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: 2019-20]

EVALUATION SCHEME

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

YEAR 4rd/ SEMESTER VII

Sr. No.	Sub Code	Subject Name	Dept.	L-T-P	Th/Lab Marks	Sessional		Subject Total	Credit
					ESE	CT	TA		
1		Open Elective-I**	Other Dept.	3--0--0	70	20	10	100	3
2		Departmental Elective-III	Core Deptt.	3--0--0	70	20	10	100	3
3		Departmental Elective-IV	Core Deptt.	3--1--0	70	20	10	100	4
4	REC701	Data Communication Networks	Core Deptt.	3--1--0	70	20	10	100	4
5	REC702	VLSI Design	Core Deptt.	3--0--0	70	20	10	100	3
6	REC751	Optical Communication Lab	Core Deptt.	0--0--2	50	-	50	100	1
7	REC752	Electronics Circuit Design Lab	Core Deptt.	0--0—2	50	-	50	100	1
8	REC753	Industrial Training Viva-Voce	Core Deptt.	0--0—3	-	-	100	100	2
9	REC754	Project-I	Core Deptt.	0--0--6	-	-	200	200	3
	TOTAL				450	100	450	1000	24

LIST OF DEPTT. ELECTIVES:

Elective – III REC 07* Departmental Elective III

1. REC070 Optical Network
2. REC071 Information Theory & Coding
3. REC072 Digital Image Processing
4. REC073 Advance Programming in Engineering

Elective – IV REC 07* Departmental Elective IV

1. REC075 Optical Communication
2. REC076 Filter Design
3. REC077 Applied Fuzzy Electronic Systems
4. REC078 Computerized Process Control

EVALUATION SCHEME

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

YEAR 4rd/ SEMESTER VIII

Sr. No	Sub Code	Subject Name	Dept.	L-T-P	Th/LAB Marks	Sessional		Subject Total	Credit
					ESE	CT	TA		
1		Open Elective-II**	Other Dept.	3-0-0	70	20	10	100	3
2		Departmental Elective-V	Core Deptt.	3-1-0	70	20	10	100	4
3		Departmental Elective-VI	Core Deptt.	3-0-0	70	20	10	100	3
4	REC851	GD &Seminar	Core Deptt.	0-0-3			100	100	2
5	REC852	Project	Core Deptt.	0-0-12	350	-	250	600	12
	TOTAL				560	60	380	1000	24

LIST OF DEPTT. ELECTIVES:

Elective – IV REC 08* Departmental Elective V

1. REC080 Electronic Switching
2. REC081 Analytical Instrumentation
3. REC082 Advanced Display Technologies & Systems
4. REC083 Satellite & RADAR systems (NPTEL: https://nptel.ac.in/courses/117105131/)

Elective – VI REC 08* Departmental Elective VI

1. REC085 Wireless & Mobile Communication (NPTEL :https://nptel.ac.in/courses/117102062/)
2. REC086 Voice Over IP
3. REC087 Speech Processing
4. REC088 Micro and Smart Systems(NPTEL: https://nptel.ac.in/courses/112108092/)

REC701 DATA 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

CO1	Identify the issues and challenges in the architecture of a network.
CO2	Understand the ISO/OSI seven layers in a network.
CO3	Realize protocols at different layers of a network hierarchy
CO4	Recognize security issues in a network.

DATA COMMUNICATION NETWORKS		**3 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

REC702 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:

CO1	Model the behaviour of a MOS Transistor
CO2	Design combinational and sequential circuits using CMOS gates
CO3	Identify the sources of power dissipation in a CMOS circuit.
CO4	Analyse SRAM cell and memory arrays

VLSI DESIGN		**3 0 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 & Yosuf Leblebici, "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.

DEPARTMENT ELECTIVES - III

REC070 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

CO1	Familiarize with multiplexing techniques, second generation optical networks, The optical layer, optical packet switching.
CO2	Understand the concept of Principles of operation, Conservation of energy, Isolators and circulators: Principles of operation.
CO3	Understand the basics of Multiplexing, SONET/SDH layers, SONET Frame structure, SONET/SDH physical layer, Elements of a SONET/SDH infrastructure.
CO4	To gain knowledge of Routing and wavelength assignment problems, Dimensioning Wavelength Routing Networks, Network Survivability.
CO5	To gain knowledge of working of OTDM, Synchronization, Header Processing, Buffering, Burst Switching, Deployment Considerations- SONET/SDH core Network.

