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**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY: KAKINADA**  
**KAKINADA – 533 003, Andhra Pradesh, India**

**DEPARTMENT OF ELECTRONICS & COMMUNICATION ENGINEERING**

**COURSE STRUCTURE & SYLLABUS M.Tech ECE Common for**  
**Communication Engineering & Signal Processing (CE&SP)**  
**Communication & Signal Processing (CSP)**

**Programme**

*(Applicable for batches admitted from 2019-2020)*



**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY KAKINADA**



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**I Semester**

S. No.	Course Type/ Code	Course Name	Teaching Scheme			Credits
			L	T	P	
1	Core 1	Advanced Digital Signal Processing	3	0	0	3
2	Core 2	Digital Image and Video Processing	3	0	0	3
3	Prog. Specific Elective	<b>Elective I</b> a. DSP Architectures b. Statistical Signal Processing c. Cognitive Radio	3	0	0	3
4	Prog. Specific Elective	<b>Elective II</b> a. Adaptive Signal Processing b. Digital Data Communication c. Coding Theory & Applications	3	0	0	3
5	Lab 1	Advanced Digital Signal Processing Lab	0	0	4	2
6	Lab2	Digital Image and Video Processing Lab	0	0	4	2
7	MC	Research Methodology and IPR	2	0	0	2
8	Aud 1	Audit Course 1	2	0	0	0
<b>Total</b>			<b>16</b>	<b>0</b>	<b>8</b>	<b>18</b>

**II Semester**

S. No.	Course Type/ Code	Name of the Subject	Teaching Scheme			Credits
			L	T	P	
1	Core 3	Pattern Recognition and Machine Learning	3	0	0	3
2	Core 4	Detection and Estimation Theory	3	0	0	3
3	Prog. Specific Elective	<b>Elective III</b> a. IOT and Applications b. Wireless Sensor Networks c. Soft Computing Techniques	3	0	0	3
4	Prog. Specific Elective	<b>Elective IV</b> a. Smart Antennas b. Biomedical Signal Processing c. Optical Networks	3	0	0	3
5	Lab 1	Pattern Recognition and Machine Learning Lab	0	0	4	2
6	Lab2	Detection and Estimation Theory Lab	0	0	4	2
7	MP	Mini Project (Seminar)	0	0	4	2
8	Aud 2	Audit Course 2	2	0	0	0
<b>Total</b>			<b>14</b>	<b>0</b>	<b>12</b>	<b>18</b>

**III Semester**

S. No.	Course Type/Code	Subject	Teaching Scheme			Credits
			L	T	P	
1	Prog. Specific Elective	<b>Elective-V</b> a. Optimization Techniques b. Modeling and Simulation Techniques c. Artificial Intelligence	3	0	0	3
2	<b>Open Elective</b>	a. Business Analytics b. Industrial Safety c. Operations Research d. Cost Management of Engineering Projects e. Composite Materials f. Waste to Energy	3	0	0	3
3	Dissertation	Dissertation Phase – I	0	0	20	10
<b>Total</b>			<b>6</b>	<b>0</b>	<b>20</b>	<b>16</b>

**IV Semester**

S. No.	Course Code	Subject	Teaching Scheme			Credits
			L	T	P	
1	Dissertation	Dissertation Phase – II	--	--	32	16
<b>Total</b>			<b>--</b>	<b>--</b>	<b>32</b>	<b>16</b>

**Audit course 1 & 2**

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

**I Year I Semester**

L	T	P	C
3	0	0	3

### ADVANCED DIGITAL SIGNAL PROCESSING

#### Course Objectives

1. At the completion of this course, the student should have in depth knowledge of processing digital signals.
2. To study about discrete time systems and to learn about FFT algorithms.
3. To study the design techniques for FIR and IIR digital filters
4. To study the finite word length effects in signal processing
5. To study the properties of random signal, Multirate digital signal processing and about QMF filters

#### Unit 1

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

#### Unit 2

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

#### Unit 3

Linear prediction & optimum linear filters, stationary random process, forward-backward linear prediction filters, solution of normal equations, AR Lattice and ARMA Lattice-Ladder Filters, Wiener Filters for Filtering and Prediction.

#### Unit 4

Adaptive Filters, Applications, Gradient Adaptive Lattice, Minimum mean square criterion, LMS algorithm, Recursive Least Square algorithm. Estimation of Spectra from Finite-Duration Observations of Signals. Nonparametric Methods for Power Spectrum Estimation, Parametric Methods for Power Spectrum Estimation, Minimum-Variance Spectral Estimation, Eigen analysis Algorithms for Spectrum Estimation.

#### Unit 5

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

#### TEXT BOOKS:

1. J.G.Proakis and D.G.Manolakis "Digital signal processing: Principles, Algorithm and Applications", 4th Edition, Prentice Hall, 2007.
2. N. J. Fliege, "Multirate Digital Signal Processing: Multirate Systems -Filter Banks – Wavelets", 1<sup>st</sup> Edition, John Wiley and Sons Ltd, 1999

**REFERENCES:**

1. Bruce W. Suter, "Multirate and Wavelet Signal Processing", 1<sup>st</sup> Edition, Academic Press, 1997.
2. M. H. Hayes, "Statistical Digital Signal Processing and Modeling", John Wiley & Sons Inc., 2002.
3. S. Haykin, "Adaptive Filter Theory", 4<sup>th</sup> Edition, Prentice Hall, 2001.
4. D.G. Manolakis, V.K. Ingle and S.M. Kogon, "Statistical and Adaptive Signal Processing", McGraw Hill, 2000.

**Course Outcomes:**

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

1. To understand theory of different filters and algorithms
2. To understand theory of multirate DSP, solve numerical problems and write algorithms
3. To understand theory of prediction and solution of normal equations
4. To know applications of DSP at block level

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**I Year I Semester**

L	T	P	C
3	0	0	3

## DIGITAL IMAGE and VIDEO PROCESSING

### Course Objectives

1. To study the image fundamentals and mathematical transforms necessary for image Processing.
2. To study the image enhancement techniques
3. To study image restoration procedures.
4. To study the image compression procedures.

### UNIT 1:

**Fundamentals of Image Processing and Image Transforms:** Introduction, Image sampling, Quantization, Resolution, Image file formats, Elements of image processing system, Applications of Digital image processing. Introduction, Need for transform, image transforms, Fourier transform, 2 D Discrete Fourier transform and its transforms, Importance of phase, Walsh transform, Hadamard transform, Haar transform, slant transform Discrete cosine transform, KL transform, singular value decomposition, Radon transform, comparison of different image transforms.

### UNIT 2:

**Image Enhancement:** Spatial domain methods: Histogram processing, Fundamentals of Spatial filtering, Smoothing spatial filters, Sharpening spatial filters. Frequency domain methods: Basics of filtering in frequency domain, image smoothing, image sharpening, Selective filtering.

**Image Restoration:** Introduction to Image restoration, Image degradation, Types of image blur, Classification of image restoration techniques, Image restoration model, Linear and Nonlinear image restoration techniques, Blind deconvolution.

### UNIT 3:

**Image Segmentation:** Introduction to image segmentation, Point, Line and Edge Detection, Region based segmentation., Classification of segmentation techniques, Region approach to image segmentation, clustering techniques, Image segmentation based on thresholding, Edge based segmentation, Edge detection and linking, Hough transform, Active contour

**Image Compression:** Introduction, Need for image compression, Redundancy in images, Classification of redundancy in images, image compression scheme, Classification of image compression schemes, Fundamentals of information theory, Run length coding, Shannon – Fano coding, Huffman coding, Arithmetic coding, Predictive coding, Transformed based compression, Image compression standard, Wavelet-based image compression, JPEG Standards.

### UNIT 4:

**Basic Steps of Video Processing:** Analog Video, Digital Video. Time-Varying Image Formation models: Three-Dimensional Motion Models, Geometric Image Formation, Photometric Image Formation, Sampling of Video signals, filtering operations.

**UNIT 5:**

**2-D Motion Estimation:** Optical flow, General Methodologies, Pixel Based Motion Estimation, Block-Matching Algorithm, Mesh based Motion Estimation, Global Motion Estimation, Region based Motion Estimation, Multi resolution motion estimation, Waveform based coding, Block based transform coding, Predictive coding, Application of motion estimation in Video coding.

**TEXT BOOKS**

1. Digital Image Processing – Gonzalez and Woods, 3rdEd., Pearson.
2. Video Processing and Communication – Yao Wang, JoemOstermann and Ya-quin Zhang. 1<sup>st</sup>Ed., PH Int.
3. S.Jayaraman, S.Esakkirajan and T.VeeraKumar, "Digital Image processing, TataMcGraw Hill publishers, 2009

**REFERENCE BOOKS**

1. Digital Image Processing and Analysis-Human and Computer Vision Application with CVIPTools– ScotteUmbaugh, 2<sup>nd</sup> Ed, CRC Press, 2011.
2. Digital Video Processing – M. Tekalp, Prentice Hall International.
4. Multi-dimensional Signal, Image and Video Processing and Coding – John Woods, 2ndEd, Elsevier.
5. Digital Image Processing with MATLAB and Labview – Vipula Singh, Elsevier.
6. Video Demystified – A Hand Book for the Digital Engineer – Keith Jack, 5<sup>th</sup>Ed., Elsevier

**Course Outcomes:**

1. Defining the digital image, representation of digital image, importance of image resolution, applications in image processing.
2. Know the advantages of representation of digital images in transform domain, application of various image transforms.
3. Know how an image can be enhanced by using histogram techniques, filtering techniques etc
4. Understand image degradation, image restoration techniques using spatial filters and frequency domain
5. Know the detection of point, line and edges in images, edge linking through local processing, global processing.
6. Understand the redundancy in images, various image compression techniques.
7. Know the video technology from analog color TV systems to digital video systems, how video signal is sampled and filtering operations in video processing.
8. Know the general methodologies for 2D motion estimation, various coding used in video processing

**I Year I Semester**

L	T	P	C
3	0	0	3

**DSP ARCHITECTURES**  
**(Elective - I)****Unit 1**

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

**Unit 2**

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

**Unit 3**

VLIW Architecture: Current DSP Architectures, GPUs as an alternative to DSP Processors, TMS320C6X Family, Addressing Modes, Replacement of MAC unit by ILP, Detailed study of ISA, Assembly Language Programming, Code Composer Studio, Mixed C and Assembly Language programming, On-chip peripherals, Simple applications developments as an embedded environment.

