DR. A.P.J. ABDUL KALAM TECHNICALUNIVERSITY, LUCKNOW

EVALUATION SCHEME & SYLLABUS

FOR

B. TECH. FINAL YEAR

ELECTRONICS ENGINEERING/ ELECTRONICS & COMMUNICATION ENGINEERING/ ELECTRONICS & TELECOMMUNICATION ENGINEERING

ON

CHOICE BASED CREDIT SYSTEM (CBCS)

[Effective from the Session: 2018-19]

EVALUATION SCHEME

B.TECH. ELECTRONICS ENGINEERING, B.TECH. ELECTRONICS & COMMUNICATION ENGINEERING, B.TECH. ELECTRONICS & TELECOMMUNICATION ENGINEERING

YEAR 4rd/ SEMESTER VII

Sr. No.	Sub Code	Subject Name	L-T-P	Th/Lab Marks	Sessional		Total	SubjectTotal	Credit
				ESE	CT	TA			
1	ROE 07*	Open Elective-I**	3--1--0	100	30	20	50	150	4
2	REC 03*	Departmental Elective-III	3--1--0	100	30	20	50	150	4
3	REC 701	Optical Communication	3--1--0	100	30	20	50	150	4
4	REC 702B	Data Communication Networks	3--1--0	100	30	20	50	150	4
5	REC 703	VLSI Design	3--1--0	100	30	20	50	150	4
6	AUC 001	Human Values & Professional Ethics	2--0--0	50	15	10	25	75	-
PRACTICAL/DESIGN/DRAWING									
7	REC 751	Optical Communication & Networking Lab	0--0--2	30	-	20	20	50	1
8	REC 752A	Electronics Circuit Design	0--0--3	30	-	20	20	50	2
9	REC 753	Industrial Training Viva-Voce	0--0--2	-	-	50	50	50	1
10	REC 754	Project	0--0--2	-	-	50	50	50	1
11	RGP 701	General Proficiency	---	-	-	-	50	50	1
	TOTAL		15—5--9	560	150	240	440	1000	26

**** Open Electives-I**

1. ROE-071 Entrepreneurship Development
2. ROE-072 Quality Management
3. ROE-073 Operation Research
4. ROE-074 Introduction to Biotechnology
5. ROE-075 Micro and smart systems

EVALUATION SCHEME

B.Tech. Electronics Engineering, B.Tech. Electronics & Communication Engineering, B.Tech. Electronics & Telecommunication Engineering

YEAR 4rd/ SEMESTER VIII

Sr. No	Sub Code	Subject Name	L-T-P	Th/LAB Marks	Sessional		Total	Subject Total	Credit
				ESE	CT	TA			
1	ROE 08*	Open Elective-II**	3--1—0	100	30	20	50	150	4
2	REC 04*	Departmental Elective-IV	3--1—0	100	30	20	50	150	4
3	REC 801	Wireless & Mobile Communication	3--1—0	100	30	20	50	150	4
4	REC 802	Optical Network	3--1—0	100	30	20	50	150	3
5	RUC 001	*HumanValues& Professional Ethics	2--0—0	50	15	10	25	75	-
PRACTICAL/DESIGN/DRAWING									
6	REC 851	Project	0--0--12	250	-	100	100	350	8
7	RGP 801	General Proficiency	----	-	-	-	50	50	1
	TOTAL		12—4--12	650	120	180	350	1000	24

**** Open Electives-II**

ROE-081 Non Conventional Energy Resources

1. ROE-082 Nonlinear Dynamic system
2. ROE-083 Product Development
3. ROE-084 Automation and Robotics

LIST OF ELECTIVES:

Elective – III REC 03* Departmental Elective III

1. REC 031Information Theory & Coding
2. REC 032Digital Image Processing
3. REC 033Voice Over IP
4. REC 034Filter Design
5. REC 035Applied Fuzzy Electronic Systems
6. REC 036 Advance Programming in Engineering

Elective – IV REC 04* Departmental Elective IV

1. REC 041Electronic Switching
2. REC 042Digital System Design using VHDL
3. REC 043Speech Processing
4. REC 044Advanced Display Technologies & Systems
5. REC 045Satellite & RADAR systems

Elective – III REC 03* Departmental Elective III

S. No.	Course Code	Course Name	MooC Equivalent Course
1.	REC 031	Information Theory & Coding	Introduction to Coding Theory (8 Weeks) / Introduction to Coding Theory(8 Weeks), &LDPC and Polar Codes in 5G Standard (4 Weeks)
2.	REC 032	Digital Image Processing	Mathematical Methods and Techniques in Signal Processing (12 weeks)
3.	REC 033	Voice Over IP	
4.	REC 034	Filter Design	
5.	REC 035	Applied Fuzzy Electronic Systems	Fuzzy Logic and Neural Networks(8 Weeks)/ Machine Learning for Engineering and Science Applications (12 Weeks)
6.	REC 036	Advance Programming in Engineering	Matlab Programming for Numerical Computation (8 Weeks) + Patent Drafting for Beginners (4 Weeks)

Elective – IV REC 04* Departmental Elective IV

S. No.	Course Code	Course Name	MooC Equivalent Course
1.	REC 041	Electronic Switching	
2.	REC 042	Digital System Design using VHDL	
3.	REC 043	Speech Processing	
4.	REC 044	Advanced Display Technologies & Systems	
5.	REC 045	Satellite & RADAR systems	Satellite Attitude Dynamics and Control (12)

REC-701 OPTICAL COMMUNICATION

COURSE OBJECTIVE:

1. To learn the basic elements of optical fiber transmission link, fiber modes configurations and structures.
2. To understand the different kind of losses, signal distortion, SM fibers.
3. To learn the various optical sources, materials and fiber splicing.
4. To learn the fiber optical receivers and noise performance in photo detector.
5. To learn link budget, WDM, solitons and SONET/SDH network.

COURSE OUTCOME: After completion of the course student will be able to:

CO701.1	Familiarize with basic concepts and theory of Optical Communication
CO701.2	Demonstrate OPCOMM components, assemble them and solve problems on Optical Communication system
CO701.3	Able to design, implements, analyse and maintains optical communication system
CO701.4	Gain knowledge of different source of light as well as receiver and their comparative study
CO701.5	To get idea about power budget and ultimately be an engineer with adequate knowledge in optical domain

REC-701 OPTICAL COMMUNICATION3 1 0

Unit	Topic	Lectures
I	Overview of optical fiber communication: The general system, Advantages of optical fiber communication. Optical spectral band. Optical Fiber waveguides: Introduction, Ray theory transmission Total internal reflection, acceptance angle, numerical aperture, skew rays. Electromagnetic mode theory for optical propagation: Electromagnetic waves, modes in a planar guide, phase and group velocity, phase shift with total internal reflection and the evanescent field, gooshanchen shift.	10
II	Cylindrical Fiber: modes, mode coupling, step index fibers Graded index fibers, Single mode Fiber: Cut-off wavelength, Mode field diameter and spot size, effective refractive index, Group delay and mode delay factor, The Gaussian approximation, equivalent step index methods. Signal distortion in optical fibers - Attenuation, Material Absorption, losses in silica glass fibers; Intrinsic absorption, Extrinsic absorption. Linear scattering losses; Ray light scattering, Mie scattering. Non linear Scattering losses: fiber bending losses; Dispersion, Chromatic dispersion: material dispersion, waveguide dispersion. Intermodal dispersion: Multimode step index fiber, Multimode graded index fiber. Overall fiber dispersion Multimode fiber, Dispersion modified single mode fibers ,Dispersion–shifted fiber, dispersion flatted fibers, nonzero-dispersion-shifted fibers (MZ-DSF), Polarization: Fiber birefringence, polarization mode dispersion, polarization-maintaining fibers, Non-linear effects: Scattering effects, Kerr effects.	10
III	Optical sources - Light Emitting Diodes (LEDs): Structures, light source materials, Quantum Efficiency on LED Power Modulation of a LED, Laser Diodes- models and threshold conditions, laser diode rate equations, External quantum efficiency, resonant frequency, laser diode structures and radiation patterns, single mode lasers modulation of laser diodes, laser lines.	6

IV	Source to fiber power launching, Source Output patterns, Power coupling calculation, Power launching versus wavelength, equilibrium numerical aperture. Photo detectors: Physical principles of photodiodes: The PIN photo detector, Avalanche photodiodes. Photo detector Noise: Noise sources, signal to noise ration. Detector Response time: Depletion layer photocurrent, response time structure of in GaAs APDs, Temperature effect on Avalanche gain, comparison of photo detectors	6
V	Optical receiver operation: Fundamental receiver operation: Digital signal transmission, error sources, front end amplifier. Digital receiver performance: Probability of error receiver sensitivity, The Quantum Unit. Eye Diagram: Eye Pattern Features, BER and Q Factor Measurement Coherent Detection: Fundamental concepts, Homodyne detection, heterodyne detection, IBER comparisons. Digital links: Point to point links, power penalties.	8

Text Book:

1. Gerd Keiser, “Optical Fiber Communications”, McGraw Hill , 5th Edition, 2013.
2. John M. Senior, “Optical Fiber Communications”, PEARSON, 3rd Edition, 2010.

Reference Books:

1. Sanjay Kumar Raghuwanshi, Santosh Kumar, “Fiber Optical Communications”, University Press, 2018.
2. Govind P. Agrawal, “Fiber Optic Communication Systems”, John Wiley, 3rd Edition, 2004.
3. Oseph C. Plais, “Fiber Optic Communication”, Pearson Education, 4th Ed, 2004.

REC-702DATA COMMUNICATION NETWORKS

COURSE OBJECTIVE: After completion of the course student will be able to:

1. Understand basic terminology of networking.
2. Evaluate the functions of various layers and their roles.

COURSE OUTCOME: After completion of the course student will be able to

CO702.1	Identify the issues and challenges in the architecture of a network.
CO702.2	Understand the ISO/OSI seven layers in a network.
CO702.3	Realize protocols at different layers of a network hierarchy
CO702.4	Recognize security issues in a network.