OPTICAL NETWORK		**3 0 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.	8

	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	
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

REC071 INFORMATION 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:

CO1	Model the Entropy, Joint Entropy and Conditional Entropy, Relative Entropy and Mutual Information, Relationship Between Entropy and Mutual Information
CO2	Design Data Compression, Examples of Codes, Kraft Inequality, Optimal Codes, Bounds on the Optimal Code Length
CO3	Identify the Examples of Channel Capacity, Symmetric Channels, Properties of Channel Capacity, Preview of the Channel Coding Theorem.
CO4	Analyse Introduction to block codes, Single-parity-check codes, Product codes, Repetition codes, Hamming codes
CO5	Design Generator matrices for convolutional codes, Generator polynomials for convolutional codes

INFORMATION THEORY & CODING		**3 0 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-check codes, Product codes, Repetition codes, Hamming codes, Minimum distance of block codes, Soft-decision decoding, Automatic-repeat-request	8

	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

REC072 DIGITAL 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:

CO1	Understand the need for image transforms and their properties
CO2	Choose appropriate technique for image enhancement both in spatial and frequency Domains.
CO3	Identify causes for image degradation and apply restoration techniques.
CO4	Compare the image compression techniques in spatial and frequency domains.
CO5	Select feature extraction techniques for image analysis and recognition.

DIGITAL IMAGE PROCESSING		**3 0 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	8

	compression algorithms, Image and video compression standards	
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.

REC073 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:

CO1	Understand the fundamentals of Matlab programming as well as understand and apply advance level programming techniques for solving problems using numerical methods.
CO2	Learn, apply, and investigate Matlab applications in advance communication systems.
CO3	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.
CO4	Learn, apply, and investigate Matlab applications in neural networks and fuzzy logic.
CO5	Learn, apply, and investigate Matlab applications in digital signal processing including multi-rate DSP algorithms.

Advance Programming in Engineering 3 0 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, Digital Filtrer 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. Rudra Pratap, "MATLAB- A quick introduction for Scientists and Engineers", Oxford University Press, 2013.
4. www.mathworks.com

DEPARTMENT ELECTIVES -IV

REC075 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:

CO1	Familiarize with basic concepts and theory of Optical Communication
CO2	Demonstrate OPCOMM components, assemble them and solve problems on Optical Communication system
CO3	Able to design, implements, analyse and maintains optical communication system
CO4	Gain knowledge of different source of light as well as receiver and their comparative study
CO5	To get idea about power budget and ultimately be an engineer with adequate knowledge in optical domain

OPTICAL COMMUNICATION **3 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, goos hanchen 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	6

	quantum efficiency, resonant frequency, laser diode structures and radiation patterns, single mode lasers modulation of laser diodes, laser lines.	
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.

REC076 FILTER 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:

CO1	Choose an appropriate transform for the given signal.
CO2	Choose appropriate decimation and interpolation factors for high performance filters.
CO3	Model and design an AR system.
CO4	Implement filter algorithms on a given DSP processor platform.

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.

REC077 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:

CO1	Understand the Operations of Fuzzy Sets, Properties of Fuzzy Sets, Geometric Interpretations of Fuzzy Sets, Possibility Theory.
CO2	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.
CO3	Realization of Fuzzy Sets and their properties; Cardinality of Classical Relations and their properties.
CO4	Aware Principle of Vertex Method, DSW Algorithm, and Restricted DSW Algorithm and their comparison, Classical Predicate Logic; Fuzzy Logic.
CO5	Understand Fundamental Issues in Control Engineering, Control Design Process, Semiformal Aspects of Design Process, Mamdani Architecture of Fuzzy Control, The Sugeno-Takagi Architecture.

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. Witold Pedrycz, Fernando Gomide, “Fuzzy Systems Engineering: Toward Human-CentricComputing”, John Wiley Publications.

REC078 COMPUTERISED PROCESS CONTROL

COURSE OBJECTIVE: Students undergoing this course are expected to:

1. Understand Basics of Computer-Aided Process Control.
2. Analyse Industrial communication System.
3. Design Process Modelling for computerized Process control.
4. Design Advanced Strategies For Computerised Process control.
5. Analyse Computerized Process Control.

