NOORUL ISLAM CENTRE FOR HIGHER EDUCATION

(Deemed to be University Under Section 3 of the UGC Act, 1956)
Kumaracoil, Thuckalay

DEPARTMENT OF

ELECTRONICS AND COMMUNICATION ENGINEERING

M.E. COMMUNICATION SYSTEMS

CURRICULUM AND SYLLABI

REGULATION 2021

NOORUL ISLAM CENTRE FOR HIGHER EDUCATION, Kumaracoil

Regulation : 2021

Curriculum and Syllabi

DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

M.E. COMMUNICATION SYSTEMS

Vision of the University

To be recognized by the Government and society at large as an institution able to deliver excellence with relevance in the field of higher education and research focusing on the needs of the nation in tune with the technological revolution to cope with the knowledge explosion and global competence.

Mission of the University

To develop the institution as a Centre of Excellence, keeping pace with the advances in the field, so as to provide quality higher education to the students and instill in them high standards of discipline and ethics so that they become enlightened individuals in the service of humanity and to carry out focused research in the frontier areas of science and technology.

Faculty of Electrical and Electronics Engineering

Department of Electronics and Communication Engineering

Vision of the Department

To impart the students of Electronics and Communication Engineering Department the latest technical knowledge, professional excellence and social responsibility.

Mission of the Department

- To attain academic excellence in Electronics and Communication Engineering through commitment in duty, innovation in learning and research.
- To establish a suitable environment for the students to develop professionalism and face life challenges with ethical integrity.
- To develop the students to understand the societal needs and equip them with technical expertise to provide the necessary solutions

Description of the programme

A Master of Engineering (M.E.) program in Communication Systems typically focuses on advanced studies in the design, analysis, and optimization of communication systems and networks. In the present scenario of Information & Communication Technology, Communication Engineering is of vital importance for any society. The communication revolution has led the whole world being global village concept. The prominent domains covered in this programme are Modern Digital Communication Techniques, Advanced Digital Signal Processing, Advanced Microwave Communication, Optical Communication & Networking, Wireless Communication and Networks, Cryptography & Network Security, Antenna Theory & Design, Image processing and Multimedia Compression Techniques.

Graduates of M.E. program in Communication Systems are well-equipped for careers in various industries, including telecommunications companies, wireless network providers, satellite communications firms, research and development organizations, and government agencies. They may work as communication engineers, network architects, systems analysts, or research scientists, among other roles.

Overall, an M.E. program in Communication Systems provides students with a solid foundation in both theoretical principles and practical skills necessary to design, analyze, and optimize communication systems in today's rapidly evolving technological landscape.

Programme Educational Objectives - PEO	
PEO-01	To equip the graduates to apply the knowledge of mathematics and science in Communication system design and related fields for professional achievement in industry, and research and development organizations.
PEO-02	To have the ability and attitude to adapt to technological changes in the related areas of Communication System.
PEO-03	To have the ability to identify and analyze social problems and provide optimal technological solutions in cost effective manner.
PEO-04	To exhibit their innovative ideas in multidisciplinary areas of communication system to meet the day to day technical challenges.

PEO-05	To exhibit a desire for life long learning through technical training and professional activities.
PEO-06	To inculcate a strong favour of research activities among the students and impart them with good scientific and engineering depth including proficiency in hardware and software.
PEO-07	To inculcate in students the finest professional attributes, ethics, a positive attitude, effective communication and presentation skills, ownership, responsibility and accountability
PEO-08	To prepare the students for successful and productive career choices in both public and private sectors in the field of communication system.
PEO-09	To equip the students by imparting professional development courses and industrial trainings, preparing students to crack various national level competitive examinations like GATE, IES, etc.
PEO-10	To provide students with an academic environment that ignites in one the spirit of excellence, develop the urge of discovery, creativity, inventiveness, and a passion to be the best by providing state-of-the-art facility

Graduate Attributes- GA	
GA-1	**Advanced Engineering Expertise** Master advanced engineering principles and apply them to design, analyze, and innovate systems that address both present and emerging global challenges across diverse industries.
GA-2	**Leadership in Research and Innovation** Lead groundbreaking research and foster innovation by identifying opportunities for technological advancements, contributing original ideas that push the boundaries of engineering knowledge.
GA-3	**Sustainable Engineering Practices** Develop and implement engineering solutions that integrate sustainability, environmental stewardship, and resource efficiency, ensuring the long-term impact and responsibility of all projects.
GA-4	**Ethical and Strategic Decision-Making** Make informed, ethical decisions in complex engineering contexts, considering societal needs, environmental implications, and the long-term consequences of engineering practices.
GA-5	**Global Competence in Engineering Solutions** Exhibit a deep understanding of global engineering standards and practices, addressing international challenges and cultural sensitivities in engineering projects to make a broader societal impact.

GA-6	**Technological Agility and Lifelong Learning** Stay ahead of technological trends and exhibit agility in learning new tools, methodologies, and technologies, ensuring continuous professional growth in a rapidly evolving engineering landscape.
GA-7	**Interdisciplinary and Collaborative Innovation** Excel in multidisciplinary collaborations, leveraging knowledge from multiple fields to solve complex, large-scale engineering problems that require comprehensive and innovative solutions.
GA-8	**Data-Driven Decision Making** Employ advanced data analytics, machine learning, and computational tools to derive insights and make informed engineering decisions that improve
GA-9	**Entrepreneurial Mindset and Innovation Leadership** Cultivate an entrepreneurial mindset, translating engineering innovations into viable products, solutions, or services, and leading teams toward commercialization and societal impact.
GA-10	**Safety, Risk, and Crisis Management** Implement and manage advanced safety protocols and risk mitigation strategies to protect individuals, communities, and ecosystems in engineering practices, particularly in high-stakes and crisis environments.

Programme Outcome - PO	
PO-A	To acquire in-depth knowledge of various aspects of communication systems namely satellite communication, mobile networks and sensor networks in wider and global perspective with an ability to evaluate and analyse and synthesize the existing and evolving applications.
PO-B	To identify, formulate and analyze complex problems in modern communication system and apply the acquired knowledge for research in a wider theoretical and practical context.
PO-C	To design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health, safety, manufacturability and sustainability.
P0-D	To conduct literature survey, identify the problems, apply appropriate research methodologies to find out optimal solutions, and validate through simulation /prototype for complex problems.
PO-E	To apply techniques, skills, and modern engineering tools necessary for engineering practice
PO-F	To develop and model complex Communication hardware and software systems for human needs.
PO-G	To comprehend the impact of engineering solutions in a global, economic, environmental, and societal context
PO-H	To apply professional and ethical principles and function with responsibility

PO-I	To identify areas of interest and function as an individual or as a member or leader in multidisciplinary teams
PO-J	To communicate facts successfully with people in engineering domain and effectively design and prepare documents and reports.
PO-K	To acquire knowledge of contemporary issues and recognize the need for lifelong learning.
PO-L	To apply knowledge of engineering and management principles in multidisciplinary environment and projects.
PO-M	To train the students to get employability in private and public sectors

Mapping of Graduate Attributes and Programme Educational Objectives (PEO)

GAs / PEOs	G A-01	GA-02	GA-03	GA-04	GA-05	GA-06	GA-07	GA-08	GA-09	GA-10
PEO-01	H	H	H	H	H	H	H	A	A	A
PEO-02	H	H	H	H	H	H	H	A	A	A
PEO-03	H	H	H	H	H	H	A	A	H	H
PE0-04	H	H	H	H	H	H	H	H	H	A
PEO-05	H	H	H	H	H	H	A	H	H	H
PEO-06	H	H	H	H	H	H	A	H	H	Not
PEO-07	H	H	H	H	H	H	H	H	H	H
PEO-08	H	H	H	H	H	H	H	A	A	A
PEO-09	H	H	H	H	H	H	H	A	A	A
PEO-10	H	H	H	H	H	H	A	A	H	H

H- Highly Associated A- Associated Not – Not Associated

Mapping of Graduate Attributes and Programme Outcomes (PO)

GAs POs	GA-01	GA-02	GA-03	GA-04	GA-05	GA-06	GA-07	GA-08	GA-09	GA-10
PO-A	H	H	H	H	H	H	H	A	A	A
PO-B	H	H	H	H	H	H	H	A	A	A
PO-C	H	H	H	H	H	H	A	A	H	H
P0-D	H	H	H	H	H	H	H	H	H	A
PO-E	H	H	H	H	H	H	A	H	H	A
PO-F	H	H	H	H	H	H	A	H	H	A
PO-G	H	H	H	H	H	H	H	H	H	H
PO-H	H	H	H	H	H	H	H	H	H	H
PO-I	H	H	H	A	A	H	H	A	H	A
PO-J	H	H	H	H	H	H	H	H	H	H
PO-K	H	H	H	H	H	H	H	H	H	H
PO-L	H	H	H	H	H	H	H	H	H	H
PO-M	H	H	H	H	H	A	H	H	H	H

H- Highly Associated A- Associated Not – Not Associated

Mapping of Programme Educational Objective (PEOs) and Programme Outcomes (POs)

PEO / PO	PEO-01	PEO-02	PEO-03	PEO-04	PEO-05	PEO-06	PEO-07	PEO-08	PEO-09	PEO-10
PO-A	H	H	H	A	H	A	A	A	A	A
PO-B	H	H	H	H	H	H	A	H	A	A
PO-C	H	H	H	H	H	H	H	A	A	A
P0-D	H	H	H	H	H	H	H	H	A	H
PO-E	H	H	H	H	H	H	A	H	A	H
PO-F	H	H	H	H	H	H	H	H	A	H
PO-G	H	H	H	H	H	H	H	H	A	H
PO-H	H	H	H	H	H	H	H	A	A	A
P0-I	H	H	H	H	H	H	H	H	A	H
PO-J	H	H	H	H	H	H	A	H	A	H
PO-K	H	H	H	H	H	H	H	H	A	H
PO-L	H	H	H	H	H	H	H	H	A	H
PO-M	H	H	H	H	H	H	H	H	A	H

H- Highly Associated A- Associated Not – Not Associated

Duration of the programme: 2Years/ 4Semesters

Total credit :66

CURRICULUM & SYLLABI

SEMESTER I

Sl. No	Course Code	Course Title	L	T	P	C
THEORY						
1.	MA3501	Advanced Mathematics	3	1	0	4
2.	EC3501	Advanced Radiation Systems	3	0	0	3
3.	EC3502	Modern Digital Communication Techniques	3	0	0	3
4.	EC3503	Advanced Digital Signal Processing	3	0	0	3
5.	PEC	**Elective-I**	3	0	0	3
6.	PEC	**Elective-II**	3	0	0	3
PRACTICAL						
7.	EC3571	Communication Systems Lab-I	0	0	2	1
TOTAL			**18**	**1**	**2**	**20**

SEMESTER II

Sl. No	Course Code	Course Title	L	T	P	C
THEORY						
1.	EC3504	Wireless Communication Engineering	3	0	0	3
2.	EC3505	Multimedia Compression Techniques	3	0	0	3
3.	EC3506	Microwave Integrated Circuits	3	0	0	3
4.	EC3507	Satellite Communication and Applications	3	0	0	3
5.	PEC	**Elective-III**	3	0	0	3
6.	PEC	**Elective-IV**	3	0	0	3

PRACTICAL						
7.	EC3572	Communication Systems Lab-II	0	0	2	1
TOTAL			**18**	**0**	**2**	**19**

SEMESTER III

Sl. No	**Course Code**	**Course Title**	**L**	**T**	**P**	**C**
THEORY						
1.	PEC	**Elective-V**	3	0	0	3
2.	OEC	Open Elective-I	3	0	0	3
PRACTICAL						
7.	EC35P1	Project Work – Phase I	0	0	12	6
TOTAL			**6**	**0**	**12**	**12**

SEMESTER IV

Sl. No	**Course Code**	**Course Title**	**L**	**T**	**P**	**C**
THEORY						
1.	EC35P2	Project Work – Phase II	0	0	32	16
PRACTICAL						
TOTAL			0	0	32	16

LIST OF PROGRAM ELECTIVES

Sl. No	Course Code	Course Title	L	T	P	C
THEORY						
1.	EC35A1	Wavelets and Multiresolution Processing	3	0	0	3
2.	EC35A2	Software Defined Radio	3	0	0	3
3.	EC35A3	Communication Network Security	3	0	0	3
4.	EC35A4	Optical Communication Networks	3	0	0	3
5.	EC35A5	Simulation Of Communication Systems & Networks	3	0	0	3
6.	EC35A6	Global Positioning Systems	3	0	0	3
7.	EC35A7	High Speed Switching Architecture	3	0	0	3
8.	EC35A8	RF System Design	3	0	0	3
9.	EC35A9	Digital Image Processing and Applications	3	0	0	3
10.	EC35B2	High Performance Communication Networks	3	0	0	3

LIST OF OPEN ELECTIVES

Sl. No	Course Code	Course Title	L	T	P	C
THEORY						
1.	EC35B1	Fundamental of Soft Computing Techniques	3	0	0	3
2.	GE35A1	Business Analytics	3	0	0	3
3.	GE35A2	Industrial Safety	3	0	0	3
4.	GE35A3	Operations Research	3	0	0	3
5.	GE35A4	Cost Management of Engineering Projects	3	0	0	3
6.	GE35A5	Composite Materials	3	0	0	3
7.	GE35A6	Waste to Energy	3	0	0	3

MA3501	ADVANCED MATHEMATICS	L	T	P	C
		3	1	0	4

OBJECTIVES

The course objective is to extend the ability of the students in the areas of Matrix Theory and Stochastic Processes. This will be applicable in Engineering practices and serve as a pre-requisite for higher studies and research.