REC-702DATA COMMUNICATION NETWORKS3 1 0		
Unit	**Topic**	**Lectures**
I	Introduction to Networks and Data Communications, Goals and Applications of Networks, Network structure and architecture, The Internet, Protocols and Standards, Layered Tasks, The OSI reference model, TCP / IP, Addressing, Line Coding Review.	8
II	Physical Layer, Transmission Media: Guided and unguided, Network Topology Design, Data Link Layer: Error detection and Correction, Framing, Flow and Error Control Protocols, Networking devices.	8
III	Multiple Access: Random Access Protocols, CDMA, CSMA/CD, CSMA/CA, Controlled Access, Channelization Wired LANs: IEEE Standards, Fast Ethernet, Gigabit Ethernet, Wireless LAN IEEE 802.11, Bluetooth IEEE 802.16	8
IV	Network Layer: Point - to Pont Networks routing, Congestion control Internetworking -TCP / IP, IP packet, IPV4, IPv6, Transport Layer Protocol: UDP and TCP, ATM, session Layer-Design issues	8
V	Application Layer: File Transfer, Electronic mail, Virtual Terminals, Cryptography, Network Security	8

Text Book:

1. Forouzan, Data Communication & Networking, McGrawhill Education
2. Lathi, B. P. & Ding, Z., (2010), Modern Digital and Analog Communication Systems,Oxford University Press
3. Stallings, W., (2010), Data and Computer Communications, Pearson.
4. Andrew S. Tanenbaum, “Computer Networks” Pearson.
5. Ajit Pal, “Data Communication and Computer Networks”, PHI
6. Dimitri Bertsekas, Robert G. Gallager, “Data Networks”, Prentice Hall, 1992

REC-703 VLSI DESIGN

COURSE OBJECTIVE:

1. To learn basic CMOS Circuits.
2. To learn CMOS process technology.
3. To learn techniques of chip design using programmable devices.
4. To learn the concepts of designing VLSI Subsystems.
5. To learn the concepts of modelling a digital system using Hardware Description Language.

COURSE OUTCOME: After completion of the course student will be able to:

CO703.1	Model the behaviour of a MOS Transistor
CO703.2	Design combinational and sequential circuits using CMOS gates
CO703.3	Identify the sources of power dissipation in a CMOS circuit.
CO703.4	Analyse SRAM cell and memory arrays

REC-703 VLSI DESIGN 3 1 0

Unit	Topics	Lectures
I	Introduction: A Brief History, Preview, MOS Transistors, CMOS Logic, CMOS Fabrication and Layout, Design Partitioning, Logic Design, Circuit Design, Physical Design, Design Verification, Fabrication, Packaging and Testing.	8
II	Delay: Introduction, Transient Response, RC delay model, Linear Delay Model, Logical Effort of Paths, Timing Analysis Delay Models. Power: Introduction, Dynamic Power, Static Power	8
III	Energy – Delay Optimization, Low Power Architectures. Interconnect: Introduction, Interconnect Modelling, Interconnect Impact, Interconnect Engineering, Logical Effort with Wires	8
IV	Dynamic logic circuits: Introduction, basic principle of pass transistor circuits, synchronous dynamic circuit techniques, dynamic CMOS circuit techniques, domino CMOS logic. Semiconductor memories: Introduction, DRAM, SRAM, ROM, flash memory.	8
V	Low – Power CMOS Logic Circuits: Introduction, Overview of Power Consumption, Low – Power Design through voltage scaling, Estimation and Optimization of switching activity, Reduction of Switched Capacitance and Adiabatic Logic Circuits. Design for Testability: Introduction, Fault Types and Models, Controllability and Observability, Ad Hoc Testable Design Techniques, Scan Based and BIST Techniques	8

Text Book:

1. Sung-Mo Kang &YosufLeblebici, "CMOS Digital Integrated Circuits: Analysis & Design",Mcgraw Hill, 4th Edition.
2. Neil H.E.Weste, David Money Harris, "CMOS VLSI Design – A circuits and SystemsPerspective" Pearson, 4th Edition

Reference Books:

1. D. A. Pucknell and K. Eshraghian, "Basic VLSI Design: Systems and Circuits", PHI, 3rd Ed.,1994.
2. W.Wolf, Modern VLSI Design: System on Chip, Third Edition, Pearson, 2002.

ELECTIVES III

REC-031INFORMATION THEORY & CODING

COURSE OBJECTIVE:

1. To learn basic of Entropy.
2. To learn Asymptotic Equipartition Property.
3. To learn Channel Capacity.
4. To learn the implementation of Block Codes
5. To learn the Convolution codes

COURSE OUTCOME: After completion of the course student will be able to:

CO031.1	Model the Entropy, Joint Entropy and Conditional Entropy, Relative Entropy and Mutual Information, Relationship Between Entropy and Mutual Information
CO031.2	Design Data Compression, Examples of Codes, Kraft Inequality, Optimal Codes, Bounds on the Optimal Code Length
CO031.3	Identify the Examples of Channel Capacity, Symmetric Channels, Properties of Channel Capacity, Preview of the Channel Coding Theorem.
CO031.4	Analyse Introduction to block codes, Single-parity-check codes, Product codes, Repetition codes, Hamming codes
CO031.5	Design Generator matrices for convolutional codes, Generator polynomials for convolutional codes

REC-031	**INFORMATION THEORY & CODING**	**3 1 0**
Unit	**Topics**	**Lectures**
I	**Entropy**: Entropy, Joint Entropy and Conditional Entropy, Relative Entropy and Mutual Information, Relationship Between Entropy and Mutual Information, Chain Rules for Entropy, Relative Entropy, and Mutual Information, Jensen's Inequality and Its Consequences, Log Sum Inequality and Its Applications, Data-Processing Inequality, Sufficient Statistics, Fano's Inequality	8
II	**Asymptotic Equipartition Property:** Asymptotic Equipartition Property Theorem, **Consequences of the AEP:** Data Compression, High-Probability Sets and the Typical Set Data Compression: Examples of Codes, Kraft Inequality, Optimal Codes, Bounds on the Optimal Code Length, Kraft Inequality for Uniquely Decodable Codes, Huffman Codes, Some Comments on Huffman Codes, Optimality of Huffman Codes, Shannon–Fano–Elias Coding	8
III	**Channel Capacity:** Examples of Channel Capacity, Symmetric Channels, Properties of Channel Capacity, Preview of the Channel Coding Theorem, Definitions, Jointly Typical Sequences, Channel Coding Theorem	8
IV	**Block** Codes Digital communication channel, Introduction to block codes, Single-parity-	8

	check codes, Product codes, Repetition codes, Hamming codes, Minimum distance of block codes, Soft-decision decoding, Automatic-repeat-request schemes **Linear codes** Definition of linear codes, Generator matrices, Standard array, Parity-check matrices, Error	
V	**Convolution codes** Encoding convolutional codes, Generator matrices for convolutional codes, Generator polynomials for convolutional codes, Graphical representation of convolutional codes, Viterbi decoder	8

Text Books:

1. Bose, Inforrmation Theory, Coding and Cryptography, Mcgrawhill Education
2. Joy A. Thomas, Thomas M. Cover, "Elements of information theory", Wiley-Interscience; 2edition (July 18, 2006)
3. S. Gravano, "Introduction to Error Control Codes" OUP Oxford (24 May 2001)
4. Robert B. Ash, "Information Theory", Dover Publications (November 1, 1990)
5. Todd k Moon, "Error Correction Coding: Mathematical Methods and Algorithms " Wiley,2005

REC-032DIGITAL IMAGE PROCESSING

COURSE OBJECTIVE:

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.
5. To study the image segmentation and representation techniques

COURSE OUTCOME: After completion of the course student will be able to:

CO032.1	Understand the need for image transforms and their properties
CO032.2	Choose appropriate technique for image enhancement both in spatial and frequency Domains.
CO032.3	Identify causes for image degradation and apply restoration techniques.
CO032.4	Compare the image compression techniques in spatial and frequency domains.
CO032.5	Select feature extraction techniques for image analysis and recognition.

REC-032	**DIGITAL IMAGE PROCESSING**	**3 1 0**
Unit	**Topics**	**Lectures**
I	**Introduction:** Overview of Image Processing, Nature of Image Processing, Application area of image processing, Digital Image Representation, Types of images, Digital Image Processing Operations, Fundamental steps in DIP, Overview of Digital Image Systems, Physical Aspect of Image Acquisition, biological Aspect of Image Acquisition, sampling & quantization, Digital Halftone Process, Image storage and File formats.	8
II	**Image Transforms:** Need for image transforms, Properties of Fourier transform, Discrete cosine transform, Discrete sine transform, Hadamard transform, Haar transform, Slant transform, SVD and KL transforms, Comparison between transforms. **Image Enhancement:** Image Quality and Need for image enhancement, Image enhancement operations, Image enhancement in spatial domain, histogram based techniques, Spatial Filtering concepts, Image smoothing spatial filters, Image Sharpening spatial filters, Image smoothing in frequency domain filtering, Image sharpening in frequency domain, Homomorphism filtering.	8
III	**Image Restoration:** Introduction to degradation, Types of Image degradations, image degradation models, noise modeling, Estimation of degradation functions, Image restoration in presence of noise only, Periodic noise and band – pass and band reject filtering, difference between enhancement & restoration, Image restoration techniques	8
IV	**Image Compression:** Image compression model, Compression algorithms and its types, Type of redundancy, lossless compression algorithms, Lossy compression algorithms, Image and video compression standards	8

V	**Image Segmentation:** Introduction, Detection of Discontinuities, Edge Detection, Hough Transforms and Shape Detection, corner detection, Principle of thresholding, Principle of region - growing.	8

Text Books:

1. Rafael C. Gonzalez Richard E woods Steven L. Eddins, ‘‘Digital Image Processing UsingMATLAB’’, Mc Graw Hill, 2nd Edition
2. Jayaraman, Digital Image Processing, McGrawhill Education
3. S. Sridhar, “Digital Image Processing”, OXFORD University Press, Second Edition.
4. Rafael C. Gonzalez Richard E woods Steven L. Eddins, ‘‘Digital Image’’, Pearson.
5. Anil K Jain, ‘’Fundamentals of Digital Image Processing”, Pearson.

REC-033VOICE OVER IP

COURSE OBJECTIVE: Students undergoing this course are expected to :

1. Understand the basic principle of VoIP.
2. Understand the different signalling protocols.
3. Learn about how to improve the quality of service (VoIP).

COURSE OUTCOME: After completion of the course student will be able to:

CO033.1	Understand the characteristics of the Call signalling systems.
CO033.2	Design SIP Architecture.
CO033.3	Model and estimate media gateways.
CO033.4	Understand the network synchronization and management.
CO033.5	Evaluate the quality of service that need for QoS.