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

CO1	Understand the Role of computers in process control, Elements of a computer aided Process control System, Classification of a Computer.
CO2	Design Phase Locked Local Loop, Mixers. Time Division Multiplexed System – TDM/PAM system
CO3	Realize Process model, Physical model, Control Model. Modelling Procedure.
CO4	Formulate of Cascade Control, Predictive control, Adaptive Control, Inferential control, Intelligent Control, Statistical control.
CO5	Design Electric Oven Temperature Control, Reheat Furnace Temperature control.

COMPUTERISED PROCESS CONTROL		**3 1 0**
Unit	**Topic**	**Lectures**
I	Basics of Computer-Aided Process Control: Role of computers in process control, Elements of a computer aided Process control System, Classification of a Computer –Aided Process Control System Computer Aided Process–control Architecture: Centralized Control Systems, Distributed control Systems, Hierarchical Computer control Systems. Economics of Computer-Aided Process control. Benefits of using Computers in a Process control. Process related Interfaces: Analog Interfaces, Digital Interfaces, Pulse Interfaces, Standard Interfaces.	**8**
II	Industrial communication System: Communication Networking, Industrial communication Systems, Data Transfer Techniques, Computer Aided Process control software, Types of Computer control Process Software, Real Time Operating System	**8**
III	Process Modelling for computerized Process control: Process model, Physical model, Control Model, Process modelling. Modelling Procedure: Goals Definition, Information Preparation, Model Formulation, Solution Finding, Results Analysis, Model Validation	**8**
IV	Advanced Strategies For Computerised Process control: Cascade Control, Predictive control, Adaptive Control, Inferential control, Intelligent Control, Statistical control.	**8**
V	Examples of Computerized Process Control: Electric Oven Temperature Control, Reheat Furnace Temperature control, Thickness and Flatness control System for metal Rolling, Computer-Aided control of Electric Power Generation Plant.	**8**

Text Books:

1. S. K. Singh, “Computer Aided Process control”, PHI.

Reference Books:

1. C. L. Smith, “Digital computer Process Control”, Ident Educational Publishers.
2. C. D. Johnson, “Process Control Instrumentation Technology”, PHI.
3. Krishan Kant, “Computer Based Industrial Control”
4. Pradeep B. Deshpande & Raymond H. Ash, “ Element of Computer Process Control withAdvance Control Applications”, Instrument Society of America, 1981.
5. C. M. Houpis & G. B. Lamond, “Digital Control System Theory”, Tata McGraw Hill.

REC751 OPTICAL COMMUNICATION LAB

List of Experiments

1. To establish analog link using Optical Fiber.
2. To establish digital link using Optical Fiber.
3. To measure Propagation loss in optical fiber.
4. To measure bending loss in optical fiber.
5. To measure Numerical Aperture in optical fiber.
6. Time Division Multiplexing of signals using optical fiber.
7. Framimg in Time Division Multiplexing using optical fiber link.
8. To study the Manchester coding/Decoding used in optical fiber.
9. To study Voice Digitzation: A Law using optical fiber link.
10. To compare the effect of Electromagnetic Interference on a copper medium and on an optical fiber medium.

REC752 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:

CO1	Understand Universal op-amp based biquad.
CO2	Identify amplitude control or stabilization applied to any sinusoidal oscillators and Op-amp/ OTA based function generator.
CO3	Design log/antilog circuits and identify applications of analog multiplier/ divider.
CO4	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.
CO5	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.

DEPARTMENT ELECTIVES -V

REC080 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:

CO1	Describe and apply fundamentals of telecommunication systems and associated technologies.
CO2	Solve problems and design simple systems related to tele-traffic and trunking efficiency.
CO3	Understand and explain the reasons for switching, and the relative merits of the possible switching modes, e.g. packet and circuit switching.
CO4	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.

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.

REC081 ANALYTICAL INSTRUMENTATION

COURSE OBJECTIVE: Students undergoing this course are expected to:

1. Understand UV – Visible Spectroscopy.
2. Understand Infrared Spectroscopy.
3. Learn working of flame photometers.
4. Interpret working of mass Spectrometers.
5. Be aware of Nuclear Magnetic Resonance (NMR) Spectroscopy.

