KERALA TECHNOLOGICAL UNIVERSITY

Master of Technology

Curriculum, Syllabus and Course Plan

Cluster	:	*1*
Branch	:	*Electronics & Communication*
Stream	:	*Telecommunication*
Year	:	*2015*
No. of Credits	:	*67*

SEMESTER 1

Examination Slot	Course Number	Name	L-T-P	Internal Marks	End Semester Examination		Credits
					Marks	Duration (hours)	
A	01EC6301	Applied Linear Algebra	3-0-0	40	60	3	3
B	01EC6303	Random Processes and Applications	3-1-0	40	60	3	4
C	01EC6205	Advanced Digital Communication	3-1-0	40	60	3	4
D	01EC6105	Advanced Digital Signal Processing	3-0-0	40	60	3	3
E		Elective I	3-0-0	40	60	3	3
S	01EC6999	Research Methodology	0-2-0	100			2
T	01EC6591	Seminar I	0-0-2	100			2
U	01EC6593	Telecommunication Lab I	0-0-2	100			1
		TOTAL	**15-4-4**	**500**	**300**	**-**	**22**

TOTAL CONTACT HOURS : 23
TOTAL CREDITS : 22

Elective I

01EC6211	Optical Communication Systems
01EC6213	Modelling and Simulation of Communication Systems
01EC6515	Spread Spectrum and CDMA Systems

SEMESTER 2

Examination Slot	Course Number	Name	L-T-P	Internal Marks	End Semester Examination		Credits
					Marks	Duration (hours)	
A	01EC6302	Estimation and Detection Theory	3-1-0	40	60	3	4
B	01EC6204	Antenna Theory and Design	3-0-0	40	60	3	3
C	01EC6506	Wireless Communication and Networks	3-0-0	40	60	3	3
D		Elective II	3-0-0	40	60	3	3
E		Elective III	3-0-0	40	60	3	3
V	01EC6592	Mini Project	0-0-4	100			2
U	01EC6594	Telecommunication Lab II	0-0-2	100			1
		TOTAL	**15-1-6**	**400**	**300**	**-**	**19**

TOTAL CONTACT HOURS : 22
TOTAL CREDITS : 19

Elective II

01EC6312 Adaptive Signal Processing
01EC6514 Digital Microwave Communication
01EC6516 Embedded Systems for Communication

Elective III

01EC6518 Information Theory
01EC6522 Image and Video Processing
01EC6524 High Performance Communication Networks

SEMESTER 3

Examination Slot	Course Number	Name	L-T-P	Internal Marks	End Semester Examination		Credits
					Marks	Duration (hours)	
A		Elective IV	3-0-0	40	60	3	3
B		Elective V	3-0-0	40	60	3	3
T	01EC7591	Seminar II	0-0-2	100			2
W	01EC7593	Project (Phase 1)	0-0-12	50			6
		TOTAL	**6-0-14**	**230**	**120**	**-**	**14**

TOTAL CONTACT HOURS : 20
TOTAL CREDITS : 14

Elective IV

01EC7511 Neuro Fuzzy Systems
01EC7213 Secure Communication
01EC7313 Space Time Coding and MIMO Systems

Elective V

01EC7515 WDM Optical Network and Optical switching
01EC7517 RF MEMS
01EC7519 Radio Frequency System Design

SEMESTER 4

Examination Slot	Course Number	Name	L-T-P	Internal Marks	End Semester Examination		Credit
					Marks	Duration (hours)	
W	01EC7594	Project (Phase 2)	0-0-23	70	30		12
		TOTAL	**0-0-23**	**70**	**30**	**-**	**12**

TOTAL CONTACT HOURS : 23
TOTAL CREDITS : 12

TOTAL NUMBER OF CREDITS: 67

SEMESTER - I

Syllabus and Course Plan

Course No.	Course Name	L-T-P	Credits	Year of Introduction
01EC6301	Applied Linear Algebra	**3-0-0**	**3**	**2015**

Course Objectives

1. To develop the skills in abstract algebra
2. To develop the skills to identify linear transformation and transforms and its role in linear systems
3. To develop the skills to formulate linear transformation problems in matrix form

Syllabus

Vector spaces, Linear independence, Linear Transformation, Coordinate transformation, System of linear equations, projection, pseudo inverse, Generalized Eigen vectors, Singular Value Decomposition

Expected Outcome

1. Understand the formulation of problems in abstract algebra framework
2. Understand and represent linear transformations
3. Understand the role of matrices in linear transformation representations

References

1. G. F. Simmons, Topology and Modern Analysis , McGraw Hill
2. Frazier, Michael W, An Introduction to Wavelets Through Linear Algebra, Springer Publications.
3. Hoffman Kenneth and Kunze Ray, Linear Algebra, Prentice Hall of India.
4. Reichard Bronson, Academic Press