REC-033	**VOICE OVER IP**	**3 1 0**
Unit	**Topics**	**Lectures**
I	**Introduction:** Carrier-Grade, VoIP, VoIP Challenges, Overview of the IP Protocol Suite, The Internet Protocol, IP Version 6, IP Multicast, The Transmission Control Protocol, The User Datagram Protocol, The Stream Control Transmission Protocol, The Real-Time Transport Protocol, The RTP Control Protocol, Security and Performance Optimization **Speech-Coding Techniques** A Little about Speech, Audio, and Music, Voice Sampling, Voice Quality, Types of Speech Coders, Waveform Coders, Analysis-by-Synthesis Codes, G.722–Wideband Audio	8
II	**Signaling Protocols:** H.323: Multimedia Conferencing over IP The H.323 Architecture, RAS Signaling, Call Signaling, Call Scenarios, H.245 Control Signaling, Conference Calls, Securing an H.323 Network. **The Session Initiation Protocol** The SIP Architecture, Overview of SIP Messaging Syntax, Examples of SIP Message Sequences, Redirect and Proxy Servers, The Session Description Protocol, Usage of SDP with SIP, SIP Extensions and Enhancements, Usage of SIP for Features and Services, Interworking	8
III	**Distributed Gateways and the Softswitch Architecture** Separation of Media and Call Control, Softswitch Architecture, Protocol Requirements for Controlling Media Gateways, Protocols for Controlling Media Gateways, MGCP, MEGACOP/H.248.1.	8
IV	**VoIP and SS7** The SS7 Protocol Suite, SS7 Network Architecture, ISUP, Performance Requirements for SS7, SIGTRAN, Interworking SS7 and VoIP Architectures	8
V	**Quality of Service** The Need for QoS, Overview of QoS Solutions, The Resource Reservation Protocol, DiffServ, Multiprotocol Label Switching, Combining QoS Solutions	8

Text Books:

1. Richard Swale, Daniel Collins," Carrier-Grade VoIP", McGraw-Hill Education 3rdEdition,2014.
2. Olivier Hersent, Jean Pierre Petit, David Gurle, "IP Telephony – Deploying Voice Over-IPProtocols", John Wiley & Sons Ltd, 2005

REC-034FILTER DESIGN

COURSE OBJECTIVE: Students undergoing this course are expected to:

1. Understand about the characteristics of different filters.
2. Understand the concept of Approximation Theory.
3. Learn about the switched capacitor filter.

COURSE OUTCOME: After completion of the course student will be able to:

CO034.1	Choose an appropriate transform for the given signal.
CO034.2	Choose appropriate decimation and interpolation factors for high performance filters.
CO034.3	Model and design an AR system.
CO034.4	Implement filter algorithms on a given DSP processor platform.

REC-034 FILTER DESIGN 3 1 0

Unit	Topics	Lectures
I	Introduction: Fundamentals, Types of filters and descriptive terminology, why we use Analog Filters, Circuit elements and scaling, Circuit simulation and modelling. Operational amplifiers: Op-amp models, Op-amp slew rate, Operational amplifiers with resistive feedback: Noninverting and Inverting, Analysing Op-amp circuits, Block diagrams and feedback, The Voltage follower, Addition and subtraction, Application of Op-amp resistor circuits.	8
II	First order filter: Bilinear transfer functions and frequency response – Bilinear transfer function and its parts, realization of passive elements, Bode plots, Active realization, The effect of A(s), cascade design.	8
III	Second order low pass and band pass filters: Design parameters, Second order circuit, frequency response of low pass and band pass circuits, Integrators and others biquads.	8
IV	Second order filters with arbitrary transmission zeros: By using summing, By voltage feed forward, cascade design revisited. Low pass filters with maximally flat magnitude: the ideal low pass filter, Butterworth response, Butterworth pole locations, low pass filter specifications, arbitrary transmission zeros.	8
V	Low pass filter with equal ripple (Chebyshev) magnitude response: The chebyshev polynomial ,The chebyshev magnitude response, Location of chebyshev poles, Comparison of maximally flat & equal–ripple responses, Chebyshev filter design Inverse chebyshev and cauer filters: Inverse chebyshev response, From specifications to pole and zero locations, Cauer magnitude response, Chebyshev rational functions, Cauer filter design.	8

Text Book:

1. Rolf. Schaumann, Haiqiao Xiao, Mac. E. Van Valkenburg, “Analog Filter Design”, 2ndIndian Edition, Oxford University Press.

Reference Books:

1. J. Michael Jacob, “Applications and Design with Analog Integrated Circuits”,Second edition, Pearson.
2. T. Deliyannis, Yichuang Sun, J.K. Fidler, “Continuous-Time Active Filter Design”,CRC Press.

REC-035 APPLIED FUZZY ELECTRONIC SYSTEMS

COURSE OBJECTIVE: Students undergoing this course are expected:

1. To understand Fuzzy Sets, Possibility Distributions.
2. To analysis Fuzzy Rule.
3. To Be aware of uncertainty in information.
4. To learn approximate method of Extension.
5. Analysis Fuzzy Logic in Control Engineering.

COURSE OUTCOME: After completion of the course student will be able to:

CO035.1	Understand the Operations of Fuzzy Sets, Properties of Fuzzy Sets, Geometric Interpretations of Fuzzy Sets, Possibility Theory.
CO035.2	Design Fuzzy Mapping Rule, Fuzzy Implication Rule, Fuzzy Rule Based Models for Function Approximations, Theoretical Foundation of Fuzzy Mapping Rules, Types of Fuzzy Rule Based Models.
CO035.3	Realization of Fuzzy Sets and their properties; Cardinality of Classical Relations and their properties.
CO035.4	Aware Principle of Vertex Method, DSW Algorithm, and Restricted DSW Algorithm and their comparison, Classical Predicate Logic; Fuzzy Logic.
CO035.5	Understand Fundamental Issues in Control Engineering, Control Design Process, Semiformal Aspects of Design Process, Mamdani Architecture of Fuzzy Control, The Sugeno-Takagi Architecture.

REC-035	**APPLIED FUZZY ELECTRONIC SYSTEMS**	**3 1 0**
Unit	**Topics**	**Lectures**
I	History of Fuzzy Logic, Fuzzy Sets, Possibility Distributions, Fuzzy Rules, Fuzzy Sets, Operations of Fuzzy Sets, Properties of Fuzzy Sets, Geometric Interpretations of Fuzzy Sets, Possibility Theory, Fuzzy Relations and their Compositions, Fuzzy Graphs, Fuzzy Numbers, Functions with Fuzzy Arguments, Arithmetic Operations of Fuzzy Numbers.	8
II	Fuzzy Rules: Fuzzy Mapping Rule, Fuzzy Implication Rule, Fuzzy Rule Based Models for Function Approximations, Theoretical Foundation of Fuzzy Mapping Rules, Types of Fuzzy Rule Based Models: Mamdani Model, TSK Model, Standard Additive Model, Fuzzy Implications and Approximate Reasoning: Propositional Logic, First Order Predicate Calculus, Fuzzy Implications, Approximate Reasoning, Criteria and Family of Fuzzy Implications, Possibility vs. Probability, Probability of Fuzzy Event, Probabilistic Interpretations of Fuzzy Sets, Fuzzy Measure.	8
III	Uncertainty in information; Classical Sets, Fuzzy Sets and their properties; Cardinality of Classical Relations and their properties, The a- Level Set, Cardinality of Fuzzy Relations and their properties; Composition; Tolerance and Equivalence relationship; Membership Functions; Fuzzification and Defuzzification process; Fuzzy to Crisp Conversions; Lambda cuts; Extension	8

	Principle, Crisp functions and its mapping, Fuzzy functions and its mapping; Fuzzy Numbers; Internal Analysis in Arithmetic	
IV	Approximate method of Extension, Vertex Method, DSW Algorithm, and Restricted DSW Algorithm and their comparison, Classical Predicate Logic; Fuzzy Logic; Approximate Reasoning; Fuzzy Tautologies, Contradictions, Equivalence, and Logical Proof; Fuzzy Rule Based Systems, Models of Fuzzy AND, OR, and Inverter; Fuzzy Algebra; Truth Tables; Fuzzy Functions; Concept of Fuzzy Logic Circuits; Fuzzy Flip- Flop; Fuzzy Logic Circuits in Current Mode, Furry Numbers.	8
V	Fuzzy Logic in Control Engineering: Fundamental Issues in Control Engineering, Control Design Process, Semiformal Aspects of Design Process, Mamdani Architecture of Fuzzy Control, The Sugeno-Takagi Architecture. Fuzzy Logic in Hierarchical Control Architecture, Historical Overview and Reflections on Mamdani`s Approach, Analysis of Fuzzy Control System via Lyapunov`s Direct Method, Linguistic Approach to the analysis of Fuzzy Control System, Parameter Plane Theory of Stability, Takagi-Sugeno-Kang Model Of Stability Analysis.	8

Text Book:

1. John Yen, Reza Langari, “Fuzzy Logic: Intellegent Control and Information”, PearsonPublication.
2. Ahmad M. Ibrahim, “Introduction to Applied Fuzzy Electronics”, Prentice Hall Publication.
3. Ahmad M. Ibrahim, “Fuzzy Logic for Embedded Systems Applications”, NewnesPublications.
4. WitoldPedrycz, Fernando Gomide, “Fuzzy Systems Engineering: Toward Human-CentricComputing”, John Wiley Publications.

REC-036 ADVANCE PROGRAMMING IN ENGINEERING

COURSE OBJECTIVE: Students undergoing this course are expected:

1. To understand interactive computation techniques and learn algorithm development in Matlab.
2. To apply Matlab programming skills in communication engineering applications.
3. To apply Matlab programming skills in control system applications.
4. To apply Matlab application in neural networks and fuzzy logic.
5. To apply Matlab programming skills in digital signal processing applications.

COURSE OUTCOME: After completion of the course student will be able to:

CO036.1	Understand the fundamentals of Matlab programming as well as understand and apply advance level programming techniques for solving problems using numerical methods.
CO036.2	Learn, apply, and investigate Matlab applications in advance communication systems.
CO036.3	Apply and investigate stability of systems and processes using time domain and frequency domain stability criterions like Routh-Hurwitz, State-space representation, Bode plots and Root Locus techniques.
CO036.4	Learn, apply, and investigate Matlab applications in neural networks and fuzzy logic.
CO036.5	Learn, apply, and investigate Matlab applications in digital signal processing including multi-rate DSP algorithms.

