Course Structure and Syllabus
of
B.Tech Programme
In

ELECTRONICS & TELECOMMUNICATION ENGINEERING

(Admission Batch: 2018-19 Onwards)

INDIRA GANDHI INSTITUTE OF TECHNOLOGY, SARANG
(An Autonomous Institute of Government of Odisha)
Dhenkanal, Odisha- 759146
www.igitsarang.ac.in

INDIRA GANDHI INSTITUTE OF TECHNOLOGY, SARANG

Course Structure for 4th Year B.Tech

ELECTRONICS AND TELECOMMUNICATION ENGINEERING

(Admission Batch: 2018-19 Onwards)

Seventh Semester

Theory

Course Code	Course Name	L-T-P (Periods/ Week)	Credits
	Programme Core Subject		
PCEC4411	Mobile Communication and Networks	3-0-0	3
PCEC4412	Internet of Things	3-0-0	3
(Any One)	***Programme Elective III*** Refer the list of programme elective III	3-0-0	3
(Any One)	***Programme Elective IV*** Refer the list of programme elective IV	3-0-0	3
(Any One)	**Open Elective IV** Refer List of Open Electives	3-0-0	3
	Total (Theory)	**15**	**15**
	Honours/ Minor	3-1-0	4
HNEC0405	Wireless Access Technology		
MNEC0405	Mobile Communication and Networks		
	Practical/ Sessional		
PJEC8402	Minor Project	0-0-6	3
PJEC8403	Seminar and Technical Paper Writing	0-0-3	2
	Total (Practical/ Sessional)	**9**	**5**
	TOTAL	**24**	**20**

TOTAL SEMESTER CREDITS: 20

TOTAL CUMULATIVE CREDITS: 145

Eighth Semester

(A) *For students who carry out Major Project in the Institute*

Theory

Course Code	Course Name	L-T-P (Periods/ Week)	Credits
(Any One)	***Programme Elective V*** Refer the list of programme elective V	3-0-0	3
(Any One)	***Programme Elective VI*** Refer the list of programme elective VI	3-0-0	3
	Total (Theory)	**6**	**6**
	Practical/ Sessional		
PJEC8405	Major Project	0-0-12	6
PJEC8406	Comprehensive Viva Voce	0-0-3	1
PJEC8404	Internship	0-0-3	2
	Total (Practical/ Sessional)	**18**	**9**
	TOTAL	**24**	**15**

OR

(B) *For students who carry out Internship based Major Project*

	Practical/ Sessional		
PJEC8407	Internship based Major Project	---	12
PJEC8406	Comprehensive Viva Voce	---	1
PJEC8404	Internship	---	2
	Total (Practical/ Sessional)		**15**
	TOTAL		**15**

TOTAL SEMESTER CREDITS: 15

TOTAL CUMULATIVE CREDITS: 160

PROGRAMME ELECTIVE SUBJECTS

Programme Elective III List for 7th Semester	
PEEC5410	Satellite Communication
PEEC5411	Mathematics for Communication Engineers
PEEC5412	Digital Switching and Telecom Network
PEEC5413	Computer Architecture and Organization

Programme Elective IV List for 7th Semester	
PEEC5414	Modern Radar Systems
PEEC5415	Digital Image Processing
PEEC5416	Computational Intelligence
PEEC5417	Robotics and Computer Vision

Programme Elective V List for 8th Semester	
PEEC5418	Wireless Sensor Networks
PEEC5419	Biomedical Signal Processing
PEEC5420	Optical Communication and Networks
PEEC5421	Industrial Electronics

Programme Elective VI List for 8th Semester	
PEEC5422	Design and Analysis of Algorithms
PEEC5423	Antenna Theory and Design
PEEC5424	Multimedia Communication
PEEC5425	Adaptive Signal Processing
PEEC5426	Advanced Control System
PEEC5427	Neural Networks for Pattern Recognition

OPEN ELECTIVE SUBJECTS

OPEN ELECTIVE-IV (OE-IV) 7th Semester						
Sl. No.	**Subject Code**	**Subject Name**	**Contact Hours**	**Credits**	**Departments to Teach the Subject**	**Students to whom Option is Open**
1	OECH6432	Mineral Processing	3-0-0	3	Chemical Engg.	All branches
2	OECH6433	Colloid and Interfacial Engineering	3-0-0	3	Chemical Engg.	All branches
3	OECE6434	Finite Element Analysis	3-0-0	3	Civil Engg.	All branches
4	OECS6435	Research Methods in Computer Science	3-0-0	3	CSE	All branches
5	OEEE6323	Analog & Digital Communication Systems	3-0-0	3	Electrical Engg.	All branches
6	OEEE6436	Internet of Things	3-0-0	3	Electrical Engg.	All branches
7	OEEC6437	Soft Computing	3-0-0	3	ETC, CSE, Electrical Engg.	All branches
8	OEME6438	Reliability Engineering	3-0-0	3	Mech. Engg.	All branches
9	OEME6439	Robotics	3-0-0	3	Mech. Engg.	All branches
10	OEMT6440	Nanocomposites	3-0-0	3	MME	All branches
11	OEPD6441	Industrial Management	3-0-0	3	Prod. Engg.	All branches

CE:	Civil Engineering	CS, CSE:	Computer Science and Engineering
EE:	Electrical Engineering	EC, ETC:	Electronics and Telecommunication Engineering
ME:	Mechanical Engineering	MT, MME:	Metallurgical and Materials Engineering
CH:	Chemical Engineering	PD, Prod.:	Production Engineering
HM:	Humanities	MA:	Mathematics

INDIRA GANDHI INSTITUTE OF TECHNOLOGY, SARANG

B.TECH SYLLABUS for ELECTRONICS AND TELECOMMUNICATION ENGINEERING

(Admission Batch: 2018-19 Onwards)

7th Semester

PCEC4411	Mobile Communication and Networks	3-0-0	Credits 3

COURSE OBJECTIVES

1. To know the evolution of cellular communication technology and its implementation in voice, data services.
2. To get knowledge on channel modeling techniques, different multiple access techniques.
3. To understand various networks/systems used for wireless communication like GSM, GPRS, Bluetooth, UMTS, CDMA-2000, IMT-2000, Wi-Fi, Wi-max.

MODULE-I **(12 Hours)**

Unit-1

Wireless communication fundamentals: Fundamental terms related to communication, General model for wireless digital communication link, bandwidth, types of signals, types of communications systems, wired versus wireless media,

Unit-2

The Cellular Concept: Introduction to cellular theory, Fundamental terms related to cellular theory. Frequency Reuse. Cellular system components. Analog and Digital Circuit switched cellular system. Channel assignment strategies. Hand-off strategies. Interference (Co-channel & Adjacent channel interference). Trunking and Grade of service (Erlang B and C formula). Improving coverage and capacity in cellular system: Cell splitting, Sectoring, Repeaters for range extension, Microcell zone concept. Location Management. GSM: Services, features, Architecture, Frame of GSM

MODULE-II **(12 Hours)**

Unit-3

Wireless channels and modelling: Introduction to radio wave propagation and wave propagation mechanism. Radio communication cases: Free space propagation model, Ground wave Propagation, Ionospheric Propagation, Tropospheric Propagation. Outdoor Propagation model (Okumura and Hata Model). Indoor Propagation models. Channel noises and losses. Fading and its type. Delay Spread, Doppler's spread and Inter symbol Interference. Coherence Time & bandwidth. Fading effects on signal and frequency components. Shadowing. Signal outages and fading margin.

Unit-4

Wireless channel modelling: channel modelling. Additive white Gaussian noise. Representation of discrete channel by filter. Stochastic radio channel modelling. Flat fading channel modelling. Wideband time dispersive channel modeling, Rayleigh fading model, Rician fading model, Nakagami fading model,

comparison of Rayleigh, Rician and Nakagami models.

MODULE-III (12 Hours)

Unit-5

Modulation Schemes: Digital Modulation- an overview, Pulse Shaping techniques: Nyquist criterion for zero ISI or ISI cancellation. Linear modulation schemes: QPSK, OQPSK, $\pi/4$ QPSK. Constant Envelop Modulation Schemes: BFSK, MSK, GMSK. Differential Modulation Schemes. Offset Modulation Schemes. orthogonal frequency division multiplexing transmitter and receiver

Unit-6

Multiple Access and Spread spectrum Techniques: Introduction to multiple access, spread spectrum multiple access (SSMA), space division multiple access (SDMA),orthogonal frequency division multiple access (OFDMA),

Equalization, Diversity: Introduction to equalization and its fundamentals, Need of equalizer in a communication receiver. Linear Equalizer, Non-linear Equalizer, Adaptive Equalizer, Diversity Techniques, RAKE receiver.

MODULE-IV (8 Hours)

Unit-7

Wireless Networks: Introduction to Wireless networks. Difference between Wireless and Fixed Networks. Circuit and Packet Switching. X.25 protocol. Wireless Data Services: Cellular Digital Packet Data. Common channel signalling, Integrated Services Digital Network (ISDN). Signalling System No. 7: services, protocol and performances. Personal Communication Services (PCS).

Ad-hoc networks: Introduction to Ad-hoc networks, Bluetooth, Wi-Fi standards, Wi-MAX standards, wireless sensor networks.

Text Books:

1. T. S. Rappaport, "Wireless Communications", Pearson, 2002.

Reference Books:

1. Upena Dalal, "Wireless Communication Networks", 1st Edition, Oxford university press, 2008.
2. V K Garg, "Wireless Communication and Networking", Morgan Kaufman Publishers, India, 2004.

Course Outcomes:

1. To describe various ways wave propagation in wireless communication and the losses associated with these paths.
2. To Easily elaborate various wireless technologies used in present scenario.
3. To solve the problems related to various models, coding techniques, and modulation schemes.

PCEC4412	Internet of Things	3-0-0	Credits 3

COURSE OBJECTIVES

1. To understand the design of IOT relevant applications in various domain.
2. To understand the concepts of Raspberry Pi, interfaces and applications in IoT domain.
3. To understand the importance of cloud computing and its applications.
4. To understand specific security and data protection issues in IoT

MODULE-I **(12 Hours)**

Unit 1

Introduction & Concepts: Introduction to Internet of Things, Physical Design of IOT, Logical Design of IOT, IOT Enabling Technologies, IOT Levels.

Unit 2

Domain Specific IOTs: Home Automation, Cities, Environment, Energy, Retail, Logistics, Agriculture, Industry, Health & Life Style.Smart Lighting, Intrusion Detection, Smoke/Gas Detectors, Cities-Smart Parking, Smart Lighting, Smart Roads, Environment-Weather Monitoring, Air pollution Monitoring, Forest Fire Detection, Energy-Smart Grids, Logistics-Route Generation & Scheduling, Agriculture Smart Irrigation, Health & Fitness Monitoring.

MODULE-II **(12 Hours)**

Unit 3

M2M: M2M, Difference between IOT and M2M.

Unit 4

IOT Physical Devices & Endpoints: What is an IOT Device, Linux on Raspberry Pi, Interfaces, Programming: Installing python. Data types and data structures, Flow, Functions, Modules, File Handling, Date/ Time Operations, Classes, Python Packages.

MODULE-III **(12 Hours)**

Unit 5

Design steps of IoT

Design steps of IoT**,** Raspberry Pi, About the Board, Linux on Raspberry Pi.

Unit 6

Raspberry Pi Interfaces – Serial, SPI, I2C, Programming Raspberry Pi with Python-Controlling LED with Raspberry Pi, interfacing an LED and Switch with Raspberry Pi, Interfacing a Light Sensor (LDR) with Raspberry Pi.

MODULE-IV **(8 Hours)**

Unit 7

Privacy and Security threats on internet of Things: Specific security and data protection issues, IoT privacy and security issues in smart cities.

Text Book:

1. Arshdeep Bahga and Vijay Audisetti, "Internet of Things, A Hands on Approach", University Press, 1st edition, 2016.

Reference Books:

1. Sébastien Ziegler, "Internet of Things Security and Data Protection", Springer Publisher, 1st edition, 2019.
2. Adrian McEwen, "Designing the Internet of Things", Wiley, 1st edition, 2015.
3. Miller, "The Internet of Things: How Smart TVs, Smart Cars, Smart Homes and Smart Cities are
4. Changing the World", Pearson, 1st edition, 2015.

Course Outcomes:

1. To analyse applications of IOT in various domain.
2. To realize the revolution of Internet in Mobile Devices, Cloud &Sensor Networks
3. To understand the importance of cloud computing and Embedded system.
4. To understand the challenges and limitations of internet of things.

