CHAITANYA BHARATHI INSTITUTE OF TECHNOLOGY
An Autonomous Institution under UGC
Hyderabad-500075

DEPARTMENT OF
ELECTRONICS & COMMUNICATION ENGINEERING

Scheme of Instruction and Syllabi
of
M.E. (ECE - CE)
(As per AICTE Model Curriculum)

M.E. (ECE)
COMMUNICATION ENGINEERING
(With effect from the AY 2019-20)

CHAITANYA BHARATHI INSTITUTE OF TECHNOLOGY (A)

Our Motto: SwayamTejaswin Bhava

Vision, Mission and Quality Policy of the Institute

VISION

To be a centre of excellence in technical education and research.

MISSION

To address the emerging needs through quality technical education and advanced research.

QUALITY POLICY

Chaitanya Bharathi Institute of Technology imparts value based technical education and training to meet the requirements of student, industry, trade/ profession, research and developmental organisations for self-sustained growth of society.

Vision and Mission of Dept. of ECE

VISION

To develop the department into a full-fledged center of learning in various fields of Electronics & Communication Engineering, keeping in view the latest developments.

MISSION

To impart value based technical education and train students and to turn out full pledged engineers in the field of Electronics & Communication Engineering with and overall background suitable for making a successful career either in industry/research or higher education in India/Abroad.

DEPARTMENT OF ELECTRONICS & COMMUNICATION ENGINEERING

Program Educational Objectives of M.E (Communication Engineering) Program

PEO1: Graduates will Design & Develop Communication systems either independently or in a group.

PEO2: Graduates will be able to learn and adopt the emerging technologies in the area of Communication Engineering.

PEO3: Graduates will demonstrate the ability to do research and become a lifelong learner.

PEO4: Graduates will develop rational approach to solve real world problems with self-confidence and ethical & societal responsibilities.

Program Outcomes of M.E (Communication Engineering) Program

PO1 Students will be able to analyze, implement and demonstrate both the wired and wireless communication systems.

PO2 Students will be able to use modern engineering tools/software to design and develop advanced communication systems.

PO3 Student will be able to write and present substantial technical report/ document.

PO4 Students will be able to independently carry out research/ investigation and development work related to solving the complex engineering problems in the domain of communication engineering.

PO5 Students will be able to develop self-confidence, team work, skills for lifelong learning and committed to social responsibilities.

CHAITANYA BHARATHI INSTITUTE OF TECHNOLOGY (A)

M.E (Communication Engineering)

SEMESTER – I

S.No	Course Code	Title of the Course	Scheme of Instruction			Scheme of Examination			Credits
			Hours per Week			Duration of SEE in Hours	Maximum Marks		
			L	T	P/S		CIE	SEE	
THEORY									
1		Program Core - 1	3	--	--	3	30	70	3
2		Program Core - 2	3	--	--	3	30	70	3
3		Program Elective-1	3	--	--	3	30	70	3
4		Program Elective-2	3	--	--	3	30	70	3
5	19MEC103	Research Methodology and IPR	2	--	--	2	25	50	2
6		Audit Course-1	2	--	--	2	--	50	Non Credit
PRACTICAL									
7		Laboratory -1 (Based Program Core)	--	--	4	--	50	--	2
8		Laboratory -2 (Based on Program Core/Program Elective)	--	--	4	--	50	--	2
Total			**16**	**--**	**8**	**--**	**245**	**380**	**18**
Clock Hours per Week: 24									

L: Lecture P: Practical CIE - Continuous Internal Evaluation
T: Tutorial S: Seminar SEE - Semester End Examination

CHAITANYA BHARATHI INSTITUTE OF TECHNOLOGY (A)

M.E (Communication Engineering)

SEMESTER – II

S.No	Course Code	Title of the Course	Scheme of Instruction			Scheme of Examination			Credits
			Hours per Week			Duration of SEE in Hours	Maximum Marks		
			L	T	P/S		CIE	SEE	
THEORY									
1		Program Core - 3	3	--	--	3	30	70	3
2		Program Core - 4	3	--	--	3	30	70	3
3		Program Elective - 3	3	--	--	3	30	70	3
4		Program Elective - 4	3	--	--	3	30	70	3
5		Audit Course - 2	2	--	--	2	--	50	Non Credit
PRACTICAL and MINI PROJECT									
6		Laboratory - 3 (Based on Program Core)	--	--	4	--	50	--	2
7		Laboratory - 4 (Based on Program Core / Program Elective)	--	--	4	--	50	--	2
8	19ECC109	Mini Project with Seminar	--	--	4	--	50	--	2
Total			**14**	**--**	**12**	**--**	**270**	**330**	**18**
Clock Hours per Week: 26									

L: Lecture P: Practical/ Project CIE - Continuous Internal Evaluation
T: Tutorial S: Seminar SEE - Semester End Examination

CHAITANYA BHARATHI INSTITUTE OF TECHNOLOGY (A)

M.E (Communication Engineering)

SEMESTER – III

S.No	Course Code	Title of the Course	Scheme of Instruction			Scheme of Examination			Credits
			Hours per Week			Duration of SEE in Hours	Maximum Marks		
			L	T	P/S		CIE	SEE	
THEORY									
1		Program Elective - 5	3	--	--	3	30	70	3
2		Open Elective	3	--	--	3	30	70	3
3	19ECC110	Dissertation /Phase - I	--	--	20	--	100	--	10
Total			**6**	**--**	**20**	**--**	**160**	**140**	**16**
Clock Hours per Week: 26									

L: Lecture P: Practical/ Project CIE - Continuous Internal Evaluation
T: Tutorial S: Seminar SEE - Semester End Examination

CHAITANYA BHARATHI INSTITUTE OF TECHNOLOGY (A)

M.E (Communication Engineering)

SEMESTER – IV

S.No	Course Code	Title of the Course	Scheme of Instruction			Scheme of Examination			Credits
			Hours per Week			Duration of SEE in Hours	Maximum Marks		
			L	T	P/S		CIE	SEE	
THEORY									
1	19ECC111	Dissertation /Phase - II	--	--	32	Viva - Voce	100	100	16
Total			**--**	**--**	**32**	**--**	**100**	**100**	**16**
Clock Hours per Week: 32									

L: Lecture P: Practical/ Project CIE - Continuous Internal Evaluation
T: Tutorial S: Seminar SEE - Semester End Examination

List of Courses for the Program ME (ECE) with specialization COMMUNICATION ENGINEERING

S.No	Course Code	Program Core Courses
1	19EC C101	Advanced Communication Networks
2	19EC C102	Advanced Digital Signal Processing
3	19EC C103	Antennas and Radiating Systems
4	19EC C104	Wireless and Mobile Communication
Practical Courses / Mini Project with Seminar / Dissertation		
5	19EC C105	Advanced Communication Networks lab
6	19EC C106	Advanced Digital Signal Processing Lab Lab
7	19EC C107	Antennas and Radiating Systems Lab
8	19EC C108	Wireless and Mobile Communication Lab
9	19EC C109	Mini Project with Seminar
10	19EC C110	Dissertation / Phase-I
11	19EC C111	Dissertation / Phase-II
Program Elective Courses		
1	19EC E101	Data and Optical Networks
2	19EC E102	DSP Architecture
3	19EC E103	Global Navigation Satellite Systems
4	19EC E104	High Performance Networks
5	19EC E105	Information Theory and Coding Techniques
6	19EC E106	Internet of Things
7	19EC E107	Microwave and Satellite Communication
8	19EC E108	MIMO Wireless Communications
9	19EC E207	Network Security and Cryptography
10	19EC E109	Pattern Recognition and Machine Learning
11	19EC E110	Remote Sensing
12	19EC E111	Signal Intelligence Systems
13	19EC E112	Software Defined and Cognitive Radio
14	19EC E113	Statistical Decision and Estimation Theory
15	19EC E114	Wireless Sensor Networks
Mandatory Course		
1	19ME C103	Research Methodology and IPR

S.No	Course Code	Audit Courses
1	19CE A101	Disaster Management
2	19EG A101	English for Research Paper Writing
3	19EG A102	Indian Constitution and Fundamental Rights
4	19IT A101	Pedagogy Studies
5	19EG A104	Personality Development through Life Enlighten ment Skills
6	19EE A101	Sanskrit for Technical Knowledge
7	19EG A103	Stress Management by Yoga
8	19EC A101	Value Education
Open Electives Courses		
1	19CS O101	Business Analytics
2	19ME O103	Composite Materials
3	19CE O101	Cost Management of Engineering Projects
4	19ME O101	Industrial Safety
5	19ME O102	Introduction to Optimizations Techniques
6	19EE O101	Waste to Energy

Note:
Program Core / Program Elective of one specialization can be Elective for other specialization provided the condition for prerequisite is satisfied. However, a prior permission of the Chairman, BoS is to be obtained.

19EC C101

ADVANCED COMMUNICATION NETWORKS

Instruction	3 L Hours per Week
Duration of SEE	3 Hours
SEE	70 Marks
CIE	30 Marks
Credits	3

Prerequisite: Students should have in depth knowledge of Computer Networks.
Course Objectives: This course aims to:

1. Familiarize the student with the basic taxonomy and terminology of the computer networking area.
2. Provide the student with knowledge of advanced networking concepts and techniques.
3. Provide the student with knowledge of Real Time Communications over Internet and Packet Scheduling.

Course Outcomes: Upon completion of this course, students will be able to:

1. Understand advanced concepts over Internet.
2. Design and develop protocols for Communication Networks.
3. Understand the mechanisms in Quality of Service in networking.
4. Optimize the Network Design and identify various IP addressing challenges.
5. Determine the choice of MPLS Protocols.

UNIT-I

Overview of Internet Concepts, Challenges and History: Overview of -ATM. TCP/IPCongestion and Flow Control in Internet; Throughput analysis of TCP congestion control, TCP for high bandwidth delay networks and Fairness issues in TCP.

UNIT-II

Issues of Real Time Communications over Internet: Adaptive applications, Latency and throughput, Integrated Services Model (IntServ),Resource reservation Protocol. Characterization of Traffic by Linearly Bounded Arrival Processes (LBAP), Leaky bucket algorithm and its properties.

UNIT-III

Packet Scheduling Algorithms-requirements and Choices: Scheduling guaranteed service Connections, GPS, WFQ and Rate proportional algorithms,

High speed scheduler design; Theory of Latency Rate servers and delay bounds in packet switched networks for LBAP traffic; Active Queue Management - RED, WRED and Virtual clock, Control theoretic analysis of active queue management.

UNIT-IV

IP Address Lookup-Challenges: Packet classification algorithms and Flow Identification, Grid of Tries, Cross producting and controlled prefix expansion algorithm.Admission control in Internet: Concept of Effective bandwidth, Measurement based admission control; Differentiated Services in Internet (DiffServ), DiffServ architecture and framework.

UNIT-V

IPV4, IPV6, IP tunneling, IP switching and MPLS, Overview of IP over ATM and its Evolution to IP switching; MPLS architecture and framework, MPLS Protocols, Traffic Engineering issues in MPLS.

Text Books:

1. J.F. Kurose & K.W. Ross, "Computer Networking- A top down approach featuring the internet", Pearson, sixth edition, 2013.
2. Nader F. Mir, "Computer and Communication Networks", second edition, 2015.

Suggested Reading:

1. Anurag Kumar, D. Manjunath and Joy Kuri, "Communication Networking: An Analytical Approach", Morgan Kaufman Publishers, 2004.
2. Jean Wairand and PravinVaraiya, "High Performance Communications Networks", 2nd edition, 2000.

19EC C102

ADVANCED DIGITAL SIGNAL PROCESSING

Instruction	3 L Hours per Week
Duration of SEE	3 Hours
SEE	70 Marks
CIE	30 Marks
Credits	3

Prerequisite: The knowledge of DSP is required.

Course Objectives: This course aims to:

1. Analyze digital IIR and FIR filters for the given specifications.
2. Understand the basic concepts of Multirate digital signal processing.
3. Learn the various parametric and non-parametric spectral estimation methods.

Course Outcomes: Upon completion of this course, students will be able to:

1. Design digital filters for the given specifications.
2. Interpret the concepts of Multirate digital signal processing.
3. Design wiener filters
4. Analyse various Power Spectral Estimation methods for random signals
5. Develop the various applications of Digital signal processing.

UNIT-I

Review of Digital Filters: FFT Algorithms, review of 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, Cascaded, lattice structures and parallel realization of FIR and IIR filters.

UNIT-II

Multirate DSP: Introduction, Decimator and Interpolator, Sampling rate conversion, multistage decimator and interpolator,polyphase filters, Uniform digital filter banks, two channel Quadrature Mirror Filter bank- perfect reconstruction conditions.

UNIT-III

Linear Prediction &Optimum Linear Filters: Introduction to discrete random signals, Power Density spectrum, Ergodic process. Forward-backward linear prediction filters, solution of normal equations, AR Lattice and ARMA Lattice-Ladder Filters, FIR and IIR Wiener filters.

UNIT-IV

Power Spectrum Estimation: Estimation of Spectra from Finite-Duration Observations of Signals, NonparametricMethods for Power Spectrum Estimation-Bartlett and Welch methods. Parametric methods for Power Spectrum Estimation-Yule Walker method and Burg method. Minimum-Variance Spectral Estimation, Eigen analysis Algorithms for Spectrum Estimation, Piserenko method and MUSIC algorithm.

UNIT-V

Applications of Digital Signal Processing: Dual-Tone Multi frequency Signal Detection, Spectral analysis of sinusoidal signals, Non-stationary signals and Random signals, sub band coding of speech signals, JPEG-2000, Transmultiplexers, Introduction to wavelets.

Text Books:

1. J.G.Proakis and D.G.Manolakis, "Digital signal processing: Principles, Algorithm andApplications", 4th Edition, Prentice Hall, 2007.
2. Sanjit. K. Mitra, "Digital signal processing", 3rd edition, McGraw Hill,2006.

Suggested Reading:

1. Emmanuel Ifeachor, Barrie W.Jervis, "Digital signal Processing, A Practical Approach", 2nd edition, Pearson, 2011.
2. Roberto Cristi, "Modern Digital signal Processing", Cengage learning, 2012.

19EC C103

ANTENNAS AND RADIATING SYSTEMS

Instruction	3 L Hours per Week
Duration of SEE	3 Hours
SEE	70 Marks
CIE	30 Marks
Credits	3

Prerequisite: Students should have prior knowledge of Electromagnetic waves.
Course Objectives: This course aims to:

1. The basic principles of an antenna and its parameters for characterizing its performance.
2. The fundamental concepts of various types of antennas, arrays for customizing the pattern parameters.
3. The concept of aperture and microstrip antennas.