REC-036	**Advance Programming in Engineering**	**3 1 0**
Unit	**Topics**	**Lectures**
I	Introduction of MATLAB, MATLAB fundamental, Interactive Computation: Logical vectors, logical operations, logical functions, Matrix and Arrays, matrices, matrix operations, MATLAB Graphics: Basics 2-D plots, 3-D plots, handle graphics, Saving and printing graphs, Linear equations. Loops, Error and Pitfalls. Program design and algorithm development, MATLAB scripts and functions and data import-export utilities.	8
II	MATLAB Applications in Communication Systems: Introduction, Generation and detection of AM, FM, and PM signals, Sampling of signals, Pulse modulation techniques (PAM, PWM, PPM), PCM, Digital modulation techniques (ASK, PSK, FSK, M-ary), OFDM, Spread-spectrum techniques	8
III	MATLAB Applications in control system: Introduction, Laplace and Inverse Laplace Transform, Transfer function, Zero, Poles and Pole – Zero map of a transfer function, State-Space representation, series/cascade, parallel and feedback Connections, Time response of control systems Routh Hurwitz Criteria. Root Locus, Frequency response Representation: Bode plots, Gain Margin, Phase Margin, Polar Plot, Nyquist Plot.	8
IV	MATLAB Application in Neural Networks: Introduction, salient features of artificial neural networks, ANN Architectures, Application using multilayer perceptron, ANN based control. MATLAB Application in Fuzzy Logic Systems: Introduction, Linguistic variables and membership functions, fuzzy operations, rule matrix, fuzzy inference systems, washing machine problem,	8

	fuzzy controller example (Water Bath).	
V	MATLAB Application in Digital Signal Processing: Introduction, signal and systems classification, operations on discrete-time signals, Multirate signal processing functions, convolution, Z- Transform, Discrete Fourier Transform, Fast Fourier Transform, Discrete Cosine Transform, DigitalFiltrer Design.	8

Text Books:

1. Raj Kumar Bansal, Ashok Kumar Goel and Manoj Kumar Sharma, "MATLAB and its Applications in Engineering ", Pearson 14th impression,2014.
2. Brian H. Hahn and Daniel T. Valentine, "Essential MATLAB for Engineering and Scientists", Academic Press, Elsevier, 5th edition, 2013.
3. RudraPratap, "MATLAB- A quick introduction for Scientists and Engineers", Oxford University Press, 2013.
4. www.mathworks.com

OPEN ELECTIVES- I

ROE-071 ENTREPRENEURSHIP DEVELOPMENT

COURSE OBJECTIVE: Students undergoing this course are expected :

1. To understand concept of entrepreneurship.
2. To prepare project reports.
3. To preparation balance sheets and assess economic viability.
4. To learn project planning and control.
5. Analyse laws concerning entrepreneur viz.

COURSE OUTCOME: After completion of the course student will be able to:

CO071.1	Understand the growth of small scale industries in developing countries and their positions vis-a-vis large industries.
CO071.2	Design assessment of viability, formulation, evaluation, financing, field-study and collection of information, preparation of project report.
CO071.3	Realization of planning and production control, quality control, marketing, industrial relations, sales and purchases, advertisement.
CO071.4	Aware the financial functions, cost of capital approach in project planning and control. Economic evaluation, risk analysis, capital expenditures.
CO071.5	Understand Role of various national and state agencies which render assistance to small scale industries.

ROE-071ENTREPRENEURSHIP DEVELOPMENT		**3-1-0**
Unit	**Topic**	**Lectures**
I	Entrepreneurship- definition, growth of small scale industries in developing countries and their positions vis-a-vis large industries; role of small scale industries in the national economy; characteristics and types of small scale industries; demand based and resources based ancillaries and sub-control types. Government policy for small scale industry; stages in starting a small scale industry.	**8**
II	Project identification- assessment of viability, formulation, evaluation, financing, field-study and collection of information, preparation of project report, demand analysis, material balance and output methods, benefit cost analysis, discounted cash flow, internal rate of return and net present value methods.	**8**
III	Accountancy- Preparation of balance sheets and assessment of economic viability, decision making, expected costs, planning and production control, quality control, marketing, industrial relations, sales and purchases, advertisement, wages and incentive, inventory control, preparation of financial reports, accounts and stores studies.	**8**
IV	Project Planning and control: The financial functions, cost of capital approach in project planning and control. Economic evaluation, risk analysis, capital expenditures, policies and practices in public enterprises. profit planning and programming, planning cash flow, capital expenditure and operations. control of financial flows, control and communication.	**8**

V	Laws concerning entrepreneur viz, partnership laws, business ownership, sales and income taxes and workman compensation act. Role of various national and state agencies which render assistance to small scale industries.	**8**

Text Books:

1. Forbat, John, “Entrepreneurship” New Age International.

Reference Books:

1. Hisrich, Entrepreneurship, McGrawhill Education
2. Havinal, Veerbhadrappa, “Management and Entrepreneurship” New Age International
3. Joseph, L. Massod, “Essential of Management", Prentice Hall of India.

ROE-072 QUALITY MANAGEMENT

COURSE OBJECTIVE: Students undergoing this course are expected:

1. To understand evolution of Quality Control, concept change, TQM Modern concept, Quality concept in design.
2. To understand effects of human factor in quality.
3. To prepare Control Charts and analyse them.
4. To learn Defects diagnosis and prevention defect study.
5. To learn concepts of ISO-9000.

COURSE OUTCOME : After completion of the course student will be able to:

CO072.1	Understand Procurement of various products, evaluation of supplies, capacity verification, Development of sources, procurement procedure and Manufacturing Quality.
CO072.2	UnderstandAttitude of top management, cooperation of groups, operators attitude, responsibility, causes of apparatus error and corrective methods.
CO072.3	Learn planning and production control, quality control, marketing, industrial relations, sales and purchases, advertisement.
CO072.4	Identify and analyse the defects, take corrective measure, and identify factors affecting reliability, MTTF, and be able to calculate reliability.
CO072.5	Understand ISO 9000 series, Taguchi method, JIT in some details.

ROE-072 QUALITY MANAGEMENT	**3-1-0**	
Unit	**Topic**	**Lectures**
I	**Quality Concepts:** Evolution of Quality Control, concept change, TQM Modern concept, Quality concept in design, Review of design, Evolution of proto type. **Control on Purchased Product** Procurement of various products, evaluation of supplies, capacity verification, Development of sources, procurement procedure. **Manufacturing Quality** Methods and techniques for manufacture, inspection and control of product, quality in sales and services, guarantee, analysis of claims.	**8**
II	**Quality Management** Organization structure and design, quality function, decentralization, designing and fitting, organization for different type products and company, economics of quality value and contribution, quality cost, optimizing quality cost, seduction program. **Human Factor in quality** Attitude of top management, cooperation of groups, operators attitude, responsibility, causes of apparatus error and corrective methods.	**8**
III	**Control Charts** Theory of control charts, measurement range, construction and analysis of R charts, process capability study, use of control charts. **Attributes of Control Chart** Defects, construction and analysis of charts, improvement by control chart, variable sample size, construction and analysis of C charts.	**8**

IV	Defects diagnosis and prevention defect study, identification and analysis of defects, correcting measure, factors affecting reliability, MTTF, calculation of reliability, building reliability in the product, evaluation of reliability, interpretation of test results, reliability control, maintainability, zero defects, quality-circle.	**8**
V	ISO-9000 and its concept of Quality Management ISO 9000 series, Taguchi method, JIT in some details	**8**

Text Books:

1. Lt. Gen. H. Lal, "Total Quality Management", Eastern Limited, 1990.

Reference Books:

1. Greg Bounds, "Beyond Total Quality Management", McGraw Hill, 1994.
2. Menon, H.G, "TQM in New Product manufacturing", McGraw Hill 1992.
3. Subburaj, Total Quality Management, McGrawhill Education

ROE-073 OPERATIONS RESEARACH

COURSE OBJECTIVE: Students undergoing this course are expected:

1. To understand definition and scope of operations research (OR).
2. To analyse transportation problems.
3. To evaluate network techniques.
4. To learn theory of games.
5. To identify models of inventory, operation of inventory system, quantity discount.

COURSE OUTCOME: After completion of the course student will be able to:

CO073.1	Understand Two variable Linear Programming model and Graphical method of solution, Simplex method, Dual Simplex method.
CO073.2	Learn allocation and assignment problems and models, processing of job through machines.
CO073.3	Identifyphases of project management, guidelines for network construction, CPM and PERT.
CO073.4	Compare the Rectangular games, Minimax theorem, graphical solution of 2 x n or m x 2 games, game with mixed strategies, reduction to linear programming model.
CO073.5	Understand Replacement models; Equipment that deteriorate with time, equipment that fail with time.

ROE-073 OPERATIONS RESEARACH		**3-1-0**
Unit	**Topic**	**Lectures**
I	**Introduction:** Definition and scope of operations research (OR), OR model, solving the OR model, art of modelling, phases of OR study. **Linear Programming:** Two variable Linear Programming model and Graphical method of solution, Simplex method, Dual Simplex method, special cases of Linear Programming, duality, sensitivity analysis.	**8**
II	**Transportation Problems:** Types of transportation problems, mathematical models , transportation algorithms, **Assignment:** Allocation and assignment problems and models, processing of job through machines.	**8**
III	**Network Techniques:** Shortest path model, minimum spanning Tree Problem, Max-Flow problem and Min-cost problem. **Project Management:** Phases of project management, guidelines for network construction, CPM and PERT.	**8**
IV	**Theory of Games :** Rectangular games, Minimax theorem, graphical solution of 2 x n or m x 2 games, game with mixed strategies, reduction to linear programming model. **Quality Systems:** Elements of Queuing model, generalized poissonqueing model, single server models.	**8**

V	**Inventory Control:** Models of inventory, operation of inventory system, quantity discount. **Replacement:** Replacement models: Equipment that deteriorate with time, equipment that fail with time.	**8**

Text Books:

1. Hillier, Introduction to Operation research, Mcgrawhill Education
2. Wayne L. Winston,"Operations Research" Thomson Learning,2003.
3. Hamdy H. Taha, "Operations Research-An Introduction" Pearson Education,2003.

Reference Books:

1. R. PanneerSeevam, "Operations Research" PHI Learning, 2008.
2. V.K.Khanna, "Total Quality Management" New Age International, 2008.

ROE-074 INTRODUCTION TO BIOTECHNOLOGY

COURSE OBJECTIVE: Students undergoing this course are expected:

1. To understand nature and scope of biotechnology.
2. To takea brief account of structure of carbohydrates, Lipids and Proteins.
3. To identify central dogma, genetic code, molecular mechanism on mutations.
4. To search applications of bBiotechnology.
5. To learn about safety and ethics.