**Unit 4**

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

**Unit 5**

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

**TEXT BOOKS**

1. M. Sasikumar, D. Shikhare, Ravi Prakash, "Introduction to Parallel Processing", 1<sup>st</sup> Edition, PHI, 2006.
2. Fayeze Gebali, "Algorithms and Parallel Computing", 1<sup>st</sup> Edition, John Wiley & Sons, 2011



## REFERENCES

1. Rohit Chandra, Ramesh Menon, Leo Dagum, David Kohr, Dror Maydan, Jeff McDonald, "Parallel Programming in OpenMP", 1st Edition, Morgan Kaufman, 2000.
2. Ann Melnichuk, Long Talk, "Multicore Embedded systems", 1st Edition, CRC Press, 2010.
3. Wayne Wolf, "High Performance Embedded Computing: Architectures, Applications and Methodologies", 1st Edition, Morgan Kaufman, 2006.
4. E.S. Gopi, "Algorithmic Collections for Digital Signal Processing Applications Using MATLAB", 1st Edition, Springer Netherlands, 2007.

## Course Outcomes:

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

1. Identify and formalize architectural level characterization of P-DSP hardware
2. Ability to design, programming (assembly and C), and testing code using Code Composer Studio environment
3. Deployment of DSP hardware for Control, Audio and Video Signal processing applications
4. Understanding of major areas and challenges in DSP based embedded systems.

I Year I Semester

L	T	P	C
3	0	0	3

**STATISTICAL SIGNAL PROCESSING**  
(Elective - I)**UNIT 1**

**Signal models and characterization:** Types and properties of statistical models for signals and how they relate to signal processing, Common second-order methods of characterizing signals including autocorrelation, partial correlation, cross-correlation, power spectral density and cross power spectral density.

**UNIT 2**

**Signal Modelling :** The least squares method, The pade approximation, Pronys method, pole zero modeling, shanks method, all-pole modeling, FIR least squares inverse filters, Iterative pre filtering, Finite data records, Autocorrelation method, Covariance method,

**UNIT 3**

**Levinson recursion:** Levinson durbin recursion, the step up and step down recursions, The Inverse Levinson durbin recursion, Thescher recursion, The cholesky decomposition, The autocorrelation extension problem, The levinson recursion, The split levinson recursion.

**Statistical parameter estimation:** Maximum likelihood estimation, maximum a posterior estimation, Cramer-Rao bound.

**UNIT 4**

**Eigen structure based frequency estimation:** Pisarenko, MUSIC, ESPRIT their application sensor array direction finding.

**Spectrum estimation:** Moving average (MA), Auto Regressive (AR), Auto Regressive Moving Average (ARMA), Various non-parametric approaches.

**UNIT 5**

**Wiener filtering:** The finite impulse case, causal and non-causal infinite impulse responses cases, Least mean squares adaptation, recursive least squares adaptation, Kalman filtering.

**TEXT BOOKS:**

1. Steven M. Kay, fundamentals of statistical signal processing: estimation Theory, Prentice-Hall, 1993.
2. Monsoon H. Hayes, Statistical digital signal processing and modeling, USA, Wiley, 1996.

**REFERENCE BOOKS:**

1. Dimitris G. Manolakis, Vinay K. Ingle, and Stephen M. Kogon, Statistical and adaptive signal processing, Artech House, Inc, 2005, ISBN 1580536107

**Course Outcomes:**

1. Analyze signals and develop their statistical models for efficient processing
2. Formulate filtering problems from real life applications and design filtering solutions to estimate a desired signal from a given mixture by minimizing a cost function
3. Design and analyze efficient algorithms for estimation of various parameters of signals with different constraints
4. Develop efficient methods for spectrum and frequency estimation suiting the requirements derived from practical problems

**I Year I Semester**

L	T	P	C
3	0	0	3

**COGNITIVE RADIO  
(Elective –I)****Unit 1**

Introduction to Cognitive Radios: Digital dividend, cognitive radio (CR) architecture, functions of cognitive radio, dynamic spectrum access (DSA), components of cognitive radio, spectrum sensing, spectrum analysis and decision, potential applications of cognitive radio.

**Unit 2**

Spectrum Sensing: Spectrum sensing, detection of spectrum holes (TVWS), collaborative sensing, geo-location database and spectrum sharing business models (spectrum of commons, real time secondary spectrum market).

**Unit 3**

Optimization Techniques of Dynamic Spectrum Allocation: Linear programming, convex programming, non-linear programming, integer programming, dynamic programming, stochastic programming.

**Unit 4**

Dynamic Spectrum Access and Management: Spectrum broker, cognitive radio architectures, centralized dynamic spectrum access, distributed dynamic spectrum access, learning algorithms and protocols.

**Unit 5**

Spectrum Trading: Introduction to spectrum trading, classification to spectrum trading, radio resource pricing, brief discussion on economics theories in DSA (utility, auction theory), classification of auctions (single auctions, double auctions, concurrent, sequential). Research Challenges in Cognitive Radio: Network layer and transport layer issues, cross-layer design for cognitive radio networks

**TEXT BOOKS:**

1. Ekram Hossain, Dusit Niyato, Zhu Han, "Dynamic Spectrum Access and Management in Cognitive Radio Networks", Cambridge University Press, 2009.
2. Kwang-Cheng Chen, Ramjee Prasad, "Cognitive radio networks", John Wiley & Sons Ltd., 2009.

## REFERENCE BOOKS

1. Bruce Fette, "Cognitive radio technology", Elsevier, 2<sup>nd</sup> edition, 2009.
2. Huseyin Arslan, "Cognitive Radio, Software Defined Radio, and Adaptive Wireless Systems", Springer, 2007.
3. Francisco Rodrigo Porto Cavalcanti, Soren Andersson, "Optimizing Wireless Communication Systems" Springer, 2009.
4. Linda Doyle, "Essentials of Cognitive Radio", Cambridge University Press, 2009

## Course Outcomes

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

1. Understand the fundamental concepts of cognitive radio networks.
2. Develop the cognitive radio, as well as techniques for spectrum holes detection that cognitive radio takes advantages in order to exploit it.
3. Understand technologies to allow an efficient use of TVWS for radio communications based on two spectrum sharing business models/policies.
4. Understand fundamental issues regarding dynamic spectrum access, the radio-resource management and trading, as well as a number of optimisation techniques for better spectrum exploitation.

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I Year I Semester

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### ADAPTIVE SIGNAL PROCESSING (Elective –II)

#### UNIT –1

**Introduction to Adaptive Systems:** Adaptive Systems: Definitions, Characteristics, Applications, Example of an Adaptive System. The Adaptive Linear Combiner - Description, Weight Vectors, Desired Response, Performance function - Gradient & Mean Square Error.

#### UNIT –2

**Development of Adaptive Filter Theory & Searching the Performance surface:**

Introduction to Filtering - Smoothing and Prediction – Linear Optimum Filtering, Problem statement, Principle of Orthogonality - Minimum Mean Square Error, Wiener- Hopf equations, Error Performance surface

**Searching the performance surface** – Methods & Ideas of Gradient Search methods, Gradient Searching Algorithm & its Solution, Stability & Rate of convergence, Learning Curve.

#### UNIT –3

**Steepest Descent Algorithms:** Gradient Search by Newton's Method, Method of Steepest Descent, Comparison of Learning Curves.

#### UNIT –4

**LMS Algorithm & Applications:** Overview - LMS Adaptation algorithms, Stability & Performance analysis of LMS Algorithms - LMS Gradient & Stochastic algorithms - Convergence of LMS algorithm.

**Applications:** Noise cancellation – Cancellation of Echoes in long distance telephone circuits, Adaptive Beam forming.

#### UNIT –5

**RLS & Kalman Filtering:** Introduction to RLS Algorithm, Statement of Kalman filtering problem, The Innovation Process, Estimation of State using the Innovation Process- Expression of Kalman Gain, Filtering Examples using Kalman filtering.

#### TEXT BOOKS

1. Adaptive Signal Processing - Bernard Widrow, Samuel D. Stearns, 2005, PE.
2. Adaptive Filter Theory - Simon Haykin, 4th Ed., 2002, PE Asia.

#### REFERENCE BOOKS

1. Optimum signal processing: An introduction - Sophocles J. Orfanidis, 2<sup>nd</sup> Ed., 1988, McGraw-Hill, New York
2. Adaptive signal processing-Theory and Applications - S. Thomas Alexander, 1986, Springer –Verlag.
3. Signal analysis – Candy, McGraw Hill Int. Student Edition
4. James V. Candy - Signal Processing: A Modern Approach, McGraw-Hill, International Edition, 1988



I Year I Semester

L	T	P	C
3	0	0	3

**DIGITAL DATA COMMUNICATIONS**  
(Elective –II)**Course objectives**

The main objectives of this subject are:

1. Different modulation techniques to improve the bandwidth and their properties.
2. Networking and different protocol systems.
3. Error estimation and correction, asynchronous and synchronous protocols.
4. Multiplexing techniques, different networking connections and interfacing devices.
5. Multiple access techniques and analysis.