Course Outcomes: Upon completion of this course, students will be able to:

1. Understand the radiation parameters of an antenna.
2. Apply the concept of current distribution to analyse the antennas.
3. Analyse the linear arrays for uniform distribution.
4. Appraise the characteristics of broad side, end fire arrays and non-uniform arrays.
5. Learn the aperture antennas using Huygen's principle, image theory and microstrip antennas.

UNIT-I

Radiation Mechanism, Fundamental Parameters of Antennas: Radiation Pattern, Radiation Power Density, Radiation Intensity, Directivity, Gain, Antenna efficiency, Beam efficiency, Bandwidth, Polarization, Input Impedance, Region separation, Antenna Temperature, Antenna vector effective length, Friis Transmission equation, Significance of current distribution.

UNIT-II

Infinitesimal dipole, Analysis of Finite length dipole, half wave dipole, Ground effects, Small Circular loop, Circular loop with non uniform current distribution.

UNIT-III

Linear Arrays: Two element array, N-Element array: Uniform Amplitude and spacing, Broadside and End fire arrays, Super directivity, planar array, Design consideration, Introduction to linear arrays with non-uniform distributions: Binomial and Tschebyscheff distribution.

UNIT-IV

Aperture Antennas: Huygen's Field Equivalence principle, Image theory, radiation equations, Rectangular Aperture. Horn Antennas: E-Plane, H-plane horns and Pyramidal horn antennas.

UNIT-V

Reflector Antennas: Plane reflector, parabolic reflector, Efficiency calculation of parabolic reflector antenna, Cassegrain reflectors.

Microstrip Antennas: Basic Characteristics, Feeding mechanisms, Rectangular Patch design using TL method and Circular Patch design using cavity model method.

Text Books:

1. Constantine A. Balanis, "Antenna Theory: Analysis and Design," 4th Edition, John Wiley, 2016
2. Edward C. Jordan and Kenneth G. Balmain, "Electromagnetic Waves and Radiating Systems," 2nd Edition, PHI, 2009
3. John D. Krauss, Ronald J. Marhefka& Ahmad S. Khan, "Antennas and Wave Propagation," 4th Edition, TMH, 2010

Suggested Reading:

1. Dennis Roody and John Coolen, "Electronic Communications", 4th Edition, Prentice Hall, 2008.
2. R.C.Johnson and H.Jasik, "Antenna Engineering hand book", Mc-Graw Hill, 1984.
3. I.J.Bhal and P.Bhartia, "Micro-strip antennas", Artech house, 1980.

19EC C104

WIRELESS AND MOBILE COMMUNICATION

Instruction	3 L Hours per Week
Duration of SEE	3 Hours
SEE	70 Marks
CIE	30 Marks
Credits	3

Prerequisite: Requires concepts of Electromagnetic theory, Antennas and Wave propagation and Digital
Communication.

Course Objectives: This course aims to:

1. Facilitate the understanding of the basics of Cellular System design Fundamentals and Large scale propagation models
2. Provide the concepts of small scale fading and Equalization.
3. Build knowledge on multiple access techniques, GSM and Cellular Standards.

Course Outcomes: Upon completion of this course, students will be able to:

1. Apply frequency-reuse concept in mobile communications, and to analyse its effects on interference, system capacity, handoff techniques.
2. Analyse path loss and interference for wireless telephony and their influences on a mobile-communication system's performance.
3. Distinguish various multiple-access techniques for mobile communications and their advantages and disadvantages.
4. Analyse and design both GSM and CDMA systems functioning with knowledge of forward and reverse channel details, advantages and disadvantages of using these technologies.
5. Understanding the higher generation Cellular standards 3G, 4G & 5G.

UNIT-I

The Cellular Concept and System Design Fundamentals: Frequency reuse, Frequency management, Channel Assignment Strategies, Handoff Strategies, Co-channel Interference, Adjacent channel interference, Power control for Reducing Interference, Cell Splitting and Sectoring.

UNIT-II

Mobile Radio Propagation Large Scale Path Loss: Free space propagation model, Reflection, Ground Reflection (Two-Ray) model, Diffraction: Knife – edge

Diffraction Model, Scattering, Practical link budget design using path loss models: Log Normal Shadowing, Determination of percentage of coverage area, Outdoor propagation models: Okumura and Hata models, Indoor propagation models: Partition losses (same floor), Partition losses between floors, Signal penetration into buildings.

UNIT-III

Mobile Radio Propagation Small Scale Fading and Multipath: Impulse response model, Spread Spectrum Sliding Correlator Channel Sounding, Parameters of Mobile Multipath Channels, Types of Small-Scale Fading: Flat Fading, Frequency selective Fading, Fast Fading and Slow Fading.

UNIT-IV

Equalization: Fundamentals of Equalization, Training a Generic Adaptive Equalizer, Equalizers in Communication Receiver, Linear Equalizers, Non-Linear Equalizers: Decision Feedback Equalization (DFE), Maximum Likelihood Sequence Estimation (MLSE) Equalizer, Algorithms for Adaptive Equalization: Zero Forcing Algorithm and Least Mean Square Algorithm.

UNIT-V

Multiple Access Techniques: FDMA, TDMA and CDMA. Comparison of these technologies based on their signal separation, Advantages and Disadvantages.
GSM System: Architecture and Interfaces, Subsystems, Logical channels, HSCSD, GPRS and EDGE.
IS-95 System: Architecture, Air interface, Physical and Logical channels, Evolution of CDMA One to CDMA 2000.
Higher Generation Cellular Standards: 3G, 4G, VoLTE, UMTS, Introduction to 5G.

Text Books:

1. T.S.Rappaport, "Wireless Communications Principles and Practice", 2nd edition, PHI,2002.
2. William C.Y.Lee, "Mobile Cellular Telecommunications Analog and Digital Systems", 2nd edition, TMH, 1995.
3. V.K.Garg and J.E.Wilkes, "Principle and Application of GSM", Pearson Education, 5th edition, 2008.

Suggested Reading:

1. V.K.Garg, "IS-95 CDMA & CDMA 2000", Pearson Education, 4th edition, 2009.
2. AshaMehrotra, "A GSM system Engineering" Artech House Publishers Boston, London, 1997.

19EC C105

ADVANCED COMMUNICATION NETWORKS LAB

Instruction	4 P Hours per Week
Duration of SEE	—
SEE	—
CIE	50 Marks
Credits	2

Prerequisite: Students should have in depth knowledge of Computer Networks.
Course Objectives: This course aims to:

1. Provide the student with knowledge sub-netting and routing mechanisms.
2. Provide the student with knowledge of basic routing protocols for Network design and implementation.
3. Provide the student with knowledge configuring User Datagram Protocol.

Course Outcomes: Upon completion of this course, students will be able to:

1. Identify the different types of network devices and their functions within a network.
2. Understand and build the skills of sub-netting and routing mechanisms.
3. Understand basic protocols of computer networks, and how they can be used to assist in Network design and implementation.
4. Configure a network using Linux and a mail server for IMAP/POP protocols
5. Design and configure UDP Client Server

List of Assignments:

1. Study of Networking Commands (Ping, Tracert, TELNET, nslookup, netstat, ARP, RARP) and Network Configuration Files.
2. Linux Network Configuration.
   a. Configuring NIC's IP Address.
   b. Determining IP Address and MAC Address using if-config command.
   c. Changing IP Address using if-config.
   d. Static IP Address and Configuration by Editing.
   e. Determining IP Address using DHCP.
   f. Configuring Hostname in /etc/hosts file.
3. Design TCP iterative Client and Server application to reverse the given input sentence.

4. Design a TCP concurrent Server to convert a given text into upper case using multiplexing system call "select".
5. Design UDP Client Server to transfer a file.
6. Configure a DHCP Server to serve contiguous IP addresses to a pool of four IP deviceswith a default gateway and a default DNS address. Integrate the DHCP server with aBOOTP demon to automatically serve Windows and Linux OS Binaries based on clientMAC address.
7. Configure DNS: Make a caching DNS client, and a DNS Proxy; implement reverseDNS and forward DNS, using TCP dump/Wireshark characterize traffic when theDNS server is up and when it is down.
8. Configure a mail server for IMAP/POP protocols and write a simple SMTP client inC/C++/Java client to send and receive mails.
9. Configure FTP Server on a Linux/Windows machine using a FTP client/SFTP clientCharacterize file transfer rate for a cluster of small files 100k each and a video file of700mb.Use a TFTP client and repeat the experiment.
10. Signaling and QoS of labeled paths using RSVP in MPLS.
11. Find shortest paths through provider network for RSVP and BGP.
12. Understand configuration, forwarding tables, and debugging of MPLS.

Suggested Reading:

1. J.F. Kurose & K.W. Ross, "Computer Networking- A top down approach featuring the internet", Pearson, Sixth Edition, 2013.
2. Nader F. Mir, Computer and Communication Networks, second edition, 2015.

19EC C106

ADVANCED DIGITAL SIGNAL PROCESSING LAB

Instruction	4 P Hours per Week
Duration of SEE	—
SEE	—
CIE	50 Marks
Credits	2

Prerequisite: The knowledge of signal processing algorithms and MATLAB are required.

Course Objectives: This course aims to:

1. Simulation of FFT, Multirate concepts using MATLAB.
2. Spectral analysis of noisy signals using MATLAB.
3. Implementation of digitalfilters using MATLAB.

Course Outcomes: Upon completion of this course, students will be able to:

1. Implement FFT algorithms for linear filtering and correlation using MATLAB.
2. Design and realize of the digital filters using MATLAB.
3. Experiment with multirate techniques using MATLAB.
4. Perform parametric and non-parametric estimation of PSD using MATLAB.
5. Design and Implement the adaptive filters using MATLAB.

List of Experiments

1. FFT of input sequence and comparison with DFT.
2. Design of IIR Butterworth, Chebyshev type-I &II, Elliptic LPF, HPF, BPF &BSF and calculate Group delay.
3. Design of FIR LPF, HPF, BPF &BSF using windows, Multiband FIR filter and calculate Group delay.
4. State space matrix representation from difference equation
5. Solution of normal equation using Levinson Durbin
6. Decimation and Interpolation using rational factors
7. Design a multirate filter
8. Maximally decimated analysis DFT filter bank
9. Cascade and parallel realization of digital IIR filter
10. Convolution and M fold Decimation.
11. Parametric Estimation of PSD
12. Nonparametric Estimation of PSD
13. Design of Adaptive filter using LMS algorithm.

Sample Mini Projects:

1. Design the best IIR band pass filter to meet the given specifications:
   Pass band cut off frequencies: [500 600] Hz
   Stop band cut off frequencies: [525 675] Hz
   Pass band ripple: d" 2dB
   Stop band attenuation: e" 60dB
   Phase response: Approximately linear in pass band Consider Butterworth, Chebyshev, Elliptic and
   Bessel filters
2. Design a three stage multirate filter to meet the given specifications:
   Pass band cut off frequency: 450 Hz
   Stop band cut off frequency: 500 Hz
   Pass band ripple: d" 3dB
   Stop band attenuation: e" 40dB
   Sampling frequency: 40 KHz
   Compare with single stage filter.
3. Consider a clean speech signal of length 5000 samples and compute the Power Spectrum. Now add 0dB random noise. Compute the power spectrum using Welch and Eigen value Estimation method and also compare with the original spectrum.
4. Design a speech signal compression using octave filter banks and also calculate the compression ratio.

Suggested Reading:

1. Vinay K. Ingle and John G. Proakis, "Digital Signal Processing using MATLAB", 4th edition, Cengage learning, 2011.

19EC C107

ANTENNAS AND RADIATING SYSTEMS LAB

Instruction	4 P Hours per Week
Duration of SEE	—
SEE	—
CIE	50 Marks
Credits	2

Prerequisite: The knowledge of antennas is essential.

Course Objectives: This course aims to:

1. Understand the characteristics and radiation pattern of Infinitesimal antenna.
2. Simulate various antennas.
3. Study the effect of change in different parameters on antenna arrays.

Course Outcomes: Upon completion of this course, students will be able to:

1. Determine specifications, design, construct and testantenna.
2. Explore and use tools for designing, analyzing and testing antennas.
3. Apply the concept of current distribution to find the field patterns.
4. Estimate the effect of the height of the monopole antenna on the radiation characteristics.
5. Study the effect of the variation of phase difference 'beta' between the elements of the array and case studies.

List of Assignments:

1. Simulation of half wave dipoleantenna.
2. Simulation of change of the radius and length of dipole wire on frequency of resonance ofantenna.
3. Simulationofquarterwave, fullwaveantennaandcomparisonoftheir parameters.
4. Simulation of monopole antenna with and without groundplane.
5. Study the effect of the height of the monopole antenna on the radiation characteristics of theantenna.
6. Simulation of a half wave dipole antennaarray.
7. Study the effect of change in distance between elements of array on radiation pattern of dipolearray.
8. Study the effect of the variation of phase difference 'beta' between the elements of the array on the radiation pattern of the dipolearray.

Note: The above experiments are to be carried out by using any appropriate simulation software.

Suggested Reading:

1. Li Ming Yang,"HFSS antenna design", 2nd edition,Electronic Industry Press, 2014.

19EC C108

WIRELESS AND MOBILE COMMUNICATION LAB

Instruction	4 P Hours per Week
Duration of SEE	—
SEE	—
CIE	50 Marks
Credits	2

Prerequisite: Requires concepts of Electromagnetic theory, Antennas & Wave propagation and Digital Communication.

Course Objectives: This course aims to:

1. Facilitate the experimental setup for understanding the Cellular concepts and experiments using GSM and CDMA and to learn AT commands in 3G networks and DSSS technique for CDMA to observe various spread spectrum parameters.
2. Provide the facility to learn 3. Build knowledge on concepts of software radio by studying building blocks such as Baseband and RF section.
3. Learn to compute GPS Satellite position, User position and key parameters of IRNSS using RINEX data.

Course Outcomes: Upon completion of this course, students will be able to:

1. Understand Cellular concepts, GSM and CDMA networks and to study GSM handset by experimentation with fault insertion techniques.
2. Understand of 3G communication system by means of various AT commands usage in GSM.
3. Analyze the concept of CDMA using DSSS kit and to generate various PN Codes.
4. Develop concepts of Software Radio in real time environment.
5. Estimation of GPS Satellite position, User position and key parameters of IRNSS using RINEX data.