COURSE OUTCOME: After completion of the course student will be able to:

CO074.1	Understand Eukaryotic and prokaryotic cells, cell wall, membrane organization, cell organelles, Nucleus, Mitochondria.
CO074.2	UnderstandMendel's laws and chromosomes, nature of genetic materials, DN A and RNA, DNA replication.
CO074.3	Analyse cloning (vectors and enzymes), DNA and genomic libraries, Transgenics, DNA fingerprinting, genomics.
CO074.4	Be aware of the bioprocess and fermentation technology, cell culture, Enzyme technology, biological fuel generation, sewage treatment, environmental biotechnology.
CO074.5	Understand safety, social, moral and ethical considerations, environmental ethics, bioethics and stem cell research, safety of new biotechnology foods.

ROE-074	**INTRODUCTION TO BIOTECHNOLOGY**	**3-1-0**
Unit	**Topic**	**Lectures**
I	**Introduction:** Concept nature and scope of biotechnology. **Cell Structure and Function:** Eukaryotic and prokaryotic cells, cell wall, membrane organization, cell organelles, Nucleus, Mitochondria, endoplasmic reticulum, chloroplast, viruses and toxins into cells. **Cell Division:** Mitosis and Meiosis.	**8**
II	**Biomolecules:** A brief account of structure of carbohydrates, Lipids and Proteins. **Genes:** Brief idea about Mendel's laws and chromosomes, nature of genetic materials, DN A and RNA, DNA replication.	**8**
III	**Gene Expression:** Central dogma, genetic code, molecular mechanism on mutations, regulations of gene expression, house-keeping genes, differentiation and development mutations and their molecular basic. **Genetic Engineering:** Introduction, cloning (vectors and enzymes), DNA and genomic libraries, Transgenics, DNA fingerprinting, genomics.	**8**
IV	**Applications of Biotechnology:** Bioprocess and fermentation technology, cell culture, Enzyme technology, biological fuel generation, sewage treatment, environmental biotechnology, biotechnology and medicine, biotechnology in agriculture, food and beverage technology, production of biological invention.	**8**
V	**Safety and Ethics:** Safety, social, moral and ethical considerations, environmental ethics, bioethics and stem cell research, safety of new biotechnology foods, agro biodiversity and donor policies.	**8**

Text Books:

1. Smith, "Biotechnology" Cambridge Press.
2. P.K. Gupta, "Elements of Biotechnology" Rastogi

Reference Books :

1. H. D. Kumar, "Modern concepts of Biotechnology" VikasPublishing House.

REC-751 OPTICAL COMMUNICATION & NETWORKING LAB

COURSE OBJECTIVE: Students undergoing this course are expected:

1. To familiarization of different types of cables and different commands.
2. To making a subnet and configuring router
3. To configure web and DHCP servers
4. To implement FTP and Configure VLAN
5. To set-up fiber optic links.

COURSE OUTCOME: After completion of the course student will be able to:

CO074.1	Identify Cat5 cable , RJ 45 Connector , Crimping Tool , Wire Stripper and Understand different commands like ping, treacert, ifconfig, dig etc.
CO074.2	Understand the working of a router & method to access the router viaconsole or using telnet
CO074.3	Configure web and DHCP servers and Assignment of IP address
CO074.4	Understand the configuration of Vlan in a switch and Different types of show commands & their purpose.
CO074.5	Implement a simple file transfer protocol (FTP) using connection oriented andconnectionless sockets

Part - A

1. Familiarization of different types of cables and different commands.
   a) Identify Cat5 cable , RJ 45 Connector , Crimping Tool , Wire Stripper
   b) Use Wire Stripper for Cutting wire shield and Understanding of Internal Structure of Cat5 Cable
   c) Finding Pin No-1 on RJ 45 Connector and Inserting Wires in connector
   d) Crimping of RJ45 connector using Crimping tool
   e) Preparation of Straight cable (used for Dissimilar devices such as PC to Switch , PC torouter) and Cross cables (used for similar devices such as PC to PC , Router to Router ,Switch to Switch).
   f) Understand different commands like ping, treacert, ifconfig, dig etc.

2. Making a subnet and configuring router.
   a) Understand the working of a router & method to access the router viaconsole or using telnet, different types of cables used for connectivity.
   b) Different types of show commands & their purpose.
   c) Assignment of IP address and enabling layer 3 connectivity.
   d) Implement sub netting.

3. Configuring web and DHCP servers.
   a) Understand Internet Information Services tool and its installation.
   b) To configure web services using IIS tool.
   c) Configure DHCP.

4. Configuring VLAN.
   a) Understand the configuration of Vlan in a switch.
   b) How to make the port of a switch as an access port & a trunk port, purpose of the Vlan ina network.
   c) Different types of show commands & their purpose.

5. To implement a simple file transfer protocol (FTP) using connection oriented andconnectionless sockets.
6. To develop a concurrent file server that spawns several threads, one for each client requestinga specific file.
7. To develop a simple chatting application using (i) Connection oriented and (ii)Connectionless sockets

Part – B (Any 4 Experiments):

1. To setting up fiber optic analog link.
2. Study and measurement of losses in optical fiber.
3. Study and measurement of numerical aperture of optical fiber.
4. Study and perform time division multiplexing (digital).
5. Study of framing in time division multiplexing.
6. Study of Manchester coding and decoding.
7. Study of voice coding and codec chip.
8. Study and measure characteristics of fiber optic LED's and photo detector.

REC-752A ELECTRONICS CIRCUIT DESIGN LAB

COURSE OBJECTIVE: Students undergoing this course are expected:

1. To understand the concept ofuniversal op-amp based biquad.
2. To analyseamplitude control or stabilization applied to any sinusoidal oscillators and Op-amp/ OTA based function generator.
3. To design log/antilog circuits and find applications of analog multiplier/ divider.
4. To learn digital system design and its hardware implementation using TTL/ CMOS ICs and Any circuit idea using 555 Timer.
5. To design the circuit, Make hardware and measure various parameters and Simulation in Spice of the designed circuit.

COURSE OUTCOME: After completion of the course student will be able to:

CO074.1	Understand Universal op-amp based biquad.
CO074.2	Identify amplitude control or stabilization applied to any sinusoidal oscillators and Op-amp/ OTA based function generator.
CO074.3	Design log/antilog circuits and identify applications of analog multiplier/ divider.
CO074.4	Understand digital system design and its hardware implementation using TTL/ CMOS ICs and any circuit idea (not studied in the course) using 555 Timer in conjunction with any otherICs.
CO074.5	Design the circuit, Make hardware and measure various parameters and Simulation in Spice of the designed circuit.

In this practical course students will carry out a design oriented project work using various analog/ digital building blocks which they have already studied in their analog electronic/ digital electronic courses such as Electronic circuits, integrated circuits and filter design. The project may include but not restricted to any of the following:

1. Universal op-amp based biquad.
2. Universal OTA biquad.
3. Amplitude control or stabilization applied to any sinusoidal oscillators.
4. Op-amp/ OTA based function generator.
5. Any application of log/antilog circuits.
6. Any applications of analog multiplier/ divider.
7. Any digital system design and its hardware implementation using TTL/ CMOS ICs.
8. Any circuit idea (not studied in the course) using 555 Timer in conjunction with any otherICs.

The above must include:

1. Design the circuit.
2. Make hardware and measure various parameters.
3. Simulation in Spice of the designed circuit.
4. Comparison of measured and simulated results.

A report is to be made for evaluation.

DEPARTMENTAL COURSE 1

REC-801WIRELESS & MOBILE COMMUNICATION

COURSE OBJECTIVES:

1. To make students familiar with fundamentals of mobile communication systems.
2. To choose system (TDMA/FDMA/CDMA) according to the complexity, installation cost, speed of transmission, channel properties etc.
3. To identify the requirements of mobile communication as compared to static communication.
4. To identify the limitations of 2G and 2.5G wireless mobile communication and use design of 3G and beyond mobile communication systems.
5. To identify various modern wireless technologies.

COURSE OUTCOME: After completion of the course student will be able to

CO801.1	Familiarize with various generations of mobile communications.
CO801.2	Understand the concept of cellular communication.
CO801.3	Understand the basics of wireless communication.
CO801.4	Understand GSM mobile communication standard, its architecture, logical channels, advantages and limitations.
CO801.5	Gain knowledge of IS-95 CDMA mobile communication standard, its architecture, logical channels, advantages and limitations.
CO801.6	Gain knowledge of 3G mobile standards and their comparison with 2G technologies.

REC-801	**Wireless & Mobile Communication**	**3 1 0**
Unit	**Topic**	**Lectures**
I	Evolution of mobile radio communication fundamentals. General Model of Wireless Communication Link, Types of Signals, Cellular Infrastructure, Cellular System Components, Antennas for Cellular Systems, Operation of Cellular Systems, Channel Assignment, Frequency reuse, Channel Assignment strategies, Handoff Strategies Cellular Interferences, Sectorization; Wireless Channel and Radio Communication, Free Space Propagation Model, Channel Noise and Losses, Fading in Land Mobile Systems, Multipath Fading, Fading Effects on Signal and Frequency, Shadowing.	8
II	Wireless Channel Modeling: AWGN Channel, Rayleigh Channel, Rician Fading Channel, Nakagami Fading Channel, Ocumura and Hata Path Loss Model; Channel Modelling: Stochastic, Flat Fading, Wideband Time-Dispersive Channel Modelling. .	8
III	Theory of Vocoders, Types of Vocoders; Spread Spectrum Modulation, Pseudo-Noise Codes with Properties and Code Generation Mechanisms, DSSS and FHSS Systems, Time Hopping and Hybrid Spread Systems; Multicarrier Modulation Techniques.Zero Inter Symbol Interference Communication Techniques, Detection Strategies, Diversity Combining Techniques: Selection Combining, Threshold Combining, Equal Gain Combining, Maximum Ratio Combining; Spatial Diversity and Multiplexing in MIMO Systems, Channel Estimation.	8

	Equalization Techniques: Transversal Filters, Adaptive Equalizers, Zero Forcing Equalizers, Decision Feedback Equalizers, and related algorithms.	
IV	Multiplexing and Multiple Access: FDMA, TDMA, CDMA, OFDMA, SC-FDMA, IDMA Schemes and Hybrid Method of Multiple Access Schemes, RAKE Receiver; Multiple Access for Radio Packet Systems: Pure ALOHA, Slotted ALOHA, CSMA and their versions; Packet and Pooling Reservation Based Multiple Access Schemes.	8
V	GSM system for mobile Telecommunication, General Packet Radio Service, Edge Technology; CDMA 2000, Wireless Local Loop, IMT 2000 and UMTS, Long Term Evolution (LTE), Mobile Satellite Communication, Introduction to Mobile Adhoc Networks, Li-Fi Communication, Ultra-Wideband Communication, Mobile data networks, Wireless Standards IMT 2000, Introduction to 4G and concept of NGN.	8

Text Book:

1. T.S. Rappaport, "Wireless Communication-Principles and practice", Pearson Publications,Second Edition.
2. Misra, Wireless Communication & Network: 3G & Beyond, McGraw Hill Education
3. Jaganathan, Principles of Modern Wireless Communication System, McGraw Hill Education
4. UpenaDalal, "Wireless Communication and Networks", Oxford Press Publications.
5. T L Singal ,"Wireless Communications ", McGraw Hill Education.