PEEC5410	Satellite Communication	3-0-0	Credits 3

COURSE OBJECTIVES

1. To understand the working of satellite communication system and its other subsystems.
2. To provide a solid foundation in orbital mechanics and launches for the satellite communication.
3. To train the students with a basic knowledge of link design of satellite with a design examples.
4. To provide better understanding of multiple access systems and earth station technology.
5. To understand the concept of satellite navigation and global positioning system.

MODULE-I **(12 Hours)**

Unit 1

Orbital Mechanics and Launchers

Introduction to state of satellite communication: Orbital mechanics and parameters, Look angle determination, Visibility test, Orbital Perturbations, Orbit determination, Launches and lunch vehicles, Orbital effects in communication systems performance.

Unit 2

Satellites

Satellite subsystems, Attitude and orbit control system, Telemetry, Tracking, Command and Monitoring, Power system, Description of communication subsystems, Transponders, Satellite antennas, Equipment reliability and space qualification.

Satellite Link Design

Basic transmission theory, System noise temperature and G/T ratio, Uplink and downlink design, Link budget, Design of satellite links for specified C/N and C/I values.

MODULE-II (12 Hours)

Unit 3

Modulation and Multiplexing techniques for satellite links

Analog frequency modulation transmission by satellite, Digital transmission, Digital transmission of analog signals, Time division multiplexing.

Unit 4

Multiple access

Comprehensive study on FDMA, TDMA and CDMA, Spread spectrum transmission and reception, Estimating channel requirements, SPADE, Random access.

MODULE-III (12 Hours)

Unit 5

Propagation effects and their impact on satellite-earth links

Quantifying attenuation and depolarization, propagation effects that is not associated with hydrometeors, Ionosphere effects, Rain and ice effects, Prediction of rain attenuation and XPD.

Unit 6

Satellite antennas

Types of antennas and relationships, Basic antennas theory- linear, rectangular and circular aperture, Gain, Pointing loss.

VSAT Systems

Overview of VSAT systems, Network architectures, Access control protocols, Basic techniques, VSAT earth station engineering

MODULE-IV (8 Hours)

Unit 7

Earth station technology

Earth station design, Design of large antennas- cassegrain antennas, Optimizing gain of large antenna, Antenna temperature, Feed system for large cassegrain antennas.

Application of satellite communication

Network distribution and direct broadcasting TV, Satellite navigation and global positioning system, Fundamentals of mobile communication satellite.

Text Books:

1. Timothy Pratt, Charles Bostian and Jeremy Allnutt, "Satellite Communications", John Wiley and sons inc, 2nd Edition, 2003.

Reference Books:

1. Dennis Roddy, "Satellite Communications", McGraw Hill Education, 4th Edition, 2017.
2. R.N. Mutagi, "Satellite Communication, Principles and Applications", Oxford University Press, 1st

Edition, 2016.
3. .K.N. Raja Rao, "Fundamentals of Satellite Communications", Prentice Hall India Pvt Limited, 1st Edition, 2004.
4. D.C. Agarwal, "Satellite Communications", Khanna Publishers, 6th Edition, 2006.

Course Outcomes

1. To understand the basic knowledge of satellite communication principles.
2. To demonstrate orbital mechanics, launch vehicles and satellite link design.
3. To visualize satellite sub systems like telemetry, tracking, command and monitoring power systems.
4. To understand the various multiple access techniques for satellite communication, satellite antennas and the application of satellite communication system.

PEEC5411	Mathematics for Communication Engineers	3-0-0	Credits 3

COURSE OBJECTIVES

1. To demonstrate various analytical skills in applied mathematics and extensive experience with the tactics of problem solving and logical thinking applicable in communication engineering.
2. To identify, formulate, abstract, and solve problems in electrical engineering using mathematical tools from a variety of mathematical areas, including linear algebra, matrix linear programming, probability.

MODULE-I **(12 Hours)**

Unit 1

Linear algebra

Vector spaces: Liner combination of vectors, Linear independence, Basis and dimension, Norms and normed vector spaces, Inner product and Inner product spaces, Weighted inner products, Induced norms.

Unit 2

Direction of Vectors: Orthogonality, orthogonal subspaces, Linear transformations: Range and Null spaces, projections and orthogonal projections, Projection theorem.

MODULE-II **(12 Hours)**

Unit 3

Linear programming

Formulation, Graphical solution, Simplex method, Big M method, Two phase method, Transportation problems, Assignment models.

Unit 4

Linear operators and Matrices

Linear operators, Operator norms, Geometry of linear equations, properties of matrix inversion, Pseudo

inverses, Eigen values and Eigen vectors: Linear dependence of Eigen vectors, computation of Eigen values and Eigen vectors, Diagonalization of a matrix, Signal subspace techniques: the signal model, the noise model.

MODULE-III (12 Hours)

Unit 5

Unit 6

Matrix Factorization

The LU factorization: Computing the determinant using the LU factorization, Computing the LU factorization, The Cholesky factorization, Unitary matrices and the QR factorization: Unitary matrices, The Singular Value Decomposition.

MODULE-IV (8 Hours)

Unit 7

PROBABILITY AND RANDOM VARIABLES

Probability, Axioms of probability, Conditional probability, Baye's theorem, Random variables - Probability function, Two dimensional random variables, Joint distributions, Marginal and conditional distributions, Functions of two dimensional random variables, Regression curve, Correlation**.**

Text Books:

1. T. K. Moon and W.C. Stirling, "Mathematical Methods and Algorithms for Signal Processing", Pearson Education, 2000.

Reference Books:

1. D. Gross, J.F. Shortle, Thompson, J. M. and Harris, C. M., "Fundamentals of Queuing Theory ", 4th Edition, Wiley,2014
2. R.A. Johnson, I and Freund J. Miller, "Miller and Freund"s Probability and Statistics for Engineers", Pearson Education, Asia, 8th Edition, 2015.
3. S. S. Sastry , "Introductory Methods of Numerical Analysis ", 5th Edition, PHI Learning,2015.

Course Outcomes:

1. Concepts on vector spaces, linear transformation, inner product spaces, Eigen values and generalized eigenvectors.
2. Apply various methods in linear algebra to solve system of linear equations.
3. Could develop a fundamental understanding of linear programming models, able to develop a linear programming model from problem description, apply the simple method for solving linear programming problems.
4. Computation of probability, random variables and associated distributions, correlations.

PEEC5412	Digital Switching and Telecommunication Network	3-0-0	Credits 3

COURSE OBJECTIVES

1. To introduce fundamental functions of a telecommunication switching systems, Electronic space division switching.
2. To introduce the concepts of space switching, time switching, and combination switching.
3. To introduce a mathematical model for the analysis of telecommunication traffic.
4. To understand about various signaling in telecommunication systems.
5. To analyze various telecommunication networks.

MODULE -I **(12 Hours)**

Unit 1

Introduction

Evolution of Telecommunications, Simple Telephone Communication, Manual switching system, major telecommunication Networks, Strowger Switching System, Crossbar Switching.

Unit 2

Electronic space division switching

Stored Program Control, Centralized SPC, Distributed SPC, Enhanced Services, Two stage networks, Three stage network n-stage networks.

MODULE -II **(12 Hours)**

Unit 3

Time Division Switching

Basic time division space switching, time division time switching, time multiplexed space and time switching, combination switching, three-stage & n stage combination switching.

Unit 4

Traffic Engineering

Network traffic load and parameters, Grade of services & blocking probability, modeling of switching systems, incoming traffic & service time characterization, blocking models and loss estimates, Delay systems.

MODULE -III **(12 Hours)**

Unit 5

Telephone Networks

Subscriber Loop Systems, Switching Hierarchy and Routing, Transmission Plan, Transmission Systems, Numbering Plan, Charging Plan, Signaling Techniques, In channel signaling, common channel signaling, Cellular mobile telephony.

Unit 6

Data Networks

Data transmission in PSTN, switching techniques, Data communication architecture, ISO-OSI Reference Model, link-to-link layers, end-to-end layers, satellite based data networks, an overview of data network standards.

MODULE-IV (08 Hours)

Unit 7

Integrated Services Digital Networks

Motivation for ISDN, New services, Network and Protocol architecture, Transmission Channels, User Network Interface, signaling, Numbering and Addressing, Service characterization, Interworking , ISDN standards, Broadband ISDN, Voice data Integration.

Text Books:

1. Thiagarajan Viswanathan, "Telecommunication Switching Systems and Networks", PHI, 2nd edition, 2010.

Reference Books:

1. J. E. Flood, "Telecommunications Switching, Traffic and Networks", Pearson Education, 1st edition, 2002.
2. A. L. Garcia and I. Widjaja, "Communication Networks", Tata McGraw Hill Education India, 2nd edition 2004.

Course Outcomes:

1. Analysis of various telecommunication networks.
2. Estimate the performance of telecommunication networks.
3. Calculation of blocking probability in multistage networks.
4. Describe integrated networks.
5. To compare telephone network, data network, and integrated service digital network.

PEEC5413	Computer Architecture and Organization	3-0-0	Credits 3

COURSE OBJECTIVES

1. To design Computer Architecture for different applications.
2. To introduce Computer Organization related concepts.

MODULE-I (12 Hours)

Unit 1

Information Representation

Number system, Binary numbers, Sign Magnitude & 2's compliment representation, Fixed and Floating point, IEEE-754 Single Precision format, IEEE-754 Double Precision format, Precision and range, BCD code, ASCII and EBCDIC.

Unit 2

Digital Electronics

Boolean Algebra, Logic gates, Truth Tables, Combinational circuits, Karnaugh map, Flip flops, Sequential circuits.

MODULE-II (12 Hours)

Unit 3

Combination RTL Components

Integrated circuits, Multiplexer, Demultiplexers, Decoder, Encoder, Registers, Shift Registers, Binary counters, Memory unit- RAM, ROM, Parity generators and checkers, Adder/ Subtractor, Programmable Logic Devices- PLA, PAL, ROM.

Unit 4

Sequential RTL Components

Registers and counters. Their applications.

MODULE-III (12 Hours)

Unit 5

Central Processing Unit

General register Organization, Stack Organization, Reverse Polish Notation, Machine Language instructions, Addressing modes, Instruction types, Instruction set selection, Instruction cycle and execution cycle. Fundamental of assembly language Programming using 8085 microprocessor, RISC vs CISC.

Unit 6

Memory Organization

Memory Hierarchy, Main Memory, Auxiliary Memory, Associative Memory, Cache Memory, Virtual Memory, Memory Management Hardware.

MODULE-IV (8 Hours)

Unit 7

Multiprocessors

Characteristics of Multiprocessors, Interconnect Structures, Interprocessor communication and Synchronization, Cache Coherence.

Pipeline and Vector Processing

Parallel Processing, Pipelining, Arithmetic Pipeline, Instruction Pipeline, RISC Pipeline, Vector Processing, Array Processing.

Text Books:

1. M. Morris Mano, "Computer system and Architecture", Pearson, 3rd Edition, 2004.

Reference Books:

1. V.C. Hammacher, Z.G Vranesic, S.G. ZAky – "Computer Organization", McGraw Hill 1996
2. J.L Hennesy & D.A. Pattersion,"Computer Architecture- A Quantitative approach", 2nd Edition-

Mergan Kaufman Pub, 1996.

Course Outcomes:

1. To demonstrate, analyze and solve problems related to Computer Architectures with Computer Organization applications.
2. To understand the working of multiprocessors and its applications.

PEEC5414	Modern Radar Systems	3-0-0	Credits 3

COURSE OBJECTIVES

1. To learn radar fundamentals like radar equation, operating frequencies and applications.
2. To study CW radar system and its application along with FM-CW radar system for altimeter.
3. To understand the working principles of MTI radar and a pulse Doppler radar.
4. To learn the various types of tracking techniques involved.
5. To study about the matched filter receiver, radar transmitters, receivers, and antennas.

MODULE-I **(12 Hours)**

Unit-1

An Introduction to Radar

Basic Radar, Maximum unambiguous range, Radar waveforms, Simple form of radar equation, Radar block diagram and operation, Radar frequencies and applications, Related problems.

Unit-2

The Radar Equation

Prediction of range performance, Minimum detectable signal, Receiver noise and SNR, Probabilities of detection and false alarm, Integration of radar pulses, Radar cross section of targets (simple targets - sphere, cone-sphere), Transmitter power, Pulse repetition frequency and range Ambiguities, Antenna parameters, System losses. Related problems.

CW and Frequency Modulated Radar

Doppler effect, CW radar – Block diagram, Isolation between transmitter and receiver, Non-zero IF receiver, Receiver bandwidth Requirements, Applications of CW radar.

FM-CW radar, Range and doppler measurement, Block diagram and characteristics (Approaching/ Receding Targets), FM-CW altimeter, Measurement errors, Multiple frequency CW radar.