List of Experiments:

1. Study of DSSS technique for CDMA to observe effect of PN codes, Chip rate, Spreading factor and Processing gain.
2. Study of GSM handset for various signaling and Fault insertion techniques (Major GSMhandset sections: clock, SIM card, charging, LCD module, Keyboard, User interface).

3. Study Transmitter and Receiver sections in Mobile Handset and also measure GMSK modulated signal.
4. Study various GSM AT Commands such as SMS and HTTP.
5. Study File system by AT commands in 3G network.
6. Establishing Call Setup, Estimation of Coverage area and Capacity in GSM and CDMA.
7. Develop concepts of Software radio by studying building blocks such as Baseband and RF section.
8. Develop Convolutional Encoder, Interleaver and De-Interleaver in Software Radio.
9. Study and analyse different modulation techniques in time and frequency domains using SDR Kit.
10. Estimation of GPS satellite position using RINEX data.
11. Estimation of key performance parameters of IRNSS L5 and S1 band signals.
12. Estimation of user position using GNSS Single Frequency receiver.

Suggested Reading:

1. T.S.Rappaport, "Wireless Communications Principles and Practice", 2nd edition, PHI, 2002.

19EC C109

MINI PROJECT WITH SEMINAR

Instruction	4 P Hours per Week
Duration of SEE	—
SEE	—
CIE	50 Marks
Credits	2

Course Outcomes: Students are able to:

1. Formulate a specific problem and give solution.
2. Develop model/models either theoretical/practical/numerical form.
3. Solve, interpret/correlate the results and discussions.
4. Conclude the results obtained.
5. Write the documentation in standard format.

Guidelines:

1. As part of the curriculum in the II- semester of the progarmme each students shall do a mini project, generally comprising about three to four weeks of prior reading, twelve weeks of active research, and finally a presentation of their work for assessment.
2. Each student will be allotted to a faculty supervisor for mentoring.
3. Mini projects should present students with an accessible challenge on which to demonstrate competence in research techniques, plus the opportunity to contribute something more original.
4. Mini projects shall have inter disciplinary/ industry relevance.
5. The students can select a mathematical modeling based/Experimental investigations or Numerical modeling.
6. All the investigations are clearly stated and documented with the reasons/explanations.
7. The mini-project shall contain a clear statement of the research objectives, background of work, literature review, techniques used, prospective deliverables, detailed discussion on results, conclusions and references.

Department committee: Supervisor and two faculty coordinators

Guidelines for awarding marks (CIE):		Max. Marks: 50
Evaluation by	**Max .Marks**	**Evaluation Criteria / Parameter**
Supervisor	20	Progress and Review
	05	Report
Department Committee	05	Relevance of the Topic
	05	PPT Preparation
	05	Presentation
	05	Question and Answers
	05	Report Preparation

19EC C110

DISSERTATION / PHASE - I

Instruction	20 P Hours per Week
Duration of SEE	—
SEE	—
CIE	100 Marks
Credits	10

Course Outcomes: At the end of the course:

1. Students will be exposed to self-learning various topics.
2. Students will learn to survey the literature such as books, national/ international refereed journals and contact resource persons for the selected topic of research.
3. Students will learn to write technical reports.
4. Students will develop oral and written communication skills to present.
5. Student will defend their work in front of technically qualified audience.

Guidelines:

1. The Project work will preferably be a problem with research potential and should involve scientific research, design, generation/collection and analysis of data, determining solution and must preferably bring out the individual contribution.

2. Seminar should be based on the area in which the candidate has undertaken the dissertation work.

3. The CIE shall include reviews and the preparation of report consisting of a detailed problem statement and a literature review.

4. The preliminary results (if available) of the problem may also be discussed in the report.

5. The work has to be presented in front of the committee consists of Head, Chairperson-BoS, Supervisor and Project coordinator.

6. The candidate has to be in regular contact with his supervisor and the topic of dissertation must be mutually decided by the guide and student.

Guidelines for the award of Marks:		Max. Marks: 100
Evaluation by	**Max. Marks**	**Evaluation Criteria / Parameter**
Supervisor	30	Project Status / Review(s)
	20	Report
Department Committee	10	Relevance of the Topic
	10	PPT Preparation(s)
	10	Presentation(s)
	10	Question and Answers
	10	Report Preparation

Note : Department committee has to assess the progress of the student for every two weeks.

19EC C111

DISSERTATION / PHASE - II

Instruction	32 PHours per Week
Duration of SEE	Viva - Voce
SEE	100 Marks
CIE	100 Marks
Credits	16

Course Outcomes: At the end of the course:

1. Students will be able to use different experimental techniques and will be able to use different software/ computational/analytical tools.
2. Students will be able to design and develop an experimental set up/ equipment/test rig.
3. Students will be able to conduct tests on existing set ups/equipment and draw logical conclusions from the results after analyzing them.
4. Students will be able to either work in a research environment or in an industrial environment.
5. Students will be conversant with technical report writing and will be able to present and convince their topic of study to the engineering community.

Guidelines:

1. It is a continuation of Project work started in semester III.
2. The student has to submit the report in prescribed format and also present a seminar.
3. The dissertation should be presented in standard format as provided by the department.
4. The candidate has to prepare a detailed project report consisting of introduction of the problem, problem statement, literature review, objectives of the work, methodology (experimental set up or numerical details as the case may be) of solution and results and discussion.
5. The report must bring out the conclusions of the work and future scope for the study. The work has to be presented in front of the examiners panel consisting of an approved external examiner, an internal examiner (HoD and BoS Chair Person) guide/co-guide.
6. The candidate has to be in regular contact with his/her guide/co-guide.

Guidelines for awarding marks in CIE:		Max. Marks: 100
Evaluation by	**Max. Marks**	**Evaluation Criteria / Parameter**
Department Review Committee	05	Review 1
	10	Review 2
	10	Review 3
	15	Final presentation with the draft copy of the report reportstandard format
	10	Submission of the report in a standard format
Supervisor	10	Regularity and Punctuality
	10	Work Progress
	10	Quality of the work which may lead to publications
	10	Analytical / Programming / Experimental Skills Preparation
	10	Report preparation in a standard format

Guidelines for awarding marks in SEE: (Max. Marks: 100)

Evaluation by	**Max. Marks**	**Evaluation Criteria / Parameter**
External and Internal Examiner(s) together	20	Power Point Presentation
	40	Quality of thesis and evaluation
	20	Quality of the project • Innovations • Applications • Live Research Projects • Scope for future study • Application to society
	20	Viva-Voce

19EC E101

DATA AND OPTICAL NETWORKS

(Program Elective)

Instruction	3 L Hours per Week
Duration of SEE	3 Hours
SEE	70 Marks
CIE	30 Marks
Credits	3

Pre requisite: Basic course on principles of Analog and digital communication systems.

Course Objectives: This course aims to:

1. Understand the network design issues and protocols
2. Analyze data network performance in terms of Quality of service parameters and compare SDH and SONET.
3. Design a simple optical network based on WDM.

Course Outcomes: Upon completion of this course, students will be able to:

1. Analyze protocol algorithms and justify the rational between trade-offs based on network design issues.
2. Identify appropriate routing and transport models.
3. Analyze quality of service in terms of congestion avoidance and packet scheduling.
4. Distinguish features of SONET and SDH networks.
5. Appreciate the importance of WDM network element and Implement simple WDM network design.

UNIT-I

Network Design Issues, Network Performance Issues, Network Terminology, centralizedand distributed approaches for networks design, Data Networks and their Design, Link layer design- Link adaptation, Link Layer Protocols, Retransmission. ARQ Mechanisms and their analysis.

UNIT-II

Queuing Models of Networks, Traffic Models, Little's Theorem, Markov chains, M/M/1 and other Markov systems. Inter-networking, Bridging, Global Internet, IP protocol and addressing, Sub netting, Classless Inter domain Routing (CIDR), IP address lookup , Routing in Internet.

UNIT-III

End to End Protocols, TCP and UDP. Congestion Control, Additive Increase/ Multiplicative Decrease, Slow Start, Fast Retransmit/ Fast Recovery**:** Congestion avoidance, RED TCP Throughput Analysis, Quality of Service in Packet Networks. Network Calculus, Packet Scheduling Algorithms.

UNIT-IV

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

UNIT-V

Network Survivability: protection in SONET/SDH & client layer, optical layer services and interfacing, optical layer protection Schemes.

WDM network design: LTD and RWA problems, dimensioning wavelength routing Networks, statistical dimensioning models. Introduction to PON, GPON, AON.

Text Books:

1. L. Peterson and B. S. Davie, "Computer Networks: A Systems Approach",5th Edition,Morgan Kaufman, 2011.
2. Rajiv Rama Swami, Sivarajan, Sasaki, "Optical Networks: A Practical Perspective", MK, Elsevier, 3rd edition, 2010.
3. C. Siva Ram Murthy and Mohan Gurusamy, "WDM Optical Networks: Concepts Design, and Algorithms", PHI, EEE, 2001.

Suggested Reading:

1. Aaron Kershenbaum, "Telecommunication Network Design Algorithms", McGraw Hill, 1993.
2. D. Bertsekas and R. Gallager, "Data Networks", 2nd Edition, Prentice Hall, 1992.

19EC E102

DSP ARCHITECTURE

(Program Elective)

Instruction	3 L Hours per Week
Duration of SEE	3 Hours
SEE	70 Marks
CIE	30 Marks
Credits	3

Prerequisite: Knowledge of microprocessor and Digital signal Processing is required.

Course Objectives: This course aims to:

1. Learn the TMS320C67XX Digital Signal processor architecture and its features.
2. Familiarity with CC Studio.
3. Understand the concept of interfacing DSP Processor.

Course Outcomes: Upon completion of this course, students will be able to:

1. Identify and formalize architectural level characterization of DSP hardware
2. Understand the architecture of TMS320C67XX DSP Processor.
3. Ability to design, programming (assembly and C), and testing code on Code Composer Studio environment using TMS320C67XX DSP Processor.
4. Develop DSP hardware on FPGA.
5. Deployment of DSP hardware for Audio and Image processing applications.

UNIT-I

Programmable DSP Hardware: Differences between DSP and other mp architectures, ProcessingArchitectures (von Neumann, Harvard), IEEE standard for Fixed and Floating Point Computations, MAC unit, Barrel shifters, On-Chip peripherals, Introduction to Texas instrument DSP processor family and Analog Devices processor family.

UNIT-II

Basic Architectural Features Of Digital Signal Processors: DSP computational building blocks, bus architecture and memory, data addressing capabilities, address generation unit, programmability and program execution, speed issues, features for external interfacing. Introduction to FPGA based DSP Systems.

UNIT-III

VLIW Architecture: Introduction, TMS320C67XX Family, Replacement of MAC unit by ILP, Detailed study of ISA, On-chip peripherals, Addressing Modes, Instruction set, Assembly Language Programming.

UNIT-IV

Dsp Interfacing & Software Development Tools for TMS320C67XX: Interfacing memory and parallel I/O peripherals, DSP tools editor, c-compiler, assembler, linker, debugger, code composer studio, Mixed C and Assembly Language programming, applications developments as an embedded environment.

UNIT-V

Application Programs: Convolution, Correlation, FFT, IIR and FIR filters, Decimation and Interpolator, DCT, DWT, Adaptive filters.

Text Books:

1. RulphChassaing, "Digital Signal Processing and Applications with the C6713 and C6416 DSK", John wiley& sons, 2005.
2. Sen M. Kuo, Woon Seng S. Gan, "Digital Signal Processors, Architecture, Implementation and Applications" Pearson, 2008.

Suggested Reading:

1. Keshab Parhi, "VLSI digital signal processing systems design and implementations", John &Wiley sons, 2007.
2. Avatar Sigh, Srinivasan S, "Digital signal processing implementations using DSP Microprocessors", Thomson, 2003.
3. B. Venkataramani&M.Bhaskar, "Digital Signal Processors, Architecture, Programming & Applications", Mc Graw Hill 2nd Edition 2011.

19EC E103

GLOBAL NAVIGATION SATELLITE SYSTEMS

(Program Elective)

Instruction	3 L Hours per Week
Duration of SEE	3 Hours
SEE	70 Marks
CIE	30 Marks
Credits	3

Prerequisite: A prior knowledge of fundamental concepts of satellite communication is required.

Course Objectives: This course aims to:

1. Explain the basic principles of various positioning techniques and introduce GPS operating principle, signal structure.
2. Make the students to understand errors affecting GNSS performance and analyze various parameters of RINEX data.
3. Make the students appreciate the significance of other GNSS systems, principle of DGPS and augmentation systems.

Course Outcomes: Upon completion of this course, students will be able to:

1. Understand GPS principle and estimate the GPS ephemerides.
2. Appreciate GPS signal structure, coordinate systems and datum.
3. Assess the performance of GNSS in the presence of various errors.
4. Analyze various GNSS parameters using observation and navigation data.
5. Compare other global and regional navigational systems and assess the performance of various augmentation systems.

UNIT-I:

GPS Fundamentals: INS, Trilateration, Hyperbolic navigation, Transit, GPS principle of operation, architecture, operating frequencies, orbits, Keplerian elements.Solar and Siderial days, GPS and UTC Time.

UNIT-II:

GPS Signals: Signal structure, C/A and P-Code, ECEF and ECI coordinate systems and WGS 84 and Indian Datums, Important components of receiver and specifications, link budget.

UNIT-III:

GPS Error Models: Ionospheric error, Tropospheric error, Ephemeris error, Clock errors, Satellite and receiver instrumental biases, Antenna Phase center variation, multipath; estimation of Total Electron Content (TEC) using dual frequency measurements, Various DOPs, UERE. Spoofing and Anti-spoofing. : Future GPS satellites, new signals and their benefits GPS integration – GPS/GIS, GPS/INS, GPS/pseudolite, GPS/cellular.

UNIT-IV:

GPS Data Processing, DGPS and Applications: RINEX Navigation and Observation formats, Code and carrier phase observables, linear combination and derived observables, Ambiguity resolution, cycle slips, Position estimation. Principle of operation of DGPS, architecture and errors.

UNIT-V:

Other Constellations and Augmentation Systems: Other satellite navigation constellations GLONASS and Galileo IRNS System. : Relative advantages of SBAS and GBAS, Wide area augmentation system (WAAS) architecture, GAGAN, EGNOS and MSAS. Local area augmentation system (LAAS) concept.