**UNIT -1**

**Digital Modulation Schemes:** BPSK, QPSK, 8PSK, 16PSK, 8QAM, 16QAM, DPSK – Methods, Band Width Efficiency, Carrier Recovery, Clock Recovery.

**UNIT -2**

**Basic Concepts of Data Communications, Interfaces and Modems:**

Data Communication Networks, Protocols and Standards, UART, USB, Line Configuration, Topology, Transmission Modes, Digital Data Transmission, DTE-DCE interface, Categories of Networks – TCP/IP Protocol suite and Comparison with OSI model.

**UNIT -3**

**Error Correction:** Types of Errors, Vertical Redundancy Check (VRC), LRC, CRC, Checksum, Error Correction using Hamming code  
**Data Link Control:** Line Discipline, Flow Control, Error Control  
**Data Link Protocols:** Asynchronous Protocols, Synchronous Protocols, Character Oriented Protocols, Bit-Oriented Protocol, Link Access Procedures.

**UNIT -4**

**Multiplexing:** Frequency Division Multiplexing (FDM), Time Division Multiplexing (TDM), Multiplexing Application, DSL.

**Local Area Networks:** Ethernet, Other Ether Networks, Token Bus, Token Ring, FDDI.

**Metropolitan Area Networks:** IEEE 802.6, SMDS

**Switching:** Circuit Switching, Packet Switching, Message Switching.

**Networking and Interfacing Devices:** Repeaters, Bridges, Routers, Gateway, Other Devices.

**UNIT -5:**

**Multiple Access Techniques:**

Frequency- Division Multiple Access (FDMA), Time - Division Multiple Access (TDMA), Code Division Multiple Access (CDMA), OFDM and OFDMA. Random Access, Aloha- Carrier Sense Multiple Access (CSMA)- Carrier Sense Multiple Access with Collision Avoidance(CSMA/CA), Controlled Access- Reservation- Polling- Token Passing, Channelization

**TEXT BOOKS**

1. Data Communication and Computer Networking - B. A.Forouzan, 2<sup>nd</sup> Ed., 2003, TMH.
2. Advanced Electronic Communication Systems - W. Tomasi, 5<sup>th</sup> Ed., 2008, PEI.

**REFERENCE BOOKS:**

1. Data Communications and Computer Networks - Prakash C. Gupta, 2006, PHI.
2. Data and Computer Communications - William Stallings, 8<sup>th</sup> Ed., 2007, PHI.
3. Data Communication and Tele Processing Systems -T. Housely, 2<sup>nd</sup> Ed, 2008, BSP.
4. Data Communications and Computer Networks- Brijendra Singh, 2<sup>nd</sup> Ed., 2005, PHI.

**Course outcomes:**

At the end of this course the student can able to:

1. Model digital communication system using appropriate mathematical techniques (error probability, constellation diagrams, pharos diagrams).
2. Understanding the basic concepts of how digital data is transferred across computer networks.
3. Independently understand basic computer network technology.
4. Understand and explain Data Communications System and its components.
5. Identify the different types of network topologies and protocols.
6. Enumerate the layers of the OSI model and TCP/IP. Explain the function(s) of each layer.
7. Identify the different types of network devices and their functions within a network
8. Understand and building the skills of sub netting and routing mechanisms.
9. Familiarity with the basic protocols of computer networks, and how they can be used
10. To assist in network design and implementation.

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**CODING THEORY AND APPLICATIONS**  
**(Elective –II)**

**UNIT –1**

**Coding for Reliable Digital Transmission and Storage:** Mathematical model of Information, A Logarithmic Measure of Information, Average and Mutual Information and Entropy, Types of Errors, Error Control Strategies.

**Linear Block Codes:** Introduction to Linear Block Codes, Syndrome and Error Detection, Minimum Distance of a Block code, Error-Detecting and Error-correcting Capabilities of a Block code, Standard array and Syndrome Decoding, Probability of an undetected error for Linear Codes over a BSC, Hamming Codes. Applications of Block codes for Error control in data storage system

**UNIT –2**

**Cyclic Codes:** Description, Generator and Parity-check Matrices, Encoding, Syndrome Computation and Error Detection, Decoding ,Cyclic Hamming Codes, Shortened cyclic codes, Error-trapping decoding for cyclic codes, Majority logic decoding for cyclic codes.

**UNIT –3**

**Convolutional Codes:** Encoding of Convolutional Codes, Structural and Distance Properties, maximum likelihood decoding, Sequential decoding, Majority- logic decoding of Convolution codes. Application of Viterbi Decoding and Sequential Decoding, Applications of Convolutional codes in ARQ system.

**UNIT –4**

**Burst –Error-Correcting Codes:**Decoding of Single-Burst error Correcting Cyclic codes, Single-Burst-Error-Correcting Cyclic codes, Burst-Error-Correcting Convolutional Codes, Bounds on Burst Error-Correcting Capability, Interleaved Cyclic and Convolutional Codes, Phased-Burst –Error-Correcting Cyclic and Convolutional codes.

**UNIT -5**

**BCH – Codes:** BCH code- Definition, Minimum distance and BCH Bounds, Decoding Procedure for BCH Codes- Syndrome Computation and Iterative Algorithms, Error Location Polynomials and Numbers for single and double error correction

**TEXT BOOKS:**

1. Error Control Coding- Fundamentals and Applications –Shu Lin, Daniel J.Costello,Jr, Prentice Hall, Inc.
2. Error Correcting Coding Theory-Man Young Rhee- 1989, McGraw-Hill Publishing.

**REFERENCE BOOKS:**

1. Digital Communications-Fundamental and Application - Bernard Sklar, PE.
2. Digital Communications- John G. Proakis, 5<sup>th</sup> Ed., 2008, TMH.
3. Introduction to Error Control Codes-Salvatore Gravano-oxford
4. Error Correction Coding – Mathematical Methods and Algorithms – Todd K.Moon, 2006, Wiley India.
5. Information Theory, Coding and Cryptography – Ranjan Bose, 2<sup>nd</sup> Ed, 2009, TMH.

**Course Outcomes:**

On completion of this course student will be able to

1. Learning the measurement of information and errors.
2. Obtain knowledge in designing Linear Block Codes and Cyclic codes.
3. Construct tree and trellis diagrams for convolution codes
4. Design the Turbo codes and Space time codes and also their applications

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**I Year I Semester**

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0	0	4	2

**ADVANCED DIGITAL SIGNAL PROCESSING LAB****List of Assignments:**

1. Basic Signal Representation
2. Correlation Auto and Cross
3. Stability Using Hurwitz Routh Criteria
4. Sampling FFT Of Input Sequence
5. Butterworth Low pass And High pass Filter Design
6. Chebychev Type I,II Filter
7. State Space Matrix from Differential Equation
8. Normal Equation Using Levinson Durbin
9. Decimation And Interpolation Using Rationale Factors
10. Maximally Decimated Analysis DFT Filter
11. Cascade Digital IIR Filter Realization
12. Convolution And M Fold Decimation & PSD Estimator
13. Estimation of PSD
14. Inverse Z Transform
15. Group Delay Calculation
16. Separation of T/F
17. Parallel Realization of IIR filter

**Course Outcomes:**

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

1. Design different digital filters in software
2. Apply various transforms in time and frequency
3. Perform decimation and interpolation



**I Year I Semester**

L	T	P	C
0	0	4	2

**DIGITAL IMAGE AND VIDEO PROCESSING LAB****List of Assignments:**

1. Perform basic operations on images like addition, subtraction etc.
2. Plot the histogram of an image and perform histogram equalization
3. Implement segmentation algorithms
4. Perform video enhancement
5. Perform video segmentation
6. Perform image compression using lossy technique
7. Perform image compression using lossless technique
8. Perform image restoration
9. Convert a colour model into another
10. Calculate boundary features of an image
11. Calculate regional features of an image
12. Detect an object in an image/video using template matching/Bayes classifier

**Course Outcomes:**

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

1. Perform image and video enhancement
2. Perform image and video segmentation
3. Detect an object in an image/video



## RESEARCH METHODOLOGY AND IPR

### Unit 1

Meaning of research problem, Sources of research problem, Criteria Characteristics of a good research problem, Errors in selecting a research problem, Scope and objectives of research problem. Approaches of investigation of solutions for research problem, data collection, analysis, interpretation, Necessary instrumentations

### Unit 2

Effective literature studies approaches, analysis Plagiarism , Research ethics,

### Unit 3

Effective technical writing, how to write report, Paper Developing a Research Proposal, Format of research proposal, a presentation and assessment by a review committee

### Unit 4

Nature of Intellectual Property: Patents, Designs, Trademarks and Copyright. Process of Patenting and Development: technological research, innovation, patenting, development. International Scenario: International cooperation on Intellectual Property. Procedure for grants of patents, Patenting under PCT.

### Unit 5

Patent Rights: Scope of Patent Rights, Licensing and transfer of technology, Patent information and databases, Geographical Indications.

### Unit 6

New Developments in IPR: Administration of Patent System. New developments in IPR, IPR of Biological Systems, Computer Software etc. Traditional knowledge Case Studies, IPR and IITs.

### TEXT BOOKS

1. Stuart Melville and Wayne Goddard, "Research methodology: an introduction for science & engineering students".
2. Wayne Goddard and Stuart Melville, "Research Methodology: An Introduction"

### REFERENCES

1. Ranjit Kumar, 2nd Edition , "Research Methodology: A Step by Step Guide for beginners"
2. Halbert, "Resisting Intellectual Property", Taylor & Francis Ltd, 2007.
3. Mayall , "Industrial Design", McGraw Hill, 1992.
4. Niebel , "Product Design", McGraw Hill, 1974.
5. Asimov , "Introduction to Design", Prentice Hall, 1962.
6. Robert P. Merges, Peter S. Menell, Mark A. Lemley, " Intellectual Property in New Technological Age", 2016.
7. T. Ramappa, "Intellectual Property Rights Under WTO", S. Chand, 2008

**Course Outcomes:**

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

1. Understand research problem formulation.
2. Analyze research related information
3. Follow research ethics
4. Understand that today's world is controlled by Computer, Information Technology, but tomorrow world will be ruled by ideas, concept, and creativity.
5. Understanding that when IPR would take such important place in growth of individuals & nation, it is needless to emphasis the need of information about Intellectual Property Right to be promoted among students in general & engineering in particular.
6. Understand that IPR protection provides an incentive to inventors for further research work and investment in R & D, which leads to creation of new and better products, and in turn brings about, economic growth and social benefits.