COURSE PLAN			
Module	**Contents**	**Hours Allotted**	**% of Marks in End-Semester**
I	Algebraic Structures: Group, Ring, Field Vector Spaces, Subspaces, Linear Combinations, Subspace spanned by set of vectors, Linear dependence and Linear independence, Spanning set and basis, Finite dimensional vector spaces	7	15
II	Solutions to Linear System of Equations : Simple systems, Homogeneous and Non-homogeneous systems, Gaussian elimination, Null Space and Range, Rank and nullity Consistency conditions in terms of rank, General Solution of a linear system, Elementary Row and Column operations, Row Reduced Form, existence and uniqueness of solutions, projection, least square solution -pseudo inverse.	7	15
FIRST INTERNAL EXAM			
III	Linear Transformations -four fundamental subspaces of linear transformation -inverse transformation - rank nullity theorem - Matrix representation of linear transformation, Change of Basis operation	7	15
IV	Inner product, Inner product Spaces, Cauchy – Schwarz inequality, Norm, Orthogonality, Gram – Schmidt orthonormalization, Orthonormal basis, Expansion in terms of orthonormal basis, Orthogonal complement, Decomposition of a vector with respect to a subspace and its orthogonal complement – Pythagoras Theorem	7	15
SECOND INTERNAL EXAM			
V	Eigenvalue – Eigenvector pairs, characteristic equation Algebraic multiplicity, Eigenvectors, Eigenspaces and geometric multiplicity, Diagonalization criterion The diagonalizing matrix, Projections, Decomposition of the matrix in terms of projections, Real Symmetric and Hermitian matrices , Properties of Eigen values, Eigen vectors, Unitary/Orthogonal diagonalizability of Complex Hermitian/Real Symmetric Matrices, Spectral Theorem, Positive and Negative Definite and Semi Definite matrices.	7	20
VI	General Matrices : Rank, Nullity, Range and Null Space of AA^T and A^TA, Singular Values, Singular Value Decomposition, Pseudoinverse and Optimal solution of a linear system of equations, The Geometry of Pseudoinverse	7	20
END SEMESTER EXAM			

Course No.	Course Name	L-T-P	Credits	Year of Introduction

Cluster: *1* Branch: *Electronics & Communication Engineering* Stream: *Telecommunication*

01EC6303	Random Processes and Applications	**3-1-0**	**4**	**2015**

Course Objectives

1. To provide necessary basic concepts in statistical signal analysis
2. To study about random processes and its properties
3. Apply the basic concepts to various elementary and some advanced applications

Syllabus

Probability theory, Random variable, Probability Density function, Conditional and Joint Distributions and densities, Functions of Random Variables, Expectation, Conditional Expectations, Random Vector, Random Processes, Chapman- Kolmogorov Equations, WSS Processes and LTI Systems, Inequalities, Central limit theorem, Random Sequences, Advanced Topics.

Expected Outcome

1. Have a fundamental knowledge of the basic probability concepts
2. Have a good knowledge of standard distributions which can describe real life phenomena
3. Acquire skills in handling situations involving several random variable and functions of random variables
4. Understand and characterize phenomena which evolve with respect to time in probabilistic manner

References

1. Henry Stark and John W. Woods, "Probability and Random Processes with Applications to Signal Processing", Pearson Education, Third edition.
2. Athanasios Papoulis and S. Unnikrishna Pillai, Probability, Random Variables and Stochastic Processes, TMH
3. Gray, R. M. and Davisson L. D., An Introduction to Statistical Signal Processing. Cambridge University Press, 2004 (Available at: http://www.ee.stanford.edu/~gray/sp.pdf)
4. Oliver C. Ibe. , Fundamentals of Applied Probability and Random Process, Elseiver, 2005.

COURSE PLAN			
Module	**Contents**	**Hours Allotted**	**% of Marks in End-Semester**
I	Introduction: Sets, Fields and Events, Definition of probability, Joint, Conditional and Total Probability, Bayes' Theorem and applications. Random Variable:- Definition, Probability Distribution Function, Probability Density function, Common density functions, Continuous, Discrete and Mixed random Variables.	8	12
II	Conditional and Joint Distributions and densities, independence of random variables. Functions of Random Variables: One function of one random variable, One function of two random variables, Two functions of two random variables.	10	18
FIRST INTERNAL EXAM			
III	Expectation: Fundamental Theorem of expectation, Moments, Joint moments, Moment Generating functions, Characteristic functions, Conditional Expectations, Correlation and Covariance, Jointly Gaussian Random Variables. Random Vector: - Definition, Joint statistics, Covariance matrix and its properties.	10	15
IV	Random Processes: -Basic Definitions, Poisson Process, Wiener Process, Markov Process, Birth- Death Markov Chains, Chapman-Kolmogorov Equations, Stationarity, Wide sense Markov Process Stationarity, WSS Processes and LTI Systems, Power spectral density, White Noise.	10	15
SECOND INTERNAL EXAM			
V	Chebyshev and Schwarz Inequalities, Chernoff Bound, Central Limit Theorem. Random Sequences: Basic Concepts, WSS sequences and linear systems, Markov Random sequences, Markov Chains, Convergence of Random Sequences: Definitions, Laws of large numbers.	10	24
VI	Advanced Topics: Ergodicity, Karhunen- Leove Expansion, Representation of Bandlimited and periodic Processes: WSS periodic Processes, Fourier Series for WSS Processes	8	16
END SEMESTER EXAM			