Text Books:

1. B.HofmannWollenhof, H.Lichtenegger, and J.Collins, "GPS Theory and Practice", Springer Wien, New York, 2000.
2. PratapMisra and Per Enge, "Global Positioning System Signals, Measurements, and Performance", Ganga-Jamuna Press, Massachusetts, 2001.

Suggested Reading:

1. Ahmed El-Rabbany, "Introduction to GPS", Artech House, Boston, 2002.
2. Bradford W. Parkinson and James J. Spilker, "Global Positioning System: Theory and Applications", Volume II, American Institute of Aeronautics and Astronautics, Inc., Washington, 1996.

19EC E104

HIGH PERFORMANCE NETWORKS

(Program Elective)

Instruction	3 L Hours per Week
Duration of SEE	3 Hours
SEE	70 Marks
CIE	30 Marks
Credits	3

Prerequisite: The knowledge in Data Communication and Computer Networks is essential.

Course Objectives: This course aims to:

1. Provide Concepts of types of networks, services and VoIP system architecture and applications.
2. Enable the students to understand the topics on VPN Remote access and Traffic modeling.
3. Provide the knowledge on Network Security and Management.

Course Outcomes: Upon completion of this course, students will be able to:

1. Analyse the types of networks and apply the services
2. Distinguish various VoIP Protocols.
3. Design, implement, and analyze Protocols for the transport of voice media over IP networks
4. Identify, formulate, Traffic modeling and evaluate the network performance.
5. Apply the Network security principles to various networks.

UNIT-I

Types of Networks, Network design issues, Data in support of network design. Networkdesign tools, protocols and architecture. Streaming stored Audio and Video, Best effort service, protocols for real time interactive applications, Beyond best effort, scheduling and policing mechanism, integrated services and RSVP-differentiated services.

UNIT-II

VoIP system architecture, protocol hierarchy, Structure of a voice endpoint, Protocols forthe transport of voice media over IP networks. Providing IP quality of service for voice, signaling protocols for VoIP, PSTN gateways, VoIP applications.

UNIT-III

VPN-Remote-Access VPN, site-to-site VPN, Tunneling to PPP, Security in VPN. MPLSoperation, Routing, Tunneling and use of FEC, Traffic Engineering, MPLS based VPN, overlay networks-P2P connections.

UNIT-IV

Traffic Modeling: Little's theorem, Need for modeling, Poisson modeling, Non-Poissonmodels, Network performance evaluation.

UNIT-V

Network Security and Management: Principles of cryptography, Authentication, integrity, key distribution and certification, Access control and fire walls, attacks and counter measures, security in many layers. Infrastructure for network management. The internet standard management framework – SMI, MIB, SNMP, Security and administration, ASN.1.

Text Books:

1. Nader F. Mir, "Computer and Communication Networks", second edition, 2015.
2. Douskalis B., "IP Telephony: The Integration of Robust VoIP Services", Pearson Ed. Asia, 2000.
3. William Stalling, "Network security, essentials", Pearson education Asia publication, 4th Edition, 2011.

Suggested Reading:

1. Larry Peterson & Bruce David, "Computer Networks: A System Approach", Morgan Kaufmann, 2003.
2. J.F. Kurose & K.W. Ross, "Computer Networking- A top down approach featuring the internet", Pearson, Sixth Edition, 2013.

19EC E105

INFORMATION THEORY AND CODING TECHNIQUES

(Program Elective)

Instruction	3 L Hours per Week
Duration of SEE	3 Hours
SEE	70 Marks
CIE	30 Marks
Credits	3

Prerequisite: Concepts of source coding and error control coding are to be known.

Course Objectives: This course aims to:

1. Study the several source coding techniques.
2. Study the channel coding theorem & various error control codes.
3. Study about Block and Turbo control coding.

Course Outcomes: Upon completion of this course, students will be able to:

1. Understand the notion of information in the quantitative sense and will be able to construct compact codes for a given data ensemble.
2. Describe the mathematical modeling and calculate the capacity of typical digital communication channels and interpret the result in terms of theoretical limits to channel coding performance.
3. Understand the fundamental coding theorem for noisy channels (Shannon's Second Theorem) and its implications.
4. Apply the principles of abstract algebra to design related codes.
5. Apply error control coding to achieve error detection and correction in digital transmission systems.

UNIT-I

Information Theory and Source Coding: Introduction, Uncertainty, Information and Entropy, Shannon's Source coding theorem, The Shannon's limit, The Kraft Inequality Huffman, Shannon – Fano, Arithmetic, Adaptive coding, RLE, Lempel-Ziv-Welch Algorithm (LZW), Lempel-Ziv Algorithms : LZ-77, LZ-78.

UNIT-II

Discrete Memory Less Channels : Models – BSC, BEC, Mutual Information, Channel Capacity, Channel coding theorem, Differential entropy and mutual information for continuous ensembles.

UNIT-III

Algebra of Finite Fields: Group, Ring & Field, Vector Spaces, GF addition, multiplication rules, Construction of Galois Fields of Prime Order, Primitive elements, Conjugacy Classes, Cyclotomic Cosets, Minimal polynomials.

UNIT-IV

Linear Codes: Introduction to BCH codes, Generator polynomials in terms of Minimal polynomials, Some examples of BCH codes, Decoder, Reed- Solomon codes & Decoder, Implementation of Reed Solomon encoders and decoders. CIRC (Cross-interleave Reed-Solomon Code) for Compact Disc (CD) digital audio system;

UNIT-V

Turbo Codes: Parallel concatenation, Interleavers, Turbo encoder, Iterative decoding using BCJR algorithm, Performance analysis.

Text Books:

1. Man Young Rhee, "Error Correcting Coding Theory", McGraw-Hill Publishing, 1989.
2. Charles Lee, "Error-control Block Codes for Communications Engineers", Artech House, 2000.
3. Shu Lin, Daniel J.Costello, Jr, "Error Control Coding- Fundamentals and Applications", Prentice Hall, Inc., 2012.

Suggested Reading:

1. Arijit Saha, Nilot Pal Manna and SurajitMandal, "Information Theory, Coding and Cryptography", Pearson, 2013.
2. R.P. Singh, S.D. and Sapre, "Communication Systems", 2nd edition, Tata McGraw-Hill Education, 2008.
3. Simon Haykin, "Communication Systems", John Wiley and Sons, 4th Edition, 2001.

19EC E106

INTERNET OF THINGS

(Program Elective)

Instruction	3 L Hours per Week
Duration of SEE	3 Hours
SEE	70 Marks
CIE	30 Marks
Credits	3

Prerequisite: Knowledge onProgramming and Problem Solving, Computer Organization and embedded systems.

Course Objectives: This course aims to:

1. Provide an overview of Internet of Things, building blocks of IoT and the real-world applications.
2. Introduce Python Programming language and packages.
3. Introduce Rasberry Pi device, its interfaces and Django Framework.

Course Outcomes: Upon completion of this course, students will be able to:

1. Understand the terminology, enabling technologies and applications of IoT
2. Learn the concept of M2M (machine to machine) and describe the differences between M2M and IoT.
3. Understand the basics of Python Scripting Language which is used in many IoT devices
4. Describe the steps involved in IoT system design methodology
5. Design simple IoT systems sing the understanding of the Rasberry Pi board and interfacing sensors, actuators and develop web applications using python based framework called Django.

UNIT-I

Introduction and Concepts: Introduction to Internet of Things, definitions and characteristics of IoT, physical design of IoT-Things in IoT, IoT Protocols, Logical Design of IoT-IoT Functional Blocks, IoT Communication Models, IoT Communication APIs, IOT Enabling TechnologiesWireless Sensor Networks, Cloud Computing, Big Data Analytics, Communication Protocols, Embedded Systems, IoT Levels & Deployment Templates.

UNIT-II

Domain Specific IoTs: IoT applications for Home Automation, Cities, Environment, Energy, Retail, Logistics, Agriculture, Industry, health and Lifestyle

IoT and M2M: Introduction, M2M, Differences between IoT and M2M, Software Defined Networking, Network Function Virtualization.

UNIT-III

Introduction to Python: Motivation for using Python for designing IoT systems, Language features of Python, Data types- Numbers, Strings, Lists, Tuples, Dictionaries, Type Conversions, Data Structures: Control of flow-if, for, while, range, break/continue, pass, functions, modules, packaging, file handling, data/ time operations, classes, Exception handling, Python packages of Interest for IoT - JSON, XML, HTTP Lib, URL Lib and SMTP Lib.

UNIT-IV

IoT Platforms Design Methodology: Introduction, IoT Design Methodology Steps-Purpose and Requirements Specification, Process Specification, Domain Model Specification, Information Model Specification, Service Specifications, IoT Level Specification, Functional View Specification, Operational View Specification, Device and Component Integration, Application Development, Case Study on IoT System for Weather Monitoring.

UNIT-V

IoT Physical Devices and End Points: Basic building blocks of an IoT device, Rasberry Pi-About theRasberry Pi board, Rasberry Pi interfaces-Serial, SPI,I2C, Other IoT Devices-pcDuino, BeagleBone Black, Cubieboard

IoT Physical Servers and Cloud Offerings: Introduction to cloud storage models and Communication APIs, WAMP-AutoBahn for IoT, Xivelycloud for IoT

Python Web Application Framework: Django Framework-Roles of Model, Template and View

Text Books:

1. ArshdeepBahga and Vijay Madisetti, “Internet of Things - A Hands-on Approach, Universities Press”, 2015.
2. Bill Lubanovic “Introducing Python: Modern Computing in Simple Packages”, O’Reilly Media, Inc, USA, 2015.

Suggested Reading:

1. Francis daCosta, “Rethinking the Internet of Things: A Scalable Approach to Connecting Everything”, 1st edition, Apress Publications, 2013.
2. Matt Richardson andShawn Wallace O’Reilly, “Getting Started with Raspberry Pi”, SPD, 2014.

19EC E107

MICROWAVE AND SATELLITE COMMUNICATION

(Program Elective)

Instruction	3 L Hours per Week
Duration of SEE	3 Hours
SEE	70 Marks
CIE	30 Marks
Credits	3

Prerequisite: A prior knowledge of electromagnetic waves and communication engineering is desired.

Course Objectives: This course aims to:

1. Acquire the essential knowledge to understand CCITT modulation plans, units for power calculations, Noise calculations.
2. Explain the students about LOS propagation, Link engineering, path and link reliability, Tropospheric scatter communication system.
3. Get the concepts of Earth station technology, V-SAT, GIS and GPS.

Course Outcomes: Upon completion of this course, students will be able to:

1. Acquire fundamental knowledge of CCITT modulation plans, power and noise calculations.
2. Analyze LOS propagation system and calculate the path and link reliability.
3. Understand and compare the Tropospheric communication system and also the concepts of Earth station Technology.
4. Calculate G/T and C/N ratios of a path link.
5. Understand the basic concepts of VSAT, GIS, GPS and payload engineering.

UNIT-I

Introductory Concepts: Transmission problem, simplified transmission system, the decibel and basic derived decibel unit, Neper, practical transmission, speech, SNR, Noise figure and noise temperature, EIRP and conversion factors, CCITT modulation plan, loading of FDM system, pilot tones, noise calculation, through super group techniques, compandors, characteristics of carrier equipment.

UNIT-II

Line-of-sight Communication Systems: Link engineering, propagation characteristics in free space, path calculations, feeding, diversity reception, noise power ratio and its measurements, frequency planning. Path and link reliability,

rainfall and other precipitation attenuation, radio link repeaters, antenna towers and masts, plain reflectors as passive repeaters, noise planning on radio links.

UNIT-III

Tropospheric Scatter Communication System: Introduction, phenomenon of tropospheric scatter, tropospheric fading, path loss calculations, aperture to medium coupling loss take of angle, equipment configuration, isolation, inter modulation, typical tropospheric scatter parameters. Frequency assignment. Earth station technology: The satellite earth space window, path loss considerations of the uplink and down path calculations.

UNIT-IV

Earth station, G/T, C/N, link calculation, C/N for the complete link, and design of communication systems via satellites, Modulation, Multiplexing and multiple access techniques: TDMA, FDMA, CDMA, SSMA, SPADE.

UNIT-V

Reliability, Redundancy, Quality assurance, Echo control and Echo suppression, introductory concepts of VSATS, GIS, GPS and Future trends, Pay load engineering – Definition, constraints, specification and configurations.

Text Books:

1. Roger L Free man, "Telecommunication transmission handbook", John Wiley, 4th Edition, 1998.
2. T.Pratt and C.W. Bostian, "Satellite Communication Systems", PHI, 1stEdition,1986.

Suggested Reading:

1. B.G.Evans, "Satellite communication system", 3rd Edition, IET, U.K., 2008.
2. Dennis Roddy, "Satellite Communication Systems", Mc Graw Hill publications, 4th Edition, 2006.
3. Wayne Tomasi "Advanced Electronics Communication System" Pearson Education, 6th Edition, 2003.

19EC E108

MIMO WIRELESS COMMUNICATIONS

(Program Elective)

Instruction	3 L Hours per Week
Duration of SEE	3 Hours
SEE	70 Marks
CIE	30 Marks
Credits	3

Prerequisite: Knowledge on communication systems,antenna and wave propagation.

Course Objectives: This course aims to:

1. Understand the basic principles and need of MIMO systems
2. Analyze the MIMO system in terms of space-time coding and various beam forming methodologies.
3. Channel estimation for single carrier and multiple carrier systems.

Course Outcomes: Upon completion of this course, students will be able to:

1. Appreciate the need of MIMO antenna based wireless communication system.
2. Understand various diversity reception techniques for MIMO.
3. Analyze channel modeling and propagation, MIMO Capacity, space-time coding.
4. MIMO receivers, MIMO for multi-carrier systems and multi-user Communications.
5. Analyze cooperative/ coordinated multi-cell MIMO and appreciate the need of MIMO in 4G.

UNIT-I

Introduction to MultiAntenna Systems, Motivation, Types of Multi-Antenna Systems: Switched beam, Adaptive Array, MIMO vs. Multi-Antenna Systems.

UNIT-II

Diversity, Exploiting multipath diversity, Transmit diversity, Delay diversity, Cyclic delay diversity, Space time codes, The Alamouti scheme, The rake receiver, Combining techniques, Spatial Multiplexing, Spectral efficiency and capacity, Transmitting independent streams in parallel, Mathematical notation.

UNIT-III

The generic MIMO problem, Eigenvalues and eigenvectors, Pre-coding and combining in MIMO systems, Advantages of pre-coding and combining,

Disadvantages of pre-coding and combining, Codebooks for MIMO, Beam forming, Beam forming principles, Interference cancellation, Switched beam former, Adaptive beam former, Narrowband beam former, Wideband beam former.