Reference Books:

1. Andrea Goldsmith, "Wireless Communications", Cambridge University Press.
2. S. Haykin& M. Moher, "Modern wireless communication", Pearson, 2005.

REC-802 OPTICAL NETWORK

COURSE OBJECTIVES:

1. To make students familiar with Optical Network.
2. To choose system components.
3. To identify the networks.
4. To identify the WDM Network Design.
5. As a prerequisite for the course in Wireless LANs Optical Switching.

COURSE OUTCOME: After completion of the course student will be able to

CO802.1	Familiarize with multiplexing techniques, second generation optical networks, The optical layer, optical packet switching.
CO802.2	Understand the concept of Principles of operation, Conservation of energy, Isolators and circulators: Principles of operation.
CO802.3	Understand the basics of Multiplexing, SONET/SDH layers, SONET Frame structure, SONET/SDH physical layer, Elements of a SONET/SDH infrastructure.
CO802.4	To gain knowledge of Routing and wavelength assignment problems, Dimensioning Wavelength Routing Networks, Network Survivability.
CO802.5	To gain knowledge of working of OTDM, Synchronization, Header Processing, Buffering, Burst Switching, Deployment Considerations- SONET/SDH core Network.

REC-802	**OPTICAL NETWORK**	**3 1 0**
Unit	**Topic**	**Lectures**
I	Introduction to Optical Network:- Optical Networks: multiplexing techniques, second generation optical networks. The optical layer, optical packet switching. Transmission Basics: wavelength, frequencies and channel spacing, wavelength standards. Non linear Effects: Effective length and area, stimulated brillouin scattering, stimulated raman scattering, Propagation in a non linear medium, self phase modulation, cross phase modulation Four wave mixing	8
II	Components:-Couplers: Principles of operation, Conservation of energy, Isolators and circulators: Principles of operation Multiplexers and filters: Gratings, diffraction pattern, Bragg grating, Fiber gratings, Fabry-perot filters, multilayers dielectric thin – film filters, Mach-Zehnder interferometers, Arrayed waveguide grating, Acousto-optic tunable filter, High channel count multiplexer Architecture. Switching : large optical switches, Optical switch Technologies, large electronic switches wavelength converters: Optoelectronic Approch , optical grating, interferometric techniques wave mixing. Crosstalk: Intra-channel crosstalk, inter-channel crosstalk, crosstalk in Networks, Bidirectional system crosstalk reduction.	8
III	Networks- SONET/SDH: Multiplexing, SONET/SDH layers, SONET Frame structure, SONET/SDH physical layer, Elements of a SONET/SDH infrastructure. ATM: Function of ATM, Adaptation layers, Quality of service. IP: Routing and forwarding, QOS, WDM Network elements: Optical line terminals, Optical line amplifiers,. Optical add/Drop multiplexers: Architecture, reconfigurable OADMS, Optical cross connects: All optical OXC configuration	8

IV	WDM Network Design Cost Trade-offs, Light path Topology Design, and Routing and wavelength assignment problems, Dimensioning Wavelength Routing Networks, Network Survivability, Basic Concepts, Protection in SONET/SDH, Protection in client layer, Optical Layer Protection, Different Schemes, Interworking between Layers, Access Networks, Network Architecture Overview, Enhanced HFC, FTTC, PON evolution	8
V	Optical Switching, OTDM, Synchronization, Header Processing, Buffering, Burst Switching, Deployment Considerations- SONET/SDH core Network	8

Text Books:

1. R. Ramaswami, & K. N. Sivarajan, "Optical Networks a Practical perspective",Morgan Kaufmann Publishers, 3rd Ed.
2. U. Black, "Optical Networks: Third Generation Transport Systems"/ PearsonEducations

Reference Books:

1. Biswanath Mukherjee "Optical WDM Networks" Springer Pub 2006

ELECTIVE IV

REC-041 ELECTRONIC SWITCHING

COURSE OBJECTIVE: Student will be able to:

1. Attain knowledge about analog and digital electronic switching.
2. Estimate traffic congestion in any telecom network.
3. Learn about call processing functions and various signalling schemes.
4. Gain the knowledge of packet switching, ATM and Banyan network switch.

COURSE OUTCOMES:

CO041.1	Describe and apply fundamentals of telecommunication systems and associated technologies.
CO041.2	Solve problems and design simple systems related to tele-traffic and trunking efficiency.
CO041.3	Understand and explain the reasons for switching, and the relative merits of the possible switching modes, e.g. packet and circuit switching.
CO041.4	Understand the principles of the internal design and operation of telecommunication switches, and the essence of the key signalling systems that are used in telecommunication networks.

REC-041	**ELECTRONIC SWITCHING**	**3 1 0**
Units	**Topic**	**Lectures**
I	Evolution of switching systems: Introduction, Message switching, Circuits switching, Functions of a switching system, Register-transistor-senders, Distribution frames, Crossbar switch, A general trucking, Electronic switching, Reed- electronic system, Digital switching systems.	8
II	Digital Switching: Switching functions, Space Division Switching, Time Division Switching, Two-Dimensional Switching, Digital Cross-Connect Systems , Digital Switching in an Analog Environment	8
III	Telecom Engineering: Network Traffic Load and Parameters, Grade of Service and Blocking Probability, Modeling Switching Systems, Incoming Traffic and Service Time Characterization, Blocking models and Loss Estimates, Delay Systems	8
IV	Control of switching systems: Introduction, Call-processing functions, Common control, Reliability, availability and security; Stored-program control. Signalling: Introduction, Customer line signalling, Audio-frequency junctions and trunk circuits, FDM carrier systems, PCM signalling, Inter-register signalling, Common-channel signalling principles, CCITT signalling system no. 6 and 7, Digital customer line signalling.	8
V	Packet Switching: Packet Switching, Statistical Multiplexing, Routing Control (dynamic routing, virtual circuit routing and fixed-path routing), Flow Control, X.25, Frame Relay, TCP/IP ATM Cells, ATM Service Categories, ATM Switching (ATM Memory Switch, Space-Memory Switch, Memory-Space Switch, Memory-Space-Memory switch, Banyan Network Switch).	8

Text Books:

1. Thiagarajan Viswanathan &Manav Bhatnagar, “Telecommunication Switching Systems andNetworks”, PHI.
2. J.E. Flood, “Telecommunication Switching, Traffic and Networks”, Pearson Education.
3. John C. Bellamy, “Digital Telephony”, John Wiley, 3rd Ed.

REC-042DIGITAL SYSTEM DESIGN USING VHDL

COURSE OBJECTIVE: Students undergoing this course are expected:

1. To understand basics of VHDL.
2. To learndigital system design automation.
3. To be aware of concurrent constructs for RT level descriptions.
4. To learn VHDL signal model.
5. To analysehardware cores and models.

COURSE OUTCOME: After completion of the course student will be able to:

CO042.1	Understand the structures, modelling, objects, data type and operators, sequential statements and processes.
CO042.2	Design Abstraction Levels, System level design flow, RTL design flow, VHDL. RTL Design with VHDL
CO042.3	UnderstandConcurrent Signal Assignments, Guarded signal assignment Sequential Constructs for RT level Descriptions.
CO042.4	Be aware of characterizing hardware languages, Signal Assignments, Concurrent and Sequential Assignments, Multiple Concurrent Drivers Standard Resolution.
CO042.5	Understand synthesis rules and styles, Memory and Queue Structures, Arithmetic Cores.

REC-042	**DIGITAL SYSTEM DESIGN USING VHDL**	**3 1 0**
Unit	**Topic**	**Lectures**
I	Introduction to VHDL, reserve words, structures, modeling, objects, data type and operators, sequential statements and processes, sequential modeling and attributes, conditional assignment, concatenation and case, array loops and assert statements, subprograms.	8
II	Digital System Design Automation– Abstraction Levels, System level design flow, RTL design flow, VHDL. RTL Design with VHDL – Basic structures of VHDL, Combinational circuits, Sequential circuits, Writing Test benches, Synthesis issues, VHDL Essential Terminologies VHDL Constructs for Structures and Hierarchy Descriptions – Basic Components, Component Instantiations, Iterative networks, Binding Alternatives, Association methods, generic Parameters, Design Configuration	8
III	Concurrent Constructs for RT level Descriptions – Concurrent Signal Assignments, Guarded signal assignment Sequential Constructs for RT level Descriptions – Process Statement, Sequential WAIT statement, VHDL Subprograms, VHDL library Structure, Packaging Utilities and Components, Sequential Statements. VHDL language Utilities - Type Declarations and Usage, VHDL Operators, Operator and Subprogram overloading, Other TYPES and TYPE –related issues, Predefined Attributes	8
IV	VHDL Signal Model – Characterizing hardware languages, Signal Assignments,	8

	Concurrent and Sequential Assignments, Multiple Concurrent Drivers Standard Resolution	
V	Hardware Cores and Models - Synthesis rules and styles, Memory and Queue Structures, Arithmetic Cores, Components with Separate Control and Data parts. Core Design Test and Testability - Issues Related to Design Test, Simple Test benches.	8

Text Book:

1. Z. Navabi, "VHDL-Modular Design and Synthesis of cores and Systems", MHE – 3rd Edition
2. Unsalan, Digital System Design with FPGA, Mcgraw Hill Education.
3. R.D.M. Hunter, T. T. Johnson, "Introduction to VHDL" Spriger Publication, 2010.
4. J Bhasker , "VHDL Primer" –Pearson Education.
5.

Reference Books:

1. C. H. Roth, "Digital System Design using VHDL", PWS Publishing
2. Douglas Perry, "VHDL- Programming by examples", MGH

REC-043SPEECH PROCESSING

COURSE OBJECTIVE: Students undergoing this course are expected:

1. To understand digital models for speech signals.
2. To analysetime domain methods of speech sampling.
3. To evaluate short time Fourier analysis.
4. To learn homomorphic speech processing.
5. To understandLinear Predictive Coding of Speech.