Course No.	Course Name	L-T-P	Credits	Year of Introduction
01EC6205	Advanced Digital Communication	**3-1-0**	**4**	**2015**

Course Objectives

1. To introduce the different aspects of digital communication over various channels, from design through performance issues to application requirement.
2. To give an idea on the advances in Multichannel and Multicarrier Systems design.

Syllabus

Digital Communication over Additive Gaussian Noise Channels- Optimum waveform receiver in additive white Gaussian noise. Digital Communication over Band limited Channels- Optimum receiver for channels with ISI and AWGN- Equalization Techniques. Spread spectrum Communication- modelling, application and synchronization of spread spectrum signals. Digital Communication over Fading Multipath Channels. Multiuser Communication - techniques and capacity.

Expected Outcome

1. Understand the design issues of Digital Communication over Additive Gaussian Noise Channels, over Band limited Channels and Fading Multipath Channels.
2. Understand the design issues in spread spectrum and multicarrier systems.
3. Understand various digital communication receivers and equalization

References

1. John G. Proakis, Digital Communications, 4/e, McGraw-Hill
2. Edward. A. Lee and David. G. Messerschmitt, “Digital Communication”, Allied Publishers (second edition).
3. Viterbi, A. J., and J. K. Omura. Principles of Digital Communication and Coding. NY: McGraw-Hill, 1979. ISBN: 0070675163.
4. Marvin K Simon, Sami M Hinedi, William C Lindsey - Digital Communication -Techniques – Signal Design & Detection, PHI.
5. Bernard Sklar,” Digital Communications: Fundamentals and applications “, Prentice Hall 2001.
6. Andrea Goldsmith,” Wireless Communications”, Cambridge University Press 2005.

COURSE PLAN

Module	Contents	Hours Allotted	% of Marks in End-Semester
I	Characterization of Communication Signals and Systems: Representation of bandpass signals and systems. Signal space representation. Representation of digitally modulated signals: memoryless modulation methods, linear modulation with memory. Power spectra, Bandwidth efficiency.	8	15
II	Optimum receiver for additive white Gaussian noise channel: correlation demodulator, matched filter demodulator, optimum detector. Performance of optimum receiver for memoryless modulation techniques: probability of error for binary modulation and M-ary orthogonal signals, QPSK, QAM.	10	15
FIRST INTERNAL EXAM			
III	Communication through band limited channels: Signal design for bandlimited channels. Optimum receiver for channels with ISI and AWGN. Equalization techniques: Linear equalization, Decision feedback equalization, ML detectors. Adaptive equalization: Algorithms	10	15
IV	Multicarrier Systems: Data transmission with multiple carriers, Multicarrier modulation with overlapping subchannels, Mitigation of subcarrier fading. Discrete implementation of multicarrier modulation. Challenges in multicarrier systems.	8	15
SECOND INTERNAL EXAM			
V	Digital communication through fading multipath channel: characterisation of fading multipath channel. The effect of signal characteristics on the choice of a channel model. Frequency-non selective slowly fading channel. Digital signalling over a frequency-selective slowly fading channel.	10	20
VI	Multiple access techniques- Capacity of multiple access methods. Spread spectrum principles, processing gain and jamming margin. Direct sequence spread spectrum (DSSS), Frequency Hopping Spread Spectrum (FHSS). Synchronisation of spread spectrum systems. CDMA signal and channel models, optimum receiver. Random access methods.	10	20
END SEMESTER EXAM			

Course No.	Course Name	L-T-P	Credits	Year of Introduction

01EC6105	Advanced Digital Signal Processing	**3-0-0**	**3**	**2015**

Course Objectives

1. To provide an overview of time frequency analysis and hence the significance of wavelet transform.
2. To enable the students to use various wavelet transforms for applications like data compression.
3. To familiarize the students with multirate sampling principles.
4. To enable the students to appreciate various applications of multirate systems.
5. To equip the students to work with various linear prediction algorithms.
6. To familiarize the students with Power spectrum estimation of signals and Power spectral density.
7. To familiarize the students with design of adaptive filters.