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I Year II Semester

L	T	P	C
3	0	0	3

**PATTERN RECOGNITION AND MACHINE LEARNING****Course Objectives**

1. To equip students with basic mathematical and statistical techniques commonly used in pattern recognition.
2. To introduce students to a variety of pattern recognition algorithms.
3. Enable students to apply machine learning concepts in real life problems.

**Unit 1**

**Introduction to Pattern Recognition:** Problems, applications, design cycle, learning and adaptation, examples, Probability Distributions, Parametric Learning - Maximum likelihood and Bayesian Decision Theory- Bayes rule, discriminant functions, loss functions and Bayesian error analysis

**Unit 2**

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

**Unit 3**

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

**Unit 4**

**Linear discriminant functions** - decision surfaces, two-category, multi-category, minimum- squared error procedures, the Ho-Kashyap procedures, linear programming algorithms, Support vector machine

**Unit 5**

**Algorithm independent machine learning** – lack of inherent superiority of any classifier, bias and variance, re-sampling for classifier design, combining classifiers

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

**TEXT BOOKS:**

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

**REFERENCES:**

1. C. Bishop, "Pattern Recognition and Machine Learning", Springer, 2006

**Course Outcomes:**

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

1. Study the parametric and linear models for classification
2. Design neural network and SVM for classification
3. Develop machine independent and unsupervised learning techniques

**I Year II Semester**

L	T	P	C
3	0	0	3

## DETECTION AND ESTIMATION THEORY

### Course Objectives

1. To enable the students to acquire the fundamental concepts of Signal Detection and Estimation
2. To get familiarize with different Hypotheses in detection and estimation problems
3. To introduce the methods of Detection and estimation of signals in white and non-white Gaussian noise.
4. To familiarize with the detection of random signals.
5. To enable the students to understand the time varying waveform detection and its estimation

### Unit 1

Review of Vector Spaces: Vectors and matrices: notation and properties, orthogonality and linear independence, bases, distance properties, matrix operations, Eigen values and eigenvectors.

### Unit 2

Properties of Symmetric Matrices: Diagonalization of symmetric matrices, symmetric positive definite and semi definite matrices, principal component analysis (PCA), singular value decomposition.

### Unit 3

Stochastic Processes: Time average and moments, ergodicity, power spectral density, covariance matrices, response of LTI system to random process, cyclostationary process, and spectral factorization.

### Unit 4

Detection Theory: Detection in white Gaussian noise, correlator and matched filter interpretation, Bayes' criterion of signal detection, MAP, LMS, entropy detectors, detection in colored Gaussian noise, Karhunen-Loeve expansions and whitening filters.

### Unit 5

Estimation Theory: Minimum variance estimators, Cramer-Rao lower bound, examples of linear models, system identification, Markov classification, clustering algorithms. Topics in Kalman and Wiener Filtering: Discrete time Wiener-Hopf equation, error variance computation, causal discrete time Wiener filter, discrete Kalman filter, extended Kalman filter, examples. Specialized Topics in Estimation: Spectral estimation methods like MUSIC, ESPRIT, DOA Estimation.

### TEXT BOOKS:

1. Steven M. Kay, "Fundamentals of Statistical Signal Processing, Volume I: Estimation Theory", Prentice Hall, 1993
2. Steven M. Kay, "Fundamentals of Statistical Signal Processing, Volume II: Detection Theory", 1st Edition, Prentice Hall, 1998
- 3.

### REFERENCES:

1. Thomas Kailath, Babak Hassibi, Ali H. Sayed, "Linear Estimation", Prentice Hall, 2000.
2. H. Vincent Poor, "An Introduction to Signal Detection and Estimation", 2nd Edition, Springer, 1998.

### Course Outcomes:

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

1. Understand the mathematical background of signal detection and estimation
2. Use classical and Bayesian approaches to formulate and solve problems for signal detection and parameter estimation from noisy signals.



**I Year II Semester**

L	T	P	C
3	0	0	3

**IoT AND APPLICATIONS**  
(Elective-III)

**Unit1**

IoT& Web Technology The Internet of Things Today, Time for Convergence, Towards the IoT Universe, Internet of Things Vision, IoT Strategic Research and Innovation Directions, IoT Applications, Future Internet Technologies, Infrastructure, Networks and Communication, Processes, Data Management, Security, Privacy & Trust, Device Level Energy Issues, IoT Related Standardization, Recommendations on Research Topics.

**Unit 2**

M2M to IoT – A Basic Perspective– Introduction, Some Definitions, M2M Value Chains, IoT chain and global information monopolies. M2M to IoT-An Architectural Overview– Building an architecture, Main design principles and needed capabilities, An IoT architecture outline, standardsconsiderations.

**Unit 3**

IoT Architecture -State of the Art – Introduction, State of the art, Architecture Reference Model-Introduction, Reference Model and architecture, IoT reference Model, IoTReference Architecture-Introduction, Functional View, Information View, Deployment and Operational View, Other Relevant architectural views.

**Unit 4**

IoT Applications for Value Creations Introduction, IoT applications for industry: Future Factory Concepts, Brownfield IoT, Smart Objects, Smart Applications, Four Aspects in your Business to Master IoT, Value Creation from Big Data and Serialization, IoT for Retailing Industry, IoT For Oil and Gas Industry, Opinions on IoT Application and Value for Industry, Home Management, e Health.

**Unit 5**

Internet of Things Privacy, Security and Governance Introduction, Overview of Governance, Privacy and Security Issues,Contribution from FP7 Projects, Security, Privacy and Trust in IoT-Data-Platforms for Smart Cities, First Steps Towards a Secure Platform, Smartie Approach. Data Aggregation for the IoTinSmart Cities, Security

**TEXT BOOKS:**

1. Vijay Madisetti and ArshdeepBahga, "Internet of Things (A Hands-on-Approach)", 1<sup>st</sup> Edition, VPT,2014.
2. Francis daCosta, "Rethinking the Internet of Things: A Scalable Approach to Connecting Everything", 1<sup>st</sup>Edition, Apress Publications,2013.

**REFERENCES:**

1. CunoPfister, "Getting Started with the Internet of Things", O Reilly Media,2011

**Course Outcomes:**

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

1. Understand the concept of IOT andM2M
2. Study IOT architecture and applications in various fields
3. Study the security and privacy issues in IoT



**I Year II Semester**

L	T	P	C
3	0	0	3

**WIRELESS SENSOR NETWORKS**  
**(Elective-III)****Unit 1**

Introduction and overview of sensor network architecture and its applications, sensor network comparison with Ad Hoc Networks, Sensor node architecture with hardware and software details.

**Unit 2**

Hardware: Examples like mica2, micaZ, telosB, cricket, Imote2, tmote, btnode, and Sun SPOT, Software (Operating Systems): tinyOS, MANTIS, Contiki, and RetOS.

**Unit 3**

Programming tools: C, nesC. Performance comparison of wireless sensor networks simulation and experimental platforms like open source (ns-2) and commercial (QualNet, Opnet)

**Unit 4**

Overview of sensor network protocols (details of atleast 2 important protocol per layer): Physical, MAC and routing/ Network layer protocols, node discovery protocols, multi-hop and cluster based protocols, Fundamentals of 802.15.4, Bluetooth, BLE (Bluetooth low energy), UWB.

**Unit 5**

Data dissemination and processing; differences compared with other database management systems, data storage; query processing. **Specialized features:** Energy preservation and efficiency; security challenges; fault-tolerance, Issues related to Localization, connectivity and topology, Sensor deployment mechanisms; coverage issues; sensor Web; sensor Grid, Open issues for future research, and Enabling technologies in wireless sensor network.

**TEXT BOOKS:**

1. H. Karl and A. Willig, "Protocols and Architectures for Wireless Sensor Networks", John Wiley & Sons, India, 2012.
2. C. S. Raghavendra, K. M. Sivalingam, and T. Znati, Editors, "Wireless Sensor Networks", Springer Verlag, 1<sup>st</sup> Indian reprint, 2010.

**REFERENCES:**

1. F. Zhao and L. Guibas, "Wireless Sensor Networks: An Information Processing Approach", Morgan Kaufmann, 1<sup>st</sup> Indian reprint, 2013.
2. Yingshu Li, MyT. Thai, Weili Wu, "Wireless sensor Network and Applications", Springer series on signals and communication technology, 2008.

**Course Outcomes:**

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

1. Design wireless sensor network system for different applications under consideration.
2. Understand the hardware details of different types of sensors and select right type of sensor for various applications.
3. Understand radio standards and communication protocols to be used for wireless sensor network based systems and application.
4. Use operating systems and programming languages for wireless sensor nodes, performance of wireless sensor networks systems and platforms.
5. Handle special issues related to sensors like energy conservation and security challenges

I Year II Semester

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**SOFT COMPUTING TECHNIQUES****(Elective-III)****UNIT -1:**

**Introduction:** Approaches to intelligent control, Architecture for intelligent control, Symbolic reasoning system, Rule-based systems, the AI approach, Knowledge representation - Expert systems.