CourseOutcome		Cognitive Skill
CO-01	Compute functions of non-diagonalizable matrices using generalized eigen vectors, find the inverse of a singular matrix using Pseudo inverse method. Apply singular value decomposition in image processing.	U.A
CO-02	Formulate real life problems and solve using Linear Programming. Minimize the cost of distributing a product from a number of sources using TP. Assign a job to some workers so that the jobs are completed at the least cost or time.	A
CO-03	Simplify a decision by breaking it down into a sequence of decision steps using DPP. Present a particular weight capacity of a cargo vehicle and a choice of cargo and seeks cargo of maximum value. To optimize both the warehouse space utilization and the products handling cost.	A
CO-04	Know the concepts which describe the random wave transforms in a probabilistic sense. Trace the nature of random signals. Analyze the random signals in the frequency domain	E
CO-05	Find approximate solutions to boundary value problems in differential equation. Maximize or minimize functional using Euler's equation. Find the extreme values of the functional with certain conditions using Isoperimetric problems.	E

R-Remember, U-Understand, A-Apply, An-Analyze, E-Evaluate, S-Synthesis

Mapping of Course Outcome with Programme Outcome

PO / CO	PO-A	PO-B	PO-C	PO-D	PO-E	PO-F	PO-G	PO-H	PO-I	PO-J	PO-K	PO-L	PO-M
CO-01	S	L	S	M	M	S	S	S	NA	S	M	L	M
CO-02	S	M	M	S	L	NA	S	M	NA	M	S	M	L
CO-03	S	M	M	S	L	NA	S	M	NA	M	S	M	L
CO-04	S	L	S	M	M	S	S	S	NA	S	M	L	M
CO-05	S	M	L	M	NA	L	M	S	M	NA	M	NA	L

S-Strong, M-Medium,L-Low,N-Not relevant

Unit I: Advanced Matrix Theory **9**

Generalized Eigen Vectors– Jordan Canonical Form — Matrix Norms – Singular Value Decomposition – Pseudo Inverse – Least Square Approximations – QR Decomposition.

Unit II: Linear Programming **9**

Formulation-Graphical Solution – Simplex Method-Two Phase Method-Transportation AndAssignment Models.

Unit III: Random Processes **9**

Classification – Stationary Random Processes – Ergodic Process - Auto Correlation – Cross Correlations – Properties - Power Spectral Density.

Unit IV: Dynamic Programming **9**

Bellman's Principle of Optimality – Characteristics Of The Dynamic Programming Model – The Recursive Equation Approach – Solution Of Discrete Dynamic Programming Problem

Unit V: Calculus of Variations **9**

Euler's Equation – Functional Dependent on First and Higher Order Derivatives – Functional Dependent on Functions of Several Independent Variables -Isoperimetric Problems.

TOTAL: 45+15=60HOURS

REFERENCES:

1. Bronson, R., "Matrix Operations", Schaum's Outline Series, McGraw–Hill, New York
2. Gupta, A.S., "Calculus of Variations with Applications", Prentice-Hall of India, New Delhi.
3. Taha, H.A., "Operations Research – An Introduction", Sixth Edition, Prentice-Hall of India, New Delhi.
4. Gupta, P.K. and Hira, D.S., "Operations Research", S.Chand& Co. New Delhi.
5. Peebles Jr., P.Z., "Probability, Random Variables and Random Signal Principles", McGraw-Hill Inc.

EC3501	ADVANCED RADIATION SYSTEMS	L	T	P	C
		3	0	0	3

OBJECTIVES

- To study radiation from a wire antennas.
- To design the antenna and antenna arrays for various radiation pattern characteristics.
- To study the radiation of aperture antennas
- To learn special antennas such as microstrip and broad band antennas.

Course Outcome		Cognitive Skill
CO-01	Studying radiation characteristics of current element	U, A
CO-02	Studying radiation characteristics of antenna arrays	An, R
CO-03	Understanding the radiation characteristics of aperture antennas	U, An
CO-04	Studying the radiations pattern of frequency independent and broad band antennas.	R, An
CO-05	Able to studying radio wave Polarization	U

R-Remember,U-Understand,A-Apply,An-Analyze,E-Evaluate, S-Synthesis

Mapping of Course Outcome with Programme Outcome

PO / CO	PO-A	PO-B	PO-C	PO-D	PO-E	PO-F	PO-G	PO-H	PO-I	PO-J	PO-K	PO-L	PO-M
CO-01	S	S	S	S	M	M	L	S	M	S	S	S	M
CO-02	S	S	S	M	S	L	S	S	S	M	M	M	S
CO-03	S	M	S	S	M	L	L	S	S	S	M	M	L
CO-04	S	S	M	M	M	L	M	M	M	S	S	L	L
CO-05	S	S	S	S	M	L	S	S	S	M	S	M	S

S-Strong, M-Medium,L-Low,N-Not relevant

Unit I: Concepts of Radiation and Wire Antennas **9**

Retarded Vector Potentials – Heuristic Approach and Maxwell's Equation Approach.The Lorentz Gauge Condition. Vector Potential in Phasor Form. Fields Radiated by an Alternating Current Element. Total Power Radiated and Radiation Resistance. Radiation FromHalf Wave Dipole From Assumed Current Distribution. Power Radiated in the Farfield, Loop Antennas and Radiation Fields.

Unit II: Antenna Arrays **9**

N Element Linear Arrays – Uniform Amplitude and Spacing. Phased Arrays. Directivity of Broadside and End Fire Arrays. Three Dimensional Characteristics. Binomial Arrays and Dolph-Tchebycheff Arrays. Planar and Circular Array.

Unit III: Aperture Antennas **9**

Magnetic Current – Duality. Electric and Magnetic Current Sheets as Sources. Huyghens Source. Radiation through an Aperture in an Absorbing Screen. Fraunhoffer and Fresnel Diffraction. Cornu Spiral. Complimentary Screens and Slot Antennas.Slot and Dipoles as Dual Antennas. Babinets Principle. Fourier Transform in Aperture Antenna Theory.

Unit IV: Horn, Microstrip, Reflector Antenna **9**

E and H Plane SectoralHorns. Pyramidal Horns. Conical and Corrugated Horns.Multimode Horns. Phase Center. Microstrip Antennas – Feeding Methods. Rectangular Patch- Transmission Line Model.Parabolic Reflector Antennas – Prime Focus and Cassegrain Reflectors, .Equivalent Focal Length of Cassegrain Antennas. Spillover and Taper Efficiencies. Optimum Illumination.

Unit V: Antenna Measurement **9**

Introduction, Antenna Ranges, Radiation Pattern,Gain Measurements, Directivity Measurements, Radiation Efficiency, Impedance Measurements, Current Measurements, Polarization Measurements And Scale Model Measurements.

TOTAL: 45+15=60HOURS

REFERENCES:

1. Bronson, R., "Matrix Operations", Schaum's Outline Series, McGraw–Hill, New York
2. Gupta, A.S., "Calculus of Variations with Applications", Prentice-Hall of India, New Delhi.
3. Taha, H.A., "Operations Research – An Introduction", Sixth Edition, Prentice-Hall of India, New Delhi.
4. Gupta, P.K. and Hira, D.S., "Operations Research", S.Chand& Co. New Delhi.
5. Peebles Jr., P.Z., "Probability, Random Variables and Random Signal Principles", McGraw-Hill Inc.

EC3502	MODERN DIGITAL COMMUNICATION TECHNIQUES	L	T	P	C
		3	0	0	3

OBJECTIVES

- To understand the basics of signal-space analysis and digital transmission.
- To understand the coherent and noncoherent receivers and its impact on different channel characteristics.
- To understand the different Equalizers
- To understand the different block coded and convolutional coded digital communication systems.
- To understand the basics of Multicarrier and Multiuser Communications.

Course Outcome		Cognitive Skill
CO-01	Able to develop the ability to understand the concepts of signal space analysis for coherent and non- coherent receivers.	U
CO-02	Able to understand equalization techniques and Algorithms	U,An
CO-03	Able to analyze the block coded digital communication	An
CO-04	Able to understand and analyze convolutional coding techniques in digital communication	U,An
CO-05	Able to illustrate Multicarrier and Multiuser Communications	U, A

R-Remember,U-Understand,A-Apply,An-Analyze,E-Evaluate, S-Synthesis

Mapping of Course Outcome with Programme Outcome

PO / CO	PO-A	PO-B	PO-C	PO-D	PO-E	PO-F	PO-G	PO-H	PO-I	PO-J	PO-K	PO-L	PO-M
CO-01	S	M	S	S	M	S	S	M	M	M	L	M	L
CO-02	S	S	S	M	M	S	M	S	S	M	L	S	M
CO-03	S	S	S	S	S	S	S	S	S	M	S	S	M
CO-04	M	S	M	S	M	M	S	S	S	L	M	S	M
CO-05	S	M	M	S	M	M	S	M	M	S	S	S	M

S-Strong, M-Medium,L-Low,N-Not relevant

Unit I: Coherent and Non-Coherent Communication 9

Coherent Receivers – Optimum Receivers In WGN – IQ Modulation & Demodulation – Noncoherent Receivers In Random Phase Channels; MFSK Receivers – Rayleigh And Rician Channels – Partially Coherent Receivers – DPSK; M-PSK; M-DPSK-BER Performance Analysis. Carrier Synchronization, Bit Synchronization.

Unit II: Equalization Techniques 9

Band Limited Channels- ISI – Nyquist Criterion- Controlled Isi-Partial Response Signals- Equalization Algorithms – Viterbi Algorithm – Linear Equalizer – Decision Feedback Equalization – Adaptive Equalization Algorithms.

Unit III: Block Coded Digital Communication 9

Architecture And Performance – Binary Block Codes; Orthogonal; Biorthogonal; Trans orthogonal – Shannon's Channel Coding Theorem; Channel Capacity; Matched Filter; Concepts Of Spread Spectrum Communication – Coded BPSK And DPSK Demodulators– Linear Block Codes; Hammning; Golay; Cyclic; BCH; Reed – Solomon Codes. Space Time Block Codes.

Unit IV:Convolutional Coded Digital Communication 9

Representation Of Codes Using Polynomial, State Diagram, Tree Diagram, And Trellis Diagram – Decoding Techniques Using Maximum Likelihood, Viterbi Algorithm, Sequential And Threshold Methods – Error Probability Performance For BPSK And Viterbi Algorithm, Turbo Coding.

Unit V: Multicarrier And Multiuser Communications 9

Single Vs Multicarrier Modulation, Orthogonal Frequency Division Multiplexing (OFDM), Modulation And Demodulation In An OFDM System, An FFT Algorithmic Implementation Of An OFDM System, Bit And Power Allocation In Multicarrier Modulation, Peak-To-Average Ratio In Multicarrier Modulation, Introduction To CDMA Systems, Multiuser Detection In CDMA Systems – Optimum Multiuser Receiver, Suboptimum Detectors, Successive Interference Cancellation.

TOTAL: 45 HOURS

REFERENCES:

1. M.K.Simon, S.M.Hinedi and W.C.Lindsey, Digital communication techniques; Signalling and detection, Prentice Hall India, New Delhi. 1995.
2. Simon Haykin, Digital communications, John Wiley and sons, 1998
3. Bernard Sklar., 'Digital Communications', second edition, Pearson Education,2001.
4. John G. Proakis., 'Digital Communication', 4th edition, McGraw Hill Publication, 2001
5. Theodore S.Rappaport., 'Wireless Communications', 2nd edition, Pearson Education,2002.
6. Stephen G. Wilson., 'Digital Modulation and Coding', First Indian Reprint ,Pearson Education, 2003.
7. Richard Van Nee &Ramjee Prasad., 'OFDM for Multimedia Communications' Artech House Publication,2001.

EC3503	ADVANCED DIGITAL SIGNAL PROCESSING	L	T	P	C
		3	0	0	3

OBJECTIVES

The purpose of this course is to provide in-depth treatment on methods and techniques in

- discrete-time signal transforms, digital filter design, optimal filtering
- power spectrum estimation, multi-rate digital signal processing
- DSP architectures which are of importance in the areas of signal processing, control and communications

Course Outcome		Cognitive Skill
CO-01	Able to understand the parametric methods of power estimation	U
CO-02	Able to analyze the adaptive filtering techniques	An
CO-03	Able to do multi-rate signal processing	A
CO-04	Able to perform analyses of speech signals	An
CO-05	Able to remember the wavelet transforms	R

R-Remember,U-Understand,A-Apply,An-Analyze,E-Evaluate, S-Synthesis

Mapping of Course Outcome with Programme Outcome

PO / CO	PO-A	PO-B	PO-C	PO-D	PO-E	PO-F	PO-G	PO-H	PO-I	PO-J	PO-K	PO-L	PO-M
CO-01	S	S	S	M	S	M	S	S	M	S	L	L	M
CO-02	S	M	S	S	M	S	S	S	S	S	L	L	L
CO-03	S	M	M	S	S	S	S	S	S	M	S	L	L
CO-04	M	S	M	M	M	M	S	M	S	L	L	M	M
CO-05	M	S	S	S	M	S	M	S	S	M	S	L	L

S-Strong, M-Medium, L-Low, N-Not relevant

Unit I: Discrete Random Signal Processing **9**

Weiner Khitchine Relation - Power Spectral Density – Filtering Random Process, Spectral Factorization Theorem, Special Types Of Random Process – Signal Modeling-Least Squares Method, Pade Approximation, Prony's Method, Iterative Prefiltering, Finite Data Records, Stochasticmodels.

Unit II: Spectrum Estimation **9**

Non-Parametric Methods - Correlation Method - Co-Variance Estimator - Performance Analysis Ofestimators – Unbiased Consistent Estimators - Periodogram Estimator - Barlett Spectrum Estimation- Welch Estimation - Model Based Approach - Ar, Ma, Arma Signal Modeling – Parameterestimation Using Yule-Walker Method.

Unit III: Linear Estimation and Prediction **9**

Maximum Likelihood Criterion - Efficiency of Estimator - Least Mean Squared Error Criterion -Wiener Filter - Discrete Wiener Hoff Equations - Recursive Estimators - Kalman Filter – Linear prediction, Prediction Error - Whitening Filter, Inverse Filter - Levinson Recursion, Lattice Realization, Levinson Recursion Algorithm for Solving Toeplitz System Of Equations.