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

CO1	Understand the Electromagnetic Radiation, Laws relating to absorption radiation, Absorption Instruments, Ultraviolet and visible absorption spectroscopy, Calorimeters.
CO2	Design basic components of IR Spectrophotometers, Type of Infrared Spectrophotometers, Sample Handling Techniques.
CO3	Learnprinciple, constructional details of flame photometers, types of flame photometers, types of flame photometers.
CO4	Be aware of Basic Mass Spectrometer, Principle of operation, Type of Mass Spectrometers, components of Mass Spectrometers, inductively coupled plasma-mass spectrometer.
CO5	Understand the Principle of NMR, types of NMR spectrometers, constructional details of NMR spectrometer

ANALYTICAL INSTRUMENTATION		**3 1 0**
Unit	**Topics**	**Lectures**
I	UV – Visible Spectroscopy: Introduction, Electromagnetic Radiation, Laws relating to absorption radiation, Absorption Instruments, Ultraviolet and visible absorption spectroscopy, Calorimeters, Double Beam spectrophotometer (Optical Diagram & Block Diagram) Microprocessor based Spectrophotometer (Block Diagram)	8
II	Infrared Spectroscopy, Basic Components of IR Spectrophotometers, Type of Infrared Spectrophotometers, Sample Handling Techniques	8
III	Flame photometers: principle, constructional details of flame photometers, types of flame photometers, types of flame photometers, clinical flame photometers, accessories for flame photometer, expression for concentration, interferences in flame photometry, procedure for determinations. Atomic Absorption Spectrometers: Atomic Absorption Spectroscopy, Atomic Absorption Instrumentation, Sources of interferences, meter scale.	8
IV	Mass Spectrometers: Basic Mass Spectrometer, Principle of operation, Type of Mass Spectrometers, components of Mass Spectrometers, inductively coupled plasma-mass spectrometer, trapped ion analyzers, ion cyclotron resonance (ICR) mass spectrometer, quadruple ion trap mass spectrometer, applications of mass spectrometry, gas chromatograph-mass spectrometer, liquid chromatograph-mass spectrometer, tandem mass spectrometry (MS/MS)	8

V	Nuclear Magnetic Resonance (NMR) Spectroscopy, Principle of NMR, types of NMR spectrometers, constructional details of NMR spectrometer, variation T-60A NMR spectrometer, sensitivity enhancement for analytical NMR-spectroscopy, Fourier transform NMR spectroscopy.	8

Text Books:

1. DA Skoog, "Principles of Instrumental Analysis," 6th Ed. Cengage
2. R. S. Kandpur, "Handbook Of Analytical Instruments", Mc Graw Hill 3rdEdition,
3. Willard, Merritt, Dean and Settle, "Instrumental Methods of Analysis", 7thEdition, CBS Publishers.

REC082 ADVANCED 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 compare Inorganic 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:

CO1	Understand Anatomy of Eye, Light Detection and Sensitivity, Spatial Vision and Pattern Perception, Binocular Vision and Depth Perception.
CO2	Understand Photolithography for Thin Film LCD, Wet Etching, Dry Etching; Flexible Displays.
CO3	Understand Thin Film Electroluminescent Displays, AC Powder Electroluminescent Displays; Organic Electroluminescent Displays: OLEDs, Active Matrix for OLED Displays
CO4	Be aware ofColorant Transposition Displays, MEMs Based Displays, 3-D Displays, 3-D Cinema Technology, Autostereoscopic 3-D Technology
CO5	Understand Liquid Crystals on Silicon Reflective Micro-display, Trans missive Liquid Crystal Micro-display, MEMs Micro-display, DLP Projection Technology.

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	8

	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 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.

REC083 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:

CO1	Understand the orbital and functional principles of satellite communication systems
CO2	Architect, interpret, and select appropriate technologies for implementation of specified satellite communication systems
CO3	Analyse and evaluate a satellite link and suggest enhancements to improve the link performance.
CO4	Select an appropriate modulation, multiplexing, coding and multiple access schemes for a given satellite communication link.
CO5	Specify, design, prototype and test analog and digital satellite communication systems as per given specifications.

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, Application Theo Radaard aErq,uation: Detection of signals and the signal to noise ratio, Probabilities of de Pulses, Radar cross section of targets, Radar cros Pulse Reception Frequency , Antenna Parameters, Sy	8
V	Tracking Radar: sequential lobbing, conical scan, mono-pulse Tracking, low angle tracking, tracking in range. 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

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.