UNIT-IV

MIMO in LTE, Pre-coding for spatial multiplexing, Pre-coding for transmit diversity, Propagation Channels, Time & frequency channel dispersion, AWGN and multipath propagation channels, Delay spread values and time variations, Fast and slow fading environment, Narrowband and wideband channels, MIMO channel models.

UNIT-V

Channel Estimation, Channel estimation techniques, Estimation and tracking, Training Based channel estimation, Blind channel estimation, MMSE channel estimation, Channel estimation in single carrier systems, Channel estimation for OFDM.

Text Books:

1. Claude Oestges and Bruno Clerckx, "MIMO Wireless Communications: From Real-worldPropagation to Space-time Code Design", Academic Press, 1st edition, 2010.
2. Mohinder Janakiraman, "Space - Time Codes and MIMO Systems", Artech House Publishers, 2004.

Suggested Reading:

1. Jerry R.Hampton, "Introduction to MIMO Communications", Cambridge university press, 1st Edition, 2014.
2. Joseph C.Liberti and Jr. Bellcore, Theodore S. Rappaport "Smart Antennas for Wireless Communications", IS-95 and third generation CDMA applications,Prentice Hall, 1st Edition, 1999.

19EC E207

NETWORK SECURITY AND CRYPTOGRAPHY

(Program Elective)

Instruction	3 L Hours per Week
Duration of SEE	3 Hours
SEE	70 Marks
CIE	30 Marks
Credits	3

Prerequisite: Concepts of Data Computer and Communication Networks.

Course Objectives: This course aims to:

1. Understand the concepts of public key and private key cryptography techniques
2. Study about message authentication and digital signature standards
3. Impart the knowledge of system security

Course Outcomes: Upon completion of this course, students will be able to:

1. Identify and utilize different forms of cryptography techniques.
2. Analyze solutions for effective key management and distribution and conduct cryptanalysis
3. Encrypt and decrypt data using symmetric key and public-key ciphers
4. Incorporate authentication and security in the network applications.
5. Distinguish among different types of threats to the system and handle the same.

UNIT-I

Security: Need, security services, Attacks, OSI Security Architecture, one time passwords, Model for Network security, Classical Encryption Techniques like substitution ciphers, Transposition ciphers, Cryptanalysis of Classical Encryption Techniques

UNIT-II

Private-Key (Symmetric) Cryptography: Block Ciphers, Stream Ciphers, RC4 Stream cipher, Data Encryption Standard (DES), Advanced Encryption Standard (AES), Triple DES, RC5, IDEA, Linear and Differential Cryptanalysis.

UNIT-III

Public-Key (Asymmetric) Cryptography: RSA, Key Distribution and Management, Diffie-Hellman Key Exchange, Elliptic Curve Cryptography,

Message Authentication Code, hash functions, message digest algorithms: MD4 MD5, Secure Hash algorithm, RIPEMD-160, HMAC.

UNIT-IV

Authentication: IP and Web Security Digital Signatures, Digital Signature Standards, Authentication Protocols, Kerberos, IP security Architecture, Encapsulating Security Payload, Key Management, Web Security Considerations, Secure Socket Layer and Transport Layer Security, Secure Electronic Transaction.

UNIT-V

System Security: Intruders, Intrusion Detection, Password Management, Worms, viruses, Trojans, Virus Countermeasures, Firewalls, Firewall Design Principles, Trusted Systems.

Text Books:

1. William Stallings, "Cryptography and Network Security, Principles and Practices", Pearson Education, 6th Edition, 2013.
2. Charlie Kaufman, Radia Perlman and Mike Speciner, "Network Security, Private Communicationina Public World", Prentice Hall, 2nd Edition,1995.

Suggested Reading:

1. Stephen Northcutt, LenyZeltser, Scott Winters, Karen Kent, and Ronald W. Ritchey, "Inside Network Perimeter Security", Pearson Education, 2nd Edition, 2005.
2. Richard Bejtlich, "The Practice of Network Security Monitoring: Understanding Incident detection and Response", William Pollock Publisher, 2013.

19EC E109

PATTERN RECOGNITION AND MACHINE LEARNING

(Program Elective)

Instruction	3 L Hours per Week
Duration of SEE	3 Hours
SEE	70 Marks
CIE	30 Marks
Credits	3

Prerequisite: The student should have knowledge of probability and random variables.

Course Objectives: This course aims to:

1. Model of pattern recognition using decision theory.
2. Develop of linear models for classification problems.
3. Analyze the unsupervised learning models and also clustering.

Course Outcomes: Upon completion of this course, students will be able to:

1. Understand, design and evaluate pattern recognition problems.
2. Implementation of the parametric and linear models for classification.
3. Design neural networks for classification problems.
4. Implementation of independent machine learning algorithms.
5. Understand and Implementing unsupervised clustering techniques.

UNIT-I

Introduction to Pattern Recognition: Pattern Recognition Systems, applications, design cycle, learning and adaptation, examples, Probability Distributions, Bayesian Decision Theory, continuous Features, Minimum Error rate classification, Classifiers, Discriminant Functions and Decision surfaces, Bayesian Decision Theory- Discrete Features. Maximum-Likelihood and Bayesian parameter estimation: Maximum Likelihood estimation, Bayesian estimation.

UNIT-II

Linear Models: Linear Models for Regression: Linear Basis Function Models, The Bias-Variance Decomposition, Bayesian Linear Regression, Linear Models for Classification: Discriminant Functions, Probabilistic Generative Models, Probabilistic Discriminative Models, Bayesian Logistic Regression.

UNIT-III

Neural Network: Feed forward operation and classification: Multilayer Networks, back propagation algorithm : Network learning, Training protocols,

Learning Curves, error surfaces, practical techniques for improving back propagation, additional networks and training methods, Adaboost, Deep Learning.

UNIT-IV

Linear Discriminant Functions: Decision surfaces: Two category case and multicategory case, two-category Linearly separable case, , Minimum- squared error procedures, the Ho-Kashyap procedures, linear programming algorithms, Support vector machines.

UNIT-V

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. C.Bishop, "Pattern Recognition and Machine Learning", Springer, 2006.
2. Richard O.Duda, Peter E.Hart and David G.Stork, "Pattern Classification", 2nd Edition John Wiley & Sons, 2001.

Suggested Reading:

1. B.Yagnanarayana, Artificial Neural Networks, Prentice Hall, New Delhi, 2007.

19EC E110

REMOTE SENSING

(Program Elective)

Instruction	3 L Hours per Week
Duration of SEE	3 Hours
SEE	70 Marks
CIE	30 Marks
Credits	3

Prerequisite: A prior knowledge of fundamental concepts of Electromagnetic spectrum, radar and satellite is
required.

Course Objectives: This course aims to:

1. Explain the fundamental concepts of remote sensing and types of remote sensing.
2. Make the students to understand the types of remote sensing and principles of microwave and LiDAR remote sensing.
3. Make the students appreciate the significance of image processing and data integration in remote sensing.

Course Outcomes: Upon completion of this course, students will be able to:

1. Understand the basic concepts, principles and advantages of remote sensing.
2. Analyze the principle behind multispectral, thermal and hyperspectral remote sensing
3. Appreciate the significance of microwave and LiDAR sensing
4. Apply the techniques of radiometric and geometric correction, Image enhancement and classification.
5. Integrate and analyze remote sensing data.

UNIT-I

Concept of Remote Sensing: Remote sensing: Definition, data, process, EM bands used in remote sensing. Interactions and recording of energy, Interaction with atmosphere, interaction with earth surface features (soil, water and vegetation), recording of energy by sensors. Transmission, reception and processing, Image interpretation and analysis. Advantages and limitations of Remote sensing. Satellite remote sensing,Orbits of Remote sensing satellites.

UNIT-II

Multispectral, Thermal and Hyper Spectral Remote Sensing:Types of Remote Sensing, across track and along track scanning, Multispectral scanners, Hyperspectral Remote Sensing, Thermal Remote Sensing.

UNIT-III

Microwave and LiDAR Sensing: Active and Passive Microwave Remote Sensing, Characteristics of Microwave images, SLAR –resolution – range and azimuth, Range resolution of real aperture and synthetic aperture RADAR, Radar remote sensing from space, RADARSAT, RISAT, LiDAR remote sensing, principles, applications.

UNIT-IV

Image Processing: Resolution: Spatial, spectral, radiometric and temporal resolution, geometric correction and radiometric correction, image enhancement, image classification – information class and spectral class, supervised and unsupervised classification.

UNIT-V

Data Integration, Analysis and Applications: Multi-approach of Remote Sensing, Integration with ground truth data, integration with GIS, Process of data analysis. Remote Sensing applications – Land use and Land cover, agriculture,forestry, mapping ocean and coastal monitoring.

Text Books:

1. Basudeb Bhatta., "Remote Sensing and GIS", Oxford University Press, 2nd Edition, 2012.
2. Lillesand T.M., and Kiefer.R.W.,"Remote Sensing and Image interpretation", John Wiley & Sons-6thEdition, 2000.
3.

Suggested Reading:

1. James B. Campbell and Randolph H. Wynne., "Introduction to Remote Sensing", The Guilford Press, 2011.
2. Michael N DeMers, "Fundamentals of GIS", John Wiley, 2nd Edition, 2008.

19EC E111

SIGNAL INTELLIGENCE SYSTEMS

(Program Elective)

Instruction	3 L Hours per Week
Duration of SEE	3 Hours
SEE	70 Marks
CIE	30 Marks
Credits	3

Prerequisite: Basic knowledge of Radar, Communication and Antenna concepts are required.

Course Objectives: This course aims to:

1. Explain the concepts of electronic intelligence using the fundamentals of radar and localization techniques with necessary mathematical analysis.
2. Explain the operating principles of COMINT Systems based on various localization and position fixing techniques.
3. Provide salient features of EW Systems and Electronic Jamming.

Course Outcomes: Upon completion of this course, students will be able to:

1. Understand the operating principles of Radar and Drones.
2. Analyze the intricacies of ELINT System.
3. Estimate position of ELINT/COMINT Systems for simple cases.
4. Compare the merits and demerits of various position fixing techniques.
5. Understand the salient features of EW Systems and Electronic Jamming.

UNIT-I

Principles of RADAR and DRONES: Radar Range equation, probability of false alarm, probability of detection, Radar cross section fluctuations, Blind speed ,Pulse Repetition Frequency (PRF), Unambiguous range, Principles and Classification of Drones and their applications.

UNIT-II

Electronic Intelligent (ELINT) Systems: Electronic Intelligence Defined, The Importance of Intercepting and Analyzing Radar Signals, Limitations Due to Noise, Probability of Intercept Problems. Inferring Radar Capabilities from observed Signal Parameters, Receivers for Radar Interception. Major ELINT Signal Parameters, the Impact of LPI Radar on ELINT, Direction Finding,

Instantaneous Direction Finding. Amplitude Comparison AOA Measurement, Phase Interferometers.

UNIT-III

Communication Intelligent (COMINT) Systems: Introduction, Emitter Location Estimation, Deriving the Location Covariance Matrix. Angle of Arrival Location Analysis, Time/Frequency Difference of Arrival Location Analysis. Geometric Dilution of Precision, Incorporation of Measurement Error.

UNIT-IV

Position Fixing Techniques: Position fixing algorithms: Eliminating Wild Bearings, Stansfield Fix Algorithm, Mean-Squared Distance Algorithm. Single-site location techniques: Fix accuracy, fix coverage. Time of Arrival, Time difference of Arrival: Position-Fixing using TDOA Measurements, Differential Doppler.

UNIT-V

Communication EW Systems and Techniques for Electronic Jamming: Introduction, Information warfare, Electronic warfare: Electronic support, Electronic attack, Electronic Protect. Typical EW System Configuration. Electronic attack: Introduction, Communication jamming, jammer deployment, narrow band/partial-band jamming, barrage jamming, follower jammer, jamming LPI targets. A General Description of the Basic Elements of Electronic Jamming. Mathematical Models of Jamming Signals: Fundamental Principles.

Text Books:

1. Richard G. Wiley, "ELINT: The Interception and analysis of Radar Signals", Artech House Inc., 2006.
2. Richard A. Poisel, "Introduction to Communication Electronic Warfare Systems", 2nd edition, Artech house, Inc.,2008.

Suggested Reading:

1. Sergei A. Vakin, Lev N. Shustov, Robert H. Dunwell "Fundamentals of Electronic Warfare", Artech House, Inc., 2001.

19EC E112

SOFTWARE DEFINED AND COGNITIVE RADIO

(Program Elective)

Instruction	3 L Hours per Week
Duration of SEE	3 Hours
SEE	70 Marks
CIE	30 Marks
Credits	3

Prerequisite: A prior knowledge of signal processing, Communication and spectral knowledge is required.

Course Objectives: This course aims to:

1. Make the students understand the difference between Superhetrodyne Radio and Software defined Radio
2. Differentiate between Cognitive Radio (CR) and SDR and study their architectures.
3. Make the students know about the CR signal processing Techniques and applications.

Course Outcomes: Upon completion of this course, students will be able to:

1. The students would learn the difference between the super hetrodyne receiver, Software Defined Radio and Cognitive Radio.
2. The different architectures of SDR and CR would be learnt by the student.
3. The various spectrum sensing methods should be understood.
4. Various signal processing techniques of CR would be known.
5. The facilities available in USRP and WARP boards are known.

UNIT-I

Introduction to SDR: What is Software-Defined Radio, The Requirement for Software-Defined Radio, Legacy Systems, The Benefits of Multi-standard Terminals, Economies of Scale, Global Roaming, Service Upgrading, Adaptive Modulation and Coding, Operational Requirements, Key Requirements, Reconfiguration Mechanisms, Handset Model, New Base-Station and Network, Architectures, Separation of Digital and RF, Tower-Top Mounting, BTS Hoteling, Smart Antenna Systems, Smart Antenna System Architectures.

UNIT-II

Basic Architecture of a Software Defined Radio: Software Defined Radio Architectures, Ideal Software Defined Radio Architecture, Required Hardware

Specifications, Digital Aspects of a Software Defined Radio, Digital Hardware, Alternative Digital Processing Options for BTS Applications, Alternative Digital Processing Options for Handset Applications, Current Technology Limitations, A/D Signal-to-Noise Ratio and Power Consumption, Impact of Superconducting Technologies on Future SDR Systems.