Unit IV: Adaptive Filters **9**

Fir Adaptive Filters - Newton's Steepest Descent Method - Adaptive Filters Based On Steepest descent Method - Widrow Hoff LMS Adaptive Algorithm - Adaptive Channel Equalization – Adaptiveecho Canceller - Adaptive Noise Cancellation - RLS Adaptive Filters - Exponentially Weighted RLS -Sliding Window RLS - Simplified IIR LMS Adaptive Filter.

Unit V: Multirate Digital Signal Processing **9**

Mathematical Description Of Change Of Sampling Rate - Interpolation And Decimation – Continuoustime Model - Direct Digital Domain Approach - Decimation By Integer Factor - Interpolation By Aninteger Factor - Single And Multistage Realization - Poly Phase Realization - Applications To Sub Bandcoding - Wavelet Transform And Filter Bank Implementation Of Wavelet Expansion Of Signals.

TOTAL: 45 HOURS

REFERENCES:

1. Monson H. Hayes, "Statistical Digital Signal Processing and Modeling", John Wiley and SonsInc., New York, 2006.
2. Sophoncles J. Orfanidis, "Optimum Signal Processing ", McGraw-Hill, 2000.
3. John G. Proakis, Dimitris G. Manolakis, "Digital Signal Processing", Prentice Hall of India, NewDelhi, 2005.
4. Simon Haykin, "Adaptive Filter Theory", Prentice Hall, Englehood Cliffs, NJ1986.
5. S. Kay," Modern spectrum Estimation theory and application", Prentice Hall, EnglehoodCliffs,NJ1988.
6. P. P. Vaidyanathan, "Multirate Systems and Filter Banks", Prentice Hall, 1992.

PRACTICAL

EC3571	COMMUNICATION SYSTEM LAB – I	L	T	P	C
		0	0	2	1

OBJECTIVES

- To have a knowledge about the radiation pattern of different antennas
- To study the different modulation techniques used practically
- To have a knowledge about spread spectrum techniques
- To study about the error correcting coding techniques.

Course Outcome		Cognitive Skill
CO-01	To have a knowledge about the radiation pattern of different antennas	U
CO-02	To study the different modulation techniques used practically	R
CO-03	To have a knowledge about spread spectrum techniques	A
CO-04	To study about the error correcting coding techniques	An
CO-05	Able to compare the performance of various filters	E

R-Remember,U-Understand,A-Apply,An-Analyze,E-Evaluate, S-Synthesis

Mapping of Course Outcome with Programme Outcome

PO / CO	PO-A	PO-B	PO-C	PO-D	PO-E	PO-F	PO-G	PO-H	PO-I	PO-J	PO-K	PO-L	PO-M
CO-01	S	M	S	S	M	S	S	M	M	M	L	M	L
CO-02	S	S	S	M	M	S	M	S	S	M	L	S	M
CO-03	S	S	S	S	S	S	S	S	S	M	S	S	M
CO-04	M	S	M	S	M	M	S	S	S	L	M	S	M
CO-05	S	M	M	S	M	M	S	M	M	S	S	S	M

S-Strong, M-Medium, L-Low, N-Not relevant

List of Experiments:

1. Antenna Radiation Pattern Measurement.
2. Simulation of Adaptive Filters and Multistage Multirate Systems.
3. Performance Evaluation of Digital Data Transmission through Fiber Optic Link.
4. Simulation of QMF using Simulation Packages.
5. Implementation of Video Link using Optical Fiber.
6. Implementation of Linear and Cyclic Codes.
7. Power Spectral Density Estimation.
8. Implementation of Pseudorandom Noise Generator.
9. Simulation of MIMO Systems
10. OFDM Transceiver Design using MATLAB/SIMULINK

SEMESTER - II

EC3504	WIRELESS COMMUNICATION ENGINEERING	L	T	P	C
		3	0	0	3

OBJECTIVES

- To introduce the concepts of wireless communication.
- To make the students to know about the various propagation methods, Channel models, capacity calculations multiple antennas and multiple user techniques used in the mobile communication.

Course Outcome		Cognitive Skill
CO-01	Learn the concepts of wireless communication and various propagation models	R and U
CO-02	Evaluate the capacity of AWGN and Fading channels.	U and An
CO-03	Discuss the concept of Transmitter and Receiver Diversity.	U
CO-04	Evaluate MIMO channel capacity	U and An
CO-05	Compare different Multiple Access technique like FDMA,TDMA and SDMA and random access technique like ALOHA and SALOHA	U

R-Remember, U-Understand, A-Apply, An-Analyze, E-Evaluate, S-Synthesis

Mapping of Course Outcome with Programme Outcome

PO / CO	PO-A	PO-B	PO-C	PO-D	PO-E	PO-F	PO-G	PO-H	PO-I	PO-J	PO-K	PO-L	PO-M
CO-01	S	S	S	S	M	S	M	M	S	S	S	S	S
CO-02	S	S	S	S	M	S	M	M	S	S	S	S	S
CO-03	S	S	S	S	M	S	M	M	S	S	S	S	S
CO-04	S	S	S	S	M	S	M	M	S	S	S	S	S
CO-05	S	S	S	S	M	S	M	M	S	S	S	S	S

S-Strong, M-Medium, L-Low,N-Not relevant

Unit I: Wireless Channel Propagation and Model **9**

Propagation Of EM Signals in Wireless Channel – Reflection, Diffraction and Scattering-Free space, Two Ray. Small Scale Fading- Channel Classification- Channel Models – Cost -231 Hata Model, Longley-Rice Model, Nlos Multipath Fading Models: Rayleigh, Rician, Nakagami, Composite Fading –Shadowing Distributions, Link Power Budget Analysis.

Unit II: Capacity of Wireless Channels **9**

Capacity In AWGN, Capacity Of Flat Fading Channel, Capacity Of Frequency Selective Fading Channels.

Unit III: Diversity **9**

Realization Of Independent Fading Paths, Receiver Diversity: Selection Combining, Threshold Combining, Maximum-Ratio Combining, Equal Gain Combining. Transmitter Diversity: Channel Known At Transmitter, Channel Unknown At The Transmitter.

Unit IV: MIMO Communications **9**

Narrowband MIMO Model, Parallel Decomposition of The MIMO Channel, MIMO Channel Capacity, MIMO Diversity Gain, Beamforming, Diversity-Multiplexing Trade-Offs, Space Time Modulation and Coding; STBC, STTC, Spatial Multiplexing And Blast Architectures.

Unit V: Standardized Wireless Systems **9**

Cognitive Radio - Cognitive Transceiver Architecture - Principles of Interweaving- Spectrum Sensing - Spectrum Management - Spectrum Sharing - Overlay - Recent Techniques.

TOTAL: 45 HOURS

REFERENCES:

1. Andrea Goldsmith, Wireless Communications, Cambridge University Press, 2007.
2. Harry R. Anderson, "Fixed Broadband Wireless System Design" John Wiley – India, 2003.
3. Andreas.F. Molisch, "Wireless Communications", John Wiley – India, 2006.
4. Simon Haykin& Michael Moher, "Modern Wireless Communications", Pearson Education, 2007.
5. Rappaport. T.S., "Wireless communications", Pearson Education, 2003.
6. Gordon L. Stuber, "Principles of Mobile Communication", Springer International Ltd., 2001.
7. UpenaDalal, "Wireless Communication " Oxford Higher Education 2009.

EC3505	MULTIMEDIA COMPRESSION TECHNIQUES	L	T	P	C
		3	0	0	3

OBJECTIVES

- To understand the need for data compression.
- To give basics of lossy and lossless compression techniques.
- To give detailed description of audio, video, image and text compression techniques and its standards.

Course Outcome		Cognitive Skill
CO-01	Infer the special features of multimedia	R
CO-02	Understand and apply the basic coding techniques used in text compression	U
CO-03	Learn and apply the various techniques in audio compression	U,A
CO-04	Understand and apply the various techniques used in image compression	U,A
CO-05	Understand and apply the various techniques used in video compression	U,A

R-Remember,U-Understand,A-Apply,An-Analyze,E-Evaluate, S-Synthesis

Mapping of Course Outcome with Programme Outcome

PO / CO	PO-A	PO-B	PO-C	PO-D	PO-E	PO-F	PO-G	PO-H	PO-I	PO-J	PO-K	PO-L	PO-M
CO-01	S	S	S	S	M	M	L	S	S	S	S	S	M
CO-02	S	S	S	M	M	L	S	S	M	M	M	M	S
CO-03	S	S	S	M	M	L	L	M	S	S	M	M	L
CO-04	S	S	M	M	M	L	M	M	M	S	S	L	L
CO-05	S	S	S	M	M	L	S	S	S	M	M	M	S

S-Strong, M-Medium,L-Low,N-Not relevant

Unit I: Introduction **9**

Introduction-Need for Image Compression-Redundancy in Images-Classification of Redundancy in Images-Image Compression Scheme-Classification of Image Compression Schemes-Fundamentals of Information Theory.

Unit II: Text Compression **9**

Compaction Techniques – Huffmann Coding – Adaptive Huffmann Coding – Arithmetic Coding – Shannon-Fano Coding – Dictionary Techniques – LZW Family Algorithms.

Unit III: Audio Compression **9**

Audio Compression Techniques - M- Law And A- Law Companding. Frequency Domain and Filtering – Basic Sub-Band Coding – Application to Speech Coding – G.722 – Application to Audio Coding – MPEG Audio, Progressive Encoding for Audio – Silence Compression, Speech Compression Techniques – Formant and CELP Vocoders

Unit IV: Image Compression **9**

Predictive Techniques – DM, PCM, DPCM: Optimal Predictors and Optimal Quantization – Contour Based Compression – Transform Coding – JPEG Standard – Sub-Band Coding Algorithms: Design of Filter Banks – Wavelet Based Compression: Implementation Using Filters – EZW, SPIHT Coders – JPEG 2000 Standards - JBIG, JBIG2 Standards.

Unit V: Video Compression **9**

Video Compression Techniques And Standards – MPEG Video Coding I: MPEG – 1 And 2 – MPEG Video Coding II: MPEG – 4 And 7 – Motion Estimation And Compensation Techniques – H.261 Standard – DVI Technology – PLV Performance – DVI Real Time Compression – Packet Video.

TOTAL: 45 HOURS

REFERENCES:

1. Khalid Sayood, Introduction to Data Compression, Morgan Kauffman Harcourt India, 2nd Edition, 2000.
2. Ze-Nian Li, and Mark S. Drew, "Fundamentals of Multimedia", Pearson Prentice Hall,October 2003.
3. K. Rammohanarao, Z. S. Bolzkovic, D. A. Milanovic, "Multimedia Communication Systems", 1st edition, Prentice Hall, May 2002.
4. Yao Wang, JoernOstermann, and Ya-Qin Zhang, "Video Processing and Communications", Prentice Hall, 2002.
5. Jayaraman, S, Esakkirajan S and Veerakumar T, "Digital Image Processing", McGraw Hill Pub., 2010.
6. Fred Halsall, Multimedia Communications: Applications, Networks, Protocols and Standards, Addison-Wesley, 2001.
7. Peter Symes , "Digital Video Compression," McGraw Hill Pub., 2004.

EC3506	MICROWAVE INTEGRATED CIRCUITS	L	T	P	C
		3	0	0	3

OBJECTIVES

- To study Fabrication of MMIC.
- To study Monolithic circuit and hybrid circuit and its analysis.
- To study various components used in MMIC.

Course Outcome		Cognitive Skill
CO-01	Demonstrate understanding on the Monolithic Microwave Integrated Circuits their applications, advantages of various fabrication techniques.	R,U
CO-02	Analyze the transformation methods for microstrip analysis, and concepts of effective dielectric constant and various losses in microstrip lines.	R,U
CO-03	Understand the concepts, types, applications and various analysis techniques of coplanar waveguides.	An
CO-04	Analyze the structure, characteristics, operation, equivalent circuit, gain expression, output power efficiency and applications of various microwave solid state active devices.	An
CO-05	Demonstrate an insight to develop the ability to evaluate the performance of microwave integrated circuits using different measurements and testing techniques.	R,U

R-Remember,U-Understand,A-Apply,An-Analyze,E-Evaluate, S-Synthesis

Mapping of Course Outcome with Programme Outcome

PO / CO	PO-A	PO-B	PO-C	PO-D	PO-E	PO-F	PO-G	PO-H	PO-I	PO-J	PO-K	PO-L	PO-M
CO-01	S	S	S	S	S	M	L	S	S	S	S	S	S
CO-02	S	S	S	M	S	L	S	S	S	M	M	M	M
CO-03	S	S	S	M	S	L	L	S	S	S	M	M	S
CO-04	S	S	M	M	S	L	M	S	M	S	S	L	S
CO-05	S	S	S	M	S	L	S	S	S	M	M	M	M

S-Strong, M-Medium,L-Low,N-Not relevant

Unit I: Technology of Hybrid MICs **9**

Dielectric Substrates - Thick Film Technology and Materials - Thin Film Technology and Materials – Methods of Testing – Encapsulation of Devices for Mics – Mounting of Active Devices.

Unit II: Microwave IC Design and Measurement Techniques **9**

Hybrid Versus Monolithic MICs – Multichip Module Technology - Fabrication Techniques, Miniaturization Techniques, Introduction to SOC, SOP, Test Fixture Measurements, Probe Station Measurements, Thermal and Cryogenic Measurements, Experimental Field Probing Techniques.

Unit III: Analysis of Microstrip Line **9**

Methods of Conformal Transformation – Numerical Method for Analysis – Hybrid Mode Analysis – Coupled Mode Analysis- Method of Images – Losses in Miscrostrips.

Unit IV: Coupled Microstrips, Slot Line and Coplanar Waveguides **9**

Coupled Microstrips – Even and Odd Mode Analysis – Microstrip Directional Couplers – Branch Line Couplers – Periodic Branch Line Couplers – Synchronous Branch Line Couplers.