**UNIT -2:**

**Artificial Neural Networks:** Concept of Artificial Neural Networks and its basic mathematical model, McCulloch-Pitts neuron model, simple perceptron, Adaline and Madaline, Feed-forward Multilayer Perceptron, Learning and Training the neural network, Data Processing: Scaling, Fourier transformation, principal-component analysis and wavelet transformations, Hopfield network, Self-organizing network and Recurrent network, Neural Network based controller.

**UNIT -3:**

**Fuzzy Logic System:** Introduction to crisp sets and fuzzy sets, basic fuzzy set operation and approximate reasoning, Introduction to fuzzy logic modeling and control, Fuzzification, inferencing and defuzzification, Fuzzy knowledge and rule bases, Fuzzy modeling and control schemes for nonlinear systems, Self-organizing fuzzy logic control, Fuzzy logic control for nonlinear time delay system.

**UNIT -4:**

**Genetic Algorithm:** Basic concept of Genetic algorithm and detail algorithmic steps, Adjustment of free parameters, Solution of typical control problems using genetic algorithm, Concept on some other search techniques like Tabu search and ant D-colony search techniques for solving optimization problems.

**UNIT -5:****Applications:**

GA application to power system optimization problem, Case studies: Identification and control of linear and nonlinear dynamic systems using MATLAB-Neural Network toolbox, Stability analysis of Neural-Network interconnection systems, Implementation of fuzzy logic controller using MATLAB fuzzy-logic toolbox, Stability analysis of fuzzy control systems.

**TEXT BOOKS:**

1. Introduction to Artificial Neural Systems - Jacek.M.Zurada, Jaico Publishing House, 1999.
2. Neural Networks and Fuzzy Systems - Kosko, B., Prentice-Hall of India Pvt. Ltd., 1994.

**REFERENCE BOOKS:**

1. Fuzzy Sets, Uncertainty and Information - Klir G.J. & Folger T.A., Prentice-Hall of India Pvt. Ltd., 1993.
2. Fuzzy Set Theory and Its Applications - Zimmerman H.J. Kluwer Academic Publishers, 1994.
3. Introduction to Fuzzy Control - Driankov, Hellendroon, Narosa Publishers.
4. Artificial Neural Networks - Dr. B. Yagananarayana, 1999, PHI, New Delhi.
5. Elements of Artificial Neural Networks - Kishan Mehrotra, Chelkuri K. Mohan, Sanjay Ranka, Penram International.
6. Artificial Neural Network - Simon Haykin, 2<sup>nd</sup> Ed., Pearson Education.
7. Introduction Neural Networks Using MATLAB 6.0 - S.N. Shivanandam, S. Sumati, S. N.

Deepa, I/e, TMH, New Delhi.

**Course Outcomes**

At the end of this course the student can able to:

1. Understand the basic concepts of Artificial neural network systems.
2. Understand the McCulloch-Pitts neuron model, simple and multilayer Perception, Adeline and Madeline concepts.
3. Data processing, Hopfield and self-organizing network.
4. Difference between crisp sets to fuzzy sets, fuzzy models, fuzzification, inference, membership functions, rule based approaches and defuzzification.
5. Self – organizing fuzzy logic control, non linear time delay systems.
6. Understand the concept of Genetic Algorithm steps. Tabu, and D-colony search techniques for solving optimization problems.
7. GA applications to power system optimization problems, identification and control of linear and nonlinear dynamic systems using MATLAB-Neural network toolbox.
8. Know the application and importance stability analysis

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I Year II Semester

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3	0	0	3

### SMART ANTENNAS (Elective-IV)

**UNIT -1:**
**Smart Antennas:**

Introduction, Need for Smart Antennas, Overview, Smart Antenna Configurations, Switched-Beam Antennas, Adaptive Antenna Approach, Space Division Multiple Access (SDMA), Architecture of a Smart Antenna System, Receiver, Transmitter, Benefits and Drawbacks, Basic Principles, Mutual Coupling Effects.

**UNIT -2:**
**DOA Estimation Fundamentals:**

Introduction, Array Response Vector, Received Signal Model, Subspace-Based Data Model, Signal Auto covariance, Conventional DOA Estimation Methods, Conventional Beam forming Method, Capon's Minimum Variance Method, Subspace Approach to DOA Estimation, MUSIC Algorithm, ESPRIT Algorithm, Uniqueness of DOA Estimates .

**UNIT -3:**

**Beam Forming Fundamentals:** Classical Beam former, Statistically Optimum Beam forming Weight Vectors, Maximum SNR Beam former, Multiple Sidelobe Canceller and Maximum, SINR Beam former, Minimum Mean Square Error (MMSE), Direct Matrix Inversion (DMI), Linearly Constrained Minimum Variance (LCMV), Adaptive Algorithms for Beam forming

**UNIT -4:**
**Integration and Simulation of Smart Antennas:**

Overview, Antenna Design, Mutual Coupling, Adaptive Signal Processing Algorithms, DOA, Adaptive Beam forming, Beam forming and Diversity Combining for Rayleigh-Fading, Channel, Trellis-Coded Modulation (TCM) for Adaptive Arrays, Smart Antenna Systems for Mobile AdHoc Networks (MANETs), Protocol, Simulations, Discussion.

**UNIT -5:**

**Space-Time Processing:** Introduction, Discrete Space-Time Channel and Signal Models, Space-Time Beam forming, Inter symbol and Co-Channel Suppression, Space-Time Processing for DS-CDMA, Capacity and Data Rates in MIMO Systems, Discussion.

**TEXT BOOKS:**

1. 'Introduction to Smart Antennas' - Constantine A. Balanis & Panayiotis I. Ioannides, Morgan & Claypool Publishers' series-2007
2. Joseph C. Liberti Jr., Theodore S Rappaport - "Smart Antennas for Wireless Communications IS-95 and Third Generation CDMA Applications", PTR – PH publishers, 1st Edition, 1989.

**REFERENCE BOOKS:**

1. T.S Rappaport - "Smart Antennas Adaptive Arrays Algorithms and Wireless PositionLocation", IEEE press 1998, PTR – PH publishers 1999. Smart Antennas - LalChandGodara, CRC Press, LLC-2004



	L	T	P	C
I Year II Semester	3	0	0	3

**BIOMEDICAL SIGNAL PROCESSING**  
**(Elective –IV)**

**Unit 1**

Acquisition, Generation of Bio-signals, Origin of bio-signals, Types of bio-signals, Study of diagnostically significant bio-signal parameters

**Unit 2**

Electrodes for bio-physiological sensing and conditioning, Electrode-electrolyte interface, polarization, electrode skin interface and motion artefact, biomaterial used for electrode, Types of electrodes (body surface, internal, array of electrodes, microelectrodes), Practical aspects of using electrodes, Acquisition of bio-signals (signal conditioning) and Signal conversion (ADC's DAC's) Processing, Digital filtering

**Unit 3**

Biomedical signal processing by Fourier analysis, Biomedical signal processing by wavelet (time-frequency) analysis, Analysis (Computation of signal parameters that are diagnostically significant)

**Unit 4**

Classification of signals and noise, Spectral analysis of deterministic, stationary random signals and non-stationary signals, Coherent treatment of various biomedical signal processing methods and applications.

**Unit 5**

Principal component analysis, Correlation and regression, Analysis of chaotic signals Application areas of Bio-Signals analysis Multi resolution analysis(MRA) and wavelets, Principal component analysis(PCA), Independent component analysis(ICA), Pattern classification-supervised and unsupervised classification, Neural networks, Support vector Machines, Hidden Markov models. Examples of biomedical signal classification examples.

**TEXT BOOKS:**

1. W. J. Tompkins, "Biomedical Digital Signal Processing", Prentice Hall, 1993.
2. Eugene N Bruce, "Biomedical Signal Processing and Signal Modeling", John Wiley & Son's publication, 2001.

**REFERENCES:**

1. Myer Kutz, "Biomedical Engineering and Design Handbook, Volume I", McGraw Hill, 2009.
2. D C Reddy, "Biomedical Signal Processing", McGraw Hill, 2005. Katarzyn J. Blinowska, Jaroslaw Zygierecz, "Practical Biomedical Signal Analysis Using MATLAB", 1st Edition, CRC Press, 2011

**Course Outcomes**

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

1. Understand different types of biomedical signal.
2. Identify and analyze different biomedical signals.
3. Find applications related to biomedical signal processing

**I Year II Semester**

L	T	P	C
3	0	0	3

**OPTICAL NETWORKS  
(Elective-IV)****Unit 1**

SONET/SDH: optical transport network, IP, routing and forwarding, multiprotocol label switching. WDM network elements: optical line terminals and amplifiers, optical add/drop multiplexers, OADM architectures, reconfigurable OADM, optical cross connects.

**Unit 2**

Control and management: network management functions, optical layer services and interfacing, performance and fault management, configuration management, optical safety.

**Unit 3**

Network Survivability: protection in SONET/SDH & client layer, optical layer protection schemes

**Unit 4**

WDM network design: LTD and RWA problems, dimensioning wavelength routing networks, statistical dimensioning models.

**Unit 5**

Access networks: Optical time division multiplexing, synchronization, header processing, buffering, burst switching, test beds, Introduction to PON, GPON, AON.

**TEXT BOOKS:**

1. Rajiv Ramaswami, Sivarajan, Sasaki, "Optical Networks: A Practical Perspective", MK, Elsevier, 3<sup>rd</sup> edition, 2010.