COURSE OUTCOME: After completion of the course student will be able to:

CO043.1	Understand the mechanism of speech production & acoustic phonetics, the acoustic theory of speech production, lossless tube models.
CO043.2	Understand time dependent processing of speech, short time energy and average magnitude, short time average zero crossing rate.
CO043.3	Design of filter banks, implementation of filter bank summation method using FFT.
CO043.4	Evaluate homomorphic system for convolution, complex cepstrum of speech, pitch detection using Homomorphic processing.
CO043.5	Understand basic principles of linear predictive analysis, the autocorrelation method, computation of the gain for the model, solution of LPC equations.

REC-043	**SPEECH PROCESSING 3 1 0**	
Unit	**Topics**	**Lectures**
I	Digital models for speech signals: Mechanism of speech production & acoustic phonetics, the acoustic theory of speech production, lossless tube models, and digital models for speech signals.	6
II	Time Domain methods of speech sampling: Time dependent processing of speech, short time energy and average magnitude, short time average zero crossing rate, discrimination between speech& silence, pitch period estimation using parallel processing, short time autocorrelation function & AMDF, pitch period estimation using autocorrelation function	10
III	Short time Fourier Analysis: Definition and properties, design of filter banks, implementation of filter bank summation method using FFT, spectrographic displays, pitch detection, analysis by synthesis phase, vocoder and channel vocoder.	8
IV	Homomorphic speech processing: Homomorphic system for convolution, complex cepstrum of speech, pitch detection using Homomorphic processing, formant estimation, Homomorphic vocoder	6
V	Linear Predictive Coding of Speech: Basic principles of linear predictive analysis, the autocorrelation method, computation of the gain for the model, solution of LPC equations for auto correlation method, prediction error and normalized mean square error, frequency domain interpretation of mean squared prediction error relation of linear predictive analysis to lossless tube models, relation between various speech parameters, synthesis of speech from linear predictive parameters, application of LPC parameters.	10

Text Book:

1. R. L. Rabiner& R.W. Schafer, “Digital Processing of speech signals”, Pearson Education.
2. B. Gold and Nelson Morgon, “Speech and audio signal processing”, Wiley India Edition,2006.

REC-044ADVANCED DISPLAY TECHNOLOGIES & SYSTEMS

COURSE OBJECTIVE: Students undergoing this course are expected:

1. To understandproperties of light.
2. To analyseDisplay Glasses, Inorganic Semiconductor TFT Technology.
3. To compareInorganic Phosphors, Cathode Ray Tubes, Vacuum Florescent Displays.
4. To differentiate between Paper like and Low Power Displays.
5. To analyseMicro-display Technologies.

COURSE OUTCOME : After completion of the course student will be able to:

CO044.1	Understand Anatomy of Eye, Light Detection and Sensitivity, Spatial Vision and Pattern Perception, Binocular Vision and Depth Perception.
CO044.2	Understand Photolithography for Thin Film LCD, Wet Etching, Dry Etching; Flexible Displays.
CO044.3	Understand Thin Film Electroluminescent Displays, AC Powder Electroluminescent Displays; Organic Electroluminescent Displays: OLEDs, Active Matrix for OLED Displays
CO044.4	Be aware ofColorant Transposition Displays, MEMs Based Displays, 3-D Displays, 3-D Cinema Technology, Autostereoscopic 3-D Technology
CO044.5	Understand Liquid Crystals on Silicon Reflective Micro-display, Trans missive Liquid Crystal Micro-display, MEMs Micro-display, DLP Projection Technology.

REC-044	**ADVANCED DISPLAY TECHNOLOGIES & SYSTEMS**	**3 1 0**
Unit	**Topic**	**Lectures**
I	Properties of Light, Geometric Optics, Optical Modulation; Vision and Perception: Anatomy of Eye, Light Detection and Sensitivity, Spatial Vision and Pattern Perception, Binocular Vision and Depth Perception; Driving Displays: Direct Drive, Multiplex and Passive Matrix, Active Matrix Driving, Panel Interfaces, Graphic Controllers, Signal Processing Mechanism; Power Supply: Fundamentals, Power Supply Sequencing.	8
II	Display Glasses, Inorganic Semiconductor TFT Technology, Organic TFT Technology; Transparent Conductors, Patterning Processes: Photolithography for Thin Film LCD, Wet Etching, Dry Etching; Flexible Displays: Attributes, Technologies Compatible with Flexible Substrate and Applications, TFT Signal Processing Techniques; Touch Screen Technologies: Introduction, Coatings, Adhesive, Interfaces with Computer Mechanism.	8
III	Inorganic Phosphors, Cathode Ray Tubes, Vacuum Florescent Displays, Filed Emission Displays; Plasma Display Panels, LED Display Panels; Inorganic Electroluminescent Displays: Thin Film Electroluminescent Displays, AC Powder Electroluminescent Displays; Organic Electroluminescent Displays: OLEDs, Active Matrix for OLED Displays; Liquid Crystal Displays: Fundamentals and Materials, Properties of Liquid Crystals, Optics and Modeling of Liquid Crystals; LCD Device Technology: Twisted Numeric and Super twisted Numeric Displays, Smectic LCD Modes, In-Plane Switching Technology, Vertical Aligned Nematic LCD Technology, Bi-stable LCDs, Cholesteric Reflective	8

	Displays; LCD Addressing, LCD Backlight and Films, LCD Production, Flexoelectro-Optic LCDs.	
IV	Paper like and Low Power Displays: Colorant Transposition Displays, MEMs Based Displays, 3-D Displays, 3-D Cinema Technology, Auto-stereoscopic 3-D Technology, Volumetric and 3-D Volumetric Display Technology, Holographic 3-D Technology; Mobile Displays: Trans-reflective Displays for Mobile Devices, Liquid Crystal Optics for Mobile Displays, Energy Aspects of Mobile Display Technology.	8
V	Micro display Technologies: Liquid Crystals on Silicon Reflective Micro-display, Trans missive Liquid Crystal Micro-display, MEMs Micro-display, DLP Projection Technology; Micro-display Applications: Projection Systems, Head Worn Displays; Electronic View Finders, Multi-focus Displays, Occlusion Displays, Cognitive Engineering and Information Displays; Display Metrology, Standard Measurement Procedures, Advanced Measurement Procedures: Spatial Effects, Temporal Effects, Viewing Angle, Ambient Light; Display Technology Dependent Issues, Standards and Patterns, Green Technologies in Display Engineering.	8

Text Book:

1. Janglin Chen, Wayne Cranton, Mark Fihn , “Handbook of Visual Display Technology”,Springer Publication.

REC-045 SATELLITE & RADAR SYSTEMS

COURSE OBJECTIVE: After completion of the course student will be able to:

1. Become familiar with satellites and satellite services.
2. Understand satellite orbits and launching.
3. Identify earth segment and space segment components.
4. Identify satellite access by various users.
5. Study DTH and compression standards.

COURSE OUTCOME: After completion of the course student will be able to:

CO045.1	Understand the orbital and functional principles of satellite communication systems
CO045.2	Architect, interpret, and select appropriate technologies for implementation of specified satellite communication systems
CO045.3	Analyse and evaluate a satellite link and suggest enhancements to improve the link performance.
CO045.4	Select an appropriate modulation, multiplexing, coding and multiple access schemes for a given satellite communication link.
CO045.5	Specify, design, prototype and test analog and digital satellite communication systems as per given specifications.

REC-045	**SATELLITE & RADAR SYSTEMS**	**3 1 0**
Unit	**Topics**	**Lectures**
I	Elements of Satellite Communication, Orbital mechanics, look angle and orbit determination, launches and lauch vehicle, orbital effects, Introduction to geo-synchronous and geo-stationary satellites.	8
II	Satellite sub-systems: Attitude and Orbit control systems, Telemetry, Tracking and command control system, Power supply system, Introduction to satellite link design, basic transmission theory, system noise temperature and G/T ratio, design of down link and uplink, design of satellite links for specified C/N, satellite data communication protocols.	8
III	Direct broadcast satellite television and radio, satellite navigation and the global positioning systems, GPS position location principle, GPS receivers and codes, Satellite Signal Acquisition, GPS navigation Message, GPS Signal Levels, Timing Accuracy, GPS Receiver Operation.	8
IV	Introduction to radar, radar block diagram and operation, radar frequencies, Applications of radar, Radar Equation, MTI and Pulse Doppler Radar: Introduction to Doppler and MTI Radar, Delay Line cancellers, Staggered Pulse Reception Frequencies, Doppler Filter Banks, Digital MTI Processing, Moving Target Detector, Limitations to MTI Performance.	8
V	Tracking Radar: sequential lobbing, conical scan, mono-pulse Tracking, low angle tracking, tracking in range. Elements of Satellite Communications, Orbital mechanics, look angle and orbit determination, launches and launch vehicle, orbital effects. Introduction to geo-synchronous and geo-stationary satellites.	8

Text / Reference Books:

1. Merrill I. Skolnik “Introduction to Radar Systems”, Mc Graw- Hill.
2. J.C.Toomay, Paul J. Hannen “Principles of Radar”, PHI Learning.
3. B.Pratt, A.Bostian, “Satellite Communications”, Wiley India.
4. D.Roddy, “Satellite Communications”, McGrawhill Education.

OPEN ELECTIVE-II

ROE-081 NON-CONVENTIONAL ENERGY RESOURCES

COURSE OBJECTIVE: Students undergoing this course are expected:

1. To identify various non-conventional energy resources.
2. To analyseSolar Thermal Energy.
3. To find resources of geothermal energy, thermodynamics of geo-thermal energy to electrical conversion.
4. To learn Principle of working, performance and limitations.
5. To understandOcean Thermal Energy Conversion (OTEC).

COURSE OUTCOME: After completion of the course student will be able to:

CO081.1	Understand theory of solar cells. solar cell materials, solar cell array, solar cell power plant, and its limitations.
CO081.2	Understand Solar radiation, flat plate collectors and their materials, applications and performance, focusing of collectors and their materials
CO081.3	Learn principle of working of various types of fuel cells and their working, performance and limitations.
CO081.4	Be aware of wind power and its sources, site selection, criterion, momentum theory, classification of rotors, concentrations and augments.
CO081.5	Understand principle of working, performance and limitations, Waste Recycling Plants.

