage, Loss 4Of 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.	
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	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:

R. Nishith, Singh AK, "Disaster Management in India: Perspectives, issues and strategies "'New Royal book Company.

Sahni, PardeepEt.Al. (Eds.)," Disaster Mitigation Experiences And Reflections", Prentice Hall Of India, New Delhi.

Goel S. L. , Disaster Administration And Management Text And Case Studies" ,Deep &Deep Publication Pvt. Ltd., New Delhi.

AUDIT 1 and 2: SANSKRIT FOR TECHNICAL KNOWLEDGE

Course Objectives

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

Unit	***Content***	***Hours***
1	Alphabets in Sanskrit, Past/Present/Future Tense, Simple Sentences	8
2	Order Introduction of roots Technical information about Sanskrit Literature	8
3	Technical concepts of Engineering-Electrical, Mechanical, Architecture, Mathematics	8

Suggested reading

"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

Unit	*Content*	*Hours*
1	Values and self-development –Social values and individual attitudes. Work ethics, Indian vision of humanism. Moral and non- moral valuation. Standards and principles. Value judgements	4
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	6
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 oflabour. 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	6
4	Character and Competence –Holy books vs Blind faith. Self-management and Good health. Science of reincarnation. Equality, Nonviolence ,Humility, Role of Women. All religions and same message. Mind your Mind, Self-control. Honesty, Studying effectively	6

Suggested reading

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

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.

Syllabus

Units	Content	Hours
History	**History of Making of the Indian Constitution:** Drafting Committee, (Composition& Working)	4
Preamble	**Philosophy of the Indian Constitution:** Salient Features	4
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.	4
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	4

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: ZilaPachayat. 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	4
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.	4

Suggested reading

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

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

Units	Content	Hours
1	**Introduction and Methodology:** Aims and rationale, Policy background, Conceptual framework and terminology Theories of learning, Curriculum, Teacher education. Conceptual framework, Research questions. Overview of methodology and Searching.	4

2	Thematic overview: Pedagogical practices are being used by teachers in formal and informal classrooms in developing countries. Curriculum, Teacher education.	2
3	Evidence on the effectiveness of pedagogical practices Methodology for the in depth stage: quality assessment of included studies. How can teacher education (curriculum and practicum) and the school curriculum and guidance materials best support effective pedagogy? Theory of change. Strength and nature of the body of evidence for effective pedagogical practices. Pedagogic theory and pedagogical approaches. Teachers' attitudes and beliefs and Pedagogic strategies.	4
4	Professional development: alignment with classroom practices and follow-up support Peer support Support from the head teacher and the community. Curriculum and assessment Barriers to learning: limited resources and large class sizes	4
5	**Research gaps and future directions** Research design Contexts Pedagogy Teacher education Curriculum and assessment Dissemination and research impact.	2

Suggested reading

Ackers J, Hardman F (2001) Classroom interaction in Kenyan primary schools, Compare, 31 (2): 245-261.

Agrawal M (2004) Curricular reform in schools: The importance of evaluation, Journal of Curriculum Studies, 36 (3): 361-379.

Akyeampong K (2003) Teacher training in Ghana - does it count? Multi-site teacher education research project (MUSTER) country report 1. London: DFID.

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.

Alexander RJ (2001) Culture and pedagogy: International comparisons in primary education. Oxford and Boston: Blackwell.

Chavan M (2003) Read India: A mass scale, rapid, 'learning to read' campaign. www.pratham.org/images/resource%20working%20paper%202.pdf.

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

Unit	*Content*	*Hours*
1	Definitions of Eight parts of yog. (Ashtanga)	8
2	Yam and Niyam. Do`s and Don'ts in life. i) Ahinsa, satya, astheya, bramhacharya and aparigraha ii) Shaucha, santosh, tapa, swadhyay, ishwarpranidhan	8
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	8

Suggested reading

‘Yogic Asanas for Group Tarining-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

Unit	Content	Hours
1	Neetisatakam-Holistic development of personality Verses- 19,20,21,22 (wisdom) Verses- 29,31,32 (pride & heroism) Verses- 26,28,63,65 (virtue) Verses- 52,53,59 (dont’s) Verses- 71,73,75,78 (do’s)	8

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: Chapter2-Verses 56, 62, 68 Chapter 12 -Verses 13, 14, 15, 16,17, 18 Personality of Role model. ShrimadBhagwadGeeta: Chapter2-Verses 17, Chapter 3-Verses 36,37,42, Chapter 4-Verses 18, 38,39 Chapter18 – Verses 37,38,63	8

Suggested reading

"Srimad Bhagavad Gita" by Swami SwarupanandaAdvaita 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.