Syllabus

Multirate signal processing, Filter banks, Continuous and Discrete wavelet transforms, Filterbank interpretation., Linear Prediction. Adaptive filters

Expected Outcome

1. Design multirate systems for applications like sub-band coding.
2. Account for the wavelet transform principles, taking into consideration, time frequency analysis and multi resolution analysis.
3. Implement various wavelet transforms on 1D as well as 2D signals.
4. Use wavelet transforms for applications like image compression.
5. Design linear prediction systems using Levinson-Durbin algorithm.
6. Have a better appreciation of Power spectrum estimation of signals and Power spectral density.
7. Learn the basics of Adaptive filters

References

1. P. P. Vaidyanathan, ”Multirate Systems and Filterbanks”, Prentice Hall
2. “Wavelet Transforms ”- Bopadikar and Rao, Pearson Education
3. “Insight into wavelets”, K. P. Soman, Prentice Hall India
4. “Digital signal Processing”, By John G. Proakis, Dimitris G. Manolakis Pearson Education
5. L. Cohen,”Time Frequency Analysis”, Prentice Hall.
6. “Wavelets and Filterbanks”, G Strang& T Nguyen , Wellesly-Cambridge
7. “Wavelets and subband coding”, M Vetterli& J Kovacevic, Prentice Hall
8. “Adaptive Filter Theory”,Simon Haykin, Prentice Hall

COURSE PLAN

Module	Contents	Hours Allotted	% of Marks in End-Semester
I	Basics of Multirate systems and its application, up sampling and Down - Sampling, Fractional Sampling rate converter. Frequency domain analysis-anti aliasing and anti imaging filter.	5	12
II	Polyphase decomposition. Efficient realization of Multirate systems. Uniform filter banks and its implementation using polyphase decomposition. Two channel Quadrature Mirror Filter Banks, Perfect Reconstruction.	7	18
	FIRST INTERNAL EXAM		
III	Time Frequency Analysis, Heisenberg's uncertainty principle. Short time Fourier transform. Continuous Wavelet Transform and its properties.	5	10
IV	Multi Resolution Analysis. Discrete Wavelet Transform, Orthonormal Wavelet Analysis – Filter bank interpretation. Application of wavelet transform for data compression. -image and speech.	10	20
	SECOND INTERNAL EXAM		
V	Power spectrum estimation of signals Power spectral density. Non parametric methods: periodogram,Backman-Tuckey method. Parametric method: ARMA, AR processes Yule-Walker method.	7	20
VI	Linear Prediction -Forward and Backward Prediction - Levinson-Durbin Algorithm --basic of steepest descend algorithm-adaptive filters-LMS algorithm- applications.	8	20
	END SEMESTER EXAM		

Course No.	01EC6211
Course Name	Optical Communication Systems
L-T-P	**3-0-0**
Credits	**3**
Year of Introduction	**2015**

Course Objectives

1. Understand the basic concepts and advantages of fiber optics communication.
2. Calculate pulse spread in optical fiber and use it to calculate the bandwidth and data rate of an optical fiber link.
3. To solve the wave equation and apply it in the analysis of symmetric slab waveguide.
4. Understand the concept and conditions for light guidance.
5. Understand the difference between single mode/multimode fibers as well as step index and graded index fibers and perform relevant calculations.
6. Know the origin of fiber optics losses, including intrinsic and extrinsic loss and know how to calculate link losses.
7. Design a basic optical fiber link.
8. To understand various optical amplifiers, WDM systems and Soliton systems

Syllabus

Optical Fibers – Dispersion, Fiber losses, Nonlinear optical effects. Optical Transmitters- LED, Semiconductor lasers, Hetrostructures- VCSEL, Transmitter design. Modulation.Optical receivers- Detectors, Receiver design, Noise, Sensitivity- BER, Sensitivity degradation. Architecture and Design of Light wave systems- Loss limited and Dispersion limited lightwave systems. Link budget analysis. Optical amplifiers- Various types, Design of EDFAs. Various Techniques for Dispersion management. Soliton based systems- Impact of amplifier noise-Timing Jitter, Gordon – Hauss Effect, Bit Error Rate Performance. WDM systems – Components and performance issues. Coherent light wave systems.

Expected Outcome

1. Understand various principles of optical communications system operating characteristics
2. Knowledge of the basic design rules and trade-offs of modern optical transmitters and receivers
3. Understand various optical amplifiers
4. Know about multiplexing techniques
5. Understand Soliton systems

References

1. Govind P. Agrawal: Fiber Optic Communication System, John Wiley and Sons,2003
2. J Diggonet, Rare earth Doped FiberLasers and Amplifiers, , 2/e CRC Press
3. Hasegawa, Solitons in Optical Communications, Clarendon Press1995
4. Govind P. Agrawal: Nonlinear Optics, Academic press 2nd Ed

COURSE PLAN

Module	Contents	Hours Allotted	% of Marks in End-Semester Examination
I	Optical Fibers – Dispersion, Fiber losses, Nonlinear optical effects. Optical Transmitters-LED, Semiconductor lasers, Heterostructures- VCSEL, Transmitter design. Modulation.	7	15
II	Optical receivers -Basic concepts, Detectors, Receiver design, Noise, Sensitivity- BER, Sensitivity degradation	7	15
	FIRST INTERNAL EXAM		
III	Architecture and Design of Light wave systems- Loss limited and Dispersion limited lightwave systems. Link budget analysis.	7	15
IV	Optical amplifiers- Various types, Design of EDFAs. Various Techniques for Dispersion management	7	15
	SECOND INTERNAL EXAM		
V	Soliton based systems- Impact of amplifier noise-Timing Jitter, Gordon – Hauss Effect, Bit Error Rate Performance.	7	20
VI	WDM systems – Components and performance issues. Coherent light wave systems-Concepts, Modulation Formats and Bit Error Rate Performance.	7	20
	END SEMESTER EXAM		