**REFERENCES:**

1. C. Siva Ram Murthy and Mohan Gurusamy, "WDM Optical Networks: Concepts Design, and Algorithms", PHI, EEE, 2001.

**Course Outcomes:**

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

1. Contribute in the areas of optical network and WDM network design.
2. Implement simple optical network and understand further technology developments for future enhanced network

I Year II Semester

L	T	P	C
0	0	4	2

**PATTERN RECOGNITION & MACHINE LEARNING LAB****List of Assignments:**

1. Implement maximum likelihood algorithm
2. Implement Bayes classifier
3. Implement linear regression
4. Design a classifier using perceptron rule
5. Design a classifier using feed forward back-propagation and delta rule algorithms
6. Implement deep learning algorithm
7. Implement linear discriminant algorithm
8. Design a two class classifier using SVM
9. Design a multiclass classifier using SVM
10. Perform unsupervised learning

**Course Outcomes:**

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

1. Perform image and video enhancement
2. Perform image and video segmentation
3. Detect an object in an image/video

I Year II Semester

L	T	P	C
0	0	4	2

**DETECTION AND ESTIMATION THEORY LAB****List of Assignments:**

1. Simulate signal and noise models.
2. Simulate spatially separated target Signal in the presence of Additive Correlated White Noise
3. Simulate spatially separated target Signal in the presence of Additive Uncorrelated White Noise
4. Simulate spatially separated target Signal in the presence of Additive Correlated Colored Noise
5. Detect Constant amplitude Signal in AWGN
6. Detect Time varying Known Signals in AWGN
7. Detect Unknown Signals in AWGN
8. Compare performance comparison of the Estimation techniques - MLE, MMSE, Bayes Estimator, MAP Estimator, Expectation Maximization (EM) algorithm
9. Performance comparison of conventional Energy Detectors and Coherent Matched Filter Techniques

**Course Outcomes:**

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

1. Simulate signals and noise
2. Detect signals in the presence of noise
3. Compare various estimation techniques

**I Year II Semester**

L	T	P	C
0	0	4	2

**MINI PROJECT****Syllabus Contents**

The students are required to search / gather the material / information on a specific a topic comprehend it and present / discuss in the class.

**Course Outcomes**

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

1. Understand of contemporary / emerging technology for various processes and systems.
2. Share knowledge effectively in oral and written form and formulate documents



III Semester

L	T	P	C
3	0	0	3

**OPTIMIZATION TECHNIQUES**  
(Elective-V)**Unit 1**

Introduction to Classical Methods & Linear Programming Problems Terminology, Design Variables, Constraints, Objective Function, Problem Formulation. Calculus method, Kuhn Tucker conditions, Method of Multipliers.

**Unit 2**

Linear Programming Problem, Simplex method, Two-phase method, Big-M method, duality, Integer linear Programming, Dynamic Programming, Sensitivity analysis.

**Unit 3**

Single Variable Optimization Problems: Optimality Criterion, Bracketing Methods, Region Elimination Methods, Interval Halving Method, Fibonacci Search Method, Golden Section Method. Gradient Based Methods: Newton-Raphson Method, Bisection Method, Secant Method, Cubic search method.

**Unit 4**

Multi Variable and Constrained Optimization Technique, Optimality criteria, Direct search Method, Simplex search methods, Hooke-Jeeve's pattern search method, Powell's conjugate direction method, Gradient based Method, Cauchy's Steepest descent method, Newton's method, Conjugate gradient method. Kuhn - Tucker conditions, Penalty Function, Concept of Lagrangian multiplier, Complex search method, Random search method

**Unit 5**

Intelligent Optimization Techniques: Introduction to Intelligent Optimization, Soft Computing, Genetic Algorithm: Types of reproduction operators, crossover & mutation, Simulated Annealing Algorithm, Particle Swarm Optimization (PSO) - Graph Grammar Approach - Example Problems. Genetic Programming (GP): Principles of genetic programming, terminal sets, functional sets, differences between GA & GP, random population generation, solving differential equations using GP.

**TEXTBOOKS**

1. S. S. Rao, "Engineering Optimisation: Theory and Practice", Wiley, 2008.
2. K. Deb, "Optimization for Engineering design algorithms and Examples", Prentice Hall, 2005.

**REFERENCES**

1. C.J. Ray, "Optimum Design of Mechanical Elements", Wiley, 2007.
2. R. Saravanan, "Manufacturing Optimization through Intelligent Techniques, Taylor & Francis Publications, 2006.
3. D. E. Goldberg, "Genetic algorithms in Search, Optimization, and Machine learning", Addison-Wesley Longman Publishing, 1989

**Course Outcomes:**

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

1. Understand importance of optimization
2. Apply basic concepts of mathematics to formulate an optimization problem Analyze and appreciate variety of performance measures for various optimization problems.

**III Semester**

L	T	P	C
3	0	0	3

**MODELING AND SIMULATION TECHNIQUES  
(Elective-V)****Unit 1**

Introduction Circuits as dynamic systems, Transfer functions, poles and zeroes, State space, Deterministic Systems, Difference and Differential Equations, Solution of Linear Difference and Differential Equations, Numerical Simulation Methods for ODEs, System Identification, Stability and Sensitivity Analysis.

**Unit 2**

Statistical methods, Description of data, Data-fitting methods, Regression analysis, Least Squares Method, Analysis of Variance, Goodness of fit.

**Unit 3**

Probability and Random Processes, Discrete and Continuous Distribution, Central Limit theorem, Measure of Randomness, Monte Carlo Methods. Stochastic Processes and Markov Chains, Time Series Models.

**Unit 4**

Modeling and simulation concepts, Discrete-event simulation, Event scheduling/Time advance algorithms, Verification and validation of simulation models.

**Unit 5**

Continuous simulation: Modeling with differential equations, Example models, Bond Graph Modeling, Population Dynamics Modeling, System dynamics

**TEXTBOOKS**

1. R. L. Woods and K. L. Lawrence, "Modeling and Simulation of Dynamic Systems", Prentice-Hall, 1997.

**REFERENCES**

1. Z. Navalih, "VHDL Analysis and Modelling of Digital Systems", McGraw-Hill, 1993.
2. J. Banks, JS. Carson and B. Nelson, "Discrete-Event System Simulation", 2nd Edition, Prentice-Hall of India, 1996

**Course Outcomes:**

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

1. Identify and model discrete systems (deterministic and random)
2. Identify and model discrete signals (deterministic and random)
3. Understand modelling and simulation techniques to characterize systems/processes.

III Semester

L	T	P	C
3	0	0	3

**ARTIFICIAL INTELLIGENCE**  
**(Elective-V)****Unit 1**

What is AI (artificial intelligence)? : the AI problems, the underlying assumption, what are AI techniques, the level of the model, criteria for success, some general references, one final word problems, state space search & heuristic search techniques: defining the problems as a state space search, production systems, production characteristics, production system characteristics, and issues in the design of search programs, additional problems. Generate-and-test, hill climbing, best-first search, problem reduction, constraint satisfaction, means-ends analysis.

**Unit 2**

Knowledge representation issues: representations and mappings, approaches to knowledge representation. Using predicate logic: representation simple facts in logic, representing instance and its relationships, computable functions and predicates, resolution. Representing knowledge using rules: procedural versus declarative knowledge, logic programming, forward versus backward reasoning.

**Unit 3**

Symbolic reasoning under uncertainty: introduction to non-monotonic reasoning, logics for non-monotonic reasoning. Statistical reasoning: probability and Bayes' theorem, certainty factors and rule-based systems, Bayesian networks, Dempster-Shafer theory fuzzy logic. Weak slot-and-filler structures: semantic nets, frames. Strong slot-and-filler structures: conceptual dependency, scripts, CYC

**Unit 4**

Game playing: overview, and example domain: overview, mini max, alpha-beta cut-off, refinements, iterative deepening, the blocks world, components of a planning system, goal stack planning, nonlinear planning using constraint posting, hierarchical planning, reactive systems, other planning techniques. Understanding: what is understanding? What makes it hard? As constraint satisfaction

**Unit 5**

Natural language processing: introduction, syntactic processing, semantic analysis, semantic analysis, discourse and pragmatic processing, spell checking connectionist models: introduction: hop field network, learning in neural network, application of neural networks, recurrent networks, distributed representations, connectionist AI and symbolic AI

**TEXTBOOKS:**

1. Elaine Rich and Kevin Knight "Artificial Intelligence", 2nd Edition, Tata McGraw-Hill, 2005.

**REFERENCES:**

1. Stuart Russel and Peter Norvig, "Artificial Intelligence: A Modern Approach", 3rd Edition, Prentice Hall, 2009

**Course Outcomes:**

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

1. Understand the concept of Artificial Intelligence, search techniques and knowledge representation issues
2. Understanding reasoning and fuzzy logic for artificial intelligence
3. Understanding game playing and natural language processing.



**III Semester**

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0	0	20	10

### (DISSERTATION) DISSERTATION PHASE – I AND PHASE – II

#### Syllabus Contents:

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

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

The student should complete the following:

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

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

- Experimental verification / Proof of concept.
- Design, fabrication, testing of Communication System.
- The viva-voce examination will be based on the above report and work.

#### Guidelines for Dissertation Phase – I and II 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 unsatisfactory performance, committee may recommend for extension or repeating the work

**Course Outcomes:**

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

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

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**III Semester**

L	T	P	C
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**OPEN ELECTIVES****BUSINESS ANALYTICS****Unit 1:**

Business analytics: Overview of Business analytics, Scope of Business analytics, Business Analytics Process, Relationship of Business Analytics Process and organisation, competitive advantages of Business Analytics.

Statistical Tools: Statistical Notation, Descriptive Statistical methods,

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

**Unit 2:**

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

**Unit 3:**

Organization Structures of Business analytics, Team management, Management Issues, Designing Information Policy, Outsourcing, Ensuring Data Quality, Measuring contribution of Business analytics, Managing Changes. Descriptive Analytics, predictive analytics, predictive Modelling, Predictive analytics analysis, Data Mining, Data Mining Methodologies, Prescriptive analytics and its step in the business analytics Process, Prescriptive Modelling, nonlinear Optimization.

**Unit 4:**

Forecasting Techniques: Qualitative and Judgmental Forecasting, Statistical Forecasting Models, Forecasting Models for Stationary Time Series, Forecasting Models for Time Series with a Linear Trend, Forecasting Time Series with Seasonality, Regression Forecasting with Casual Variables, Selecting Appropriate Forecasting Models.