UNIT-III

Signal Processing Devices and Architectures: General Purpose Processors, Digital Signal Processors, Field Programmable Gate Arrays, Specialized Processing Units, Tilera Tile Processor, Application-Specific Integrated Circuits, Hybrid Solutions, Choosing a DSP Solution. GPP-Based SDR, Non real time Radios, High-Throughput GPP-Based SDR, FPGA-Based SDR, Separate Configurations, Multi-Waveform Configuration.

UNIT-IV

Cognitive Radio: Techniques and signal processingHistory and background, Communication policy and Spectrum Management, Cognitive radio cycle, Cognitive radio architecture, SDR architecture for cognitive radio, Spectrum sensing Single node sensing: energy detection, cyclostationary and wavelet based sensing- problem formulation and performance analysis based on probability of detection versus SNR. Cooperative sensing: different fusion rules, wideband spectrum sensing- problem formulation and performance analysis based on probability of detection vs SNR.

UNIT-V

Cognitive Radio: Hardware and Applications: Spectrum allocation models. Spectrum handoff, Cognitive radio performance analysis.Hardware platforms for Cognitive radio (USRP and WARP), details of USRP board, Applications of Cognitive radio.

Text Books:

1. Peter B. Kenington,"RF and Baseband Techniques for Software Defined Radio", Artech House, Inc © 2005.
2. Eugene Grayver,"Implementing Software Defined Radio", Springer, New York Heidelberg Dordrecht London, ISBN 978-1-4419-9332-8 2013.
3. Bruce A. Fette, "Cognitive Radio Technology", Elsevier, ISBN 10: 0-7506-7952-2, 2006.

Suggesting Reading:

1. Hüseyin Arslan"Cognitive Radio, Software Defined Radio and Adaptive Wireless Systems", Springer, ISBN 978-1-4020-5541-6 (HB), 2007.

19EC E113

STATISTICAL DECISION AND ESTIMATION THEORY

(Program Elective)

Instruction	3 L Hours per Week
Duration of SEE	3 Hours
SEE	70 Marks
CIE	30 Marks
Credits	3

Prerequisite: Concepts of probability and signals is required.

Course Objectives: This course aims to:

1. Study and understand the importance of random variables and random processes in the communications.
2. Understand random signal modelings and statistical decisions.
3. Acquire the knowledge about estimation theory.

Course Outcomes: Upon completion of this course, students will be able to:

1. Apply random variables and random process concepts in communications.
2. Demonstrate mathematical modeling of random processes such as noise.
3. Analyze various random processes modelings such as AR processes, MA processes, ARMA processes and including Markov chains.
4. Understand binary hypothesis techniques.
5. Compare parameter estimation techniques.

UNIT-I

Random Variables: Random Variable Concept, discrete and continuous Random Variables: Probability distribution and Probability density functions,moments, independent, uncorrelated and orthogonal random variables.

UNIT-II

Random Process: Random process concept, Temporal characteristics: Stationarity and independence, time averages. Ergodicity: mean ergodic and correlation ergodic processes. Correlation functions: autocorrelation function and its properties, cross correlation function and its properties, Spectral characteristics: power density spectrum and its properties.

UNIT-III

Random Signal Modeling:AR processes, MA processes, ARMA processes, Markov chains: Discrete timeMarkov chains and continuous time Markov chains.

UNIT-IV

Statistical Decision Theory: Introduction, Bayes binary hypothesis testing, Mini-max hypothesis testing and Neyman-Pearson hypothesis testing.

UNIT-V

Parameter Estimation Theory: Introduction, Maximum likelihood estimation, Bayes' Estimation: Minimum mean square error estimates, Minimum mean absolute value of error estimate, Least-Square Estimation and recursive least square estimator.

Text Books:

1. Payton. Z.PeeblesJr, "Probability Random variables and Random signal principles", TMH, 4th edition 2003.
2. MouradBarkat, "Signal Detection and Estimation", Artech House, 2nd Edition, 2005.
3. D.G. Manolakis, V.K. Ingle and S.M. Kogon, "Statistical and Adaptive Signal Processing", McGraw Hill, 2000.

Suggested Reading:

1. Papoulis and S.U. Pillai, "Probability, Random Variables and Stochastic Processes", 4th Edition, McGraw-Hill, 2002.

19EC E114

WIRELESS SENSOR NETWORKS

(Program Elective)

Instruction	3 L Hours per Week
Duration of SEE	3 Hours
SEE	70 Marks
CIE	30 Marks
Credits	3

Prerequisite: The knowledge of Wireless/Mobile communications is essential.

Course Objectives: This course aims to:

1. Understanding of Sensor node architecture with hardware and software details for data storage and data dissemination.
2. Familiarization of sensor network protocols such as network based and cluster based protocols.
3. Analysis of issues pertaining to connectivity, coverage and security in a WSN.

Course Outcomes: Upon completion of this course, students will be able to:

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

UNIT-I

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. Data dissemination and processing; differences compared with other database management systems, data storage; query processing.

UNIT-II

Hardware: Examples like mica2, mica-Z, telos-B, cricket, Imote2, T-node, Bt-node, and Sun SPOT, Software (Operating Systems): tiny OS, MANTIS, Contiki, and Ret-OS.

UNIT-III

Programming Tools: C, net-C. Performance comparison of wireless sensor networks simulation and experimental platforms like open source (NS-2) and commercial

UNIT-IV

Overview of Sensor Network Protocols (Details of At Least 2 Important Protocols Per Layer)**:** Physical, MAC and routing/ Network layer protocols, node discovery protocols, multi-hop and cluster based protocols, Fundamentals of 802.15.4, Bluetooth, Bluetooth low energy (BLE), UWB.

UNIT-V

Specialized Features of WSN: 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. F. Zhao and L. Guibas, "Wireless Sensor Networks: An Information ProcessingApproach", Morgan Kaufmann, 1st Indian reprint, 2013.
2. H. Karl and A. Willig, "Protocols and Architectures for Wireless Sensor Networks", John Wiley & Sons, India, 2012.
3. C. S. Raghavendra, K. M. Sivalingam, and T. Znati, Editors, "Wireless Sensor Networks", Springer Verlag, 1st Indian reprint, 2010.

Suggested Reading:

1. YingshuLi, MyT. Thai, Weili Wu, "Wireless sensor Network and Applications", Springer series on signals and communication technology, 2008.

19ME C103

RESEARCH METHODOLOGY AND IPR

(Program Elective)

Instruction	2 P Hours per Week
Duration of SEE	2 Hours
SEE	50 Marks
CIE	25 Marks
Credits	2

Course Objectives: This course aims to:

1. Motivate to choose research as career
2. Formulate the research problem, prepare the research design
3. Identify various sources for literature review and data collection report writing
4. Equip with good methods to analyze the collected data
5. Know about IPR copyrights

Course Outcomes: Upon completion of this course, students will be able to:

1. Define research problem, review and asses the quality of literature from various sources
2. Improve the style and format of writing a report for technical paper/ Journal report, understand and develop various research designs
3. Collect the data by various methods: observation, interview, questionnaires
4. Analyze problem by statistical techniques: ANOVA, F-test, Chi-square
5. Understand apply for patent and copyrights

UNIT-I

Research Methodology: Research Methodology: Objectives and Motivation of Research, Types of Research, research approaches, Significance of Research, Research Methods verses Methodology, Research Process, Criteria of Good Research, Problems Encountered by Researchers in India, Benefits to the society in general. Defining the Research Problem: Selection of Research Problem, Necessity of Defining the Problem

UNIT-II

Literature Survey Report Writing: Literature Survey: Importance and purpose of Literature Survey, Sources of Information, Assessment of Quality of Journals and Articles, Information through Internet. Report writing: Meaning of interpretation, layout of research report, Types of reports, Mechanics of writing

a report. Research Proposal Preparation: Writing a Research Proposal and Research Report, Writing Research Grant Proposal

UNIT-III

Research Design: Research Design: Meaning of Research Design, Need of Research Design, Feature of a Good Design, Important Concepts Related to Research Design, Different Research Designs, Basic Principles of Experimental Design, Developing a Research Plan, Steps in sample design, types of sample designs.

UNIT-IV

Data Collection and Analysis: Data Collection: Methods of data collection, importance of Parametric, non parametric test, testing of variance of two normal population, use of Chi-square, ANOVA, Ftest, z-test

UNIT-V

Patents and Copyright: Patent: Macro economic impact of the patent system, Patent document, How to protect your inventions. Granting of patent, Rights of a patent, how extensive is patent protection. Copyright: What is copyright. What is covered by copyright. How long does copyright last? Why protect copyright? Related Rights: what are related rights? Enforcement of Intellectual Property Rights: Infringement of intellectual property rights, Case studies of patents and IP Protection

Text Books:

1. C.R Kothari, "Research Methodology, Methods & Technique"; New Age International Publishers, 2004.
2. R. Ganesan, "Research Methodology for Engineers", MJP Publishers, 2011.
3. Y.P. Agarwal, "Statistical Methods: Concepts, Application and Computation", Sterling Publs., Pvt., Ltd., New Delhi, 2004.

Suggested Reading:

1. Ajit Parulekar and Sarita D' Souza, "Indian Patents Law – Legal & Business Implications"; Macmillan India ltd , 2006
2. B. L.Wadehra; "Law Relating to Patents, Trade Marks, Copyright, Designs & Geographical Indications"; Universal law Publishing Pvt. Ltd., India 2000.
3. P. Narayanan; "Law of Copyright and Industrial Designs"; Eastern law House, Delhi 2010.

19CE A101

DISASTER MANAGEMENT

(Audit Course)

Instruction	2 P Hours per Week
Duration of SEE	2 Hours
SEE	50 Marks
CIE	—
Credits	Non Credit

Course Objectives: This course aims to:

1. Equip the students with the basic knowledge of hazards, disasters, risks and vulnerabilities including natural, climatic and human induced factors and associated impacts
2. Impart knowledge in students about the nature, causes, consequences and mitigation measures of the various natural disasters
3. Enable the students to understand risks, vulnerabilities and human errors associated with human induced disasters
4. Enable the students to understand and assimilate the impacts of any disaster on the affected area depending on its position/ location, environmental conditions, demographic, etc.
5. Equip the students with the knowledge of the chronological phases ina disaster management cycle and to create awareness about the disaster management framework and legislations in the context of national and global conventions

Course Outcomes: Upon completion of this course, students will be able to:

1. Ability to analyse and critically examine existing programs in disaster management regarding vulnerability, risk and capacity at different levels
2. Ability to understand and choose the appropriate activities and tools and set up priorities to build a coherent and adapted disaster management plan
3. Ability to understand various mechanisms and consequences of human induced disasters for the participatory role of engineers in disaster management
4. Understand the impact on various elements affected by the disaster and to suggest and apply appropriate measures for the same
5. Develop an awareness of the chronological phases of disaster preparedness, response and relief operations for formulating effective disaster management plans and ability to understand various

participatory approaches/strategies and their application in disaster management

UNIT-I

Introduction: Basic definitions- Hazard, Disaster, Vulnerability, Risk, Resilience, Mitigation, Management; classification of types of disaster- Natural and man-made; International Decade for natural disaster reduction (IDNDR); International strategy for disaster reduction (ISDR), National disaster management authority (NDMA).

UNIT-II

Natural Disasters: Hydro meteorological disasters: Causes, Early warning systems- monitoring and management, structural and non-structural measures for floods, drought and Tropical cyclones; Geographical based disasters: Tsunami generation, causes, zoning, Early warning systems- monitoring and management, structural and non-structural mitigation measures for earthquakes, tsunami, landslides, avalanches and forest fires. Case studies related to various hydro meteorological and geographical based disasters.

UNIT-III

Human Induced Hazards: Chemical disaster- Causes, impacts and mitigation measures for chemical accidents, Risks and control measures in a chemical industry, chemical disaster management; Case studies related to various chemical industrial hazards eg: Bhopal gas tragedy; Management of chemical terrorism disasters and biological disasters; Radiological Emergencies and case studies; Case studies related to major power break downs, fire accidents, traffic accidents, oil spills and stampedes, disasters due to double cellar construction in multi-storeyed buildings.

UNIT-IV

Disaster Impacts: Disaster impacts- environmental, physical, social, ecological, economical, political, etc.; health, psycho-social issues; demographic aspects-gender, age, special needs; hazard locations; global and national disaster trends; climate change and urban disasters.

UNIT-V

Concept of Disaster Management: Disaster management cycle – its phases; prevention, mitigation, preparedness, relief and recovery; risk analysis, vulnerability and capacity assessment; Post-disaster environmental response-water, sanitation, food safety, waste management, disease control; Roles and

responsibilities of government, community, local institutions, NGOs and other stakeholders; Policies and legislation for disaster risk reduction, DRR Programs in India and the activities of National Disaster Management Authority.

Text Books:

1. Pradeep Sahni," Disaster Risk Reduction in South Asia", Prentice Hall, 2003.
2. B. K. Singh," Handbook of Disaster Management: techniques & Guidelines", Rajat Publication, 2008.

Suggested Reading:

1. Ministry of Home Affairs". Government of India, "National disaster management plan, Part I and II",
2. K. K. Ghosh," Disaster Management", APH Publishing Corporation, 2006.
3. http://www.indiaenvironmentportal.org.in/files/file disaster_management_india1.pdf
4. http://www.ndmindia.nic.in/ (National Disaster management in India, Ministry of Home Affairs)
5. Hazards, Disasters and your community: A booklet for students and the community, Ministry of home affairs.

19EG A101

ENGLISH FOR RESEARCH PAPER WRITING

(Audit Course)

Instruction	2 P Hours per Week
Duration of SEE	2 Hours
SEE	50 Marks
CIE	—
Credits	Non Credit

Course Objectives: This course aims to:

1. Understand the nuances of language and vocabulary in writing a ResearchPaper.
2. Develop the content, structure and format of writing a research paper.
3. Enable the students to produce original research papers without plagiarism.

Course Outcomes: Upon completion of this course, students will be able to:

1. Interpret the nuances of research paper writing.
2. Differentiate the research paper format and citation of sources.
3. Review the research papers and articles in a scientific manner.
4. Avoid plagiarism and be able to develop their writing skills in presenting the researchwork.
5. Create a research paper and acquire the knowledge of how and where to publish their original research papers.

UNIT-I

Academic Writing: Meaning & Definition of a research paper– Purpose of a research paper – Scope – Benefits – Limitations – outcomes.

UNIT-II

Research Paper Format: Title – Abstract – Introduction – Discussion – Findings – Conclusion – Style of Indentation – Font size/Font types – Indexing – Citation ofsources.