DEPARTMENT ELECTIVES –VI

REC085 WIRELESS & 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

CO1	Familiarize with various generations of mobile communications.
CO2	Understand the concept of cellular communication.
CO3	Understand the basics of wireless communication.
CO4	Understand GSM mobile communication standard, its architecture, logical channels, advantages and limitations.
CO5	Gain knowledge of IS-95 CDMA mobile communication standard, its architecture, logical channels, advantages and limitations.
CO6	Gain knowledge of 3G mobile standards and their comparison with 2G technologies.

Wireless & Mobile Communication		**3 0 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	8

	Combining; Spatial Diversity and Multiplexing in MIMO Systems, Channel Estimation. 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. Upena Dalal, "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.

REC086 VOICE 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:

CO1	Understand the characteristics of the Call signalling systems.
CO2	Design SIP Architecture.
CO3	Model and estimate media gateways.
CO4	Understand the network synchronization and management.
CO5	Evaluate the quality of service that need for QoS.

VOICE OVER IP		**3 0 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

REC087 SPEECH PROCESSING

COURSE OBJECTIVE: Students undergoing this course are expected:

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

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

CO1	Understand the mechanism of speech production & acoustic phonetics, the acoustic theory of speech production, lossless tube models.
CO2	Understand time dependent processing of speech, short time energy and average magnitude, short time average zero crossing rate.
CO3	Design of filter banks, implementation of filter bank summation method using FFT.
CO4	Evaluate homomorphic system for convolution, complex cepstrum of speech, pitch detection using Homomorphic processing.
CO5	Understand basic principles of linear predictive analysis, the autocorrelation method, computation of the gain for the model, solution of LPC equations.

SPEECH PROCESSING		**3 0 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.

REC088 MICRO AND SMART SYSTEMS

COURSE OBJECTIVE: Students undergoing this course are expected to:

1. Understand Microsystems versus MEMS
2. Analyse micro sensors, actuators, systems and smart materials.
3. Evaluate Micromachining technologies.
4. To learn Modeling of solids in Microsystems.
5. Analysis Integration of micro and smart systems.
6.

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

CO1	Understand the Why miniaturization?, Microsystems versus MEMS, Why micro fabrication.
CO2	Design Silicon capacitive accelerometer, piezo-resistive pressure sensor, conductometric gas sensor.
CO3	Realizesilicon as a material for micro machining, thin film deposition, lithography, etching, silicon micromachining.
CO4	Understand bar, beam, energy methods for elastic bodies, heterogeneous layered beams, bimorph effect, residual stress and stress gradients, poisson effect and the anticlastic curvature of beams
CO5	Understand integration of Microsystems and microelectronics, microsystems packaging, case studies of integrated Microsystems

MICRO AND SMART SYSTEMS		**3 0 0**
Unit	**Topics**	**Lectures**
I	Introduction, Why miniaturization?, Microsystems versus MEMS, Why micro fabrication?, smart materials, structures and systems, integrated Microsystems, applications of smart materials and Microsystems,.	8
II	Micro sensors, actuators, systems and smart materials: Silicon capacitive accelerometer, piezo-resistive pressure sensor, conductometric gas sensor, an electrostatic combo -drive, a magnetic micro-relay, portable blood analyzer, piezoelectric inkjet print head, micro-mirror array for video projection, smart materials and systems.	8
III	Micromachining technologies: silicon as a material for micro machining, thin film deposition, lithography, etching, silicon micromachining, specialized materials for Microsystems, advanced processes for micro fabrication.	8
IV	Modeling of solids in Microsystems: Bar, beam, energy methods for elastic bodies, heterogeneous layered beams, bimorph effect, residual stress and stress gradients, poisson effect and the anticlastic curvature of beams, torsion of beams and shear stresses, dealing with large displacements, In-plane stresses. Modelling of coupled electromechanical systems: electrostatics, Coupled Electro-mechanics: statics, stability and pull-in phenomenon, dynamics. Squeezed film effects in electro-mechanics.	8
V	Integration of micro and smart systems: integration of Microsystems and	8

	microelectronics, microsystems packaging, case studies of integrated Microsystems, case study of a smart-structure in vibration control. Scaling effects in Microsystems: scaling in: mechanical domain, electrostatic domain, magnetic domain, diffusion, effects in the optical domain, biochemical phenomena.	

Text book:

1. G. K. Ananthasuresh, K. J. Vinoy, S. Gopalakrishnan, K. N. Bhat and V. K. Atre, “Micro and smart systems”, Wiley India, 2010.