MODULE-II **(12 Hours)**

Unit-3

MTI and Pulse Doppler Radar

Introduction to MTI radar and it's principle, MTI radar block diagram, Delay line cancellers – Filter characteristics, Blind speeds, Double cancellation, Staggered PRFs. Range gated doppler filters. MTI radar parameters, Limitations to MTI performance. Non-coherent MTI, MTI versus Pulse doppler radar.

Unit-4

Tracking Radar

Tracking with radar, , Monopulse tracking radar – Amplitude comparison monopulse (one- and two-coordinates), Phase comparison monopulse, Conical scan and sequential lobing, Target limitation to tracking accuracy. Tracking in range, Acquisition and scanning Patterns. Comparison of trackers.

MODULE-III (12 Hours)

Unit-5

Detection of Radar Signals in Noise

Introduction, Matched filter receiver – Response characteristics and derivation, Correlation function and Cross-correlation receiver, Efficiency of non-matched filters, Matched filter for non-white noise, Detector and detection criteria, Constant false alarm rate receiver.

Unit-6

Information from radar signal and radar clutter

Basic radar measurements, accuracy measurement, Radar clutter- surface clutter radar equation, land, sea and weather clutters.

MODULE-IV (8 Hours)

Unit-7

Radar Transmitters

Linear beam power tubes, solid state RF power sources, Magnetron and crossed-field amplifiers.

Radar Receivers

Noise figure and noise temperature. Displays – types. Duplexers – Branch type and Balanced type, Circulators as duplexers. Introduction to phased array antennas – Basic concepts, Radiation pattern, Beam steering and beam width changes, Series versus parallel feeds, Applications, Advantages and limitations.

Text Books:

1. Merrill I. Skolnik, "Introduction to Radar Systems", Tata McGraw- Hill, 3rd edition, 2001.

Reference Books:

1. Merrill I. Skolnik, "Introduction to Radar Systems", Tata McGraw- Hill Special Indian Edition, 2nd edition, 2007
2. Byron Edde, "Radar Principles, Technology, Applications", Pearson Education, 6th edition, 2011.
3. Mark A. Richards, James A. Scheer, William A. Holm, "Principles of Modern Radar", SciTech publishing Inc, 1st edition, 2010.

Course Outcomes:

1. To understand the factors affecting the radar performance using radar range equation.
2. To analyze the principle of FM-CW radar and apply it in FM-CW altimeter.
3. To analyze the principle of each and every block of MTI, Pulse Doppler radar and tracking of radar.
4. To understand the basic principle of transmitters, receivers and also extraction of signal in noise.

PEEC5415	Digital Image Processing	3-0-0	Credits 3

COURSE OBJECIVES

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

MODULE-I **(12 Hours)**

Unit-1

Fundamentals – Steps in digital image processing, sampling and quantization, Components of image processing system.

Unit-2

Image Sampling and Quantization, relationship between pixels.

MODULE-II **(12 Hours)**

Unit-3

Image Enhancement – Point processing, spatial filtering (smoothing and sharpening filters), enhancement in frequency domain.

Unit-4

Filtering in the Frequency Domain- Preliminary concepts, 2D DFT and its properties, basic filtering in the frequency domain, image smoothing and sharpening.

MODULE-III **(12 Hours)**

Unit-5

Image Restoration and Reconstruction-Image restoration/degradation model, noise models, restoration in the presence of noise only, estimating the degradation function.

Unit-6

Color Image Processing- Color models, Color transformation.

MODULE-IV **(8 Hours)**

Unit-7

Wavelets and Multi-resolution Processing- Multi resolution expansions, wavelet transforms in one and two dimension.

Image Compression- Fundamentals, Some basic compression models, Error-free compression,
Lossy compression.

Text books:

1. R.C. Gonzalez, R.E. Woods, "Digital Image Processing", Pearson Education , 3rd Edition, 2007

Reference Books:

1. S. Sridhar, "Digital Image Processing", Oxford University Press,2011
2. B. Chanda, Dutta D. Majumder ,"Digital Image Processing And Analysis", Prentice Hall India, 2002.
3. S. Sridhar, "Digital Image Processing" , Oxford University Press,2011 .

Course Outcomes:

1. Review the fundamental concepts of a digital image processing system.
2. Analyze images in the frequency domain using various transforms.
3. Evaluate the techniques for image enhancement and image restoration.
4. Categorize various compression techniques.
5. Interpret Image compression standards.

PEEC5416	Computational Intelligence	3-0-0	Credits 3

COURSE OBJECTIVES

1. To give students knowledge of non-traditional technologies and fundamentals of artificial neural networks, fuzzy sets, fuzzy logic, Fuzzy Inference System and Genetic algorithms.
2. To provide knowledge on fuzzification and defuzzification methods supported in fuzzy logic.
3. To understand the need for optimization and different techniques involved.

MODULE-I **(12 Hours)**

Unit 1

Introduction

Soft computing constituents and conventional Artificial Intelligence, Neuro-Fuzzy and Soft Computing characteristics.

Unit 2

Fuzzy Sets, Fuzzy Rules and Fuzzy Reasoning

Introduction, Basic definitions and terminology, Set-theoretic operations, MF Formulation and parameterization, More on fuzzy union, intersection, and complement, Extension principle and fuzzy relations, Fuzzy If-Then rules, Fuzzy reasoning.

Fuzzy Inference System

Mamdani fuzzy models, Sugeno Fuzzy Models, Tsukamoto fuzzy models

MODULE-II (12 Hours)

Unit 3

Derivative-based optimization

Descent methods, the method of steepest descent, Newton's methods, Step size determination, conjugate gradient methods, Analysis of quadratic case, nonlinear least-squares problems, Incorporation of stochastic mechanism.

Unit 4

Derivative-free optimization

Genetic algorithm simulated annealing, random search, Downhill simplex search, Swarm Intelligence, genetic programming.

Adaptive Networks

Architecture, Back propagation for feed forward networks, Extended back propagation for recurrent networks, Hybrid learning rule: combing steepest descent and LSE.

MODULE-III (12 Hours)

Unit 5

Supervised learning neural networks

Perceptions, Adeline, Back propagation multi-layer perceptions, Radial Basic Function networks.

Unit 6

Unsupervised learning and other neural networks

Competitive learning networks, Kohonen self-organizing networks, learning vector quantization, Hebbian learning and the Hopfield network.

MODULE-IV (8 Hours)

Unit 7

Adaptive Neuro-fuzzy inference systems

ANFIS architecture, Hybrid learning algorithms, Learning methods that cross-fertilize ANFIS and RBNF, ANFIS as universal approximator, Simulation examples.

Text Books:

1. J.S.R. Jang, C. T. Sun and E. Mizutani, "Neuro-fuzzy and Soft Computing", PHI, 2005.
2. S. Rajasekaran, G. A. Vijaylakshmi Pai, "Neural Networks, Fuzzy Logic, and Genetic Algorithms", PHI, 2001.

Reference Books:

1. George J. Klir and Bo Yuan, "Fuzzy Sets and Fuzzy Logic: Theory and Applications", Prentice Hall, 1995.

Course Outcomes:

1. Apply fuzzy logic and reasoning to handle uncertainty and solve various engineering problems.
2. Apply genetic algorithms to combinatorial optimization problems.
3. Learn the application of algorithms for engineering Optimization.

PEEC5417	Robotics and Computer Vision	3-0-0	Credits 3

COURSE OBJECTIVES

1. To introduce students the fundamentals of image formation
2. To analyze the forward kinematics and inverse kinematics of serial and parallel robots.

MODULE-I **(12 Hours)**

Unit-1

Robotics Fundamentals

Components, degrees of freedom, joints, reference frames, characteristics.

Unit-2

Kinematics

Transformations and their representation using matrix, forward and inverse kinematic equations; Denavit-Hardenberg representation, degeneracy and dexterity.

MODULE-II **(12 Hours)**

Unit-3

Computer Vision Fundamentals

Relationships to other fields, image geometry, definitions, levels of computation.

Unit-4

Binary image processing

Geometric processing, binary algorithms (e.g., component labeling, distance transforms, medial axis)

MODULE-III **(12 Hours)**

Unit-5

Regions and segmentations

Thresholding, region representation, split and-merge.

Unit-6

Hough Transform

Theory and applications

MODULE – IV **(8 Hours)**

Unit-7

Differential motions and velocities

Jacobian, differential motions of a frame, Jacobian and the differential operator.

Image filtering

Histograms, linear systems, mean and median filters, Gaussian smoothing

Text Books:

1. M.P.Groover,"Industrial Robotics Technology Programming and Applications", McGraw-Hill, 2008.

Reference Books:

1. D. Forsyth, J. Ponce,"Computer Vision - A Modern Approach", Pearson, 2nd edition,2012.

Course Outcomes:

1. To understand robotics and its application.
2. To identify basic concepts, terminology, theories, models and methods in the field of computer vision.

HONOURS

HNEC0405	Wireless Access Technology	3-1-0	Credits 4

Course Objectives:

1. To understand the next generation wireless access technologies (LTE/NR).
2. To study the concept of spectrum allocation, architecture of future communication systems.
3. To understand the frame structure, channel sounding and physical layer control signaling of NR.

MODULE-I **(12 Hours)**

Unit-1

Overview of LTE

LTE -Basic Radio Access, LTE Evolution, LTE requirements, LTE Enabling Technologies: OFDM, SC-FDM, MIMO, LTE Physical layer modeling, spectrum flexibility: Carrier Aggregation, License-Assisted Access.

Unit-2

LTE physical layer- Bandwidth allocation, Time framing, Time-Frequency representation, OFDM multi carrier transmission, Single carrier frequency division, multiplexing, physical layer channels.

MODULE-II **(12 Hours)**

Unit-3

NR Overview

Higher-Frequency Operation and Spectrum Flexibility, Ultra-Lean Design, Forward Compatibility, Transmission Scheme, Bandwidth Parts, and Frame Structure, Duplex Schemes, Scheduling and Data Transmission, Control Channels.

Unit-4

Radio Interface Architecture

Overall System Architecture: 5G Core Network, Radio-Access Network, Radio Protocol Architecture, User-Plane Protocols: Service Data Adaptation Protocol, Packet-Data Convergence Protocol, Medium-Access Control.

MODULE-III (12 Hours)

Unit-5

Transmission Structure

Transmission Scheme, Time-Domain Structure, Frequency-Domain Structure, Bandwidth Parts, Frequency-Domain Location of NR Carriers.

Unit-6

Channel Sounding

Downlink Channel Sounding: Basic CSI-RS Structure, Frequency-Domain Structure of CSI-RS Configurations, Time-Domain Property of CSI-RS Configurations, CSI-IM—Resources for Interference Measurements, Uplink Channel Sounding: SRS Sequences and Zadoff-Chu Sequences, Multiport SRS, Time-Domain Structure of SRS.

MODULE-IV (12 Hours)

Unit-7

Physical-Layer Control Signaling

Downlink: Physical Downlink Control Channel, Control Resource Set, Blind Decoding and Search Spaces, Downlink Scheduling Assignments, Signaling of Frequency-Domain Resources, Signaling of Time-Domain Resources, Signaling of Transport-Block Sizes. Uplink: Basic PUCCH Structure, PUCCH Format 0 and 1, Resources and Parameters for PUCCH Transmission, Uplink Control Signaling on PUSCH.

Text Books:

1. E. Dahalment, S. Parkvall, J. Skold, "5G NR: The Next Generation Wireless Access Technology", Elsevier Academic press, 2018.

Reference Books:

1. H. Zarrinkoub, "Understanding LTE with MATLAB", John Willey & Sons Publications, 2014.
2. Jonathan Rodriguez, "Fundamentals of 5G Mobile Networks", Wiley, 2015.
3. ZhangYin, ChenMin, "Cloud Based 5G Wireless Networks", Springer, 2016

Course Outcomes:

1. Learn next generation wireless access technologies.
2. Apply physical channel modeling, radio interfacing in projects.
3. Learn various advanced technologies such as uplink and downlink control signaling, time frequency frame structure and multi carrier transmission.

MINOR

MNEC0405	Mobile Communication and Networks	3-1-0	Credits 4

COURSE OBJECTIVES

1. To know the evolution of cellular communication technology and its implementation in voice, data services.
2. To get knowledge on channel modeling techniques, different multiple access techniques.
3. To understand various networks/systems used for wireless communication like GSM, GPRS, Bluetooth, UMTS, CDMA-2000, IMT-2000, Wi-Fi, Wi-max.