Monte Carlo Simulation and Risk Analysis: Monte Carlo Simulation

Using Analytic Solver Platform, New-Product Development Model, Newsvendor Model, Overbooking Model, Cash Budget Model.

**Unit 5:**

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

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

**Reference:**

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

**COURSE OUTCOMES**

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

III Semester

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**OPENELECTIVES  
INDUSTRIALSAFETY****Unit-1:**

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-2:**

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-3:**

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

**Unit-4:**

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

**Unit-5:**

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 andimportance

**Reference:**

1. Maintenance Engineering Handbook, Higgins & Morrow, Da InformationServices.
2. Maintenance Engineering, H. P. Garg, S. Chand andCompany.
3. Pump-hydraulic Compressors, Audels, McgrewHillPublication.
4. Foundation Engineering Handbook, Winterkorn, Hans, Chapman &HallLondon

III Semester

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**OPENELECTIVES  
OPERATIONSRESEARCH****Unit 1:**

Optimization Techniques, Model Formulation, models, General L.R Formulation, Simplex Techniques, Sensitivity Analysis, Inventory Control Models

**Unit 2**

Formulation of a LPP - Graphical solution revised simplex method - duality theory - dual simplex method - sensitivity analysis - parametric programming

**Unit 3:**

Nonlinear programming problem - Kuhn-Tucker conditions min cost flow problem - max flow problem - CPM/PERT

**Unit 4**

Scheduling and sequencing - single server and multiple server models - deterministic inventory models - Probabilistic inventory control models - Geometric Programming.

**Unit 5**

Competitive Models, Single and Multi-channel Problems, Sequencing Models, Dynamic Programming, Flow in Networks, Elementary Graph Theory, Game Theory Simulation

**References:**

1. H.A. Taha, Operations Research, An Introduction, PHI, 2008
2. H.M. Wagner, Principles of Operations Research, PHI, Delhi, 1982.
3. J.C. Pant, Introduction to Optimisation: Operations Research, Jain Brothers, Delhi, 2008
4. Hitler Libermann Operations Research: McGraw Hill Pub. 2009
5. Pannerselvam, Operations Research: Prentice Hall of India 2010
6. Harvey M Wagner, Principles of Operations Research: Prentice Hall of India 2010

**Course Outcomes:**

**At the end of the course,** the student should be able to

1. Students should be able to apply the dynamic programming to solve problems of discrete and continuous variables.
2. Students should be able to apply the concept of non-linear programming
3. Students should be able to carry out sensitivity analysis
4. Student should be able to model the real world problem and simulate it.



III Semester

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**OPEN ELECTIVE****COST MANAGEMENT OF ENGINEERING PROJECTS****Pre-requisite:** MEFA & Management Science**Course Educational Objectives:**

- To learn cost concepts in decision making
- To learn different stages and aspects of a project and execution
- To learn resources planning, quality management.
- To learn application of techniques such as linear programming, PERT/CPM
- To learn profit planning and budgeting

**Unit I:** Introduction and Overview of the Strategic Cost Management Process**Unit II:** Cost concepts in decision-making; Relevant cost, Differential cost, Incremental cost and Opportunity cost. Objectives of a Costing System; Inventory valuation; Creation of a Database for operational control; Provision of data for Decision-Making.**Unit III:** Project: meaning, Different types, why to manage, cost overruns centres, various stages of project execution: conception to commissioning. Project execution as conglomeration of technical and nontechnical activities. Detailed Engineering activities. Pre project execution main clearances and documents Project team: Role of each member. Importance Project site: Data required with significance. Project contracts. Types and contents. Project execution Project cost control. Bar charts and Network diagram. Project commissioning: mechanical and process**Unit IV:** Cost Behavior and Profit Planning Marginal Costing; Distinction between Marginal Costing and Absorption Costing; Break-even Analysis, Cost-Volume-Profit Analysis. Various decision-making problems. Standard Costing and Variance Analysis. Pricing strategies: Pareto Analysis. Target costing, Life Cycle Costing. Costing of service sector. Just-in-time approach, Material Requirement Planning, Enterprise Resource Planning, Total Quality Management and Theory of constraints. Activity-Based Cost Management, Bench Marking; Balanced Score Card and Value-Chain Analysis. Budgetary Control; Flexible Budgets; Performance budgets; Zero-based budgets. Measurement of Divisional profitability pricing decisions including transfer pricing.**Unit V:** Quantitative techniques for cost management, Linear Programming, PERT/CPM, Transportation problems, Assignment problems, Simulation, Learning Curve Theory.**Course Outcomes:** After completion of this course, the student will be able to

- Understand the cost management process and various costs involved in a project
- Analyze various aspects of a project like project site, project team, contracts, execution and commissioning
- Perform various costing and cost management and cost management, profit planning
- Apply linear programming PERT/CPM to cost management

**Reference Books:**

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

**III Semester**

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**OPEN ELECTIVE  
COMPOSITE MATERIALS****UNIT-I:**

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

**UNIT – II:**

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

**UNIT – III:**

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

**UNIT-IV:**

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

**UNIT – V:**

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

**TEXT BOOKS:**

1. Material Science and Technology – Vol 13 – Composites by R.W.Cahn – VCH, West Germany.
2. Materials Science and Engineering, An introduction. WD Callister, Jr., Adapted by R. Balasubramaniam, John Wiley & Sons, NY, Indian edition, 2007.

**References:**

1. Hand Book of Composite Materials-ed-Lubin.
2. Composite Materials – K.K.Chawla.
3. Composite Materials Science and Applications – Deborah D.L.Chung.
4. Composite Materials Design and Applications – Danial Gay, Suong V. Hoa, and Stephen W. Tasi.



**III Semester**

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**OPEN ELECTIVE  
WASTE TO ENERGY****Unit-I:**

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

**Unit-II:**

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

**Unit-III:**

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

**Unit-IV:**

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

**Unit-V:**

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

**References:**

1. Non Conventional Energy, Desai, Ashok V., Wiley Eastern Ltd., 1990.
2. Biogas Technology - A Practical Hand Book - Khandelwal, K. C. and Mahdi, S. S., Vol. I & II, Tata McGraw Hill Publishing Co. Ltd., 1983.
3. Food, Feed and Fuel from Biomass, Challal, D. S., IBH Publishing Co. Pvt. Ltd., 1991.
4. Biomass Conversion and Technology, C. Y. WereKo-Brobby and E. B. Hagan, John Wiley & Sons, 1996.

**AUDIT 1 and 2: ENGLISH FOR RESEARCH PAPER WRITING**

<b>Course objectives:</b> 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 Ensure the good quality of paper at very first-time submission		
<b>Syllabus</b>		
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
2	Clarifying Who Did What, Highlighting Your Findings, Hedging and Criticising, Paraphrasing and Plagiarism, Sections of a Paper, Abstracts. Introduction	4
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
5	skills are needed when writing the Methods, skills needed when writing the Results, skills are needed when writing the Discussion, skills are needed when writing the Conclusions	4
6	useful phrases, how to ensure paper is as good as it could possibly be the first- time submission	4

**Suggested Studies:**

1. Goldbort R (2006) Writing for Science, Yale University Press (available on Google Books)
2. Day R (2006) How to Write and Publish a Scientific Paper, Cambridge University Press
3. Highman N (1998), Handbook of Writing for the Mathematical Sciences, SIAM. Highman'sbook .
4. Adrian Wallwork , English for Writing Research Papers, Springer New York Dordrecht Heidelberg London, 2011

**AUDIT 1 and 2: DISASTER MANAGEMENT**

**Course Objectives:** -Students will be able to:  
 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	<b>Introduction</b> Disaster: Definition, Factors And Significance; Difference Between Hazard And Disaster; Natural And Manmade Disasters: Difference, Nature, Types And Magnitude.	4
2	<b>Repercussions Of Disasters And Hazards:</b> 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.	4
3	<b>Disaster Prone Areas In India</b> 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	<b>Disaster Preparedness And Management</b> 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	<b>Risk Assessment</b> 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	<b>Disaster Mitigation</b> 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:**

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

**AUDIT 1 and 2: SANSKRIT FOR TECHNICAL KNOWLEDGE****Course Objectives**

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

**Syllabus**

Unit	Content	Hours
1	<ul style="list-style-type: none"><li>• Alphabets in Sanskrit,</li><li>• Past/Present/Future Tense,</li><li>• Simple Sentences</li></ul>	8
2	<ul style="list-style-type: none"><li>• Order</li><li>• Introduction of roots</li><li>• Technical information about Sanskrit Literature</li></ul>	8
3	<ul style="list-style-type: none"><li>• Technical concepts of Engineering-Electrical, Mechanical, Architecture, Mathematics</li></ul>	8

**Suggested reading**

1. "Abhyaspustakam" – Dr. Vishwas, Samskrita-Bharti Publication, New Delhi
2. "Teach Yourself Sanskrit" Prathama Deeksha-Vempati Kutumbshastri, Rashtriya Sanskrit Sansthanam, New Delhi Publication
3. "India's Glorious Scientific Tradition" Suresh Soni, Ocean books (P) Ltd., New Delhi.