Course No.
Course Name
L-T-P
Credits
Year of Introduction
01EC6213
Modelling and Simulation of Communication Systems
3-0-0
3
2015

Course Objectives

1. To introduce the main ideas underlying the simulation of communication systems.
2. To understand the role of simulation in engineering systems.
3. To focus on the modeling, performance evaluation techniques and validation.

Syllabus

Modelling and simulation of systems, error sources in simulation, modelling of communication channels, validation, performance estimation and evaluation, analysis of simulation results.

Expected Outcome

1. Simulate a communication system.
2. Analyse the performance of the communication system

References

1. M.C. Jeruchim, Philip Balaban and K.Samshanmugam, “Simulation of communication systems,” Plemum press, New York, 2007.
2. M.Law and W. David Kelton ,” Simulation Modelling and analysis” ,Tata McGraw Hill, New York, 2008.
3. Raj Jain, The Art of Computer Systems Performance Analysis, John Wiley and Sons.
4. Jerry Banks and John S.Carson, "Discrete-event system Simulation”, Prentice Hall, Inc., New Jersey.

COURSE PLAN

Module	Contents	Hours Allotted	% of Marks in End-Semester Examination
I	Modelling and Simulation Approach: Basic concepts of modelling – modelling of systems, devices, random process and hypothetical systems. Error sources in simulation. Validation of devices, system models and random process models, simulation environment and software issues. Role of simulation in communication system and random process. Steps involved in simulation study.	7	15
II	Generation and Parameter Estimation: Monte Carlo simulation, random number Generation, Generating independent random sequences. Parameter estimation: Estimating mean, variance, confidence interval, Estimating the Average Level of a Waveform, Estimating the Average power of a waveform, Power Spectral Density of a process, Delay and Phase.	8	15
	FIRST INTERNAL EXAM		
III	Modelling of Communication Systems: Information sources, source coding, base band modulation, channel coding, RF modulation, filtering, multiplexing, detection/demodulation- carrier and timing recovery for BPSK and QPSK	7	15
IV	Communication Channel Models: Fading and multipath channels- statistical characterization of multipath channels and time-varying channels with Doppler effects, models for multipath fading channels. Methodology for simulating communication systems operating over fading channels.	6	15
	SECOND INTERNAL EXAM		
V	Performance Estimation and Evaluation: Estimation of Performance Measures - Estimation of SNR, Performance Measures for Digital Systems, Importance sampling method.	6	20

VI

Analysis of simulation Results: Model Verification Techniques, Model Validation Techniques, Transient Removal, Terminating Simulations, Stopping Criteria, Variance Reduction.

Case Studies: (1) Performance of 16-QAM equalized Line of Sight Digital Radio Link, (2) performance evaluation of CDMA Cellular Radio System.

8
20
END SEMESTER EXAM

Course No.
Course Name
L-T-P
Credits
Year of Introduction

01EC6515
Spread Spectrum and CDMA Systems
3-0-0
3
2015

Course Objectives

1. To familiarize fundamentals of Spread Spectrum.
2. To get an idea about performance analysis of Spread Spectrum system under various channel conditions.
3. To provide an overview of Spread Spectrum multiple access networks.
4. To get an overview of CDMA systems.

Syllabus

Introduction to spread spectrum communication. Properties and generation of spreading sequences. Synchronization and Tracking of spread spectrum systems. Performance analysis of spread spectrum system under AWGN channel. Performance of Spread Spectrum Multiple Access Networks.

Introduction to spread spectrum multiple access in cellular environments. Multi-user Detection. CDMA Systems

Expected Outcome

1. Generate various spreading sequences and codes.
2. Should be able to comment about the feasibility of given SS system from its performance analysis.
3. Should be able to provide solutions to various issues present in SS systems.