UNIT-III

Research Methodology: Methods (Qualitative – Quantitative) Review of Literature. Criticizing, Paraphrasing & Plagiarism.

UNIT-IV

Process of Writing a Research Paper: Choosing a topic - Thesis Statement – Outline – Organizing notes - Language of Research – Word order, Paragraphs – Writing first draft–Revising/Editing - The final draft and proof reading.

UNIT-V

Research Paper Publication: Reputed Journals – National/International – ISSN No, No. of volumes, Scopus Index/UGC Journals – Free publications - Paid Journalpublications – /Advantages/Benefits

Text Book:

1. C. R Kothari, Gaurav, Garg, Research Methodology Methods and Techniques, New Age International Publishers. 4th Edition.

Suggested Reading:

1. Day R, "How to Write and Publish a Scientific Paper", Cambridge University Press, 2006.
2. MLA "Hand book for writers of Research Papers", East West Press Pvt. Ltd, New Delhi, 7th Edition.
3. Lauri Rozakis, Schaum's, "Quick Guide to Writing Great Research Papers", Tata McGraw Hills Pvt. Ltd, NewDelhi.

Online Resources:

1. NPTEL:https://onlinecourses.nptel.ac.in/noc18_mg13/preview

19EGA102

INDIAN CONSTITUTION AND FUNDAMENTAL RIGHTS

(Audit Course)

Instruction	2 P Hours per Week
Duration of SEE	2 Hours
SEE	50 Marks
CIE	—
Credits	Non Credit

Course Objectives: This course aims to:

1. The history of Indian Constitution and its role in the Indian democracy.
2. 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 Indiannationalism.
3. Have knowledge of the various Organs of Governance and Local Administration.

Course Outcomes: Upon completion of this course, students will be able to:

1. Understand the making of the Indian Constitution and its features.
2. Understand the Rights of equality, the Right of freedom and the Right to constitutionalremedies.
3. Have an insight into various Organs of Governance - composition and functions.
4. Understand powers and functions of Municipalities, Panchayats and Co-operativeSocieties.
5. Understand Electoral Process, specialprovisions.

UNIT-I

History of Making of the Indian Constitutions: History, Drafting Committee (Composition &Working).

Philosophy of the Indian Constitution: Preamble, Salient Features.

UNIT-II

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

UNIT-III

Organs of Governance: Parliament : Composition, Qualifications, Powers and Functions

Union executives : President, Governor, Council of Ministers, Judiciary, appointment and transfer of judges, qualifications, powers and functions

UNIT-IV

Local Administration: District's Administration head: Role and importance. Municipalities: Introduction, Mayor and role of Elected Representative, CEO of Municipal Corporation. Panchayati Raj: Introduction, PRI: Zilla Panchayat, Elected Officials and their roles, CEO Zilla Panchayat: positions and role.

Block level: Organizational Hierarchy(Different departments) Village level: role of elected and appointed officials. Importance of grass root democracy.

UNIT-V

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

Text Books:

1. The Constitution of India, 1950 (Bare Act), GovernmentPublication.
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.

Online Resources:

1. http://www.nptel.ac.in/courses/103107084/Script.pdf

19IT A101

PEDAGOGY STUDIES
(Audit Course)

Instruction	2 P Hours per Week
Duration of SEE	2 Hours
SEE	50 Marks
CIE	—
Credits	Non Credit

Course Objectives: This course aims to:

1. Present the basic concepts of design and policies of pedagogy studies.
2. Provide understanding of the abilities and dispositions with regard to teaching techniques, curriculum design and assessment practices.
3. Familiarize various theories of learning and their connection to teaching practice.
4. Create awareness about the practices followed by DFID, other agencies and other researchers.
5. Provide understanding of critical evidence gaps that guides the professional development.

Course Outcomes: Upon completing this course, students will be able to:

1. Illustrate the pedagogical practices followed by teachers in developing countries both in formal and informal classrooms.
2. Examine the effectiveness of pedagogical practices.
3. Understand the concept, characteristics and types of educational research and perspectives of research.
4. Describe the role of classroom practices, curriculum and barriers to learning.
5. Understand Research gaps and learn the future directions.

UNIT-I

Introduction and Methodology: Aims and rationale, Policy background, Conceptual framework and terminology - Theories of learning, Curriculum, Teacher education - Conceptual framework, Research questions - Overview of methodology and Searching.

UNIT-II

Thematic Overview: Pedagogical practices followed by teachers in formal and informal classrooms in developing countries - Curriculum, Teacher education.

UNIT-III

Evidence on the Effectiveness of Pedagogical Practices: Methodology for the in depth stage: quality assessment of included studies - How can teacher education (curriculum and Practicum) and the school curriculum and guidance material best support effective pedagogy? - Theory of change - Strength and nature of the body of evidence for effective pedagogical practices - Pedagogic theory and pedagogical approaches - Teachers' attitudes and beliefs and pedagogic strategies.

UNIT-IV

Professional Development: alignment with classroom practices and follow up support - Support from the head teacher and the community – Curriculum and assessment - Barriers to learning: Limited resources and large class sizes.

UNIT-V

Research Gaps and Future Directions: Research design – Contexts – Pedagogy - Teacher education - Curriculum and assessment – Dissemination and research impact.

Text Books:

1. Ackers J, Hardman F, "Classroom Interaction in Kenyan Primary Schools, Compare", 31 (2): 245 – 261, 2001.
2. Agarwal M, "Curricular Reform in Schools: The importance of evaluation", Journal of Curriculum Studies, 36 (3): 361 – 379, 2004.

Suggested Reading:

1. Akyeampong K, "Teacher Training in Ghana – does it count? Multisite teacher education research project (MUSTER)", Country Report 1.London: DFID, 2003.
2. Akyeampong K, Lussier K, Pryor J, Westbrook J, "Improving teaching and learning of Basic Maths and Reading in Africa: Does teacher Preparation count?, International Journal Educational Development, 33 (3): 272- 282, 2013.
3. Alexander R J, "Culture and Pedagogy: International Comparisons in Primary Education", Oxford and Boston: Blackwell, 2001.
4. Chavan M, "Read India: A mass scale, rapid, 'learning to read' campaign", 2003.

Web Resources:

1. https://onlinecourses.nptel.ac.in/noc17_ge03/preview
2. www.pratham.org/images/resources%20working%20paper%202.pdf.

19EG A104

PERSONALITY DEVELOPMENT THROUGH LIFE ENLIGHTENMENT SKILLS

(Audit Course)

Instruction	2 P Hours per Week
Duration of SEE	2 Hours
SEE	50 Marks
CIE	—
Credits	Non Credit

Course Objectives: This course aims to:

1. Learn to achieve the highest goal happily.
2. Become a person with stable mind, pleasing personality and determination.
3. Awaken wisdom among themselves.

Course Outcomes: Upon completing this course, students will be able to:

1. Develop their personality and achieve their highest goal oflife.
2. Lead the nation and mankind to peace andprosperity.
3. To practice emotional self regulation.
4. Develop a positive approach to work and duties.
5. Develop a versatilepersonality.

UNIT-I

Neetisatakam – Holistic Development of Personality- Verses 19, 20, 21, 22 (Wisdom) - Verses 29, 31, 32 (Pride and Heroism) - Verses 26,28,63,65 (Virtue)

UNIT-II

Neetisatakam – Holistic Development of Personality (cont'd) - Verses 52, 53, 59 (dont's) - Verses 71,73,75 & 78 (do's) - Approach to day to day works and duties.

UNIT-III

Introduction to Bhagavad Geetha for Personality Development - Shrimad Bhagawad Geeta: Chapter 2 – Verses 41, 47, 48 - Chapter 3 – Verses 13,21,27,35-Chapter6–Verses5,13,17,23,35-Chapter18–Verses45, 46, 48Chapter – 6: Verses 5, 13, 17, 23, 35; Chapter – 18: Verses 45, 46, 48

UNIT-IV

Statements of basic knowledge - Shrimad Bhagawad Geeta: Chapter 2- Verses 56, 62,68 - Chapter 12 – Verses 13, 14, 15, 16, 17, 18 - Personality of Role model from Shrimad Bhagawat Geeta.

UNIT-V

Role of Bahgavad Geeta in the Present Scenario - Chapter 2 – Verses 17 - Chapter 3 – Verses 36, 37, 42 - Chapter 4 – Verses 18, 38, 39 - Chapter 18 – Verses 37, 38, 63.

Text Books:

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

Suggested Reading:

1. NTPEL: http://nptel.ac.in/downloads/109104115/

19EE A101

SANSKRIT FOR TECHNICAL KNOWLEDGE

(Audit Course)

Instruction	2 P Hours per Week
Duration of SEE	2 Hours
SEE	50 Marks
CIE	—
Credits	Non Credit

Course Objectives: This course aims to:

1. Get a working knowledge in illustrious Sanskrit, the scientific language in the world
2. Make the novice Learn the Sanskrit to develop the logic in mathematics, science & other subjects
3. Explore the huge knowledge from ancient Indian literature

Course Outcomes: Upon completing this course, students will be able to:

1. Develop passion towards Sanskrit language
2. Decipher the latent engineering principles from Sanskrit literature
3. Correlates the technological concepts with the ancient Sanskrit history.
4. Develop knowledge for the technological progress
5. Explore the avenue for research in engineering with aid of Sanskrit

UNIT-I

Introduction to Sanskrit Language: Sanskrit Alphabets-vowels-consonants-significance of Amarakosa-parts of speech-Morphology-creation of new words-significance of synonyms-sandhi-samasa-sutras-active and passive voice-Past/Present/Future Tense-syntax-Simple Sentences (elementary treatment only)

UNIT-II

Role of Sanskrit in Basic Sciences: Brahmagupthas lemmas (second degree indeterminate equations), sum of squares of n-terms of AP- sulba_sutram or baudhayana theorem (origination of pythogorous theorem)-value of pie-Madhava's sine and cosine theory (origination of Taylor's series).
The measurement system-time-mass-length-temp, Matter elasticity-optics-speed of light (origination of michealson and morley theory).

UNIT-III

Role of Sanskrit in Engineering-I (Civil, Mechanical, Electrical and Electronics Engineering): Building construction-soil testing-mortar-town planning-Machine

definition-crucible-furnace-air blower- Generation of electricity in a cell-magnetism-Solar system-Sun: The source of energy, the earth-Pingala chandasutram (origination of digital logic system)

UNIT-IV

Role of Sanskrit in Engineering-II (Computer Science Engineering & Information Technology): Computer languages and the Sanskrit languages-computer command words and the vedic command words-analogy of pramana in memamsa with operators in computer language-sanskrit analogy of physical sequence and logical sequence, programming.

UNIT-V

Role of Sanskrit in Engineering-III (Bio-technology and Chemical Engineering): Classification of plants-plants, the living-plants have senses-classification of living creatures

Chemical laboratory location and layout-equipment-distillation vessel-kosthiyanthram-

Text Books:

1. M Krishnamachariar, History of Classical Sanskrit Literature, TTD Press, 1937.
2. M.R. Kale, A Higher Sanskrit Grammar: For the Use of School and College Students, Motilal Banarsidass Publishers, ISBN-13: 978-8120801783, 2015
3. Kapail Kapoor, Language, Linguistics and Literature: The Indian Perspective, ISBN-10: 8171880649, 1994.
4. Pride of India, Samskrita Bharati Publisher, ISBN: 81-87276-27-4, 2007
5. Shri Rama Verma, Vedas the source of ultimate science, Nag publishers, ISBN:81-7081-618-1, 2005

19EG A103

STRESS MANAGEMENT BY YOGA

(Audit Course)

Instruction	2 P Hours per Week
Duration of SEE	2 Hours
SEE	50 Marks
CIE	—
Credits	Non Credit

Course Objectives: This course aims to:

1. Creating awareness about different types of stress and the role of yoga in the management ofstress.
2. Promotion of positive health and overall wellbeing (Physical, mental, emotional, social andspiritual).
3. Prevention of stress related health problems by yogapractice.

Course Outcomes: Upon completing this course, students will be able to:

1. Understand yoga and its benefits.
2. Enhance Physical strength andflexibility.
3. Learn to relax andfocus.
4. Relieve physical and mentaltension through asanas
5. Improve work performance andefficiency.

UNIT-I

Meaning and Definition of Yoga - Historical perspective of Yoga - Principles of Astanga Yoga by Patanjali.

UNIT–II

Meaning and Definition of Stress - Types of stress - Eustress and Distress. Anticipatory Anxiety and Intense Anxiety and depression. Meaning of Management- Stress Management.

UNIT-III

Concept of Stress According to Yoga - Stress assessment methods - Role of Asana, Pranayama and Meditation in the management of stress.

UNIT-IV

Asanas- (5 Asanas in each posture) - Warm up - Standing Asanas - Sitting Asanas - Prone Asanas - Supine asanas - Surya Namaskar

UNIT-V

Pranayama- Anulom and Vilom Pranayama - Nadishudhi Pranayama - Kapalabhati Pranayama - Bhramari Pranayama - Nadanusandhana Pranayama.

Meditation Techniques: Om Meditation - Cyclic meditation : Instant Relaxation technique (QRT), Quick Relaxation Technique (QRT), Deep Relaxation Technique (DRT)

Text Books:

1. "Yogic Asanas for Group Training - Part-I": Janardhan Swami Yogabhyasi Mandal, Nagpur.
2. "Rajayoga or Conquering the Internal Nature" by Swami Vivekananda, Advaita Ashrama (Publication Department), Kolkata.
3. Nagendra H.R nadNagaratna R, "Yoga Perspective in Stress Management", Bangalore, Swami Vivekananda Yoga Prakashan

Suggested Reading:

1. https://onlinecourses.nptel.ac.in/noc16_ge04/preview
2. https://freevideolectures.com/course/3539/indian-philosophy/11

19EC A101

VALUE EDUCATION
(Audit Course)

Instruction	2 P Hours per Week
Duration of SEE	2 Hours
SEE	50 Marks
CIE	—
Credits	Non Credit

Course Objectives: This course aims to

1. Understand the need and importance of Values for self-development and for National development.
2. Imbibe good human values and Morals
3. Cultivate individual and National character.

Course outcomes: After completion of the Course, Students will be able to

1. Gain necessary Knowledge for self-development
2. Learn the importance of Human values and their application in day to day professional life.
3. Appreciate the need and importance of interpersonal skills for successful career and social life
4. Emphasize the role of personal and social responsibility of an individual for all-round growth.
5. Develop a perspective based on spiritual outlook and respect women, other religious practices, equality, non-violence and universal brotherhood.