MODULE-I **(12 Hours)**

Unit-1

Wireless communication fundamentals: Fundamental terms related to communication, General model for wireless digital communication link, bandwidth, types of signals, types of communications systems,wired versus wireless media,

Unit-2

The Cellular Concept: Introduction to cellular theory, Fundamental terms related to cellular theory. Frequency Reuse. Cellular system components. Analog and Digital Circuit switched cellular system. Channel assignment strategies. Hand-off strategies. Interference (Co-channel & Adjacent channel interference). Trunking and Grade of service (Erlang B and C formula). Improving coverage and capacity in cellular system: Cell splitting, Sectoring, Repeaters for range extension, Microcell zone concept. Location Management. GSM: Services, features, Architecture, Frame of GSM

MODULE-II **(12 Hours)**

Unit-3

Wireless channels and modelling: Introduction to radio wave propagation and wave propagation mechanism. Radio communication cases: Free space propagation model, Ground wave Propagation, Ionospheric Propagation, Tropospheric Propagation. Outdoor Propagation model (Okumura and Hata Model). Indoor Propagation models. Channel noises and losses. Fading and its type. Delay Spread, Doppler's spread and Inter symbol Interference. Coherence Time & bandwidth. Fading effects on signal and frequency components. Shadowing. Signal outages and fading margin.

Unit-4

Wireless channel modelling: channel modelling. Additive white Gaussian noise. Representation of discrete channel by filter. Stochastic radio channel modelling. Flat fading channel modelling. Wideband time dispersive channel modelling, Rayleigh fading model, Rician fading model, Nakagami fading model, comparison of Rayleigh, Rician and Nakagami models.

MODULE-III **(12 Hours)**

Unit-5

Modulation Schemes: Digital Modulation- an overview, Pulse Shaping techniques: Nyquist criterion for zero ISI or ISI cancellation. Linear modulation schemes: QPSK, OQPSK, $\pi/4$ QPSK. Constant Envelop Modulation

Schemes: BFSK, MSK, GMSK. Differential Modulation Schemes. Offset Modulation Schemes. orthogonal frequency division multiplexing transmitter and receiver

Unit-6

Multiple Access and Spread spectrum Techniques: Introduction to multiple access, spread spectrum multiple access (SSMA), space division multiple access (SDMA),orthogonal frequency division multiple access (OFDMA),

Equalization, Diversity: Introduction to equalization and its fundamentals, Need of equalizer in a communication receiver. Linear Equalizer, Non-linear Equalizer, Adaptive Equalizer, Diversity Techniques, RAKE receiver.

MODULE-IV (8 Hours)

Unit-7

Wireless Networks: Introduction to Wireless networks. Difference between Wireless and Fixed Networks. Circuit and Packet Switching. X.25 protocol. Wireless Data Services: Cellular Digital Packet Data. Common channel signalling, Integrated Services Digital Network (ISDN). Signalling System No. 7: services, protocol and performances. Personal Communication Services (PCS).

Ad-hoc networks: Introduction to Ad-hoc networks, Bluetooth, Wi-Fi standards, Wi-MAX standards, wireless sensor networks.

Text Books:

1. T. S. Rappaport, "Wireless Communications", Pearson, 2002.

Reference Books:

1. Upena Dalal, "Wireless Communication Networks", 1st Edition, Oxford university press, 2008.
2. V K Garg, "Wireless Communication and Networking", Morgan Kaufman Publishers, India, 2004.

Course Outcomes:

1. To describe various ways wave propagation in wireless communication and the losses associated with these paths.
2. To Easily elaborate various wireless technologies used in present scenario.
3. To solve the problems related to various models, coding techniques, and modulation schemes.

OPEN ELECTIVE-IV (OE-IV) 7th Semester

OECH6432	Mineral Processing	3L-0T-0P	3 Credits

Objectives of the Course:

1. This course will brief about how most of the ores undergo after mining in order to provide a more concentrated material for the procedures of extractive metallurgy.
2. It gives the preliminary idea about the primary operations such as comminution and concentration.
3. This course will also provide the information about a modern mineral processing plant, including sizing, sampling and bulk material handling.

Module-I: **(4 weeks/12 Hours)**

Unit I: Comminution: Fundamentals of Rock Breakage, Energy Estimations, Liberation, Reduction Ratio, Primary Crushers, Secondary Crushers, Circuits, Selection Criterion. Grinding Mills, Critical Speed, Recent Developments & Mass Balancing (Importance, Techniques, Numerical Examples and their Relevance

Unit II: Industrial Screening: Applications, Basic Design Features, Types of Screens, Performance Evaluation and Factors Affecting Performance. Movement of Solids in Fluids: Equation of Motion, Drag Curve, Free & Hindered Terminal Settling Velocities in Gravitational and Centrifugal Force Fields, Applications & Classifiers (Various Types and Their Applications).

Module-II: **(4 weeks/12 Hours)**

Unit III: Hydrocyclone: Principles of Operation, Design Variables, Operating Variables, Performance Evaluation of Hydrocyclone, Control of Cyclone Operation, Recent Developments.

Unit IV: Gravity Concentration: Fundamentals, Flowing Film Type, Static Bath Type, Jigging, Centrifugal & Enhanced Gravity Type Concentrators.

Module-III: **(4 weeks/12 Hours)**

Unit V: Flotation: Fundamentals, Role of Reagents, Flotation Machines, and Applications.

Unit VI: Bulk Material Storage and Handling: Properties of Bulk Solids, Measurements, Storage, Flow Modes, Silos, Bins and Hopper Design, Common Problems.

Module-IV: **(2 weeks/6 Hours)**

Unit VII: Slurry Transportation: Pipe Line Flow, Mixture properties, Design perspective, Influence of several factors, Basic calculations, Case studies.

Books for Reference:

1. Mineral Processing Technology by B.A.Wills and Tim Napier-Munn.
2. Principal of Mineral Dressing by A.M. Gaudin – McGraw Hill Company, 1971.
3. Jain, S.K., Ore Processing, Oxford – IBH Publishing, 1984.
4. Taggart, A.F., Handbook of Mineral Dressing, John Wiley and Sons, New York, 1990.

5. Wills, B.A. Mineral Processing Technology, Pergamon Press, 1985.
6. Vijayendra, H.G., Handbook on Mineral Dressing, Vikas Publishing House Pvt. Ltd. 1995.

Course Outcomes:

At the end of the course, the students should be able to

1. Solve problem related to changes in size and shape of the mineral.
2. Understand briefly about the operation of a mineral plant
3. Can handle problem related to material transportation, material handling and storage.

OECH6433	Colloid and Interfacial Engineering	3L-0T-0P	3 Credits

Objective of the course: To provide comprehensive knowledge on concepts and principles of colloids, interfaces and their applications.

Module-I **(12 Hours/4 Weeks)**

Unit – 1 (6 Hours/2 Weeks) General introduction of colloids, interfaces, surfactants, and micellization. Intermolecular forces, van der Waals' forces (Keesom, Debye, and London interactions).

Unit – 2 (6 Hours/2 Weeks) Colloidal systems and colloidal stability (van der Waals' attraction and potential energy curves). Brownian motion and Brownian flocculation.

Module-II **(12 Hours/4 Weeks)**

Unit – 3 (6 Hours/2 Weeks) Surface and interfacial tension and surface free energy. Surface tension for curved interfaces.

Unit – 4 (6 Hours/2 Weeks) Surface excess and Gibbs equation. Theory of surface tension, contact angle, and wetting.

Module-III **(12 Hours/4 Weeks)**

Unit – 5 (6 Hours/2 Weeks) Thermodynamics of interfaces, thermodynamics of micelle and mixed micellar formation.

Unit – 6 (6 Hours/2 Weeks) Electrical phenomena at interfaces (Electro kinetic phenomena, Electrical double layer). Emulsion and micro emulsion, General applications.

Module-IV **(6 Hours/2 Weeks)**

Unit –7 (6 Hours/2 Weeks) Enhanced petroleum recovery, super hydrophobic and self-cleaning surfaces. Novel fabrication of nano-structured particles. Measurement techniques of surface tension, Contact angle, Zeta potential, Particle size.

Text Books

1. Principles of Colloid and Surface Chemistry, 3rd ed. by P CHiemenz and R Rajagopalan, Mercel Dekker.

2. Introduction to Colloid & Surface Chemistry, 4th ed. by D J Shaw, Butterworth Heinemann.
3. Colloid and Surface Chemistry by P. Somasundaran, Create Space Independent Publishing Platform.
4. Introduction to Applied Colloid and Surface Chemistry by G. M. Kontogeorgis and S. Kiil, John Wiley & Sons.

Course Outcomes:

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

1. Understand the colloidal science engineering fundamentals.
2. Characterize interfaces and surface phenomena.

OECE6434	Finite Element Analysis	(3-0-0)	Credit-03

Module I:

Introduction: The Continuum, Equations of Equilibrium, Boundary Conditions, Strain displacement relations, Stress strain Relations, Plane stress and plane Strain problems, Different methods of structural analysis including numerical methods. Basics of finite element method (FEM), different steps involved in FEM, Different approaches of FEM, Direct method, Energy approach, Weighted residual Method.

Module II:

One and Two Dimensional Problems: Detail formulation including shape functions. stress strain relations, strain displacement relations and derivation of stiffness matrices using energy approach, Assembling of element matrices, application of displacement boundary conditions, Numerical solution of one dimensional problems using bar, truss, beam elements and frames. Derivation of shape function using Lagrange's interpolation, Pascal's triangle, Convergence criteria.

Module III:

Finite Element modeling of two dimensional problems using Constant strain Triangle (CST) elements, Stress strain relations for isotropic and orthotropic materials, Four nodded rectangular elements, axisymmetric solids subjected to axisymmetric loading.

Isoparametric Elements: Natural coordinates, isoparametric elements, four node, eight node elements. Numerical integration, order of integration.

Module IV:

Plate Bending: Bending of plates, rectangular elements, triangular elements and quadrilateral elements, Concept of 3D modeling.

Text Books:

1. C. S. Krishnamoorthy, Finite Element analysis-Theory and Programming, TMH

2. Finite Element Method, R. Dhanraj and K. P. Nair, Oxford University Press
3. Finite Element Methods for Engineers by U.S. Dixit, Cengage Learning

Reference Books:

1. R. D. Cook., Concepts and Applications of Finite Element Analysis, Wiley.
2. M. Mukhopadhyay-Matrix and Finite Element Analysis of Structures
3. O. C Zienkiewicz .and R. L. Taylor, Finite Element Method, McGraw Hill
4. Introduction to Finite Elements in Engineering, T.P. Chandrupatla and A.D. Belegundu
5. Finite Element Analysis in Engineering Design, S. Rajasekharan.

OECS6435	Research Methods in Computer Science	(3-0-0)	Credit-03

Prerequisites:

The course does not have any formal prerequisites. You must have a research project in sufficient maturity so you can finish a meaningful portion of your research and a complete paper by the end of the semester. The research topic can be a portion of your B.Tech, MCA, MS, M.Tech or PhD thesis project, a significant extension of course projects from the past, or something you are passionate about. This course is most appropriate for graduate students who are interested in research but do not have extensive prior research experience.

Course Objectives:

1. To introduce research and research methodologies in CS to students going to peruse research in CS.
2. To understand the strengths and weakness of each of these methods.
3. How to choose suitable method(s) for the investigations?
4. How to carry out investigations using these methods?
5. What are the threats associated with these methods and how to deal with them.
6. Reporting the results of these investigations. Writing technical articles/research papers.
7. Understanding roles of authors, reviewers. How to review research articles?

Module I: **10 Hrs.**

Introduction to Research, Research Methods in Computer Science, Analytical vs. Empirical Methods, Surveys, Case Studies, Controlled Experiments, Ethnography and Action Research, Quantitative, Qualitative, and Mixed Methods, Choosing research methods, Validity threats, Meaning of Research Problem, Data collection methods - primary and secondary sources, Types of data analysis methods, Analysis and Interpretation of Quantitative Data, Descriptive Statistics, Sampling, sampling distribution, Parameter Estimation, Statistical Inference, confidence interval and Hypothesis Testing using normal distribution, Tests of significance, test of difference of mean and proportions, t-tests, ANOVA, Chi-square Tests, correlation and regression, Review Process, Review guidelines, Validity threats, Review decisions, Research Qualitative Methods, Study Designs, Elements, and Methods, The nature and types of qualitative research, Study Designs, Elements, and Methods, The nature and types of qualitative research, problem definition, Sources of research problem, Scope and

objectives of research problem, Criteria characteristics of a good research problem, Errors in selecting a research problem, Approaches of solutions for research problem, Necessary Instrumentation, use of SPSS package.

Module II: 10 Hrs.