Unit V: Lumped Elements and Non-Reciprocal Components **9**

Design and Fabrication Using Microstrips – Flat Resistors – Flat Inductors – Interdigital Capacitors – Sandwich Capacitors – Ferromagnetic Substrates for Non-Reciprocal Devices – Microstrip Circulators – Latching Circulators – Isolators – Phase Shifters.

TOTAL: 45 HOURS

REFERENCES

1. Gupta,K.C, and Amarjitsingh – "Microwave Integrated Circuits" – John Wiley and sons – Wiley Eastern Reprint, 1978.
2. Hoffmann, R.K – "Handbook of Microwave Integrated Circuits" – Artech House, 1987.

EC3507	SATELLITE COMMUNICATION AND APPLICATIONS	L	T	P	C
		3	0	0	3

OBJECTIVES

- To study about the satellite orbits and launching.
- To become familiar with theory of earth segment and space segment components
- To understand the concept of Space link and multiple access techniques
- To know about application of satellite services.

Course Outcome		Cognitive Skill
CO-01	Describe the motion of satellite in the orbit and compute the look angle.	U, A
CO-02	Describe the concepts of signal propagation effects, link design and perform interference calculation.	U,A
CO-03	Calculate the carrier-to-noise ratio at the input of earth station or satellite transponder.	An, E
CO-04	Critically analyze the design requirements and the performance of satellite communication systems.	An, E
CO-05	Understand the concept of technology: FDMA, TDMA, CDMA and various applications.	U, An

R-Remember, U-Understand, A-Apply, An-Analyze, E-Evaluate, S-Synthesis

Mapping of Course Outcome with Programme Outcome

PO / CO	PO-A	PO-B	PO-C	PO-D	PO-E	PO-F	PO-G	PO-H	PO-I	PO-J	PO-K	PO-L	PO-M
CO-01	S	S	L	S	S	S	S	L	S	S	S	S	S
CO-02	S	S	L	M	S	S	S	L	S	S	L	S	S
CO-03	S	S	L	M	S	S	S	L	S	S	L	S	S
CO-04	S	S	L	S	S	S	S	L	S	S	S	M	S
CO-05	S	S	L	M	S	S	S	L	S	S	S	S	S

S-Strong, M-Medium, L-Low, N-Not relevant

Unit I: Orbital Mechanics **9**

Kepler's Laws of Motion, Orbits, Orbit Equations, Orbit Description, Locating the Satellite in the Orbit with Respect to Earth, Orbital Elements-Look Angle Determination and Visibility - Orbital Perturbations, Orbit Determination, Launch Vehicles, Orbital Effects in Communication System-Spectrum Allocations for Satellite System.

Spacecraft Sub Systems and Earth Station

Spacecraft Subsystems- Altitude and Orbit Control, Telemetry and Tracking, Power Systems, Communication Subsystems, Transponders, Antennas, Earth Stations.

Unit II: Space Links and Multiple Access **9**

The Space Link, Transmission Losses, Link Power Budget Equation, System Noise, Satellite Uplink, Down Link, C/N Ratio

Multiple Access Techniques

Frequency Division Multiple Access (FDMA), Time Division Multiple Access (TDMA). Code Division Multiple Access (CDMA).

Unit III: Broadcast Application **9**

Television Applications- Entertainment Programming - Cable TV -Video Teleconferencing digital Video Broadcasting Standard- The Satellite Standard (DVB-S) - Supporting DVB Services—Sound, Service Information, and Conditional Access data Broadcasting And Internet Protocol Encapsulation - IP Encapsulation In The Mpeg Transport Stream - Packet Identification Direct-To-Home Satellite Television Broadcasting- DTH System Architecture- Satellite Architecture Satellite Digital Audio Radio Service- XM Satellite Radio-Sirius Satellite Radio

Unit IV: MSS and Location Application **9**

VSAT Networks, Mobile Satellite Service -Geo and Non-Geo MSS Systems- Intelligent MSS Services- Multiple Access In MSS- Ground Segment Architecture In MSS, Location Applications –COSPAS-SARSAT, INMARSAT .

Unit V: Satellite Navigation and Global Positioning System 9

Global Navigation Satellite Systems- Basic Concepts Of GPS, Space Segment, Control Segment, User Segment, GPS Constellation, GPS Measurement Characteristics, Indian Remote Sensing And ISRO GPS Systems Inertial Navigation-Introduction To Differential GPS, LADGPS, WADGPS, WAAS, Geo Uplink Subsystem (GUS), Clock Steering Algorithms, Geo Orbit Determination.

TOTAL: 45 HOURS

REFERENCES

1. Dennis Roddy, “Satellite Communications”, Third Edition, McGraw Hill International Editions, 2001
2. Bruce R.Elbert, "The Satellite Communication Applications Hand Book, Artech House Boston,1997.
3. Mohinder S. Grewal, Lawrence R. Weill, Angus P. Andrews, Global Positioning Systems, Inertial Navigation, and Integration, 2011, 1st Edition, John Wiley & Sons, New Jersey.
4. T. Pratt, C.W. Boastian, Jeremy Allnutt, Satellite Communication, 2013, 2nd Edition, John Wiley & Sons, New Jersey.
5. Wilbur L.Pritchard, HendriG.Suyderhood, Robert A.Nelson,"Satellite Communication Systems Engineering", II Edition, Prentice Hall, New Jersey, 1993
6. Tri T.Ha, "Digital satellite communication", 2nd Edition, McGraw Hill, New york.1990

EC3572	COMMUNICATION SYSTEM LAB – II	L	T	P	C
		3	0	0	3

OBJECTIVES

- To have an idea about the different compression techniques
- To study about the micro strip antennas
- To study about the Global Positioning Systems.

Course Outcome		Cognitive Skill
CO-01	To have an idea about the different compression techniques	U
CO-02	To study about the micro strip antennas	R
CO-03	To study about the Global Positioning Systems.	A
CO-04	Able to test the radiation pattern of various antennas	An
CO-05	Able to design an optical link	E

R-Remember,U-Understand,A-Apply,An-Analyze,E-Evaluate, S-Synthesis

Mapping of Course Outcome with Programme Outcome

PO / CO	PO-A	PO-B	PO-C	PO-D	PO-E	PO-F	PO-G	PO-H	PO-I	PO-J	PO-K	PO-L	PO-M
CO-01	S	S	M	S	M	S	S	S	M	S	L	S	L
CO-02	S	S	S	M	M	S	S	S	S	M	L	M	M
CO-03	M	S	S	S	S	S	S	S	S	M	M	L	M
CO-04	S	S	M	S	M	M	S	S	S	L	M	L	S
CO-05	S	S	S	S	S	M	S	M	M	S	S	L	L

S-Strong, M-Medium, L-Low, N-Not relevant

List of Experiments

Use Network Analyser for the following experiments:

1. Measurement of transmission line parameters.S-parameter estimation of Microwave devices.
2. Design and testing of a Microstrip coupler.
3. Characteristics of $\lambda/4$ and $\lambda/2$ transmission lines.

Use appropriate simulation tools for the following experiments:

4. Channel equalizer design (LMS, RLS)
5. Antenna Radiation Pattern measurement.
6. Performance Evaluation of digital modulation schemes
7. OFDM transceiver design
8. Simulation of Microstrip Antennas
9. Performance evaluation of simulated

PROGRAM ELECTIVES

EC35A1	WAVELETS AND MULTIRESOLUTION PROCESSING	L	T	P	C
		3	0	0	3

OBJECTIVES

- To introduce preliminary knowledge required for wavelets.
- To study in detail about multiresolution analysis.
- To learn about continuous wavelet transform.
- To discuss about discrete wavelet transform.
- To give an idea about the application area of this subject to students

Course Outcome		Cognitive Skill
CO-01	Understand the concepts and definitions in wavelet transform	R
CO-02	Familiar with the concepts of multiresolution analysis	U
CO-03	Understand the concepts and properties of Continuous Wavelet Transform	U
CO-04	Familiar with the concepts and properties of Discrete Wavelet Transform	A
CO-05	Understand the applications of Wavelet transform	An

R-Remember, U-Understand, A-Apply, An-Analyze, E-Evaluate, S-Synthesis

Mapping of Course Outcome with Programme Outcome

PO / CO	PO-A	PO-B	PO-C	PO-D	PO-E	PO-F	PO-G	PO-H	PO-I	PO-J	PO-K	PO-L	PO-M
CO-01	S	S	S	S	M	S	M	M	M	M	L	L	L
CO-02	S	M	M	S	M	S	M	S	M	S	L	L	M
CO-03	S	M	S	S	S	S	S	S	M	S	M	L	L
CO-04	M	S	S	M	M	S	S	S	S	M	S	M	L
CO-05	M	S	M	M	S	S	M	M	S	M	M	M	M

S-Strong, M-Medium,L-Low,N-Not relevant

Unit I: Introduction **9**

Vector Spaces - Properties - Dot Product - Basis - Dimension, Orthogonality and Orthonormality - Relationship Between Vectors and Signals - Signal Spaces - Concept of Convergence - Hilbert Spaces for Energy Signals - Generalised Fourier Expansion.

Unit II: Multi Resolution Analysis **9**

Definition of Multi Resolution Analysis (MRA) – Haar Basis - Construction of General Orthonormal MRA-Wavelet Basis for MRA – Continuous Time MRA Interpretation for the DTWT – Discrete Time MRA- Basis Functions for the DTWT – PRQMF Filter Banks

Unit III: Continuous Wavelet Transform **9**

Wavelet Transform - Definition and Properties - Concept of Scale And Its Relation With Frequency - Continuous Wavelet Transform (CWT) - Scaling Function and Wavelet Functions (DAUBECHIES, COIFLET, MEXICAN HAT, SINC, Gaussian, Bi-Orthogonal) - Tiling of Time -Scale Plane for CWT.

Unit IV: Discrete Wavelet Transform **9**

Filter Bank and Sub Band Coding Principles - Wavelet Filters - Inverse DWT Computation by Filter Banks -Basic Properties of Filter Coefficients - Choice of Wavelet Function Coefficients - Derivations of Daubechies Wavelets -Mallat's Algorithm for DWT – Multi-Band Wavelet Transforms.Lifting Scheme: Wavelet Transform Using Polyphase Matrix Factorization - Geometrical Foundations of Lifting Scheme - Lifting Scheme In Z -Domain

Unit V: Applications **9**

Signal Compression – Image Compression Techniques: EZW-SPHIT Coding - Image Denoising Techniques: Noise Estimation –Shrinkage rules -. Shrinkage Functions - Edge Detection and Object Isolation, Image Fusion, and Object Detection. Curve and Surface Editing- Variational Modeling and Finite Element Method Using Wavelets.

TOTAL: 45 HOURS

REFERENCES

1. Rao.R.M and A.S.Bopardikar, "Wavelet Transforms: Introduction to theory and Applications", Pearson Education Asia Pte. Ltd., 2000.
2. K.P.Soman and K.I.Ramachandran," Insight into Wavelets – From Theory to practice", Prentice- Hall, 2004.
3. Strang G, Nguyen T, "Wavelets and Filter Banks," Wellesley Cambridge Press, 1996
4. Vetterli M, Kovacevic J., "Wavelets and Sub-band Coding," Prentice Hall, 1995
5. Mallat S., "Wavelet Signal Processing", Academic Press, 1996

EC35A2	SOFTWARE DEFINED RADIO	L	T	P	C
		3	0	0	3

OBJECTIVES

- To have an introduction about SDR.
- To study about the optimum receivers for AWGN channel and fading channel
- To discuss about the estimation theory.
- To study in detail about various synchronization techniques.
- To study about different types of adaptive equalization techniques and applications of SDR.

Course Outcome		Cognitive Skill
CO-01	Understand the architecture and various signal processing techniques for SDR	R, U
CO-02	Able to acquire and apply the knowledge about the optimum receivers for AWGN channel and fading channel	U, A
CO-03	Understand and analyze the performance of estimators in SDR.	U, An
CO-04	Understand the concept of synchronization and estimate SNR values.	U, E
CO-05	Understand the concept of adaptive equalization and apply it for echo cancellation.	U, A

R-Remember, U-Understand, A-Apply, An-Analyze, E-Evaluate, S-Synthesis

Mapping of Course Outcome with Programme Outcome

PO / CO	PO-A	PO-B	PO-C	PO-D	PO-E	PO-F	PO-G	PO-H	PO-I	PO-J	PO-K	PO-L	PO-M
CO-01	S	S	S	S	M	S	M	M	S	S	S	S	S
CO-02	S	S	S	S	M	S	M	M	S	S	S	S	S
CO-03	S	S	S	S	M	S	M	M	S	S	S	S	S
CO-04	S	S	S	S	M	S	M	M	S	S	S	S	S
CO-05	S	S	S	S	M	S	M	M	S	S	S	S	S

S-Strong, M-Medium,L-Low,N-Not relevant

PREREQUISITE: Digital Communication, Communication Theory

Unit I: Introduction to Software-Defined Radio **9**

Introduction - Networking and SDR- RF Architectures for SDR -Processing Architectures for SDR- Software Environments for SDR, Receive Techniques for SDR, Digital Signal Processing Techniques for SDR, Transmit Techniques for SDR-Components of an SDR- AD9363 Details-ZYNQ Details -Linux Industrial Input/Output Details

Unit II:Optimum Receivers forAWGN Channel and Fading Channels **9**

Detection of Known Signals in Noise, Correlation Receiver, Matched Filter Receiver, Optimum Receiver for CPM Signals, Envelope Detectors for M-Aray and Correlated Binary Signals. Diversity Technique, Rake Demodulator, Coded Waveform for Fading Channel

Unit III: Estimation Theory **9**

Minimum Mean Square Error Estimator, Maximum Aposteriori Estimator, Maximum Likelihood Estimation, Receivers Based on MLSE -Symbol-Spaced MLSE-Fractionally-Spaced MLSE, Cramer Rao Bound (CRB) for Parameter Estimation.