UNIT-I

Human Values, Ethics and Morals: Concept of Values, Indian concept of humanism, human values; Values for self-development, Social values, individual attitudes; Work ethics, moral and non- moral behaviour, standards and principles based on religion, culture and tradition.

UNIT-II

Value Cultivation, and Self-Management: Need and Importance of cultivation of values such as Sense-of Duty, Devotion to work, Self-reliance, Confidence, Concentration, Integrity & discipline, and Truthfulness.

UNIT-III

Spiritual Outlook and Social Values: Personality and Behavior, Scientific attitude and Spiritual (soul) outlook; Cultivation of Social Values Such as Positive

Thinking, Punctuality, Love & Kindness, Avoiding fault finding in others, Reduction of anger, forgiveness, Dignity of labour, True friendship, Universal brotherhood and religious tolerance.

UNIT-IV

Values in Holy Books : Self-management and Good health; **and internal & external Cleanliness,** Holy books versus Blind faith, Character and Competence, Equality, Nonviolence, Humility, Role of Women.

UNIT-V

Dharma, Karma and Guna: Concept of soul; Science of Reincarnation, Character and Conduct, Concept of Dharma; Cause and Effect based Karma Theory; The qualities of Devine and Devilish; Satwic, Rajasic and Tamasicgunas.

Text Books:

1. Chakroborty, S.K. "Values & Ethics for organizations Theory and practice", Oxford University Press, New Delhi, 1998.
2. Jaya Dayal Goyandaka, "Srimad Bhagavad Gita", with Sanskrit Text, Word meaning and Prose meaning, Gita Press, Gorakhpur, 2017.

19CS O101

BUSINESS ANALYTICS

(Open Elective)

Instruction	3 L Hours per Week
Duration of SEE	3 Hours
SEE	70 Marks
CIE	30 Marks
Credits	3

Course Objectives: This course aims to:

1. Understanding the basic concepts of business analytics and applications
2. Study various business analytics methods including predictive, prescriptive and prescriptive analytics
3. Prepare the students to model business data using various data mining, decision making methods

Course Outcomes: Upon completing this course, students will be able to:

1. To understand the basic concepts of business analytics
2. Identify the application of business analytics and use tools to analyze business data
3. Become familiar with various metrics, measures used in business analytics
4. Illustrate various descriptive, predictive and prescriptive methods and techniques
5. Model the business data using various business analytical methods and techniques

UNIT-I

Introduction to Business Analytics: Introduction to Business Analytics, need and science of data driven (DD) decision making, Descriptive, predictive, prescriptive analytics and techniques, Big data analytics, Web and Social media analytics, Machine Learning algorithms, framework for decision making, challenges in DD decision making and future.

UNIT-II

Descriptive Analytics: Introduction, data types and scales, types of measurement scales, population and samples, measures of central tendency, percentile, decile and quadrille, measures of variation, measures of shape-skewness, data visualization

UNIT-III

Forecasting Techniques: Introduction, time-series data and components, forecasting accuracy, moving average method, single exponential smoothing, Holt's method, Holt-Winter model, Croston's forecasting method, regression model for forecasting, Auto regression models, auto-regressive moving process, ARIMA, Theil's coefficient

UNIT-IV

Decision Trees: CHAID, Classification and Regression tree, splitting criteria, Ensemble and method and random forest. **Clustering**: Distance and similarity measures used in clustering, Clustering algorithms, K-Means and Hierarchical algorithms, **Prescriptive Analytics**- Linear Programming(LP) and LP model building,

UNIT-V

Six Sigma: Introduction, introduction, origin, 3-Sigma Vs Six-Sigma process, cost of poor quality, sigma score, industry applications, six sigma measures, DPMO, yield, sigma score, DMAIC methodology, Six Sigma toolbox

Text Books:

1. U Dinesh Kumar, "Data Analytics", Wiley Publications, 1st Edition, 2017
2. Marc J. Schniederjans, Dara G. Schniederjans, Christopher M. Starkey, "Business analytics Principles, Concepts, and Applications with SAS", Associate Publishers, 2015.

Suggested Reading:

1. S. Christian Albright, Wayne L. Winston, "Business Analytics - Data Analysis and Decision Making", 5th Edition, Cengage, 2015.

Web Resources:

1. https://onlinecourses.nptel.ac.in/noc18-mg11/preview
2. https://nptel.ac.in/courses/110105089/

19ME O103

COMPOSITE MATERIALS

(Open Elective)

Instruction	3 L Hours per Week
Duration of SEE	3 Hours
SEE	70 Marks
CIE	30 Marks
Credits	3

Course Objectives: This course aims to:

1. Composite materials and their constituents.
2. Classification of the reinforcements and evaluate the behavior of composites.
3. Fabrication methods of metal matrix composites.
4. Manufacturing of Polymer matrix composites.
5. Failure mechanisms in composite materials.

Course Outcomes: Upon completing this course, students will be able to:

1. Classify and characterize the composite materials.
2. Describe types of reinforcements and their properties.
3. Understand different fabrication methods of metal matrix composites.
4. Understand different fabrication methods of polymer matrix composites.
5. Decide the failure of 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 prepegs – hand layup method – Autoclave method – Filament winding method – Compression moulding – Reaction injection moulding. Properties and applications.

UNIT-V

Strength: Lamina Failure Criteria-strength ratio, maximum stress criteria, maximum strain criteria, interacting failure criteria, hygrothermal failure. Laminate first play failure-insight strength;

Text Books:

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

Suggested Reading:

1. Ed-Lubin, "Hand Book of Composite Materials"
2. K.K.Chawla, "Composite Materials".
3. Deborah D.L. Chung, "Composite Materials Science and Applications"
4. Daniel Gay, Suong V. Hoa, and Stephen W. Tsai, "Composite Materials Design and Applications"

19CE O101

COST MANAGEMENT OF ENGINEERING PROJECTS

(Open Elective)

Instruction	3 L Hours per Week
Duration of SEE	3 Hours
SEE	70 Marks
CIE	30 Marks
Credits	3

Course Objectives: This course aims to:

1. Enable the students to understand the concepts of Project management.
2. Provide knowledge on concepts of Project Planning and scheduling.
3. Create an awareness on Project Monitoring and Cost Analysis
4. Provide adequate knowledge to the students on Recourse Management Costing-Variance Analysis
5. Train the students with the concepts of Budgetary Control for cost management and to provide basic platform on Quantitative techniques for cost management.

Course Outcomes: Upon completing this course, students will be able to:

1. Acquire in-depth knowledge about the concepts of project management and understand the principles of project management.
2. Determine the critical path of a typical project using CPM and PERT techniques.
3. Prepare a work break down plan and perform linear scheduling using various methods.
4. Solve problems of resource scheduling and levelling using network diagrams.
5. Learn the concepts of budgetary control and apply quantitative techniques for optimizing project cost.

UNIT-I

Project Management: Introduction to project managements, stakeholders, roles, responsibilities and functional relationships. Principles of project management, objectives and project management system. Project team, organization, roles, responsibilities. Concepts of project planning, monitoring, staffing, scheduling and controlling.

UNIT-II

Project Planning and Scheduling: Introduction for project planning, defining activities and their interdependency, time and resource estimation. Work break down structure. Linear scheduling methods-bar charts, Line of Balance (LOB), their limitations. Principles, definitions of network-based scheduling methods: CPM, PERT. Network representation, network analysis-forward and backward passes.

UNIT-III

Project Monitoring and Cost Analysis: introduction-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, Time cost tradeoff-Crashing project schedules, its impact on time on time, cost. Project direct and indirect costs.

UNIT-IV

Resources Management and Costing-Variance Analysis: Planning, Enterprise Resource Planning, Resource scheduling and levelling. Total Quality Management and Theory of constraints. Activity-Based Cost Management, Bench Marking; Balanced Score Card and Value-Chain Analysis

Standard Costing and Variance Analysis. Pricing strategies: Pareto Analysis. Target costing, Life Cycle Costing. Costing of service sector. Just-in-time approach, Material Requirement

UNIT-V

Budgetary Control: Flexible Budgets; Performance budgets; Zero-based budgets. Measurement of Divisional profitability pricing decisions including transfer pricing.

Quantitative Techniques for Cost Management: Linear Programming, PERT/ CPM, Transportation Assignment problems, Simulation, Learning Curve Theory.

Text Books:

1. Charles T Horngren "Cost Accounting A Managerial Emphasis", Pearson Education; 14th edition 2012,
2. Charles T. Horngren and George Foster, "Advanced Management Accounting" Prentice-Hall; 6th Revised edition, 1987
3. Robert S Kaplan Anthony A. Atkinson, "Management & Cost Accounting" , Pearson; 2nd edition, 1996
4. K. K Chitkara, "Construction Project Management: Planning, scheduling and controlling", Tata McGraw-Hill Education. 2004.
5. Kumar Neeraj Jha "Construction Project Management Theory and Practice", Pearson Education India; 2nd edition, 2015.

19ME O101

INDUSTRIAL SAFETY
(Open Elective)

Instruction	3 L Hours per Week
Duration of SEE	3 Hours
SEE	70 Marks
CIE	30 Marks
Credits	3

Course Objectives: This course aims to:

1. Causes for industrial accidents and preventive steps to be taken.
2. Fundamental concepts of Maintenance Engineering.
3. About wear and corrosion along with preventive steps to be taken
4. The basic concepts and importance of fault tracing.
5. The steps involved in carrying out periodic and preventive maintenance of various equipment used in industry

Course Outcomes: Upon completion of this course, students will be able to:

1. Identify the causes for industrial accidents and suggest preventive measures.
2. Identify the basic tools and requirements of different maintenance procedures.
3. Apply different techniques to reduce and prevent Wear and corrosion in Industry.
4. Identify different types of faults present in various equipment like machine tools, IC Engines, boilers etc.
5. Apply periodic and preventive maintenance techniques as required for industrial equipment like motors, pumps and air compressors and machine tools etc.

UNIT–I

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

UNIT–II

Fundamentals of Maintenance Engineering: Definition and aim of maintenance engineering, Primary and secondary functions and responsibility of maintenance

department, Types of maintenance, Types and applications of tools used for maintenance, Maintenance cost & its relation with replacement economy, Service life of equipment.

UNIT–III

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

UNIT–IV

Fault Tracing: Fault tracing-concept and importance, decision tree concept, need andapplications, sequence of fault finding activities, show as decision tree, draw decision tree for problems in machine tools, hydraulic, pneumatic, automotive, thermal and electrical equipment's like, any one machine tool, Pump, Air compressor, Internal combustion engine, Boiler, Electrical motors, Types of faults in machine tools and their general causes.

UNIT–V

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

Text Books:

1. H. P. Garg, "Maintenance Engineering", S. Chand and Company
2. Audels, "Pump-hydraulic Compressors", Mcgraw Hill Publication

Suggested Reading:

1. Higgins & Morrow, "Maintenance Engineering Handbook", Da Information Services.
2. Winterkorn, Hans, "Foundation Engineering Handbook", Chapman & Hall London.

19ME O102

INTRODUCTION TO OPTIMIZATION TECHNIQUES

(Open Elective)

Instruction	3 L Hours per Week
Duration of SEE	3 Hours
SEE	70 Marks
CIE	30 Marks
Credits	3

Course Objectives: This course aims to:

1. Come to know the formulation of LPP models
2. Understand the Transportation and Assignment techniques
3. Come to know the procedure of Project Management along with CPM and PERT techniques
4. Understand the concepts of queuing theory and inventory models
5. Understand sequencing techniques

Course Outcomes: Upon completing this course, students will be able to:

1. Formulate a linear programming problems (LPP)
2. Build and solve Transportation Models and Assignment Models.
3. Apply project management techniques like CPM and PERT to plan and execute project successfully
4. Apply queing and inventory concepts in industrial applications
5. Apply sequencing models in industries

UNIT - I

Operations Research: Definition, scope, Models, Linear programming problems (LPP), Formulation, Graphical Method, and Simplex Method

UNIT - II

Transportation Models: Finding an initial feasible solution - North West Corner Method, Least Cost Method, Vogel's Approximation Method, Finding the optimal solution, Special cases in Transportation problems - Unbalanced Transportation problem, Degeneracy in Transportation, Profit Maximization in Transportation.

UNIT - III

Project Management: Definition, Procedure and Objectives of Project Management, Differences between PERT and CPM, Rules for drawing Network diagram, Scheduling the activities, Fulkerson's rule, Earliest and Latest times, Determination of ES and EF times in forward path, LS & LF times in backward

path, Determination of critical path, duration of the project, Free float, Independent float and Total float

UNIT - IV

Queuing Theory and Inventory: Kendols Notation, single server models, Inventory control - deterministic inventory models - Probabilistic inventory control models.

UNIT - V

Sequencing Models: Introduction, Objectives, General assumptions, processing 'n' jobs through two Machines, processing 'n' jobs through three machines.

Text Books:

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.

Suggested Reading:

1. Hitler Libermann, "Operations Research", McGraw Hill Pub.2009.
2. Pannerselvam, "Operations Research", Prentice Hall of India, 2010.
3. Harvey M Wagner, "Principles of Operations Research", Prentice Hall of India, 2010.

19EE O101

WASTE TO ENERGY
(Open Elective)

Instruction	3 L Hours per Week
Duration of SEE	3 Hours
SEE	70 Marks
CIE	30 Marks
Credits	3

Course Objectives: This course aims to:
1. Know the various forms of waste
2. Understand the processes of Biomass Pyrolysis.
3. Learn the technique of Biomass Combustion.

Course Outcomes: Upon completing this course, students will be able to:
1. Understand the concept of conservation of waste
2. Identify the different forms of wastage
3. Choose the best way for conservation to produce energy from waste
4. Explore the ways and means of combustion of biomass
5. Develop a healthy environment for the mankind

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 Program in India.

Text Books:

1. Desai, Ashok V, "Non Conventional Energy", Wiley Eastern Ltd., 1990.
2. Khandelwal, K. C. and Mahdi, S. S, "Biogas Technology - A Practical Hand Book", Vol. I &II, Tata McGraw Hill Publishing Co. Ltd., 1983.

Suggested Reading:

1. Challal, D. S., "Food, Feed and Fuel from Biomass", IBH Publishing Co. Pvt. Ltd., 1991.
2. C. Y. WereKo-Brobby and E. B. Hagan, "Biomass Conversion and Technology", John Wiley & Sons, 1996.