Survey Research, Sampling Methods, Survey Study Designs, Case Studies, Introduction to Mixed Methods Research, Study Designs and Method, An Empirical Research Framework, Research Problems, Literature Reviews, Study Designs, Controlled Experiments, Elements and Methods Example Experiments Effective literature studies approach, Analysis, Plagiarism, Research Ethics, Effective technical writing, How to write report, paper, Developing a research proposal, Format of research Proposal, A presentation and assessment by a review committee, IEEE guidelines for writing abstract, journal papers, power point presentation, thesis and project report, Writing research papers, purpose, nature and evaluation, content and format, Research Presentations, The Art of Scientific and Technical Writing.

Module III: 10 Hrs.

Nature of Intellectual property, Patents, Design, Trade and copy right, Process of patenting and development, Technological research, innovation, patenting, development, International scenarios: International cooperation on intellectual property, Procedure for grants of patents, Patenting under PCT, use of **Turnitin** service.

Module IV: 10 Hrs.

Patent rights: Scope of patent rights, Licensing and transfer of technology, Patent information and databases, Geographical Administrations, New Developments in IPR, Administration of patent system, New Development in IPR: IPR of biological system, software etc., Traditional knowledge case studies, IPR and IITs, case studies

Text Book:

There is no text book for the course. A teacher may use lecture notes and videos, read research papers and Web Pages, which will be freely available on internet websites.

Reference books:

1. Research Design. Qualitative, Quantitative, and Mixed Methods Approaches. By John W. Creswell, Fourth Edition. SAGE Publication, 2014
2. The Craft of Research, By Wayne C. Booth, Gregory G. Colomb, Joseph M. Williams, Joseph Bizup, William T. FitzGerald, Third Edition, The University of Chicago Press, 2008
3. The Elements of Style. William Strunk Jr. and E. B. White, Fourth Edition, Pearson, 1999
4. Research Methodology By Panneerselvam R, 2nd Edition, PHI, 2014
5. Statistical Design and Analysis of Experiments With Applications to Engineering and Science, Robert L. Mason, Second Edition, Wiley Inter Science.[Good for Data Analysis and Hypothesis Testing]
6. THE DESIGN OF DESIGN: ESSAYS FROM A COMPUTER CIENTIST, Frederick P. Brooks Jr., Addison-Wesley Professional, 2010.

OEEE6323	Analog and Digital Communication Systems	3-0-0	Credit-3

Course Objectives:

1. Introduction to analog and digital communication systems.
2. Analysis of signal in frequency domain.
3. Study of analog modulation schemes.
4. Study of digital modulation techniques

Module I **(12 Hours)**

Elements of Communication System-Analogue System, Digital System, Distinguishing features. Electromagnetic Spectrum, Bandwidth. Comparison between Analog & Digital Communication Systems. Frequency domain analysis of signals and systems: Fourier series, Fourier Transforms, Power and Energy, Sampling and Band limited signals, Band pass signals.

Module II **(12 Hours)**

Introduction to modulation, Amplitude Modulation (AM),Depth of Modulation, Modulated Waveform, Powers in Carrier, and Sidebands, Generation of DSBC and SSB, Balanced Modulator, AM Demodulators. Frequency Modulation (FM) - Frequency Deviation, Frequency Modulated Waveform, Spectrum. Narrow Band FM and Wideband FM. Generation of FM; Narrow Band FM Modulator, Wideband FM Modulator, FM Discriminator, Angle Modulation.

Module III **(12 Hours)**

Pulse modulation systems: Pulse amplitude modulation, Pulse Time Modulation. Pulse code modulation: PCM system, Inter symbol interference, Time Division Multiplexing of PCM signals, Line codes, Bandwidth of PCM system, Noise in PCM systems, Delta Modulation (DM), Limitations of DM, Adaptive Delta Modulation, Noise in Delta Modulation, Comparison between PCM and DM, Delta or Differential PCM (DPCM), S-Ary System.

Module IV **(6 Hours)**

Digital Modulation Techniques. Phase Shift Keying (PSK), Frequency Shift Keying (FSK) – their Basic Principle, Waveform, Generation and Detection. Ideal low pass, Band pass and Band rejection filters – their impulse response (no mathematical derivation).

Program Outcomes:

At the end of this course students will demonstrate the ability to

1. Analyse signals in frequency domain.
2. Analyze and compare different analog modulation schemes for their efficiency and bandwidth.
3. Analyze different digital modulation schemes.
4. Investigate pulsed modulation system and analyze their system performance.

TEXT BOOKS:

1. John G.Proakis, M. Salehi, COMMUNICATION SYSTEMS ENGINEERING, 2nd ed. New Delhi, India: PHI Learning Private Limited, 2009.
2. R.P Singh and S.D Sapre, COMMUNICATION SYSTEMS Analog & Digital, 2nd ed. New Delhi, India: Tata McGraw Hill Education Private Limited, 2009.
3. Martin S. Roden, "Analog and Digital Communication Systems", SPD Publisher.

REFERENCE BOOKS:

1. H.Taub and D. L. Shilling, "Principle of Communication System", TMH Publisher.
2. Modern Digital and Analog Communication Systems, by B.P. Lathi, Oxford.

OEEE6436	Internet of Things	3-0-0	3 Credits

Course Objectives:

1. To understand the design of IOT relevant applications in various domain.
2. To understand the concepts of Raspberry Pi, interfaces and applications in IoT domain.
3. To understand the importance of cloud computing and its applications.
4. To understand specific security and data protection issues in IoT

MODULE-I **(12 Hours)**

Unit 1

Introduction & Concepts: Introduction to Internet of Things, Physical Design of IOT, Logical Design of IOT, IOT Enabling Technologies, IOT Levels.

Unit 2

Domain Specific IOTs: Home Automation, Cities, Environment, Energy, Retail, Logistics, Agriculture, Industry, Health & Life Style. Smart Lighting, Intrusion Detection, Smoke/Gas Detectors, Cities-Smart Parking, Smart Lighting, Smart Roads, Environment-Weather Monitoring, Air pollution Monitoring, Forest Fire Detection, Energy-Smart Grids, Logistics-Route Generation & Scheduling, Agriculture Smart Irrigation, Health & Fitness Monitoring.

MODULE-II **(12 Hours)**

Unit 3

M2M: M2M, Difference between IOT and M2M.

Unit 4

IOT Physical Devices & Endpoints: What is an IOT Device, Linux on Raspberry Pi, Interfaces,

Programming: Installing python. Data types and data structures, Flow, Functions, Modules, File Handling, Date/ Time Operations, Classes, Python Packages.

MODULE-III (12 Hours)

Unit 5

Design steps of IoT

Design steps of IoT**,** Raspberry Pi, About the Board, Linux on Raspberry Pi.

Unit 6

Raspberry Pi Interfaces – Serial, SPI, I2C, Programming Raspberry Pi with Python-Controlling LED with Raspberry Pi, interfacing an LED and Switch with Raspberry Pi, Interfacing a Light Sensor (LDR) with Raspberry Pi.

MODULE-IV (8 Hours)

Unit 7

Privacy and Security threats on internet of Things: Specific security and data protection issues, IoT privacy and security issues in smart cities.

Text Book:

2. Arshdeep Bahga and Vijay Audisetti, "Internet of Things, A Hands on Approach", University Press, 1st edition, 2016.

Reference Books:

1. Sébastien Ziegler, "Internet of Things Security and Data Protection", Springer Publisher, 1st edition, 2019.
2. Adrian McEwen, "Designing the Internet of Things", Wiley, 1st edition, 2015.
3. Miller, "The Internet of Things: How Smart TVs, Smart Cars, Smart Homes and Smart Cities are Changing the World", Pearson, 1stedition, 2015.

Course Outcomes:

1. To analyse applications of IOT in various domain.
2. To realize the revolution of Internet in Mobile Devices, Cloud &Sensor Networks
3. To understand the importance of cloud computing and Embedded system.
4. To understand the challenges and limitations of internet of things.

OEEC6437	Soft Computing	3-0-0	Credits 3

COURSE OBJECTIVES

1. To familiarize with soft computing concepts.
2. To introduce the fuzzy logic concepts, fuzzy principles and relations.
3. To know the basics of ANN and Learning Algorithms.
4. To analyze Ann as function approximation.
5. To know Genetic Algorithm and its applications to soft computing.
6. To analyze Hybrid system usage, application and optimization

MODULE-I (10 Hours)

Unit-1

Introduction

What is Soft Computing? Difference between Hard and Soft computing, Requirement of Soft computing, Major Areas of Soft Computing, Applications of Soft Computing.

Unit-2

Fuzzy Systems

Fuzzy Set theory, Fuzzy versus Crisp set, Fuzzy Relation, Fuzzification, Minmax Composition, Defuzzification Method, Fuzzy Logic, Fuzzy Rule based systems, Predicate logic, Fuzzy Decision Making, Fuzzy Control Systems, Fuzzy Classification.

MODULE-II (12 Hours)

Unit-3

Neural Networks

What is Neural Network, Learning rules and various activation functions, Single layer Perceptron, Back Propagation networks, Architecture of Backpropagation (BP) Networks, Backpropagation Learning, Variation of Standard Back propagation Neural Network.

Unit-4

Introduction to Associative Memory, Adaptive Resonance theory and Self Organizing Map, Recent Applications.

MODULE-III (10 Hours)

Unit-5

Genetic Algorithm

History of Genetic Algorithms (GA), Working Principle, Various Encoding methods, Fitness function.

Unit-6

GA Operators- Reproduction, Crossover, Mutation, Convergence of GA, Bit wise operation in GA, Multi-level Optimization.

MODULE-IV **(10 Hours)**

Unit-7

Hybrid Systems

Sequential Hybrid Systems, Auxiliary Hybrid Systems, Embedded Hybrid Systems, Neuro-Fuzzy Hybrid Systems, Neuro-Genetic Hybrid Systems, Fuzzy-Genetic Hybrid Systems.

GA based Backpropagation Networks

GA based Weight Determination, K - factor determination in Columns.

Fuzzy Backpropagation Networks

LR type Fuzzy numbers, Fuzzy Neuron, Fuzzy BP Architecture, Learning in Fuzzy BP, Application of Fuzzy BP Networks.

Text Books:

1. S, Rajasekaran & G.A. Vijayalakshmi Pai, Neural Networks, Fuzzy Logic & Genetic Algorithms, Synthesis & applications, PHI Publication, 1st Edition, 2009.
2. F. O. Karry and C. de Silva, "Soft Computing and Intelligent Systems Design – Theory, Tools and Applications", Pearson Education.

Reference Books:

1. J. S. R. Jang. C. T. SUN and E. Mizutani, "Neuro-fuzzy and soft-computing". PHI Pvt. Ltd., New Delhi.
2. Fredric M. Ham and Ivica Kostanic, "Principle of Neuro Computing for Science and Engineering", Tata McGraw Hill.
3. S. Haykins, "Neural networks: a comprehensive foundation". Pearson Education, India.
4. V. Keeman, "Learning and Soft computing", Pearson Education, India.
5. R. C. Eberhart and Y. Shi, "Computational Intelligence Concepts to Implementation". Morgan Kaufmann Publishers (Indian Reprint).
6. David E. Goldberg, "Genetic Algorithms in search, optimization, and machine learning", Addison-Wesley Publishing Company, Inc, 1989.

Course Outcomes:

1. To analyze the facts and outline the different process carried out in fuzzy logic, ANN and Genetic Algorithms.
2. To understand the concepts and meta-cognitive of soft computing.
3. To Apply Soft computing techniques the solve character recognition, pattern classification, regression and similar problems.
4. To identify process/procedures to handle real world problems using soft computing.
5. To apply various techniques of soft computing to defend the best working solutions.
6. To Design hybrid system to revise the principles of soft computing in various applications.

OEME6438	Reliability Engineering	3-0-0	Credit-3

OBJECTIVES:

To stress the importance of reliability in Engineering and products also the concept of maintainability, failure modes and testing methods.

UNIT I: CONCEPTS OF RELIABILITY, SYSTEM AND MODELS [12 Hours]

Definition of reliability – reliability Vs quality-reliability function-MTTF – hazard rate function- bathtub curve – derivation of the reliability function-constant failure rate model – time dependent failure models. Weibull distribution – normal distribution – the lognormal distribution. Serial configuration – parallel configuration – combined series parallel systems – system structure function, minimal cuts and minimal paths – Markov analysis – load sharing systems, standby system, degraded systems, three state devices – covariate models, static models, dynamic models, physics of failure models.

UNIT II : DESIGN FOR RELIABILITY AND MAINTAINABILITY [12 Hours]

Reliability design process – system effectiveness – economic analysis and life cycle cost – reliability allocation – optimal, Arinc, Agree, – Design methods – parts and material selection, derating, stress- strength analysis – failure analysis – identification of failure mode – determination of causes –assessment of effects – classification of seventy – computation of critically index – corrective action – system safety and FTA. Analysis of downtime – the repair time distribution – stochastic point processes – system repair time – reliability under preventive maintenance – state dependent systems with repair – MTTR-mean system downtime – MTR – MH/OH – cost model – fault isolation and self-diagnostics – repair Vs replacement – replacement model – proactive, preventive, predictive

Maintenance – maintenance and spares provisioning – maintainability prediction and demonstration – concepts and definition of availability.