Unit IV: Synchronization Techniques **9**

Carrier and Symbol Synchronization, Frame Synchronization, Carrier Phase Estimation – PLL, Decision Directed Loops, Symbol Timing Estimation, Maximum Likelihood and Non-Decision Directed Timing Estimation, Joint Estimation.

Unit V: Adaptive Equalization and Applications of SDR **9**

Zero Forcing Algorithm, LMS Algorithm, Linear Equalization – Fractionally-Spaced Equalizers, Non-Linear Equalization – The Predictive DFE, Adaptive Decision – Feedback Equalizer, and Equalization of Trellis-Coded Signals, Kalman Algorithm, Blind Equalizers, and Stochastic Gradient Algorithm, Echo Cancellation, Applications of SDR- Cognitive Radio- Vehicular Networking

TOTAL: 45 HOURS

REFERENCES

1. Travis F. Collins, Robin Getz, Di Pu, Alexander M. Wyglinski, "Software-Defined Radio for Engineers" 2018
2. Heinrich Meyer, Mare Moeneclacy and Stefan.A. Fechtel, "Digital Communication Receivers", Vol I & II, John Wiley, New York, 1997
3. John. G. Proakis, "Digital Communication", 4th ed., McGraw Hill, New York, 2001
4. K. Vasudevan, Digital Communications and Signal Processing, IIT ,Kanpur,2020
5. E.A. Lee and D.G. Messerschmitt, "Digital Communication", 2nd edition, Allied Publishers, New Delhi, 1994
6. Simon Marvin, "Digital Communication Over Fading channel; An unified approach to performance Analysis", John Wiley, New York, 2000
7. Bernard Sklar, "Digital Communication Fundamentals and Applications, Prentice Hall, 1998

EC35A3	COMMUNICATION NETWORK SECURITY	L	T	P	C
		3	0	0	3

OBJECTIVES

- To learn the basics of security
- To learn the types of symmetric, asymmetric key algorithms and key management
- To understand the concept of Firewalls, web security and wireless network security

Course Outcome		Cognitive Skill
CO-01	Describe network security services and mechanisms.	R, U
CO-02	Identify and classify particular examples of attack	U, An
CO-03	Recognize symmetrical and asymmetrical cryptography and knowing various encryption standards.	An, E
CO-04	Understand data integrity and digital signature and concepts of firewalls in networks.	U
CO-05	Understand and analyse the various wireless network security systems and the concept of secure in Adhoc sensor networks.	U, An

R-Remember,U-Understand,A-Apply,An-Analyze,E-Evaluate, S-Synthesis

Mapping of Course Outcome with Programme Outcome

PO / CO	PO-A	PO-B	PO-C	PO-D	PO-E	PO-F	PO-G	PO-H	PO-I	PO-J	PO-K	PO-L	PO-M
CO-01	S	S	L	S	S	S	S	L	S	S	S	S	S
CO-02	S	S	L	M	S	S	S	L	S	S	L	S	S
CO-03	S	S	L	M	S	S	S	M	S	S	L	S	M
CO-04	S	M	L	S	S	S	S	L	S	S	S	M	S
CO-05	S	S	L	M	S	S	S	L	S	S	S	S	S

S-Strong, M-Medium,L-Low,N-Not relevant

Unit I: Introduction to Security **9**

Introduction to Information Security, Computer Security & Network Security, Need for Security, Security Goals, Types of Attacks: Passive Attack, Active Attack, Attacks on Confidentiality, Attacks on Integrity and Availability. Security Services and Mechanisms, Techniques: Cryptography, Steganography, Revision on Mathematics for Cryptography.

Unit II: Symmetric and Asymmetric Key Algorithms **9**

Modern Symmetric- Substitutional Ciphers, Transposition Ciphers, Stream And Block Ciphers (DES, 3DES, AES and Its Mode of Operations), Stream Ciphers, Asymmetric-Key Cryptosystem- RSA, Key Management - Diffie-Hellman (DH) Mechanism, Kerberos – Needham Schroeder Protocol.

Unit III:Authentication, Digital Signatures and Certificates **9**

Message Integrity & Message Authentication - Message Authentication Code (MAC), Cryptographic Hash Functions – Birthday Attacks, Digital Signatures - Digital Signature Standards (FIPS 186-2), DSA (ANSI X9.30), RSA (ANSI X9.31) – Public Key Distribution – RSA Schemes, Digital Certificates - PKI Certificates, PKI Life Cycle Management.

Unit IV: Trusted Identity **9**

Entity Authentication: Password System- Fixed and One Time Passwords (S/Key) RFC 2289 – Callback Systems, Zero Knowledge, Challenge and Response Systems – Radius — ITU-T X.509.

Unit V: Security at Layers **9**

Network Layer Security - IPsec, Transport Layer Security- SSL/TLS, SSH, Application Layer Security –PGP, S/MIME, Firewall - Concepts, Architecture, Packet Filtering, Proxy Services And Bastion Hosts.

TOTAL: 45 HOURS

REFERENCES:

1. BehrouzA.Forouzan, “Cryptography and Network Security”, Special Edition, Tata McGraw Hill, 2007.
2. Bruce Scheneier, “Applied Cryptography”, John Wiley & Sons, 1994.
3. Charlie Kaufmann, Radia Perlman, Mike Speciner, "Network Security", Second Edition, Prentice Hall, 2002
4. Douglas R.Stinson, “Cryptography: Theory and Practice”, CRC Press Series on Discrete Mathematics and its Applications, 1995.
5. David M. Durton, “Elementary Number Theory”, Tata Mcgraw Hill, Sixth Edition, 2009.
6. William Stallings “Cryptography and Network Security: Principles and Practice”, 3rd Edition, Pearson Education, 2002.
7. William Stallings “Network Security Essentials: Applications and Standards”, 2nd Edition, Pearson Education, 2000.

EC35A4	OPTICAL COMMUNICATION NETWORKS	L	T	P	C
		3	0	0	3

OBJECTIVES

- To learn the basic optical system components
- To learn the types of optical network architectures, Wave length Routing Networks, packet switching and Access networks
- To understand the concept of network management

Course Outcome		Cognitive Skill
CO-01	Learn the optical system components and network design.	R
CO-02	Understand the optical network architecture.	U
CO-03	Learn wavelength routing network.	U
CO-04	Understand the basic concepts of a packet switching network.	U
CO-05	Understand and apply the various techniques on network management and survivability	U

R-Remember,U-Understand,A-Apply,An-Analyze,E-Evaluate, S-Synthesis

Mapping of Course Outcome with Programme Outcome

PO / CO	PO-A	PO-B	PO-C	PO-D	PO-E	PO-F	PO-G	PO-H	PO-I	PO-J	PO-K	PO-L	PO-M
CO-01	S	S	S	S	M	M	L	S	S	S	S	S	M
CO-02	S	S	S	M	M	L	S	S	S	M	M	M	S
CO-03	S	S	S	M	M	L	L	S	S	S	M	M	L
CO-04	S	S	M	M	M	L	M	M	M	S	S	L	L
CO-05	S	S	S	M	M	L	S	S	S	M	M	M	S

S-Strong, M-Medium,L-Low,N-Not relevant

Unit I: Optical System Components **9**

Light Propagation in Optical Fibers – Loss & Bandwidth, System Limitations, Non-Linear Effects; Solitons; Optical Network Components – Couplers, Isolators & Circulators, Multiplexers & Filters, Optical Amplifiers, Switches, Wavelength Converters.

Unit II: Optical Network Architectures **9**

Introduction to Optical Networks; SONET / SDH Standards, Metropoliton Area Networks, Layered Architecture; Broadcast and Select Networks–Topologies For Broadcast Networks, Media Access Control Protocols, Testbeds For Broadcast & Select WDM; Wavelength Routing Architecture.

Unit III: Wavelength Routing Networks **9**

The Optical Layer, Node Designs, Optical Layer Cost Tradeoff, Routing and Wavelength Assignment [RWA], Virtual Topology Design, Wavelength Routing Testbeds, Architectural Variations.

Unit IV: Packet Switching and Access Networks **9**

Photonic Packet Switching – OTDM, Multiplexing and Demultiplexing, Synchronisation, Broadcast OTDM Networks, Switch-Based Networks; Access Networks – Network Architecture Overview, OTDM Networks; Optical Access Network Architectures; Future Access Networks.

Unit V: Network Design and Management **9**

Transmission System Engineering – System Model, Power Penalty - Transmitter, Receiver, Optical Amplifiers, Crosstalk, Dispersion; Wavelength Stabilization ; Overall Design Considerations; Control and Management – Network Management Functions, Configuration Management,Performance Management, Fault Management, Optical Safety, Service Interface.

TOTAL: 45 HOURS

REFERENCES:

1. Rajiv Ramaswami and Kumar N. Sivarajan, “Optical Networks: A Practical Perspective”, Harcourt Asia Pte Ltd., Second Edition 2004.
2. C. Siva Ram Moorthy and Mohan Gurusamy, “WDM Optical Networks: Concept, Design and Algorithms”, Prentice Hall of India, Ist Edition, 2002.
3. Biswanath Mukherjee, “Optical Communication Networks”, Mc-GrawHill©1997, First EditionISBN 0-07-044435-8.
4. P.E. Green, Jr., “Fiber Optic Networks”, Prentice Hall, NJ, 1993.
5. Rajiv Ramaswami and Kumar N. Sivarajan, “Optical Networks: A Practical Perspective”, Harcourt Asia Pte Ltd., First Edition 2004.

EC35A5	SIMULATION OF COMMUNICATION SYSTEMS & NETWOKS	L	T	P	C
		3	0	0	3

OBJECTIVES

- To learn simulation of random variables and random process
- To learn modeling of radio communication channels
- To understand various simulation techniques
- To understand simulation methodologies and performance evaluation
- To analyse some digital communication optical communication and satellite communication techniques as case studies through simulation.

Course Outcome		Cognitive Skill
CO-01	Able to know the Modeling of Communication System	Un
CO-02	Able to learn modeling of Random Variables and Random Process	An
CO-03	Able to Measures Estimation of Performance	E
CO-04	To understand simulation methodologies of Communication Networks	Un
CO-05	Able to analyze Network of Queues	An

R-Remember,U-Understand,A-Apply,An-Analyze,E-Evaluate, S-Synthesis

Mapping of Course Outcome with Programme Outcome

PO / CO	PO-A	PO-B	PO-C	PO-D	PO-E	PO-F	PO-G	PO-H	PO-I	PO-J	PO-K	PO-L	PO-M
CO-01	M	M	S	S	S	S	M	S	S	L	L	M	S
CO-02	M	M	S	S	S	S	M	S	S	L	L	M	S
CO-03	M	M	S	S	S	S	M	S	S	L	L	M	S
CO-04	M	M	S	S	S	S	M	S	S	L	L	M	S
CO-05	M	M	S	S	S	S	M	S	S	L	L	M	S

S-Strong, M-Medium, L-Low, N-Not relevant

Unit I: Modelling of Communication System **9**

Model of Speech and Picture Signals, Pseudo Noise Sequences, Non-Linear Sequences, Analog Channel Model, Noise And Fading, Digital Channel Model-Gilbert Model of Bursty Channels, HF, Troposcatterand Satellite Channels, Switched Telephone Channels, Analog and Digital Communication System Models, Light Wave System Models.

Unit II: Simulation of Random Variables and Random Process **9**

Univariate and Multivariate Models, Transformation of Random Variables, Bounds and Approximation, Random Process Models-Markov and ARMA Sequences, Sampling Rate for Simulation, Computer Generation and Testing of Random Numbers

Unit III: Estimation of Performance Measures **9**

Quality of an Estimator, Estimator for SNR, Probability Density Functions of Analog Communication System, BER of Digital Communication Systems, Monte Carlo Method and Importance of Sampling Method, Estimation of Power Spectral Density

Unit IV: Communication Networks **9**

Queuing Models, M/M/I And M/M/I/N Queues, Little Formula, Burke's Theorem, M/G/I Queue, Embedded Markov Chain Analysis of TDM Systems, Polling, Random Access Systems

Unit V: Network Of Queues **9**

Queues in Tandem, Store and Forward Communication Networks, Capacity Allocation, Congestion and Flow Chart, Routing Model, Network Layout And Reliability

TOTAL: 45 HOURS

REFERENCES

1. M.C.Jeruchim,PhilipBalaban and K.SamShanmugam, "Simulation of communication systems", Plenum Press, New York,1992
2. A.M.Law and W.DavidKelton, "Simulation Modelling and analysis", McGraw Hill Inc., New York,1991
3. J.F.Hayes, “Modelling and Analysis of Computer Communication networks”, Plenum Press, New York,1984
4. Jerry Banks and John S.Carson, “Discrete-event System Simulation”, Prentice Hall Inc., New Jersey,1984

EC35A6	GLOBAL POSITIONING SYSTEMS	L	T	P	C
		3	0	0	3

OBJECTIVES

- To have an idea about the basics and concepts of various global techniques
- To have a knowledge of different laws of planetary motion.
- To study about the different coding techniques used.
- To discuss about the different atmospheric effects on GPS.

Course Outcome		Cognitive Skill
CO-01	Able to get an idea about the basics and concepts of various global techniques	U
CO-02	Able to gain a knowledge of Coordinate Systems	An
CO-03	Able to understand knowledge of different laws of planetary motion.	An
CO-04	Able to study different coding techniques used	A
CO-05	Able to discuss about the different atmospheric effects on GPS	E

R-Remember, U-Understand, A-Apply, An-Analyze, E-Evaluate, S-Synthesis

Mapping of Course Outcome with Programme Outcome

PO / CO	PO-A	PO-B	PO-C	PO-D	PO-E	PO-F	PO-G	PO-H	PO-I	PO-J	PO-K	PO-L	PO-M
CO-01	M	M	S	S	S	S	M	S	S	L	L	M	S
CO-02	M	M	S	S	S	S	M	S	S	L	L	M	S
CO-03	M	M	S	S	S	S	M	S	S	L	L	M	S
CO-04	M	M	S	S	S	S	M	S	S	L	L	M	S
CO-05	M	M	S	S	S	S	M	S	S	L	L	M	S

S-Strong, M-Medium,L-Low,N-Not relevant

Unit I: **9**

History Of GPS – BC-4 System – Hiran – NNSS – NAVSTAR GLONASS and GNSs Systems – GPS Constellation – Space Segment – Control Segment – User Segment – Single And Dual Frequency – Point – Relative – Differential GPS – Static And Kinematic Positioning – 2d And 3d – Reporting Anti Spoofing (As); Selective Availability (Sa) – DOP Factors.