References

1. R. L. Peterson, R. Ziemer and D. Borth: “Introduction to Spread Spectrum Communications,” Prentice Hall, 1995.
2. A. J. Viterbi: “CDMA - Principles of Spread Spectrum Communications,” Addison-Wesley, 1995.
3. Vijay K. Garg, Kenneth F. Smolik, Joseph E. Wilkes: Applications of CDMA in Wireless/Personal Communications, Prentice Hall, 1997
4. S. Verdu: “Multiuser Detection” , Cambridge University Press, 1998 (with correction: 2003)
5. Mosa Ali Abu – Rgheff “Introduction to CDMA Wireless communication” Else Vier
6. M. K. Simon, J. K. Omura, R. A. Scholtz and B. K. Levitt: “Spread Spectrum Communications Handbook”, McGraw Hill, New York, 2002.
7. Cooper and McGillem: “Modern Communications and Spread Spectrum” McGraw- Hill, 1986.
8. J. G. Proakis: “Digital Communications,” McGraw Hill, 4th edition, 2001.
9. S. Glisic and B. Vucetic: “Spread Spectrum CDMA Systems for Wireless Communications,” Artech House, 1997

COURSE PLAN
Module
Contents
Hours Allotted
% of Marks in End-Semester Examination
I

Fundamentals of Spread Spectrum **:** Introduction to spread spectrum communication, pulse noise jamming, low probability of detection, direct sequence spread spectrum, frequency-hopping and time-hopping spread spectrum systems, correlation functions.

7
15

II

Spreading sequences- maximal-length sequences, gold codes, Walsh orthogonal codes- properties and generation of sequences. Synchronization and Tracking: delay lock and tau-dither loops, coarse synchronization- principles of serial search and match filter techniques

8

15

FIRST INTERNAL EXAM

III

Performance Analysis of SS system : Performance of spread spectrum system under AWGN, multi-user Interference, jamming and narrow band interferences Low probability of intercept methods, optimum intercept receiver for direct sequence spread spectrum, RAKE receiver Capacity. Coverage and Control of Spread Spectrum Multiple Access Networks. Error probability of DS-CDMA system under AWGN and fading channels.

7
15

IV

Basics of spread spectrum multiple access in cellular environments, reverse Link power control, multiple cell pilot tracking, soft and hard handoffs, cell coverage issues with hard and soft handoff, spread spectrum multiple access outage, outage with imperfect power control, Erlang capacity of forward and reverse links.

6
15

SECOND INTERNAL EXAM

V

Multi-user Detection -MF detector, decorrelating detector, MMSE detector. Interference Cancellation: successive, Parallel Interference Cancellation, performance analysis of multiuser detectors and interference cancellers.

6
20

VI

CDMA Systems: General aspects of CDMA cellular systems, IS-95 standard, Downlink and uplink, Evolution to Third Generation systems, WCDMA and CDMA-2000 standards, Principles of Multicarrier communication, MCCDMA and MC-DS-CDMA

8
20

END SEMESTER EXAM

Course No.
Course Name
L-T-P
Credits
Year of Introduction

01EC6999
Research Methodology
0-2-0
2
2015

Course Objectives

1. To prepare the student to do the M. Tech project work with a research bias.
2. To formulate a viable research question.
3. To develop skill in the critical analysis of research articles and reports.
4. To analyze the benefits and drawbacks of different methodologies.
5. To understand how to write a technical paper based on research findings.

Syllabus

Introduction to Research Methodology-Types of research- Ethical issues- Copy right-royalty-Intellectual property rights and patent law-Copyleft- Openacess-
Analysis of sample research papers to understand various aspects of research methodology:
Defining and formulating the research problem-Literature review-Development of working hypothesis-Research design and methods- Data Collection and analysis- Technical writing- Project work on a simple research problem

Approach

Course focuses on students' application of the course content to their unique research interests. The various topics will be addressed through hands on sessions.

Expected Outcome

Upon successful completion of this course, students will be able to
1. Understand research concepts in terms of identifying the research problem
2. Propose possible solutions based on research
3. Write a technical paper based on the findings.
4. Get a good exposure to a domain of interest.
5. Get a good domain and experience to pursue future research activities.

References

1. C. R. Kothari, Research Methodology, New Age International, 2004
2. Panneerselvam, Research Methodology, Prentice Hall of India, New Delhi, 2012.
3. J. W. Bames, Statistical Analysis for Engineers and Scientists, Tata McGraw-Hill, New York.
4. Donald Cooper, Business Research Methods, Tata McGraw-Hill, New Delhi.
5. Leedy P. D., Practical Research: Planning and Design, McMillan Publishing Co.
6. Day R. A., How to Write and Publish a Scientific Paper, Cambridge University Press, 1989.
7. Manna, Chakraborti, Values and Ethics in Business Profession, Prentice Hall of India, New Delhi, 2012.
8. Sople, Managing Intellectual Property: The Strategic Imperative, Prentice Hall ofIndia, New Delhi, 2012.