UNIT III: OPTIMIZATION OF SYSTEM RELIABILITY [7 Hours]

Optimization techniques for system reliability with redundancy – heuristic methods applied to optimal system reliability- redundancy allocation by dynamic programming – reliability optimization by non linear programming.

TEXT BOOKS:

1. Charles E. Ebling, "An introduction to Reliability and Maintainability Engg", Tata McGraw-Hill, 2000.

REFERENCES:

1. Patrick D T O'Connor, "Practical Reliability Engineering", John-Wiley and Sons inc, 2002.
2. David J Smith, "Reliability, Maintainability and Risk: Practical Methods for Engineers", Butterworth, 2002
3. Way kuo, Rajendra Prasad V, Frank A and Tillman, ching- lai Hwang "Optimal Reliability Design and Applications", Cambridge University Press P ltd., 2001.

4. Srinath I.S, Engineering Design and Reliability, ISTE, 1999.
5. Oleg Vinogradov, "Introduction to Mechanical Reliability: A Designers Approach, Hemisphere Publications, 1991.

OUTCOMES

The Student must apply and optimize reliability for time independent and time dependent failure models through various testing methods for various manufacturing amnesty process

OEME6439	Robotics	3-0-0	Credit-3

Course objective:

To expose students to the automation, robot kinematics and robot arm dynamics. To acquire knowledge on Classification and structure of robotic system, robot programming and its applications.

Module I **(13 Hours)**

Introduction, Automation and Robotics, brief history, Social and economic aspects, Advantages overview of robots and future application; Classification & structure of robotic system: Classification, Configuration, wrist, end effectors, Links, Joints, Drive system; Control System: Basic control system concepts, model, transformation and block diagrams, controllers ON & OFF, transient response.

Module II **(11 Hours)**

Robot Kinematics: Direct & inverse kinematics, rotation matrix, composite rotation matrix, homogenous transformations, links, joints D-H representation, Geometrical approach of direct & reverse kinematics; Robot Arm dynamics: Joint velocities, KE, PE & motion equation of manipulating trajectory planning, joint interpolated trajectory

Module III **(9 Hours)**

Robot Programming: Languages, Graphics, Storing & operating, Task programs; Sensors: State and external state sensors, tactile and non-tactile sensors, force – torque sensors, Image processing & analysis, Computer vision.

Essential Reading:

1. Groover, Industrial Robot, PHI. 2. Y. Korem, Robotics, Mc Graw-Hill.

Course Outcomes:

1. Complete knowledge of robotic system
2. Idea about robot kinematics and robot arm dynamics
3. Learning of robot languages and the use of sensors

OEMT6440	Nanocomposites	3-0-0	Credits 3

Objectives of the Course:
To become familiar with nanocomposite processing, properties and their applications in the engineering.

Module-I: (12 hours)
Introduction to nanocomposites, composite materials, mechanical properties of nanocomposite materials, stress strain relationship, toughness, strength, plasticity, Ceramic matrix nanocomposites, Different types, Synthesis (Conventional powder method; Polymer precursor route; Spray pyrolysis; Vapour techniques (CVD and PVD) and Chemical methods, which include the sol-gel process, colloidal and precipitation approaches and the template synthesis). Structure, Properties and New Application

Module-II: (10 hours)
Metal matrix nanocomposites, Different types, Synthesis (Spray pyrolysis; Liquid metal infiltration; Rapid solidification; Vapour techniques (PVD, CVD); Electro deposition and Chemical methods, which include colloidal and sol-gel processes), Structure, Properties and New Application, ceramic-metal nanocomposites, Different types, Synthesis, Structure, Properties and New Application

Module-III: (10 hours)
Polymer Matrix nanocomposites (PMNC): Different types synthesis (Intercalation / Prepolymer from Solution In-situ Intercalative Polymerization, In situ polymerization Mixing, Melt Intercalation), structure, Properties and New Application

Module-IV: (10 hours)
Carbon nanotubes Nanocomposites: Different types, Synthesis, Structure, Properties and New Application, Natural nano-biocomposites, bio-mimetic nanocomposites and biologically inspired nanocomposites: Different types, Synthesis, Structure, Properties and New Application

Suggested Reference Books:

1. P. M. Ajayan, L. S. Schadler and P. V. Braun, Nanocomposite Science and Technology, Wiley-VCH, 2003.
2. C. P. Poole and F. J. Owens, Introduction to Nanotechnology, Wiley Interscience 2003.
3. H. S. Nalwa, Encyclopaedia of Nanotechnology, 2004.
4. Chung; Deborah D. L., Composite Materials: Science and Applications, Spinger International Edition, Springer-Verlag, London (2004)-Indian Edition 2006.

Course Outcomes:

1. Students will be able to identify nanocomposites for a given application
2. Understanding properties of a nanocomposite by relating them to its structure

3. Identifying a suitable nanocomposite process for a given application
4. Applying nanocomposite fundamentals in real life situations

OEPD6441	INDUSTRIAL MANAGEMENT	3L-0T-0P	3 Credits

Course Objective

The objective of this course is to produce graduates who Contribute to the success of companies through effective problem solving. Design, develop, implement, and improve integrated systems that include people, materials, information, equipment, and environments.

Module I **[12]**

Basic Management Theory: Evolution of Management Thought, Scientific Management, Organization as a System, Function of Management, Principles of Management, Planning, Decision Making, Organizing Principle, Delegation of Authority, Line and Staff Function, Leadership, Motivation, Communication, Controlling.

Module II **[10]**

Personnel Management: Organization as Social System, Motivation and Behaviour, Role of Personnel Management, Recruitment, Selection, Training, Performance Appraisal, Job Evaluation and Merit Rating, Wage Policy, Incentives, Group Dynamics, Job Satisfaction and Morale.

Materials Management: Purchasing, Selection of Vendor, Learning Curve Concept, MRP.

Module III **[10]**

Marketing Management: Selling and Marketing Concept, Role of Marketing Management in the Process of Marketing Management, Product Life Cycle, New Product Development Strategy, Market Research, Consumer Behaviour, Sales Promotion Advertising, Pricing Strategy, Break even analysis, Channel of Distribution.

Module IV **[08]**

Financial Management: Scope, Time Value of Money, Depreciation cost of a product, Financial Statement Analysis, Ratio Analysis, Working Capital, Sources of Finance.

Industrial Relation: Trade Union, Industrial Dispute, Workers Participation In Management, Industrial Legislation, Labour Law, Factory Act.

Text Books:

1. Industrial Engineering & Production Management, M. Mahajan, Dhanpat Rai Publication.
2. Industrial Engineering & Management Science, T. R. Banga, N. K. Agarwal, S. C. Sharma, Khanna Publication.

Reference Books:

1. Personnel Management, A. Mannappa, M. S. Saiyadain.

2. Fundamentals of Financial Management, Prasanna Chandra, TMH.

Course Outcomes:

Upon successful completion of the course, student will able to:

1. Understand the theories and principles of modern management.
2. Apply the concepts to the management of organisations in private and public sector
3. Understand how managers can effectively plan in today's dynamic environment.
4. Be familiar with the design of organisation structure.
5. Describe how environmental uncertainty affects organisation design

INDIRA GANDHI INSTITUTE OF TECHNOLOGY, SARANG

B.TECH SYLLABUS for ELECTRONICS AND TELECOMMUNICATION ENGINEERING

(Admission Batch: 2018-19 Onwards)

8th Semester

PEEC5418	Wireless Sensor Networks	3-0-0	Credits 3

COURSE OBJECTIVES

1. To provide broad coverage of challenges and latest issues related to design and management of WSN
2. To understand the basic WSN technology with emphasis placed on standardization basic sensor systems.
3. To know WSN architecture, Localization, Tracking issues and communication link quality.
4. To learn key routing protocols for sensor networks and main design issues.
5. To gain knowledge of the Sensor management, sensor network middleware, operating systems.

MODULE-I **(12 Hours)**

Unit 1

Overview and Characteristics of WSN

Introduction to Wireless Sensor Networks: Sensor Network concepts, Networked wireless sensor devices, Node and Network Architecture, Main features of WSNs, Current Operating Systems, Advantages of Sensor networks, Applications, and Key design challenges.

Unit 2

Sensor Deployment Mechanisms: Structured versus randomized deployment, Network topology, Connectivity, Connectivity using power control, Issues of coverage, Coverage metrics, Mobile deployment.

MODULE-II **(12 Hours)**

Unit 3

Localization and Tracking: Issues and approaches, Problem formulations: Sensing model, Collaborative localization, Coarse-grained and Fine-grained node localization, Time Synchronization, Network clustering, Query Models, Tracking multiple objects.

Unit 4

Wireless Communications: Link quality, shadowing and fading effects

MODULE-III **(12 Hours)**

Unit 5

Medium-access and sleep scheduling: Fundamentals of Traditional MAC protocols, Energy efficiency in MAC protocols, Asynchronous sleep techniques, Sleep-scheduled techniques, and Contention-free protocols.

SMAC, Traffic-adaptive medium access protocol (TRAMA).

Unit 6

Technologies for WSNs-ZigBee technology, Ultrawide bandwidth technology, Bluetooth technology, Comparison among technologies.

MODULE-IV **(8 Hours)**

Unit 7

Routing: Routing Protocols, Issues in designing routing protocols, Classification of routing protocols, Metric-based approaches, , Multi-path routing, Lifetime-maximizing energy-aware routing techniques, Data-centric, Data-gathering with compression, Geographic routing.

Security: Privacy issues, Attacks and countermeasures.

Text Books:

1. Bhaskar Krismachari, "Networking Wireless Sensors", Cambridge University Press, 2005.

Reference Books:

1. Feng Zhao, Leonidas Guibas,"Wireless Sensor Networks: An Information Processing Approach", Morgan Kaufmann Series in Networking 2004.
2. Kazem Sohraby, Daniel Minoli, Taieb Znati, "Wireless Sensor Networks: Technology, Protocols, and Applications", Wiley Inter Science, 2008.
3. C.S Raghavendra, Krishna M, Sivalingam, TaiebZnati," Wireless Sensor Networks", Springer, 2006.

Course Outcomes:

1. Able to design new protocols in a WSN platform.
2. Capable of investigating novel ideas in the area of networking via term-long research projects.
3. Able to analyze modeling and simulation of various communication networks.
4. Will be able to Gain insights to generate test and estimate parameters.

PEEC5419	Biomedical Signal Processing	3-0-0	Credits 3

COURSE OBJECTIVES

1. To introduce different types of biomedical signals and their importance in diagnosis.
2. To demonstrate various biomedical signal acquisition, processing, and analysis techniques used in health care and biomedical research.

MODULE-I **(12 Hours)**

Unit 1

Introduction to Biomedical Signals: Action potential, Examples of Biomedical signals: ECG, EEG, EMG,

VMG, VAG, EGG, PCG.

Unit 2

Objectives of Biomedical Signal Analysis, Difficulties in Biomedical Signal Analysis, why computer-aided diagnosis

MODULE-II (12 Hours)

Unit 3

Cardio-logical Signal Processing: Pre-processing, QRS Detection Methods, Rhythm analysis, Arrhythmia Detection Algorithms

Unit 4

Automated ECG Analysis, ECG Pattern Recognition, Heart rate variability analysis, Detection of the P Wave.

MODULE-III (12 Hours)

Unit 5

Adaptive Noise Canceling: Principles of Adaptive Noise Canceling, Adaptive Noise Canceling with the LMS adaptation, Algorithm.

Unit 6

Noise Canceling Method to Enhance ECG Monitoring, Fetal ECG Monitoring.

MODULE-IV (8 Hours)

Unit 7

Neurological Signal Processing: Modeling of EEG Signals, Detection of EEG spikes and wave complexes, Detection of Alpha, Beta and Gamma Waves, Auto Regressive (A.R.) modeling of seizure EEG, Sleep Stage analysis, Inverse Filtering.

Text Books:

1. R. Rangayan, "Biomedical Signal Analysis", Wiley, Second Edition, 2009.

Reference Books:

1. D.C.Reddy,"Biomedical Signal Processing: Principles and Techniques", Tata McGraw Hill, New Delhi, 2005.
2. Biomedical Signal Processing & Signal Modeling, Eugene N. Bruce, Wiley, 2001.
3. Biomedical Signal and Image Processing, K. Najarian and R. Splinter, The CRC Press, Second Edition, 2004.