Unit II: **9**

Coordinate Systems – Geo Centric Coordinate System – Conventional Terrestrial Reference System – Orbit Description – Keplerian Orbit – Kepler Elements – Satellite Visibility – Topocentric Motion – Disturbed Satellite Motion – Perturbed Motion – Disturbing Accelerations - Perturbed Orbit – Time Systems – Astronomical Time System – Atomic Time – GPS Time – Need For Coordination – Link To Earth Rotation – Time and Earth Motion Services.

Unit III: **9**

C/A Code; P-Code; Y-Code; L1, L2 Carrier Frequencies – Code Pseudo Ranges – Carries Phases – Pseudo Ranges – Satellite Signal Signature – Navigation Messages And Formats – Undifferencedand Differenced Range Models – Delta Ranges – Signal Processing And Processing Techniques – Tracking Networks – Ephemerides – Data Combination: Narrow Lane; Wide Lane – OTF Ambiguity.

Unit IV: **9**

Propagation Media – Multipath – Antenna Phase Centre – Atmosphere In Brief – Elements Of Wave Propagation – Ionospheric Effects On GPS Observations – Code Delay – Phase Advances – Integer Bias – Clock Error – Cycle Slip – Noise-Bias – Blunders – Tropospheric Effects On GPS Oberservables – Multipath Effect – Antenna Phase Centre Problems And Correction.

Unit V: **9**

Inter Disciplinary Applications – Crystal Dynamics – Gravity Field Mapping – Atmospheric Occulation – Surveying – Geophysics – Air Borne GPS – Ground Transportation – Space Borne GPS – Metrological And Climate Research Using GPS.

TOTAL: 45 HOURS

REFERENCES

1. B.Hoffman - Wellenhof, H.Lichtenegger and J.Collins, "GPS: Theory and Practice", 4th revised edition, Springer, Wein, New york,1997
2. A.Leick, "GPS Satellites Surveying", 2nd edition, John Wiley & Sons,NewYork,1995
3. B.Parkinson, J.Spilker, Jr.(Eds), "GPS: Theory and Applications", Vol.I&Vol.II, AIAA, 370 L'Enfant Promenade SW, Washington, DC 20024, 1996
4. A.Kleusberg and P.Teunisen(Eds), “GPS for Geodesy”, Springer-Verlag, Berlin,1996
5. L.Adams, "The GPS - A Shared National Asset”, Chair, National Academy Press, Washington, DC, 1995
6. http://www.auslig.gov.au
7. http://igscb.jpl.nasa.gov
8. http://gibs.leipzig.ifag.de
9. http://www.navcen.uscg.mil

EC35A7	HIGH SPEED SWITCHING ARCHITECTURE	L	T	P	C
		3	0	0	3

OBJECTIVES

- Students will get an introduction about various high speed networks.
- Students will be provided with an up-to-date survey of developments in High Speed Networks.
- Enable the students to know techniques involved in LAN switching and ATM switching.
- Students will get an introduction about various Queuing techniques involved in high speed networks

Course Outcome		Cognitive Skill
CO-01	Able to understand the concept of various high speed networks.	U
CO-02	Able to of understand the developments in High Speed Networks.	R
CO-03	Able to do analysis on LAN switching	An
CO-04	Able to apply the queuing techniques in high speed networks	A
CO-05	Able to evaluate the performance of switching networks	E

R-Remember, U-Understand, A-Apply, An-Analyze, E-Evaluate, S-Synthesis

Mapping of Course Outcome with Programme Outcome

PO / CO	PO-A	PO-B	PO-C	PO-D	PO-E	PO-F	PO-G	PO-H	PO-I	PO-J	PO-K	PO-L	PO-M
CO-01	M	S	S	M	S	S	S	S	M	S	L	L	M
CO-02	S	M	S	S	M	S	S	S	S	S	L	L	M
CO-03	M	S	M	S	M	M	M	S	S	S	S	L	M
CO-04	S	S	S	M	M	M	S	M	S	L	L	M	M
CO-05	M	S	S	S	M	S	M	S	S	S	L	L	L

S-Strong, M-Medium,L-Low,N-Not relevant

Unit I: High Speed Network **9**

Introduction- LAN, WAN, Network Evolution Through ISDN To B-ISDN, Transfer Mode And Control Of B-ISDN, SDH Multiplexing Structure, ATM Standard, ATM Adaptation Layers.

Unit II: LAN Switching Technology **9**

Switching Concepts, Switch Forwarding Techniques, Switch Path Control, LAN Switching, Cut Through Forwarding, Store and Forward, Virtual Lans

Unit III: ATM Switching Architecture **9**

Switch Model, Blocking Networks - Basic - and- Enhanced Banyan Networks, Sorting Networks - Merge Sorting, Re-Arrangable Networks - Full-and- Partial Connection Networks, Non Blocking Networks - Recursive Network Construction, Comparison Of Non-Blocking Network, Switching With Deflection Routing - Shuffle Switch, Tandem Banyan

Unit IV: Queues in ATM Switches **9**

Internal Queueing -Input, Output and Shared Queueing, Multiple Queueing Networks – Combined Input, Output and Shared Queueing - Performance Analysis of Queued Switches.

Unit V: IP Switching **9**

Addressing Model, IP Switching Types - Flow Driven and Topology Driven Solutions, IP OverATM Address and Next Hop Resolution, Multicasting, IPV6 Over ATM.

Total: 45 Hours

REFERENCES

1. Achillepattavina, Switching Theory: Architectures and Performance In Broadband Atm Networks "John Wiley & Sons Ltd, New York. 1998
2. Christopher Y Metz, Switching Protocols & Architectures, Mcgraw - Hill Professional Publishing, Newyork.1998.
3. Rainer Handel, Manfred N Huber, Stefan Schroder, Atm Networks - Concepts Protocols, Applications Iii Edition, Addison Wesley, New York. 1999.
4. John A.Chiong: Internetworking AtmFor The Internet And Enterprise Networks. Mcgraw Hill, New York, 1998.

EC35A8	RF SYSTEM DESIGN	L	T	P	C
		3	0	0	3

OBJECTIVES

- To have a basics of RF design
- To get an idea about the filter designed for RF communication.
- To discuss about the various active and components and their applications
- To study about the RF amplifier design.

Course Outcome		Cognitive Skill
CO-01	Understand the concepts of basics of RF design	R
CO-02	Familiar with the concepts of various RF Filter design	A
CO-03	Able to gain the knowledge of different active RF components and its applications.	U
CO-04	Understand the concepts and design of RF Amplifiers	U
CO-05	Familiar with the design of RF oscillators and its uses	A

R-Remember, U-Understand, A-Apply, An-Analyze, E-Evaluate, S-Synthesis

Mapping of Course Outcome with Programme Outcome

PO / CO	PO-A	PO-B	PO-C	PO-D	PO-E	PO-F	PO-G	PO-H	PO-I	PO-J	PO-K	PO-L	PO-M
CO-01	S	S	S	S	M	S	M	M	M	L	L	L	S
CO-02	S	M	S	S	S	S	M	S	M	S	L	L	M
CO-03	S	M	M	S	S	M	S	S	M	S	M	S	L
CO-04	M	S	S	M	M	S	S	S	S	M	S	M	S
CO-05	M	S	M	M	S	S	M	M	S	M	M	M	M

S-Strong, M-Medium,L-Low,N-Not relevant

Unit I: RF Issues **9**

Importance of RF Design, Electromagnetic Spectrum, RF Behaviour of Passive Components, Chip Components and Circuit Board Considerations, Scattering Parameters, Smith Chart and Applications.

Unit II: RF Filter Design 9

Overview, Basic Resonator And Filter Configuration, Special Filter Realizations, Filter Implementations, Coupled Filter.

Unit III: Active RF Components & Applications **9**

RF Diodes, Bjt, RF FETs, High Electron Mobility Transistors; Matching And Biasing Networks – Impedance Matching Using Discrete Components, Microstripline Matching Networks, Amplifier Classes Of Operation And Biasing Networks.

Unit IV: RF Amplifier Designs 9

Characteristics, Amplifier Power Relations, Stability Considerations, Constant Gain Circles, Constant VSWR Circles, Low Noise Circuits, Broadband, High Power and Multistage Amplifiers.

Unit V: Oscillators, Mixers & Applications **9**

Basic Oscillator Model, High Frequency Oscillator Configuration, Basic Characteristics of Mixers; Phase Locked Loops; RFDirectional Couplers and Hybrid Couplers; Detector and Demodulator Circuits.

TOTAL: 45 HOURS

REFERENCES:

1. Reinhold Ludwig and Powel Bretchko, RF Circuit Design – Theory and Applications, Pearson Education Asia, First Edition, 2001.
2. Joseph . J. Carr, Secrets of RF Circuit Design , McGraw Hill Publishers, Third Edition, 2000.
3. Mathew M. Radmanesh, Radio Frequency & Microwave Electronics, Pearson Education Asia, Second Edition, 2002.
4. Ulrich L. Rohde and David P. NewKirk, RF / Microwave Circuit Design, John Wiley & Sons USA 2000.
5. Roland E. Best, Phase - Locked Loops : Design, simulation and applications, McGraw Hill Publishers 5TH edition 2003.

EC35A9	DIGITAL IMAGE PROCESSING AND APPLICATIONS	L	T	P	C
		3	0	0	3

OBJECTIVES

- To study the image fundamentals and mathematical transforms necessary for image processing.
- To study the image enhancement techniques
- To study image restoration procedures.
- To study the image compression procedures.
- To study the image segmentation and representation techniques.

Course Outcome		Cognitive Skill
CO-01	Familiar with the basics of Digital Image Processing system and the basic preliminaries	R
CO-02	Idea about the various 2D Separable image Transforms	U
CO-03	Knowledge about Image Filtering & 2D Image Degradation model	U
CO-04	Discussion about the various segmentation techniques	A
CO-05	Design of various Image compression Techniques	E

R-Remember,U-Understand,A-Apply,An-Analyze,E-Evaluate, S-Synthesis

Mapping of Course Outcome with Programme Outcome

PO / CO	PO-A	PO-B	PO-C	PO-D	PO-E	PO-F	PO-G	PO-H	PO-I	PO-J	PO-K	PO-L	PO-M
CO-01	S	S	S	S	M	M	L	S	S	S	S	M	M
CO-02	S	S	S	M	M	L	S	S	S	M	M	L	S
CO-03	S	M	S	M	M	L	L	S	M	S	M	M	L
CO-04	S	S	M	M	M	L	M	M	M	S	S	L	L
CO-05	S	S	M	M	M	L	S	S	S	M	M	M	S

S-Strong, M-Medium,L-Low,N-Not relevant

Unit I: Digital Image Fundamentals and Transforms **9**

Elements of Digital Image Processing Systems, Elements of Visual Perception, Psycho Visual Model, Brightness, Contrast, Hue, Saturation, Mach Band Effect, Image Transforms - Discrete Cosine Transform, Walsh Transform, Hadamard Transform, Slant Transform, Haar Transform Discrete Wavelet Transform.

Unit II: Image Enhancement and Restoration **9**

Histogram Modification And Specification Techniques, Noise Distributions, Spatial Averaging, Homomorphic Filtering, Pseudo Color Image Processing, Full Color Image Processing. Image Restoration – Degradation Model, Unconstrained And Constrained Restoration, Wiener Filtering, Geometric Transformations – Spatial Transformations, Gray-Level Interpolation.

Unit III: Image Segmentation, Representation and Description **9**

Point, Line And Edge Detection – Edge Linking Via Hough Transform – Thresholding – Region Based Segmentation, Region Growing, Region Splitting and Merging – Image Representation Schemes – Boundary Descriptors – Regional Descriptors – Relational Descriptors.

Unit IV: Image Compression **9**

Need For Data Compression, Huffman, Shannon Fano Coding, Run Length Encoding, Shift Codes, Arithmetic Coding, Vector Quantization, Block Truncation Coding. Transform Coding – DCT, JPEG, MPEG Standards

Unit V: Applications **9**

Imaging Applications: Patterns and Pattern Classes, Optical Character Recognition- Rule Based Character Recognition- Face and Facial Feature Extraction - Video Motion Analysis- Image Fusion- Watermarking – Spatial & Frequency Domain

TOTAL: 45 HOURS

REFERENCES:

1. Rafael C. Gonzalez, Richard E.Woods, 'Digital Image Processing', Pearson Education, Inc., Second Edition, 2004.
2. Anil K. Jain, 'Fundamentals of Digital Image Processing', Prentice Hall of India, 2002.
3. David Salomon : Data Compression – The Complete Reference, Springer Verlag New York Inc., 2nd Edition, 2001
4. Rafael C. Gonzalez, Richard E.Woods, Steven Eddins, ' Digital Image Processing using MATLAB', Pearson Education, Inc., 2004.
5. William K.Pratt, ' Digital Image Processing', John Wiley, NewYork, 2002.
6. MilmanSonka, Vaclav Hlavac, Roger Boyle, 'Image Processing, Analysis, and Machine Vision', Brooks/Cole, Vikas Publishing House, II ed., 1999.
7. Sid Ahmed, M.A., 'Image Processing Theory, Algorithms and Architectures', McGrawHill, 1995.

EC35B2	HIGH PERFORMANCE COMMUNICATION NETWORKS	L	T	P	C
		3	0	0	3

OBJECTIVES

- To ensure a comprehensive understanding of high speed computer network architectures
- To study mathematical models related to network performance analysis.
- To focus on current and emerging networking technologies.