**Course Output**

Students will be able to

1. Understanding basic Sanskrit language
2. Ancient Sanskrit literature about science & technology can be understood
3. Being a logical language will help to develop logic in students



### Course Objectives

Students will be able to

1. Understand value of education and self- development
2. Imbibe good values in students
3. Let the should know about the importance of character

### Syllabus

Unit	Content	Hours
1	<ul style="list-style-type: none"> <li>• Values and self-development –Social values and individual attitudes. Work ethics, Indian vision of humanism.</li> <li>• Moral and non- moral valuation. Standards and principles.</li> <li>• Value judgements</li> </ul>	4
2	<ul style="list-style-type: none"> <li>• Importance of cultivation of values.</li> <li>• Sense of duty. Devotion, Self-reliance. Confidence, Concentration. Truthfulness, Cleanliness.</li> <li>• Honesty, Humanity. Power of faith, National Unity.</li> <li>• Patriotism.Love for nature ,Discipline</li> </ul>	6
3	<ul style="list-style-type: none"> <li>• Personality and Behavior Development - Soul and Scientific attitude. Positive Thinking. Integrity and discipline.</li> <li>• Punctuality, Love and Kindness.</li> <li>• Avoid fault Thinking.</li> <li>• Free from anger, Dignity of labour.</li> <li>• Universal brotherhood and religious tolerance.</li> <li>• True friendship.</li> <li>• Happiness Vs suffering, love for truth.</li> <li>• Aware of self-destructive habits.</li> <li>• Association and Cooperation.</li> <li>• Doing best for saving nature</li> </ul>	6
4	<ul style="list-style-type: none"> <li>• Character and Competence –Holy books vs Blind faith.</li> <li>• Self-management and Good health.</li> <li>• Science of reincarnation.</li> <li>• Equality, Nonviolence ,Humility, Role of Women.</li> <li>• All religions and same message.</li> <li>• Mind your Mind; Self-control.</li> <li>• Honesty, Studying effectively</li> </ul>	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

**Course Objectives:**

Students will be able to:

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

**Syllabus**

Units	Content	Hours
1	<b>•History of Making of the Indian Constitution:</b> History Drafting Committee, ( Composition & Working)	4
2	<b>•Philosophy of the Indian Constitution:</b> Preamble Salient Features	4
3	<input type="checkbox"/> <b>Contours of Constitutional Rights &amp; Duties:</b> <input type="checkbox"/> Fundamental Rights <input type="checkbox"/> Right to Equality <input type="checkbox"/> Right to Freedom <input type="checkbox"/> Right against Exploitation <input type="checkbox"/> Right to Freedom of Religion <input type="checkbox"/> Cultural and Educational Rights <input type="checkbox"/> Right to Constitutional Remedies <input type="checkbox"/> Directive Principles of State Policy <input type="checkbox"/> Fundamental Duties.	4
4	<input type="checkbox"/> <b>Organs of Governance:</b> <input type="checkbox"/> Parliament <input type="checkbox"/> Composition <input type="checkbox"/> Qualifications and Disqualifications <input type="checkbox"/> Powers and Functions <b>• Executive</b> <input type="checkbox"/> President <input type="checkbox"/> Governor <input type="checkbox"/> Council of Ministers <input type="checkbox"/> Judiciary, Appointment and Transfer of Judges, Qualifications <input type="checkbox"/> Powers and Functions	4

5	<input type="checkbox"/> <b>Local Administration:</b> <input type="checkbox"/> District's Administration head: Role and Importance, <input type="checkbox"/> Municipalities: Introduction, Mayor and role of Elected Representative, CEO of Municipal Corporation. <input type="checkbox"/> Pachayati raj: Introduction, PRI: ZilaPachayat. <input type="checkbox"/> Elected officials and their roles, CEO ZilaPachayat: Position and role. <input type="checkbox"/> Block level: Organizational Hierarchy (Different departments), <input type="checkbox"/> Village level: Role of Elected and Appointed officials, <input type="checkbox"/> Importance of grass root democracy	O 4
6	<input type="checkbox"/> <b>Election Commission:</b> <input type="checkbox"/> Election Commission: Role and Functioning. <input type="checkbox"/> Chief Election Commissioner and Election Commissioners. <input type="checkbox"/> State Election Commission: Role and Functioning. <input type="checkbox"/> Institute and Bodies for the welfare of SC/ST/OBC and women.	4

#### Suggested reading

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

#### Course Outcomes:

Students will be able to:

1. Discuss the growth of the demand for civil rights in India for the bulk of Indians before the arrival of Gandhi in Indian politics.
2. Discuss the intellectual origins of the framework of argument that informed the conceptualization of social reforms leading to revolution in India.
3. Discuss the circumstances surrounding the foundation of the Congress Socialist Party [CSP] under the leadership of Jawaharlal Nehru and the eventual failure of the proposal of direct elections through adult suffrage in the Indian Constitution.
4. Discuss the passage of the Hindu Code Bill of 1956.

**Course Objectives:**

Students will be able to:

4. Review existing evidence on the review topic to inform programme design and policy making undertaken by the DfID, other agencies and researchers.
5. Identify critical evidence gaps to guide the development.

**Syllabus**

Units	Content	Hours
1	<input type="checkbox"/> <b>Introduction and Methodology:</b> <input type="checkbox"/> Aims and rationale, Policy background, Conceptual framework and terminology <input type="checkbox"/> Theories of learning, Curriculum, Teacher education. <input type="checkbox"/> Conceptual framework, Research questions. <input type="checkbox"/> Overview of methodology and Searching.	4
2	<ul style="list-style-type: none"> <li>• Thematic overview: Pedagogical practices are being used by teachers in formal and informal classrooms in developing countries.</li> <li>• Curriculum, Teacher education.</li> </ul>	2
3	<ul style="list-style-type: none"> <li>• Evidence on the effectiveness of pedagogical practices</li> <li>• Methodology for the in depth stage: quality assessment of included studies.</li> <li>• How can teacher education (curriculum and practicum) and the school curriculum and guidance materials best support effective pedagogy?</li> <li>• Theory of change.</li> <li>• Strength and nature of the body of evidence for effective pedagogical practices.</li> <li>• Pedagogic theory and pedagogical approaches.</li> <li>• Teachers' attitudes and beliefs and Pedagogic strategies.</li> </ul>	4
4	<ul style="list-style-type: none"> <li>• Professional development: alignment with classroom practices and follow-up support</li> <li>• Peer support</li> <li>• Support from the head teacher and the community.</li> <li>• Curriculum and assessment</li> <li>• Barriers to learning: limited resources and large class sizes</li> </ul>	4
5	<input type="checkbox"/> <b>Research gaps and future directions</b> <input type="checkbox"/> Research design <input type="checkbox"/> Contexts <input type="checkbox"/> Pedagogy <input type="checkbox"/> Teacher education <input type="checkbox"/> Curriculum and assessment <input type="checkbox"/> Dissemination and research impact.	2

**Suggested reading**

1. Ackers J, Hardman F (2001) Classroom interaction in Kenyan primary schools, Compare, 31 (2): 245-261.
2. Agrawal M (2004) Curricular reform in schools: The importance of evaluation, Journal of Curriculum Studies, 36 (3): 361-379.
3. Akyeampong K (2003) Teacher training in Ghana - does it count? Multi-site teacher education research project (MUSTER) country report 1. London: DFID.
4. Akyeampong K, Lussier K, Pryor J, Westbrook J (2013) Improving teaching and learning of basic maths and reading in Africa: Does teacher preparation count? International Journal Educational Development, 33 (3): 272-282.
5. Alexander RJ (2001) Culture and pedagogy: International comparisons in primary education. Oxford and Boston: Blackwell.



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

## Course Outcomes:

Students will be able to understand:

1. What pedagogical practices are being used by teachers in formal and informal classrooms in developing countries?
2. What is the evidence on the effectiveness of these pedagogical practices, in what conditions, and with what population of learners?
3. How can teacher education (curriculum and practicum) and the school curriculum and guidance materials best support effective pedagogy?

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**Course Objectives**

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

**Syllabus**

Unit	Content	Hours
1	• Definitions of Eight parts of yog. ( Ashtanga )	8
2	Yam and Niyam. Do's and Don't's in life. i) Ahinsa, satya, astheya, bramhacharya and aparigraha ii) Shaucha, santosh, tapa, swadhyay, ishwarpranidhan	8
3	• Asan and Pranayam 1. Various yog poses and their benefits for mind & body 2. Regularization of breathing techniques and its effects-Types of pranayam	8

**Suggested reading**

1. 'Yogic Asanas for Group Training-Part-I' : Janardan Swami YogabhyasiMandal, Nagpur
2. "Rajayoga or conquering the Internal Nature" by Swami Vivekananda, Advaita Ashrama (Publication Department), Kolkata

**Course Outcomes:**

Students will be able to:

1. Develop healthy mind in a healthy body thus improving social health also
2. Improve efficiency



### Course Objectives

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

### Syllabus

Unit	Content	Hours
1	Neetisatakam-Holistic development of personality <ul style="list-style-type: none"> <li>• Verses- 19,20,21,22 (wisdom)</li> <li>• Verses- 29,31,32 (pride &amp; heroism)</li> <li>• Verses- 26,28,63,65 (virtue)</li> <li>• Verses- 52,53,59 (don't's)</li> <li>• Verses- 71,73,75,78 (do's)</li> </ul>	8
2	<ul style="list-style-type: none"> <li>• Approach to day to day work and duties.</li> <li>• Shrimad Bhagwad Geeta : Chapter 2-Verses 41, 47,48,</li> <li>• Chapter 3-Verses 13, 21, 27, 35, Chapter 6-Verses 5,13,17, 23, 35,</li> <li>• Chapter 18-Verses 45, 46, 48.</li> </ul>	8
3	<ul style="list-style-type: none"> <li>• Statements of basic knowledge.</li> <li>• Shrimad Bhagwad Geeta: Chapter2-Verses 56, 62, 68</li> <li>• Chapter 12 -Verses 13, 14, 15, 16,17, 18</li> <li>• Personality of Role model. Shrimad Bhagwad Geeta: Chapter2-Verses 17, Chapter 3-Verses 36,37,42,</li> <li>• Chapter 4-Verses 18, 38,39</li> <li>• Chapter18 – Verses 37,38,63</li> </ul>	8

### Suggested reading

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

### Course Outcomes

Students will be able to

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