COURSE PLAN			
Module	**Contents**	**Hours Allotted**	**% of Marks in End-Semester n**
I	Introduction to Research Methodology: Motivation towards research - Types of research: Find examples from literature. Professional ethics in research - Ethical issues-ethical committees. Copy right - royalty - Intellectual property rights and patent law - Copyleft-Openacess-Reproduction of published material - Plagiarism - Citation and acknowledgement. Impact factor. Identifying major conferences and important journals in the concerned area. Collection of at least 4 papers in the area.	5	
II	Defining and formulating the research problem -Literature Survey-Analyze the chosen papers and understand how the authors have undertaken literature review, identified the research gaps, arrived at their objectives, formulated their problem and developed a hypothesis.	4	
FIRST ASSESSMENT			
III	Research design and methods: Analyze the chosen papers to understand formulation of research methods and analytical and experimental methods used. Study of how different it is from previous works.	4	No end semester written examinatio n
IV	Data Collection and analysis. Analyze the chosen papers and study the methods of data collection used. - Data Processing and Analysis strategies used– Study the tools used for analyzing the data.	5	

COURSE PLAN			
Module	**Contents**	**Hours Allotted**	**% of Marks in End-Semester**
SECOND ASSESSMENT			
V	Technical writing - Structure and components, contents of a typical technical paper, difference between abstract and conclusion, layout, illustrations and tables, bibliography, referencing and footnotes-use of tools like Latex.	5	
VI	Identification of a simple research problem – Literature survey- Research design- Methodology –paper writing based on a hypothetical result.	5	
END SEMESTER ASSESSMENT			

Course No.	Course Name	L-T-P	Credits	Year of Introduction
01EC6591	Seminar I	**0-0-2**	**2**	**2015**

Course Objectives

To make students

1. Identify the current topics in the specific stream.
2. Collect the recent publications related to the identified topics.
3. Do a detailed study of a selected topic based on current journals, published papers and books.
4. Present a seminar on the selected topic on which a detailed study has been done.
5. Improve the writing and presentation skills.

Approach

Students shall make a presentation for 20-25 minutes based on the detailed study of the topic and submit a report based on the study.

Expected Outcome

Upon successful completion of the seminar, the student should be able to

1. Get good exposure in the current topics in the specific stream.
2. Improve the writing and presentation skills.
3. Explore domains of interest so as to pursue the course project

Course No.	Course Name	L-T-P	Credits	Year of Introduction
01EC6593	Telecommunication Lab I	**0-0-2**	**1**	**2015**

Syllabus

List of Exercises / Experiments

Pre-requisite: Basic course on MATLAB and Communication Engineering Lab
Tools: Numerical Computing Environments – GNU Octave or MATLAB or any other equivalent tool, NS2/OPNET.

Random Processes– Generation of discrete time i.i.d. random processes with different distributions (Bernoulli, Binomial, Geometric, Poisson, Uniform, Gaussian, Exponential, Laplacian, Rayleigh, Rician) - pmf/pdf estimation, AR, MA and ARMA processes - spectral estimation - Visualization of Central Limit Theorem, Whitening Filter.

Communication system Design for Band limited Channels - Signal Design for Zero ISI and Controlled ISI - Partial Response Signaling.
Carrier Phase Modulation and Quadrature Amplitude Modulation - BER Performance in AWGN channel.
Synchronization in Communication Systems: Carrier and Clock Synchronization- Frequency Offset Estimation and Correction.
Modeling and Simulation of Networks using NS2/OPNET: Unicast Routing Basics - Measurements and Statistics of Delays, Throughput, and Packet Behavior - TCP and Packet Trace Tools - Real-Audio vs. TCP-based Traffic.
TCP Connections- Congestion and Congestion Control Parameters. MAC Protocols: CSMA and CSMA/CD in Ethernet and LAN Environments. Multimedia Networking applications: RTSP and Transport of Video using UDP. OMNEST and OMNET

SEMESTER - II

Syllabus and Course Plan

Course No.	Course Name	L-T-P	Credits	Year of Introduction
01EC6302	Estimation And Detection Theory	**3-1-0**	**4**	**2015**

Course Objectives

1. Familiarize the basic concepts of detection theory, decision theory and elementary hypothesis testing
2. Acquire knowledge about parameter estimation, and linear signal waveform estimation
3. Get a broad overview of applications of detection and estimation

Syllabus

Detection theory, Hypothesis testing, Detection with unknown signal parameters, Non parametric detection, Parameter estimation, Cramer-Rao lower bound, Linear Signal Waveform Estimation, Levinson Durbin and innovation algorithms, Applications of detection and estimation.

Expected Outcome

1. Understand Signal detection in the presence of noise
2. Understand the basic concepts of estimation theory
3. Ability to apply the concepts of estimation and detection in various signal processing applications

References

1. S.M. Kay, Fundamentals of Statistical Signal Processing: Detection Theory, Prentice Hall, 1998
2. S.M. Kay, Fundamentals of Statistical Signal Processing: Estimation Theory, Prentice Hall, 1993
3. H.L. Van Trees, Detection, Estimation and Modulation Theory, Part I, Wiley, 1968.
4. H.V. Poor, An Introduction to Signal Detection and Estimation, 2nd edition, Springer, 1994.
5. L.L. Scharf, Statistical Signal Processing, Detection and Estimation Theory, Addison-Wesley:1990