Course Outcome		Cognitive Skill
CO-01	Able to understand evolution of communication and networking	U
CO-02	Able to identify the existing communication networks around	R
CO-03	Able to analyze the various services provided by the network	An
CO-04	Able to analyze the parameters of networking	An
CO-05	Able to select the wireless network for channel access in various network design	E

R-Remember,U-Understand,A-Apply,An-Analyze,E-Evaluate, S-Synthesis

Mapping of Course Outcome with Programme Outcome

PO / CO	PO-A	PO-B	PO-C	PO-D	PO-E	PO-F	PO-G	PO-H	PO-I	PO-J	PO-K	PO-L	PO-M
CO-01	M	M	S	M	S	M	S	M	M	M	L	M	M
CO-02	M	S	M	S	M	S	S	S	S	M	L	M	L
CO-03	S	S	M	M	S	S	S	S	S	M	M	L	L
CO-04	S	S	M	M	M	M	S	M	S	L	L	M	M
CO-05	S	S	S	S	M	S	S	SM	M	M	M	L	M

S-Strong, M-Medium,L-Low,N-Not relevant

Unit I: Switching Networks **9**

Switching – Packet Switching - Ethernet, Token Ring, FDDI, DQDB, Frame Relay, SMDS, Circuit Switched – SONET, DWDM, DSL, Intelligent Networks – CATV, ATM – Features, Addressing Signaling&Routing,Header Structure, ATM Adaptation Layer, Management Control, BISDN, Internetworking With ATM.

Unit II: Multimedia Networking Applications **9**

Streaming Stored Audio and Video, Best Effort Service, Protocols For Real Time Interactive Applications, Beyond Best Effort, Scheduling and Policing Mechanism, Integrated Services, RSVP- Differentiated Services.

Unit III: Advanced Networks Concepts **9**

VPN-Remote-Access VPN, Site-to-Site VPN, Tunneling to PPP, Security in VPN.MPLS-Operation, Routing, Tunneling And Use Of FEC, Traffic Engineering, and MPLS Based VPN, Overlay Networks p2p Connections-IPV4 Vs. V6.

Unit IV:Packet Queues and Delay Analysis **9**

Little's Theorem, Birth and Death Process, Queueing Discipline- Control & Stability -, Markovian FIFO Queueing System, Non-Markovian - Pollaczek-Khinchin Formula and M/G/1, M/D/1, Self-Similar Models and Batch-Arrival Model, Networks of Queues – Burke's Theorem and Jackson Theorem.

Unit V: Network Security and Management **9**

Principles of Cryptography – Elliptic-AES- Authentication – Integrity – Key Distribution and Certification – Access Control and: Fire Walls – DOS-Attacks and Counter Measures – Security in Many Layers. Infrastructure for Network Management – The Internet Standard Management Framework – SMI, MIB, SNMP, Security and Administration – ASN.1.

TOTAL: 45 HOURS

REFERENCES:

1. Aunurag Kumar, D. Manjunath, Joy Kuri, "Communication Networking", Morgan Kaufmann Publishers, 2011.
2. J.F. Kurose & K.W. Ross, "Computer Networking- A Top Down Approach Featuring the Internet", Pearson, 2nd Edition, 2003.
3. Nader F.Mir, "Computer and Communication Networks", Pearson Education, 2009.
4. Walrand .J. Varatya, "High Performance Communication Network", Morgan Kaufmann – Harcourt Asia Pvt. Ltd., 2nd Edition, 2000.
5. HersentGurle& petit, "IP Telephony, Packet Pored Multimedia Communication Systems", Pearson Education 2003.
6. Fred Halsall and Lingana Gouda Kulkarni, "Computer Networking and the Internet", Fifth Edition, Pearson Education, 2012.
7. Larry L.Peterson& Bruce S.David, "Computer Networks: A System Approach"- Morgan Kaufmann Publisher, 1996.

OPEN ELECTIVES

EC35B1	FUNDAMENTAL OF SOFT COMPUTING TECHNIQUES	L	T	P	C
		3	0	0	3

OBJECTIVES

To introduce the techniques of soft computing and adaptive neuro-fuzzy inferencing systems which differ from conventional AI and computing in terms of its tolerance to imprecision and uncertainty.

- To introduce the ideas of fuzzy sets, fuzzy logic and use of heuristics based on human experience
- To become familiar with neural networks that can learn from available examples and generalize to form appropriate rules for inferencing systems
- To provide the mathematical background for carrying out the optimization associated with neural network learning
- To familiarize with genetic algorithms and other random search procedures useful while seeking global optimum in self-learning situations

Course Outcome		Cognitive Skill
CO-01	To understand the concepts of ANN, different features of fuzzy logic and their modeling, control aspects and different hybrid control schemes.	U
CO-02	To understand the basics of artificial neural network.	U
CO-03	To get knowledge on modeling and control of artificial neural network.	R
CO-04	To get knowledge on modeling and control of fuzzy control schemes.	U, R
CO-05	To acquire knowledge on hybrid control schemes.	A

R-Remember,U-Understand,A-Apply,An-Analyze,E-Evaluate, S-Synthesis

Mapping of Course Outcome with Programme Outcome

PO / CO	PO-A	PO-B	PO-C	PO-D	PO-E	PO-F	PO-G	PO-H	PO-I	PO-J	PO-K	PO-L	PO-M
CO-01	M	M	S	M	M	S	S	M	S	N	M	M	S
CO-02	M	M	S	M	M	S	M	M	S	N	M	M	S
CO-03	M	M	S	M	M	S	M	M	S	N	S	L	S
CO-04	M	M	S	M	M	S	M	M	S	N	M	L	S
CO-05	M	M	S	M	M	S	M	M	S	N	M	L	S

S-Strong, M-Medium,L-Low,N-Not relevant

Unit I: Artificial Neural Networks **9**

Basic Concepts-Single Layer Perceptron-Multi Layer Perceptron-Adaline-Madaline-Learning Rules-Supervised Learning-Back Propagation Networks-Training Algorithm, Practical Difficulties, Advanced Algorithms-Adaptive Network- Radial Basis Network-Modular Network-Applications

Unit II: Unsupervised Networks **9**

Introduction- Unsupervised Learning -Competitive Learning Networks-Kohonen Self Organising Networks-Learning Vector Quantisation - Hebbian Learning - Hopfield Network-Content Addressable Nature, Binary Hopfield Network, Continuous Hopfield Network Travelling Salesperson Problem - Adaptive Resonance Theory –Bidirectional Associative Memory-Principle Component Analysis

Unit III: Fuzzy Systems **9**

Fuzzy Sets-Fuzzy Rules: Extension Principle, Fuzzy Relation- Fuzzy Reasoning – Fuzzy Inference Systems: Mamdani Model, Sugeno Model. Tsukamoto Model -Fuzzy Decision Making- Multiobjective Decision Making,-Fuzzy Classification-Fuzzy Control Methods - Application

Unit IV: Neuro-Fuzzy Modelling **9**

Adaptive Neuro Fuzzy Based Inference Systems – Classification and Regression Trees: Decision Tress, Cart Algorithm – Data Clustering Algorithms: K Means Clustering, Fuzzy C Means Clustering, Mountain Clustering, Subtractive Clustering – Rule Base Structure Identification – Neuro Fuzzy Control: Feedback Control Systems, Expert Control, Inverse Learning, Specialized Learning, Back Propagation Through Real –Time Recurrent Learning.

Unit V: Genetic Algorithm **9**

Fundamentals of Genetic Algorithm-Mathematical Foundations-Genetic Modeling-Survival of the Fittest-Crossover-Inversion and Deletion-Mutation-Reproduction-Generational Cycle-Rank Method-Rank Space Method- Other Derivative Free Optimization-Simulated Annealing, Random Search, Downhill Simplex Search-Application

TOTAL: 45 HOURS

REFERENCES

1. Jang J.S.R.,Sun C.T and Mizutani E – "Neuro Fuzzy and Soft computing", Pearson education (Singapore) 2004
2. David E.Goldberg : "Genetic Algorithms in Search, Optimization, and Machine Learning", Pearson Education, Asia, 1996
3. LaureneFauseett:"Fundamentals of Neural Networks", Prentice Hall India, New Delhi, 1994.
4. Timothy J.Ross:"Fuzzy Logic Engineering Applications", McGraw Hill, NewYork, 1997.
5. S.Rajasekaran and G.A.VijayalakshmiPai "Neural networks,Fuzzylogics,and Genetic algorithms", Prentice Hall of India, 2003
6. George J.Klir and Bo Yuan,"Fuzzy Sets and Fuzzy Logic",Prentice Hall Inc., New Jersey, 1995

GE35A1	BUSINESS ANALYTICS	L	T	P	C
		3	0	0	3

OBJECTIVES

- To make students understandable about the Regression Analysis, Business analytics, forecasting and decision analysis.

Course Outcome		Cognitive Skill
CO-01	Ability to understand the concepts of Business Analytics.	U,R
CO-02	Can understand the factors of Trendiness and Regression analysis.	U,R
CO-03	Students can understand about organization structures of business analytics.	U,R
CO-04	One can understand the concepts of Forecasting Techniques.	U,R
CO-05	Can understand the Decision analysis.	U,R

R-Remember, U-Understand, A-Apply, An-Analyze, E-Evaluate, S-Synthesis

Mapping of Course Outcome with Programme Outcome

PO / CO	PO-A	PO-B	PO-C	PO-D	PO-E	PO-F	PO-G	PO-H	PO-I	PO-J	PO-K	PO-L
CO-01	S	S	M	M	M	S	S	M	S	S	S	M
CO-02	S	S	M	M	M	S	S	M	S	S	S	M
CO-03	S	S	M	M	M	S	S	M	S	S	S	M
CO-04	S	S	M	M	M	S	S	M	S	S	S	M
CO-05	S	S	M	M	M	S	S	M	S	S	S	M

S-Strong, M-Medium,L-Low,N-Not relevant

Unit I: Business Analytics **9**

Overview of Business Analytics, Scope of Business Analytics, Business Analytics Process, Relationship Of Business Analytics Process and Organization, Competitive Advantages of Business Analytics.Statistical Tools: Statistical Notation, Descriptive Statistical Methods, Review of Probability Distribution and Data Modeling, Sampling and Estimation Methods Overview.

Unit II: Trendiness and Regression Analysis **9**

Modeling Relationships and Trends in Data, Simple Linear Regression.Important Resources, Business Analytics Personnel, Data and Models for Business Analytics, Problem Solving, Visualizing and Exploring Data, Business Analytics Technology.

Unit III: Organization Structures of Business Analytics **9**

Team Management, Management Issues, Designing Information Policy, Outsourcing, Ensuring Data Quality, Measuring Contribution of Business Analytics, Managing Changes.Descriptive Analytics, Predictive Analytics, Predicative Modeling, Predictive Analytics Analysis, Data Mining, Data Mining Methodologies, Prescriptive Analytics and Its Step in the Business Analytics Process, Prescriptive Modeling, Nonlinear Optimization.

Unit IV: Forecasting Techniques **9**

Qualitative and Judgmental Forecasting, Statistical Forecasting Models, Forecasting Models for Stationary Time Series, Forecasting Models for Time Series With a Linear Trend, Forecasting Time Series With Seasonality, Regression Forecasting With Casual Variables, Selecting Appropriate Forecasting Models.Monte Carlo Simulation and Risk Analysis: Monte Carle Simulation Using Analytic Solver Platform, New-Product Development Model, Newsvendor Model, Overbooking Model, Cash Budget Model.

Unit V: Decision Analysis **9**

Formulating Decision Problems, Decision Strategies with the Without Outcome Probabilities, Decision Trees, the Value Of Information, Utility And Decision Making. Recent Trends In: Embedded and Collaborative Business Intelligence, Visual DataRecovery, Data Storytelling and Data Journalism.

TOTAL: 45 HOURS

REFERENCES

1. Business analytics Principles, Concepts, and Applications by Marc J. Schniederjans, DaraG.Schniederjans, Christopher M. Starkey, Pearson FT Press.2014
2. Business Analytics by James Evans, persons Education.3rd edition 2018

GE35A2	INDUSTRIAL SAFETY	L	T	P	C
		3	0	0	3

OBJECTIVES

- To make students understandable about the Industrial safety, Maintenance and fault tracing.

Course Outcome		Cognitive Skill
CO-01	Ability to understand the concepts of Industrial Safety.	R,U
CO-02	Can understand the fundamentals of Maintenance Engineering.	R,U,A
CO-03	Students can understand the ways to prevent from wear and corrosion.	R,U,A
CO-04	One can understand the concepts of fault tracing.	R,U,A
CO-05	Can understand the functions of periodic and preventive maintenance.	A

R-Remember, U-Understand, A-Apply, An-Analyze, E-Evaluate, S-Synthesis

Mapping of Course Outcome with Programme Outcome

PO / CO	PO-A	PO-B	PO-C	PO-D	PO-E	PO-F	PO-G	PO-H	PO-I	PO-J	PO-K	PO-L
CO-01	S	M	M	L	L	S	M	S	M	S	S	S
CO-02	M	S	M	M	L	S	M	M	S	S	S	S
CO-03	M	M	L	S	L	S	S	M	M	M	S	S
CO-04	M	S	L	M	L	S	M	S	S	M	S	L
CO-05	M	S	L	M	L	S	S	S	M	S	S	M

S-Strong, M-Medium, L-Low, N-Not relevant

Unit I: Industrial Safety **9**

Accident, Causes, Types, Results And Control, Mechanical and Electrical Hazards, Types, Causes and Preventive Steps/Procedure, Describe Salient Points of Factories Act 1948 For Health and Safety, Wash Rooms, Drinking Water Layouts, Light, Leanliness, Fire, Guarding, Pressure Vessels, Etc, Safety Color Codes. Fire Prevention And Firefighting, Equipment and Methods.

Unit II: Fundamentals of Maintenance Engineering **9**

Definition and Aim of Maintenance Engineering, Primary and Secondary Functions and Responsibility of Maintenance Department, Types of Maintenance, Types and Applications of Tools Used for Maintenance, Maintenance Cost & Its Relation with Replacement Economy, Service Life of Equipment.