ROE-081NON-CONVENTIONAL ENERGY RESOURCES3-1-0		
Unit	**Topic**	**Lectures**
I	**Introduction :** Various non-conventional energy resources- Introduction, availability, classification, relative merits and demerits. **Solar Cells:** Theory of solar cells. solar cell materials, solar cell array, solar cell power plant, limitations.	**8**
II	**Solar Thermal Energy:** Solar radiation, flat plate collectors and their materials, applications and performance, focusing of collectors and their materials, applications and performance; solar thermal power plants, thermal energy storage for solar heating and cooling, limitations.	**8**
III	**Geothermal Energy:** Resources of geothermal energy, thermodynamics of geo-thermal energy conversion-electrical conversion, non-electrical conversion, environmental considerations. **Magneto-hydrodynamics (MHD):** Principle of working of MHD Power plant, performance and limitations. **Fuel Cells:** Principle of working of various types of fuel cells and their working, performance and limitations.	**8**

IV	**Thermo-electrical and thermionic Conversions:** Principle of working, performance and limitations. **Wind Energy:** Wind power and its sources, site selection, criterion, momentum theory, classification of rotors, concentrations and augments, wind characteristics. performance and limitations of energy conversion systems.	**8**
V	**Bio-mass:** Availability of bio-mass and its conversion theory. **Ocean Thermal Energy Conversion (OTEC):** Availability, theory and working principle, performance and limitations. **Wave and Tidal Wave:** Principle of working, performance and limitations. Waste Recycling Plants.	**8**

Text Books:

1. Khan, Non Conventional Energy Resources, McGrawhill Education
2. Raja etal, "Introduction to Non-Conventional Energy Resources" Scitech Publications.
3. John Twideu and Tony Weir, "Renewal Energy Resources" BSP Publications, 2006.
4. M.V.R. Koteswara Rao, " Energy Resources: Conventional & Non-Conventional " BSP Publications,2006.

References Books:

1. D.S. Chauhan,"Non-conventional Energy Resources" New Age International.
2. C.S. Solanki, "Renewal Energy Technologies: A Practical Guide for Beginners" PHI Learning.
3. Peter Auer, "Advances in Energy System and Technology". Vol. 1 & II Edited by Academic Press.
4. Godfrey Boyle," Renewable Energy Power For A Sustainable Future", Oxford University Press.

ROE-082 NON-LINEAR DYNAMIC SYSTEMS

COURSE OBJECTIVE: Students undergoing this course are expected:

1. To understand concept of dynamic systems.
2. To perform stability analysis.
3. To identify different method of stability.
4. To learn Bifurcation theory.
5. To analysechaos and measure chaos.

COURSE OUTCOME: After completion of the course student will be able to:

CO082.1	Understand Concept of dynamic systems, importance of non-linearity, nonlinear dynamics of flows (in 1, 2, and 3 dimensions) and Maps (1 and 2 dimensions) in phase space.
CO082.2	Understand Stability via Lyapunov's indirect method, converse Lyapunov functions, sublevel sets of Lyapunow functions, Lasalle's invariance principle.
CO082.3	Identify stable manifold theorem, centre manifold theorem, normal form theory and applications to nonlinear systems.
CO082.4	Evaluate Elementary Bifurcation theory, catastrophe, strange attractor, fractals, fractal geometry and fractal dimension.
CO082.5	Understand Deterministic Chaos, routes to chaos (period doubling, quasi-periodicity, intermittency, universality, renormalization); Measurement of Chaos.

ROE-082NON-LINEAR DYNAMIC SYSTEMS 3-1-0		
Unit	**Topic**	**Lectures**
I	**Dynamic systems:** Concept of dynamic systems, importance of non-linearity, nonlinear dynamics of flows (in 1, 2, and 3 dimensions) and Maps (1 and 2 dimensions) in phase space, Equilibrium, Periodicity. Picard's theorem, Peano's theorem, boundedness of solutions, omega limit points of bounded trajectories.	**8**
II	**STABILITY-I:** Stability via Lyapunov's indirect method, converse Lyapunov functions, sublevel sets of Lyapunow functions, Lasalle's invariance principle.	**8**
III	**Stability-II**: Lyapunov's direct method, converse Lyapunov's theorems, Brokett's theorem, applications to control system, stable manifold theorem, centre manifold theorem, normal form theory and applications to nonlinear systems.	**8**
IV	**Bifurcation:** Elementary Bifurcation theory, catastrophe, strange attractor, fractals, fractal geometry and fractal dimension.	**8**
V	**Chaos:** Deterministic Chaos, routes to chaos (period doubling, quasiperiodicity, intermittency, universality, renormalization); Measurement of Chaos (Poincare section, Lyapunov index, entropy);control of chaos.	**8**

Text Books:

1. D.K. Arrowsmith and C.M. Place, "An Introduction to Dynamical Systems" Cambridge University press, London, 1990.
2. K.T. Alligood, T.D. Sauer, and J.A Yorke, "CHAOS: An Introduction to Dynamical System" Springer Verlag, 1997.

Reference Books:

1. H.K. Khalis, "Nonlinear Systems" Prentice Hall, 1996.
2. R. R. Mohler, "Non linear systems, Vol-I: Dynamics and Control" Prentice Hall, 1991.
3. J.M. T. Thomson and H.B. Stewart, "Nonlinear Dynamics and Chaos" John Wiley & Sons, 1986.
4. Stanislaw H. Zak, "Systems and control" Oxford University Press, 2003.

ROE-083PRODUCT DEVELOPMENT

COURSE OBJECTIVE: Students undergoing this course are expected:

1. To understand old and new design methods.
2. To understandmorphology of design .
3. To be aware of transformations, brainstorming&synetics.
4. To learn reliability considerations.
5. To differentiate between Innovation and Invention.

COURSE OUTCOME: After completion of the course student will be able to:

CO083.1	Understand Concept of Product, definition and scope. Design definitions, old and new design methods, design by evolution, examples such as evolution of sewing M/C, bicycle.
CO083.2	Learn transformation and convergent phases of product design, identification of need, Analysis of need. Design criteria; functional.
CO083.3	Learn Decision making under Multiple Criteria. Economic aspects, Fixed and variable costs, Break-even analysis.
CO083.4	Identify reliability of systems in series and parallel, Failure rate, MTTF and MTBF, Optimum spares from Reliability considerations. Design of display and controls, Man-machine interface.
CO083.5	Understand improving method & quality of product. Innovation versus Invention. Technological Forecasting. Use of Standards for Design.

ROE-083 PRODUCT DEVELOPMENT		**3-1-0**
Unit	**Topic**	**Lectures**
I	Concept of Product, definition and scope. Design definitions, old and new design methods, design by evolution, examples such as evolution of sewing M/C, bicycle, safety razor etc., need based developments, technology based developments physical reliability& economic feasibility of design concepts.	**8**
II	Morphology of design, divergent, transformation and convergent phases of product design, identification of need, Analysis of need. Design criteria; functional, aesthetics, ergonomics, form, shape, size, colour. Mental blocks, Removal blocs, Ideation techniques, Creativity, Check list.	**8**
III	Transformations, Brainstorming&Synetics, Morphological techniques. Utility Concept, Utility Value, Utility Index, Decision making under Multiple Criteria. Economic aspects, Fixed and variable costs, Break-even analysis.	**8**
IV	Reliability considerations, Bath tub curve, Reliability of systems in series and parallel, Failure rate, MTTF and MTBF, Optimum spares from Reliability considerations. Design of display and controls, Man-machine interface, Compatibility of displays and controls. Ergonomic aspects, Anthropometric data and its importance in design. Application of Computers in Product development & design.	**8**
V	Existing techniques, such as work-study, SQC etc. for improving method & quality of product. Innovation versus Invention. Technological Forecasting. Use of Standards for Design.	**8**

Text Books:

1. A.K. Chitab& R.C. Gupta “Product design & Manufacturing” – Prentice Hall (EE)
2. R.P. Crewford, “The Technology of creation Thinking” Prentice Hall.

Reference Books:

1. Ulrich, Product design & Development, McGrawhill Education
2. C.D. Cain, “Product Design & Decision” Bussiness Books.
3. C.D. Cain, “Engg. Product Design” Bussiness Books.

ROE-084 AUTOMATION AND ROBOTICS

COURSE OBJECTIVE: Students undergoing this course are expected:

1. To classify robots.
2. To understand robot coordinate systems and manipulator kinematics.
3. To learnfundamental principles of robotics.
4. To learn language based programming.
5. To find various applications of robot.

COURSE OUTCOME: After completion of the course student will be able to:

CO084.1	Understand Drive system, control system, sensors, end effectors, gripper actuators and gripper design of robot.
CO084.2	Understand robot co-ordinate system representation, transformation, homogenous transform and its inverse, relating the robot to its world.
CO084.3	Understand path velocity and force control systems, computed torque control, adaptive control, Seroo system for robot control, and introduction to robot vision.
CO084.4	Learn the task level programming, robot programming synthesis, robot programming for welding, machine tools, material handling, assembly operations.
CO084.5	Identify application of robot in welding, machine tools, material handling, assembly operations parts sorting and parts inspection.

ROE-084 AUTOMATION AND ROBOTICS		**3-1-0**
Unit	**Topic**	**Lectures**
I	**Introduction:** Definition, Classification of Robots, geometric classification and control classification. **Robot Elements:** Drive system, control system, sensors, end effectors, gripper actuators and gripper design.	**8**
II	**Robot Coordinate Systems and Manipulator Kinematics:** Robot co-ordinate system representation, transformation, homogenous transform and its inverse, relating the robot to its world. Manipulators Kinematics, parameters of links and joints, kinematic chains, dynamics of kinematic chains, trajectory planning and control, advanced techniques of kinematics and dynamics of mechanical systems, parallel actuated and closed loop manipulators.	**8**
III	**Robot Control:** Fundamental principles, classification, position, path velocity and force control systems, computed torque control, adaptive control, Seroo system for robot control, and introduction to robot vision.	**8**
IV	**Robot Programming:** Level of robot programming, language based programming, task level programming, robot programming synthesis, robot programming for welding, machine tools, material handling, assembly operations, collision free motion planning.	**8**
V	**Applications:** Application of robot in welding, machine tools, material handling, assembly operations parts sorting and parts inspection.	**8**

Text Books:

1. An Introduction to Robot Technology, by CoifetChirroza, Kogan Page.
2. Robotics for Engineers, by Y. Koren, McGraw Hill.
3. Robots and Robotics By Miller, MGrawhill Education
4. Robotic: Control, Sensing, Vision and Intelligence, by Fu, McGraw Hill.
5. Introduction to Industrial Robotics, by Nagrajan, Pearson India
6. Robotics, by J.J. Craig, Addison-Wesley.

Reference Books:

1. Industrial Robots, by Groover, McGraw Hill.
2. Robots & Manufacturing Automation, by Asfahl, Wiley
3. Fundamentals of Robotics: Analysis and Control, by Schilling, Pearson India
4. Automation & Robotics, byGhoshal, Oxford University Press
5. Introduction to AI Robotics, by Murphy, PHI, India.