Course Outcomes:

1. To understand different types of commonly encountered biomedical signals.
2. To analyze the different signal processing techniques and algorithms used for different types of biomedical signals.

PEEC5420	Optical Communication and Networks	3-0-0	Credits 3

COURSE OBJECTIVE

1. To delve into the advantage of optical communication over other communication system.
2. To gain knowledge of different type of optical fiber and optical fiber components.
3. To have knowledge over ray optics and wave representation of light in fiber communication.

MODULE-I **(12 Hours)**

Unit-1

Overview of optical fiber communication

Introduction to optical communication: Evolution of Fiber Optic Systems, Basic optical laws and definition

Ray and Wave Representation

Ray optics representation, modes in step index fiber, linearly polarized modes, propagation modes in single mode fibers.

Unit-2

Material & Structure

Graded index fiber structure, graded-index numerical aperture (NA). Elementary ideas on fiber materials, fabrication and fiber optic cables.

MODULE-II **(12 Hours)**

Unit-3

Signal degradation and distortion in optical fiber

Attenuation, Absorption, Scattering losses, bending losses, core and cladding losses. Material dispersion, wave guide dispersion, inters modal dispersion.

Unit-4

Optical Sources

Basic ideas of light sources and their principle of operation (LEDs and LASERs), power-bandwidth product of LEDs and resonant frequencies of LASER diodes.

Optical Amplifier

Principle and operation of SOA and EDFA

MODULE-III **(12 Hours)**

Unit-5

Digital Transmission System

(Fundamentals): Digital signal transmission, error sources, Digital transmission systems, link power budget, Rise time budget.

Unit-6

Optical Receiver Operation

Fundamentals of Optical receiver operation. Physical principles of photo detectors, Avalanche photo diodes.

MODULE-IV **(8 Hours)**

Unit-7

Optical Networks

Introduction to Optical Networks (SONET, IP), Optical layer, Transparency and All-Optical Networks, Optical Packet Switching, Fiber Optic Network Topology & principles, LAN, MAN. Multiplexing methods in fiber optic networks. Concepts of WDM and TDM.

Text book:

1. Gerd Keiser, "Optical Fiber Communications", Tata McGraw Hill, 4th Edition, 2008.

Reference book:

1. John M. Senior, "Optical Fiber Communications", PEARSON, 3rd Edition, 2010
2. R. Ramaswami, K. N. Sivarajan, G. H. Sasaki." Optical Networks: A Practical Perspective", 3rd edition, 2003.

Course Outcomes:

1. Understand the principles fiber-optic communication.
2. Analyze system performance of optical communication systems.
3. Able to design optical network.

PEEC5421	Industrial Electronics	3-0-0	Credits 3

Course Objectives:

1. Choose a device for a specific application.
2. Describe the operation of various converters, invertors, choppers, regulator.
3. Understand the working of SMPS.
4. Understand the working principle of solar cells, its advantages and applications.

MODULE-I **(12 Hours)**

Unit-1

Power diode

Switching characteristics and specifications. Characteristics of fast recovery diodes. Choice of diodes depending upon frequency of operations. Series and parallel operations. Thermal characteristics.

Unit-2

Power Transistor

Power BJT : Structure of vertical power transistor, Principle of operation, its VI and switching characteristics, Safe operating area. Base drive circuits and Darlington configuration of Power BJT. Construction operating principle and switching characteristics of power MOSFET and IGBT. Study of Losses in power semiconductor devices- calculation of loss in power BJT.

Mounting, Cooling and Protection of Power Semiconductor Devices

Concept of thermal resistance, heat sink and thermal equivalent circuit. Different mounting techniques of power semiconductor devices. Concept of protection: Transient protection, MOV and Snubber.

MODULE-II (12 Hours)

Unit-3

SCR and Thyristor:

Switching characteristics & Two transistors method of SCR. Principles of operation and characteristics of SCR. Layer diagram, Characteristics, operating principle and application of thyristor. Family devices - Photo sensitive SCR, GTO, SCS, TRIAC & DIAC. Commutation circuits of SCR – natural and forced commutation – class A, B, C, D and Class E.

Unit-4

Polyphase controlled rectifier:

Three phase half wave and full wave control rectifier- Operation with inductive and resistive load, use of free wheel diode. Calculation of Vdc, Vrms, ripple factor, PIV and efficiency of three phase control rectifier. Concept of full control and half control rectifier.

MODULE-III (12 Hours)

Unit-5

Choppers

Principle of operation of chopper. Functional operation of forced, commutated and Jone's chopper and their applications. 4-quadrant chopper. Operation of Cycloconverter and its applications.

Unit-6

Inverters

Operation of self-oscillating and driving inverter. Working principle of voltage driver, current driver, half bridge and full bridge inverter. Inverter loads. Three phase inverter. Applications of inverter.

MODULE-IV (8 Hours)

Unit-7

Switch Mode Power Supply

Switching Regulator (SMPS)-Principle of operation, Block and circuit diagram and PWM control circuit consideration of switching regulator. Principle of operation of buck converter, boost converter, buck-boost Converter. Review of Linear Regulators. Advantage and disadvantage of switching regulator in comparison with linear regulator.

UPS And Solar Cell

Principle of operation of ON line UPS, standby UPS, cold and warm, utility of static switch. Use of storage devices and working principle of battery charger. Concept of Solar Cell, its application. Solar battery charger and inverter.

Text Books:

1. P.C. Sen, "Principles of Electric Machines and Power Electronics", Wiley India, 2nd edition, 2007.

Reference Books:

1. S.K. Bhattacharya, S. Chatterjee, "Industrial Electronics And control", McGraw Hill Education, 2017.
2. M. H. Rashid, "Power Electronics: Circuits, Devices and Applications", Pearson Education; 3rd edition, 2014.
3. V.R. Moorthi, "Power Electronics Devices, Circuits and Industrial Applications", Oxford University press, 2000.

Course Outcomes:

1. To model, analyse and control power electronic devices.
2. To identify thyristors, choppers, inverters and can monitor and control the behavior of a process or product.
3. To know about SMPS, UPS and solar cells.

PEEC5422	Design and Analysis of Algorithms	3-0-0	Credits 3

COURSE OBJECTIVES

1. To provide the basic understanding of different algorithm design techniques.
2. To understand the techniques used in the algorithm analysis.
3. To know the efficiency of alternative algorithmic solutions for the same problem.
4. To understand the limitations of algorithmic power.

MODULE-I **(12 Hours)**

Unit 1

Foundation: The Role of Algorithms in Computing, Algorithms as a technology, Insertion sort, Analyzing algorithms, Designing algorithms, Growth of Functions, Divide-and-Conquer, substitution method for solving recurrences, Recursion-tree method for solving recurrences, Master method for solving recurrences, Proof of the master

theorem.

Unit 2

Sorting: Heaps, Maintaining the heap property, Building a heap, heap sort algorithm, Priority queues, Description of quick sort, Performance of quick sort, Randomized version of quicksort, Analysis of quicksort.

MODULE-II (12 Hours)

Unit 3

Advanced Design and Analysis Techniques: Dynamic Programming, Rod cutting, Matrix-chain multiplication, Elements of dynamic programming, Longest common subsequence, Greedy Algorithms, Elements of the greedy strategy, Huffman codes, Matroids and greedy methods, A task-scheduling problem as a matroid.

Unit 4

Data Structures: Elementary Data Structures Stacks and queues, Hash Tables, Direct-address tables, Hash functions, Open addressing, Binary Search Trees, Insertion and deletion.

MODULE-III (12 Hours)

Unit 5

Graph Algorithms: Elementary Graph Algorithms, Representations of graphs, Breadth-first search, Depth-first search, Topological sort, Strongly connected components, Bellman-Ford algorithm, Dijkstra's algorithm, Floyd-Warshall algorithm, Johnson's algorithm for sparse graphs.

Unit 6

Linear Programming and Number-Theoretic Algorithms: Standard and slack forms, Formulating problems as linear programs, The simplex algorithm, Duality, The RSA public-key cryptosystem.

MODULE-IV (08 Hours)

Unit 7

String Matching and NP-Completeness: Naive string-matching algorithm, Rabin-Karp algorithm, Knuth-Morris-Pratt algorithm, Polynomial time, Polynomial-time verification, NP-completeness and reducibility, NP-completeness proofs, NP-complete problems.

Text Book:

1. T.H. Cormen, C.E. Leiserson, R.L. Rivest, C.Stein, "Introduction to Algorithms", MIT Press, 3rd Edition, Cambridge, 2009.

Reference Books:

1. Harsh Bhasin, "Algorithms, Design and Analysis", Oxford University Press, 1st Edition, 2015.
2. Sanjay Dasgupta, Umesh Vazirani, "Algorithms", McGraw-Hill Education, 1st Edition, 2006.

Course Outcomes:

1. To design algorithms for various computing problems.
2. To analyze the time and space complexity of algorithms.
3. To apply different algorithm design techniques for a given problem.

4. To modify existing algorithms to improve efficiency.

PEEC5423	Antenna Theory and Design	3-0-0	Credits 3

COURSE OBJECTIVES

1. Understanding of antenna fundamentals
2. Ability to design and analyze the performance of common antenna types.
3. Understand when to use analytical versus numerical techniques and evaluate the potential design options for applications

MODULE-I **(12 Hours)**

Unit 1

REVIEW OF MAXWELL'S EQUATION

Radiation of E.M waves and introducing Antenna; Vector Potential and Retarded Vector Potential; Radiation fields of a Hertzian dipole(electric); Duality Principle, Radiation fields due to short magnetic dipole.

Unit 2

ANTENNA CHARACTERISTICS

Radiation Pattern, Beam Width; Radiation Resistance and efficiency; Directivity and Gain; Impedance, VSWR, Polarization; Effective height and Receive Aperture; Noise Temperature of Antenna.

MODULE-II **(12 Hours)**

Unit 3

RADIATION

Radiation fields and Characteristics of λ/2 dipole; discussion on λ/4 monopole antenna; Current distribution and Radiation patterns of center-fed dipoles of length λ, 3λ/2 and 2 λ. Horizontal and Vertical antennas over a plane ground. Radiation from rectangular apertures, Uniform and Tapered aperture, Horn antenna , Reflector antenna , Aperture blockage , Feeding structures , Slot antennas, Microstrip antennas – Radiation mechanism – Application ,Numerical tool for antenna analysis

Unit 4

ANTENNA ARRAY

Types of array: Linear and corporate array, Electric Field due to 2 element arrays, 3 element Arrays; Pattern Multiplication; Uniform Linear Array: End fire and Broad side; Phased array.

MODULE-III **(12 Hours)**

Unit 5

SPECIAL ANTENNAS

Characteristics and properties of :Travelling Wave Antenna, Helical Antenna, Folded Dipole, Yagi-Uda Array,

Loop Antenna, Electrically Short Antennas, Broad Band Antenna (Log periodic Antenna), Microstrip Patch Antenna.

Unit 6

Radiation from an aperture: Sectoral and Pyramidal Horn Antennas, Design of Optimum Horn Antenna; Parabolic and Corner Reflectors and feed systems. [Major stress on Characteristics features, applications (including frequency at which used), advantages and disadvantages, major design principles and equation.

MODULE-IV (8 Hours)

Unit 7

PROPAGATION OF RADIO WAVES

Methods of Propagation: Ground Wave Propagation, Components of ground wave, Sky wave Propagation; Ionospheric Layers; Virtual Height, Critical Frequency, MUF, Skip distance, Sporadic Reflections. Space wave propagation: Tropospheric Scatter. Friss Transmission Formula, SNR of a Radio Link. Physical (Medium) effects on Radio wave Propagation: Absorption, Refraction and Radio Horizon, Diffraction, Multipath Propagation and fading, Noise, Doppler effect.

Text Book:

1. A. Balanis, "Antenna Theory: Analysis & Design",Willey, 4th Edition, 2006.

Reference Books:

1. John D. Kraus and Ronald J. Marhcfka, "Antenna", Tata- MacGraw Hill, 3rd Edition, 2006.
2. Mathew N.O. Sadiku, "Elements of Electromagnetics", Oxford University Press, 5th edition, 2010
3. EC Jordan & K.G. Balmain, "Electromagnetic Waves & Radiating Systems", Pearson Education, 2nd edition, 2010.
4. K.D Prasad, Satya Prakashan, "Antenna& Wave Propagation", New Delhi, 3rd Edition, 2009

Course Outcomes:

1. Understanding of antenna fundamentals and design of antennas such as dipole, loop, micrsotrip patch antennas and arrays.
2. Learn industry standard simulation software Ansoft HFSS.