Unit III: Wear and Corrosion and their Prevention **9**

Wear- Types, Causes, Effects, Wear Reduction Methods, Lubricants-Types and Applications, Lubrication Methods, General Sketch, Working and Applications, I. Screw Down Grease Cup, II. Pressure Grease Gun, III. Splash Lubrication, IV. Gravity Lubrication, V. Wick Feed Lubrication VI. Side Feed Lubrication, VII. Ring Lubrication, Definition, Principle and Factors Affecting the Corrosion. Types of Corrosion, Corrosion Prevention Methods.

Unit IV: Fault Tracing **9**

Fault Tracing-Concept and Importance, Decision Tree Concept, Need and Applications, Sequence of Fault-Finding Activities, Show as Decision Tree, Draw Decision Tree for Problems in Machine Tools, Hydraulic, Pneumatic, Automotive, Thermal and Electrical Equipment's Like, I. Anyone Machine Tool, II. Pump III. Air Compressor, IV. Internal Combustion Engine, V. Boiler, VI. Electrical Motors, Types of Faults in Machine Tools and Their General Causes.

Unit V: Periodic and Preventive Maintenance: 9

Periodic Inspection-Concept and Need, Degreasing, Cleaning and Repairing Schemes, Overhauling of Mechanical Components, Overhauling of Electrical Motor, Common Troubles and Remedies of Electric Motor, Repair Complexities and Its Use, Definition, Need, Steps and Advantages of Preventive Maintenance. Steps/Procedure for Periodic and Preventive Maintenance of: I. Machine Tools, II. Pumps, III. Air Compressors, IV. Diesel Generating (Dg) Sets, Program and Schedule of Preventive Maintenance of Mechanical and Electrical Equipment, Advantages of Preventive Maintenance. Repair Cycle Concept and Importance.

TOTAL: 45 HOURS

REFERENCES

1. Maintenance Engineering Handbook, Higgins & Morrow, Da Information Services.
2. Maintenance Engineering, H. P. Garg, S. Chand and Company.
3. Pump-hydraulic Compressors, Audels, Mcgrew Hill Publication.
4. Foundation Engineering Handbook, Winterkorn, Hans, Chapman & Hall London.

GE35A3	OPERATIONS RESEARCH	L	T	P	C
		3	0	0	3

OBJECTIVES

- To make students understandable about the optimization techniques

Course Outcome		Cognitive Skill
CO-01	Ability to understand the concepts of Optimization Techniques.	U, An
CO-02	Can understand the fundamentals of LPP formulation.	U, An
CO-03	Students can understand the Non-Linear Programming.	U, An
CO-04	One can understand the concepts Scheduling and Sequencing.	U, An
CO-05	Can understand the functions of Competitive models.	U, An

R-Remember, U-Understand, A-Apply, An-Analyze, E-Evaluate, S-Synthesis

Mapping of Course Outcome with Programme Outcome

PO / CO	PO-A	PO-B	PO-C	PO-D	PO-E	PO-F	PO-G	PO-H	PO-I	PO-J	PO-K	PO-L
CO-01	S	S	M	L	L	M	S	M	S	S	S	L
CO-02	S	S	S	M	L	M	S	M	S	S	S	L
CO-03	S	S	S	L	L	M	S	M	S	S	S	L
CO-04	S	S	S	L	L	M	S	M	S	S	S	L
CO-05	S	S	S	L	L	M	S	M	S	S	S	L

S-Strong, M-Medium, L-Low, N-Not relevant

Unit I: Optimization Techniques: 9

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

Unit II: LPP Formulation 9

Formulation of a LPP - Graphical Solution Revised Simplex Method - Duality Theory - Dual Simplex Method - Sensitivity Analysis - Parametric Programming

Unit III: Nonlinear Programming: 9

Nonlinear Programming Problem - Kuhn-Tucker Conditions Min Cost Flow Problem - Max Flow Problem - CPM/Pert

Unit IV: Scheduling and Sequencing: 9

Single Server and Multiple Server Models - Deterministic Inventory Models - Probabilistic Inventory Control Models - Geometric Programming.

Unit V: Competitive Models: 9

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

TOTAL: 45 HOURS

REFERENCES

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

GE35A4	COST MANAGEMENT OF ENGINEERING PROJECTS	L	T	P	C
		3	0	0	3

OBJECTIVES

- To make students understandable about the cost concepts in decision making and profit planning.

Course Outcome		Cognitive Skill
CO-01	Ability to understand the strategic cost management.	U
CO-02	Can understand the fundamentals of cost concepts in decision making.	U,A
CO-03	Students can understand the process involved in project execution.	A
CO-04	One can understand the concepts of cost behavior and profit planning.	A
CO-05	Can understand the functions of quantitative techniques.	A, An

R-Remember, U-Understand, A-Apply, An-Analyze, E-Evaluate, S-Synthesis

Mapping of Course Outcome with Programme Outcome

PO / CO	PO-A	PO-B	PO-C	PO-D	PO-E	PO-F	PO-G	PO-H	PO-I	PO-J	PO-K	PO-L
CO-01	S	S	M	L	L	M	M	M	L	S	S	L
CO-02	S	S	M	L	L	M	S	S	L	S	S	L
CO-03	S	S	S	L	L	M	M	M	L	S	S	L
CO-04	S	S	S	L	L	M	M	M	L	S	S	L
CO-05	S	S	M	L	L	M	S	S	L	S	S	L

S-Strong, M-Medium,L-Low,N-Not relevant

Unit I: Strategic Cost Management **9**

Introduction and Overview of The Strategic Cost Management Process.

Unit II: Cost Concepts in Decision Making: **9**

Relevant Cost, Differential Cost, Incremental Cost and Opportunity Cost. Objectives of A Costing System; Inventory Valuation; Creation of A Database for Operational Control; Provision of Data for Decision-Making.

Unit III: Project **9**

Meaning, Different Types, Why to Manage, Cost Overruns Centres, Various Stages of Project Execution: Conception to Commissioning. Project Execution as Conglomeration of Technical and Nontechnical Activities. Detailed Engineering Activities. Pre Project-Execution Main Clearances and Documents Project Team: Role of Each Member. Importance Project Site: Data Required With Significance. Project Contracts. Types and Contents. Project Execution Project Cost Control. Bar Charts and Network Diagram. Project Commissioning: Mechanical and Process

Unit IV: Cost Behavior and Profit Planning **9**

Cost Behavior and Profit Planning Marginal Costing; Distinction Between Marginal Costing And Absorption Costing; Break-Even Analysis, Cost-Volume-Profit Analysis. Various Decision-Making Problems.Standard Costing And Variance Analysis. Pricing Strategies: Pareto Analysis. Target Costing, Life Cycle Costing. Costing of Service Sector.Just-In-Time Approach, Material Requirement Planning, Enterprise Resource Planning, Total Quality Management And Theory of Constraints.Activity-Based Cost Management, Bench Marking; Balanced Score Card And Value-Chain Analysis.Budgetary Control; Flexible Budgets; Performance Budgets; Zero-Based Budgets.Measurementof Divisional Profitability Pricing Decisions Including Transfer Pricing.

Unit V: Quantitative Techniques **9**

Quantitative Techniques for Cost Management, Linear Programming, Pert/Cpm, Transportation Problems, Assignment Problems, Simulation, Learning Curve Theory.

TOTAL: 45 HOURS

REFERENCES

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

GE35A5	COMPOSITE MATERIALS	L	T	P	C
		3	0	0	3

OBJECTIVES

- To make students understandable about the material characteristics, processing and classifications of composite materials.

Course Outcome		Cognitive Skill
CO-01	Ability to understand the functional requirements of composite materials.	U,A
CO-02	Can understand the properties and applications of reinforcements.	U,A
CO-03	Students can understand the process involved in metal matrix composite fabrication.	U,A
CO-04	One can understand the concepts of polymer matrix composites fabrication.	U,A,AN
CO-05	Can understand the physical characteristics of composite materials.	R,U,AN

R-Remember, U-Understand, A-Apply, An-Analyze, E-Evaluate, S-Synthesis

Mapping of Course Outcome with Programme Outcome

PO / CO	PO-A	PO-B	PO-C	PO-D	PO-E	PO-F	PO-G	PO-H	PO-I	PO-J	PO-K	PO-L
CO-01	S	M	M	L	L	S	M	S	M	S	S	S
CO-02	S	S	M	M	L	S	M	M	S	S	S	S
CO-03	S	M	S	S	L	S	S	M	M	M	S	S
CO-04	S	S	S	M	L	S	M	S	S	M	S	L
CO-05	S	S	M	M	L	S	S	S	M	S	S	M

S-Strong, M-Medium,L-Low,N-Not relevant

Unit I: Introduction **9**

Definition – Classification and Characteristics of Composite Materials.Advantages and Application of Composites. Functional Requirements of Reinforcement and Matrix. Effect of Reinforcement (Size, Shape, Distribution, Volume Fraction) on Overall Composite Performance.

Unit II: Reinforcements **9**

Preparation-Layup, Curing, Properties and Applications of Glass Fibers, Carbon Fibers, Kevlar Fibers and Boron Fibers. Properties And Applications of Whiskers, Particle Reinforcements. Mechanical Behavior of Composites: Rule of Mixtures, Inverse Rule of Mixtures. Isostrain and Isostress Conditions.

Unit III: Manufacturing of Metal Matrix Composites **9**

Casting – Solid State Diffusion Technique, Cladding – Hot Isostatic pressing. Properties and Applications. Manufacturing of Ceramic Matrix Composites: Liquid Metal Infiltration – Liquid Phase Sintering. Manufacturing of Carbon – Carbon Composites: Knitting, Braiding, Weaving. Properties and Applications.

Unit IV: Manufacturing of Polymer Matrix Composites **9**

Preparation of Moulding Compounds and Prepregs – Hand Layup Method – Autoclave Method – Filament Winding Method – Compression Molding – Reaction Injection Moulding. Properties and Applications.

Unit V: Strength **9**

Laminar Failure Criteria-Strength Ratio, Maximum Stress Criteria, Maximum Strain Criteria, Interacting Failure Criteria, Hygro Thermal Failure. Laminate First Play Failure-Insight Strength; Laminate Strength-Ply Discount Truncated Maximum Strain Criterion; Strength Design Using Caplet Plots; Stress Concentrations.

TOTAL: 45 HOURS

TEXT BOOKS

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

REFERENCES

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

GE35A6	WASTE TO ENERGY	L	T	P	C
		3	0	0	3

OBJECTIVES

- To make students understandable about the gasification process, bio materials and its design considerations.

Course Outcome		Cognitive Skill
CO-01	Ability to understand the process of obtaining Energy from waste substances.	U
CO-02	Can understand manufacturing of pyrolytic oils and gases, yields and applications.	A
CO-03	Students can understand kinetic consideration in gasifier operation.	U
CO-04	One can understand the Design, construction and operation of Bio Mass chamber.	E
CO-05	Can understand the basic Properties of biogas	R

R-Remember, U-Understand, A-Apply, An-Analyze, E-Evaluate, S-Synthesis

Mapping of Course Outcome with Programme Outcome

PO / CO	PO-A	PO-B	PO-C	PO-D	PO-E	PO-F	PO-G	PO-H	PO-I	PO-J	PO-K	PO-L
CO-01	S	M	M	M	M	M	M	M	M	M	L	M
CO-02	S	S	M	M	M	M	M	M	M	M	L	M
CO-03	S	S	M	M	M	M	M	M	M	M	L	M
CO-04	S	S	M	M	M	M	M	M	M	M	L	M
CO-05	S	M	M	M	M	M	M	M	M	M	L	M

S-Strong, M-Medium,L-Low,N-Not relevant

Unit I: Introduction to Energy from Waste **9**

Classification of Waste as Fuel – Agro Based, Forest Residue, Industrial Waste - MSW – Conversion Devices – Incinerators, Gasifiers, Digestors.

Unit II: Biomass Pyrolysis: Pyrolysis **9**

Types, Slow Fast – Manufacture of Charcoal – Methods -Yields and Application – Manufacture of Pyrolytic Oils and Gases, Yields and Applications.

Unit III: Biomass Gasification **9**

Gasifiers – Fixed Bed System – Downdraft and Updraft Gasifiers –Fluidized Bed Gasifiers – Design, Construction and Operation – Gasifier Burner Arrangement for Thermal Heating – Gasifier Engine Arrangement and Electrical Power – Equilibrium and Kinetic Consideration in Gasifier Operation.

Unit IV: Biomass Combustion **9**

Biomass Stoves – Improved Chullahs, Types, Some Exotic Designs, Fixed Bed Combustors, Types, Inclined Grate Combustors, Fluidized Bed Combustors, Design, Construction and Operation - Operation of All the Above Biomass Combustors.

Unit V: Biogas **9**

Properties of Biogas (Calorific Value and Composition) - Biogas Plant Technology and Status - Bio Energy System - Design and Constructional Features - Biomass Resources and Their Classification - Biomass Conversion Processes - Thermo Chemical Conversion - Direct Combustion - Biomass Gasification - Pyrolysis and Liquefaction - Biochemical Conversion - Anaerobic Digestion - Types of Biogas Plants – Applications - Alcohol Production From Biomass - Bio Diesel Production - Urban Waste to Energy Conversion - Biomass Energy Programme in India.

TOTAL: 45 HOURS

REFERENCES

1. Non Conventional Energy, Desai, Ashok V., Wiley Eastern Ltd., 2003.
2. Biogas Technology - A Practical Hand Book - Khandelwal, K. C. and Mahdi, S. S., Vol. I & II, Tata McGraw Hill Publishing Co. Ltd., 1983.
3. Food, Feed and Fuel from Biomass, Challal, D. S., IBH Publishing Co. Pvt. Ltd., 1991.
4. Biomass Conversion and Technology, C. Y. WereKo-Brobby and E. B. Hagan, John Wiley& Sons, 1996.