PEEC5424	Multimedia Communication	3-0-0	Credits 3

COURSE OBJECTIVES

1. Understanding the basic need of multimedia and component of multimedia.
2. To understand encoding and decoding of digital data streams.
3. To introduce methods for the generation of these codes and their decoding techniques.
4. To have a detailed knowledge of compression and decompression techniques.

MODULE- I **(12 Hours)**

Unit 1

Introduction to Multi media

Multimedia Signals, Elements of multimedia communication systems, Challenges involved with multimedia communication.

Unit 2

Representation of Multimedia Signals

Multimedia information representation, multimedia networks, multimedia applications, Application and networking terminology. Text, Unformatted text, Formatted text, Hypertext, Images, Graphics, Digitized documents, Digitized pictures, Audio, PCM speech, CD quality audio, Synthesized audio, Video, Broadcast television, Digital video, Video content.

MODULE II **(12 Hours)**

Unit 3

Audio and Video Compression

Audio compression–DPCM-Adaptive PCM –adaptive predictive coding-linear Predictive coding-code excited LPC-perpetual coding Video compression –principles-H.261-H.263-MPEG 1, 2, and 4.

Unit 4

Text and image compression

Compression principles-source encoders and destination encoders-lossless and lossy compression-entropy encoding –source encoding -text compression –static Huffman coding dynamic coding –arithmetic coding – Lempel ziv-welsh Compression-image compression

MODULE III **(12 Hours)**

Unit 5

Frameworks for Multimedia Standardization

Standardization Activities**,** Standards to Build a New Global Information Infrastructure (GII), Standardization Processes on Multimedia Communications, ITU-T Mediacom 2004 Framework for Multimedia Communications.

Unit 6

Motion Estimation

Introduction to Motion estimation, Block based motion estimation, Fast search motion estimation algorithm.

Module IV **(08 Hours)**

Unit 7

Applications Layer – MPEG, JPEG

MPEG Applications, JPEG Application, Digital TV and Storage Media, Multimedia Conferencing, Streaming Media, and Interactive Broadcasting, Media Description, Searching and Retrieval, Media Distribution and Consumption. Media Streaming, MPEG-4 Delivery Framework, Streaming Video over the Internet, Broadband Access, Quality of Service, Framework.

Text Book:

1. K. R. Rao, Zoran S. Bojkovic and Dragorad A. Milovanovic, "Introduction to Multimedia Communications: Applications, Middleware, Networking", Wiley Interscience, 1st edition, 2006.

Reference Books:

1. Fred Halshall "Multimedia communication – Applications, Networks, Protocols and Standards", Pearson Education, 2007
2. Fred Halsall, "Multimedia Communications: Applications, Networks, Protocols and Standards," Pearson education, 4th edition, 2009
3. Chen Chang Wen, Li, Zhu, Lian, Shiguo, "Intelligent Multimedia Communication: Techniques and Applications", Springer-Verlag, 2010.

Course Outcomes:

1. To understand the multimedia communication and to know how communication and computing technologies bring new user interface.
2. To understand the various multimedia standards and their applications.
3. Apply the compression concepts in multimedia communication.

PEEC5425	Adaptive Signal Processing	3-0-0	Credits 3

COURSE OBJECTIVES

1. To provide a solid foundation in open and closed loop adaption as well as adaptive linear combiner.
2. To understand the concept of searching the performance surface and gradient estimation.
3. To study the basic knowledge of LMS algorithm and Z- Transform in Adaptive Signal Processing.
4. To provide better understanding of application of adaptive filter.

MODULE-I **(12 Hours)**

Unit 1

INTRODUCTION

Open and closed loop adaptation, applications of closed loop adaptation,

Unit 2

The Adaptive Linear Combiner: Description, Weight Vectors, Desired Response, Performance Function; Gradient and Minimum Mean-Square Error, Wiener–Hopf Equations, Error Performance.

MODULE-II **(12 Hours)**

Unit 3

THEORY OF ADAPTATION:

Searching the Performance Surface: Searching the Performance Surface – Methods and Ideas of Gradient

Search Methods, Gradient Searching Algorithm and its Solution, Stability and Rate of Convergence, Learning Curves, Gradient Search by Newton's Method, Method of Steepest Descent, and Comparison of Learning Curves.

Unit 4

GRADIENT ESTIMATION

Gradient component estimation by derivative measurement, the performance penalty, derivative measurement and performance penalties with multiple weights, variance of the gradient estimate.

MODULE-III (12 Hours)

Unit 5

ADAPTIVE ALGORITHS

LMS Algorithm: Derivation of LMS Algorithms, Convergence of the Weight Vector with example, Noise in Weight Vector Solution.

Unit 6

Z- Transform in Adaptive Signal Processing**:** Transfer Function, Frequency Response, Impulse Response and Stability, Inverse z-Transform, Correlation and Power Spectra, The Performance Function.

MODULE-IV (8 Hours)

Unit 7

APPLICATION OF ADAPTIVE FILTER

Interference in electrocardiography, cancellation of donor-heart interference, cancellation of maternal ECG in electrocardiography, cancellation noise in speech signals, adaptive echo cancellation in long distance telephone line, self tunning filter.

Text Book:

1. Bernand Widrow and Samuel D. Stearns, "Adaptive Signal Processing", Pearson Education, 2009.

Reference Books:

1. S. Haykin and T. Kailath, Adaptive Filter Theory, Pearson Education, 4th Edition, 2005.
2. Tulay Adali, Simon Haykin, "Adaptive Signal Processing – Next Generation Solutions", Wiley, 2012.

Course Outcomes:

1. Able to apply mathematical models for error performance.
2. Explain the concept of searching the performance surface and gradient estimation.
3. Able to design LMS algorithm and Z- Transform in Adaptive Signal Processing.
4. Visualize the basic application of adaptive filter.

PEEC5426	Advanced Control System	3-0-0	Credits 3

COURSE OBJECTIVES

1. To understand discrete time control system, linear and nonlinear control systems and different models.
2. To study and analyze the stability of nonlinear and linear systems.

MODULE-I **(12 Hours)**

Unit 1

Discrete - Time Control Systems :

Introduction, Discrete Time Control Systems and Continuous Time Control Systems, Sampling Process.

Digital Control Systems:

Sample and Hold, Analog to digital conversion, Digital to analog conversion.

The Z-transform:

Discrete-Time Signals, The Z-transform, Z-transform of Elementary functions, Important properties and Theorms of the Z-transform. The inverse Z-transform, Z-Transform method for solving Difference Equations. **Z-Plane Analysis of Discrete Time Control Systems:**

Impulse sampling & Data Hold, Reconstruction of Original signals from sampled signals, Sampling theorem, folding, aliasing.

Unit 2

Pulse Transfer function:

Starred Laplace Transform of the signal involving Both ordinary and starred Laplace Transforms; General procedures for obtaining pulse Transfer functions, Pulse Transfer function of open loop and closed loop systems.

Mapping between the s-plane and the z-plane, Stability analysis of closed loop systems in the z- plane: Stability analysis by use of the Bilinear Transformation and Routh stability criteria, Jury stability.

MODULE -II **(12 Hours)**

Unit 3

State Variable Analysis & Design: Introduction:

Concepts of State, State Variables and State Model (of continuous time systems), State Model of Linear Systems, State Model for Single-Input-Single-Output Linear Systems, Linearization of the State Equation.

Unit 4

State Models for Linear Continuous – Time Systems:

State- Space Representation Using Physical Variables, State – space Representation Using Phase Variables, Phase variable formulations for transfer function with poles and zeros, State – space Representation using Canonical Variables, Derivation of Transfer Function for State Model.

MODULE -III **(12 Hours)**

Unit 5

Diagonalization of Vecors

Eigenvalues and Eigenvectors, Generalized Eigenvectors.

Solution of State Equations:

Properties of the State Transition Matrix, Computation of State Transition Matrix, Computation by Techniques Based on the Cayley-Hamilton Theorem, Sylvester's Expansion theorem.

Unit 6

Concepts of Controllability and Observability:

Controllability, Observability, Effect of Pole-zero Cancellation in Transfer Function, Pole Placement by State Feedback, Observer Systems. State Variables and Linear Discrete – Time Systems: State Models from Linear Difference Equations/z-transfer Functions, Solution of State Equations (Discrete Case), An Efficient Method of Discretization and Solution, Linear Transformation of State Vector (Discrete-Time Case), Derivation of z-Transfer Function from Discrete-Time State Model.

MODULE -IV (08 Hours)

Unit 7

Nonlinear Systems :

Introduction, Behaviour of Non linear Systems, Investigation of nonlinear systems. Common Physical Non Linearities, Saturation, Friction, Backlash, Relay, Multivariable Nonlinearity.

Stability of Non Linear Systems

Limit Cycles, Construction of PhaseTrajectories: Construction by Analytical Method, Construction by Graphical Methods.

Text Book :

1. K.Ogata, "Discrete-Time Control System", 2nd edition, PHI, 2009.

Reference Books :

1. I. J. Nagrath and M. Gopal., "Control Systems Engineering, 5th edition, New Age International (P) Ltd. Publishers, 2009.
2. Stefani Shahian, Savant Hostetter, "Design of Feedback Control Systems", 4th edition, Oxford University Press, 2009.
3. Richard C. Dorf. and Robert H.Bishop, "Modern Control Systems", 11th edition, Pearson Education Inc., 2008.
4. M. Gopal, "Control Systems (Principles & Design)", 3rd edition, Tata Mc.Graw Hill, 2008.

Course Outcomes:

1. Analysis and design of discrete time control system.
2. Linearize the nonlinear physical systems.
3. Study the nonlinear system behavior by phase plane and describing function methods

PEEC5427	Neural Network for Pattern Recognition	3-0-0	Credits 3

COURSE OBJECTIVES

1. To learn basics about pattern recognition and density estimation.
2. To get an understanding of Bayesian theory and multi layer perceptron.
3. To understand various parameter estimation methods
4. To learn about neural network.

MODULE-I **(12 Hours)**

Unit 1

Statistical pattern recognition

Character recognition, Classification and regression, Pre-processing and feature extraction, The curse of dimensionality, Polynomial curve fitting, Model complexity, Multivariate non-linear functions, Bayes' theorem, Decision boundaries, Minimizing risk

Unit 2

Probability Density Estimation and Single-Layer Networks

Parametric methods, Maximum likelihood, Bayesian inference, Sequential parameter estimation, Non-parametric methods, Mixture models, Linear discriminate functions, Linear separability, Generalized linear discriminant, Least-squares techniques, The perceptron, Fisher's linear discriminant

MODULE-II **(12 Hours)**

Unit 3

The multi-layer perceptron

Feed-forward network mappings, Threshold units, Sigmoidal units, Weight-space symmetries, Higher-order networks, Projection pursuit regression, Kolmogorov's theorem, Error back-propagation, The Jacobian matrix, The Hessian matrix

Unit 4

Radial basis functions

Exact interpolation, Radial basis function networks, Network training, Regularization theory, Noisy interpolation theory Relation to kernel regression Radial basis function networks for classification Comparison with the multi-layer perceptron Basis function optimization Supervised training.

MODULE-III **(12 Hours)**

Unit 5

Error functions and Parameter Optimization Algorithms

Sum-of-squares error Minkowski error Input-dependent variance Modeling conditional distributions Estimating posterior probabilities Sum-of-squares for classification Cross-entropy for two classes Multiple independent attributes Cross-entropy for multiple classes Entropy General conditions for outputs to be

probabilities
surfaces Local quadratic approximation Linear output units Optimization in practice Gradient descent Line search Conjugate gradients Scaled conjugate gradients Newton's method Quasi-Newton methods The Leven berg-Marquardt; algorithm

Unit 6

Pre-processing and Feature Extraction

Pre-processing and post-processing , Input normalization and encoding, Missing data Time series prediction, Feature selection , Principal component analysis, In variances and prior knowledge

MODULE-IV (08 Hours)

Unit 7

Learning and Generalization

Bias and variance, Regularization, Training with noise, Soft weight sharing, Growing and pruning algorithms, Committees of networks, Mixtures of experts , Model order selection, Vapnik- Chervonenkis dimension

Text Book:

1. Christopher M. Bishop "Neural network for pattern recognition" Oxford University Press, 2nd edition, 2005.

Reference Books:

1. R. O. Duda, P. E. Hart and D. G. Stork, John Wiley "Pattern Classification", Wiley Interscience, 2nd edition, 2007
2. R. Schalkoff, "Pattern Recognition: Statistical, Structural and Neural Approaches", Wiley, 2012.
3. S. Theodoridis and K. Koutroumbas, "Pattern Recognition", Academic Press, 4th Edition, 2009

Course Outcomes:

1. Learn different learning theories of pattern recognition.
2. Understand theory regarding Bayesian decision.
3. Understand several parameter estimation techniques.
4. Learn several aspects of neural networks.