COURSE PLAN

Module	Contents	Hours Allotted	% of Marks in End-Semester Examination
I	Detection Theory, Decision Theory, and Hypothesis Testing :Elementaryhypothesis testing, Neyman-Pearson Theorem, Minimum probability of error, Bayes risk, Multiple hypothesis testing	10	15
II	Matched filter, Composite hypothesis testing: Generalized likelihood-ratio test. Detection of Signals with unknown Amplitude, Chernoff bound	9	15
	FIRST INTERNAL EXAM		
III	Parameter Estimation: Minimum Variance Unbiased Estimator, Cramer-Rao lower bound, Fisher information matrix, Linear Models, Best Linear Unbiased Estimator.	9	15
IV	Maximum Likelihood Estimation, Invariance principle, Least Square Estimation, Non-linear least square estimation, Minimum mean square estimation, Minimum mean absolute error, Maximum A Posteriori Estimators	9	15
	SECOND INTERNAL EXAM		
V	Linear Signal Waveform Estimation: Wiener Filter, Kalman Filter, Choosing an estimator	10	20
VI			

Applications of detection and estimation**:** Applications in diverse fields such as communications, system identification, adaptive filtering, pattern recognition, speech processing, and image processing

9
20
END SEMESTER EXAM

Course No.
Course Name
L-T-P
Credits
Year of Introduction

01EC6204
Antenna Theory and Design
3-0-0
3
2015

Course Objectives

1. To give idea about analysis and design of antennas and antenna arrays.

Syllabus

Review of Antenna Parameters, Antenna matching. Review of dipole antennas, Monopole antennas, Vee and rhombic antennas. Folded dipole. Analysis of Circular Loop and Biconical Antenna. Helical Antennas. Current induced in a dipole antenna. Near fields of linear antennas, arrays of parallel dipoles, Yagi-Uda antennas. Aperture antenna. Radiation from open-ended wave-guides, horn antennas, optimum horn design, rectangular micro-strip antennas – Field analysis and design. parabolic reflector antennas, aperture-field and current-distribution methods, radiation patterns of reflector antennas, dual-reflector antennas, lens antennas. Frequency independent antennas. Antenna arrays. Grating lobes. One dimensional arrays. Concept of beam steering. Design of array. Adaptive Beam forming. 2D arrays

Expected Outcome

1. Understand the analysis of practical antennas
2. Understand the design antennas
3. Understand general antenna arrays and array design method

References

1. Sopholes J. Orfanidis – Electromagnetic waves and antennas. Available at: http://eceweb1.rutgers.edu/~orfanidi/ewa/
2. Consrantive A Balanis -Antenna Theory - Analysis and Design – 2/e John Wiley & Sons.
3. John D. Krans, Ronald J. Marhefka : Antennas for all Applications , 3/e, TMH
4. Thomas A Milligan – Modern Antenna Design ,2/e John Wiley & Sons.

COURSE PLAN

Module	Contents	Hours Allotted	% of Marks in End-Semester Examination
I	Review of Antenna Parameters:- Polarization, Input impedance, Gain. Relation between radiation fields and magnetic vector potential – Helmholtz equation and Lorentz conditions. Antenna matching – T match, baluns, gamma and omega match.	7	15
II	Review of dipole antennas (short dipole and arbitrary length), Monopole antennas, Vee and rhombic antennas. Folded dipole and it's properties. Analysis of Circular Loop andBiconical Antenna. Helical Antennas (normal mode and axial mode) – relation for far fields, radiation resistance and gain.	7	15
	FIRST INTERNAL EXAM		
III	Current induced in a dipole antenna – Pocklington and Hallen's integral equations. Solution of Hallen's integral equation for current induced in a dipole antenna for delta gap model. Near fields of linear antennas, self and mutual impedance, arrays of parallel dipoles, Yagi-Uda antennas.	7	15
IV	Aperture antenna – Field equivalence principle. Radiation from open-ended wave-guides, horn antennas, horn radiation fields, horn directivity, optimum horn design, rectangular micro-strip antennas – Filed analysis and design	7	15
	SECOND INTERNAL EXAM		
V	Parabolic reflector antennas, gain and beam width of reflector antennas, aperture-field and current-distribution methods, radiation patterns of reflector antennas, dual-reflector antennas, lens antennas -hyperbolic lens and zoned lens. Frequency independent antennas – Rumsey Principle – Spiral Antennas. Design of log periodic dipole arrays.	7	20
VI			

Antenna arrays – General expression for array factor. Grating lobes. One dimensional arrays- Broad side, end fire and Chebyshev arrays. Concept of beam steering. Design of array using Schelkunnof's zero placement method and Fourier series method. Woodward-Lawson frequency-sampling design, Narrow beam design and Butler matrix beam former. Adaptive Beam forming. 2D arrays – Rectangular and Circular array.

7

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END SEMESTER EXAM

Course No.	Course Name	L-T-P	Credits	Year of Introduction
01EC6506	Wireless Communication and Networks	**3-0-0**	**3**	**2015**

Course Objectives

1. To familiarise radio propagation characteristics.
2. To understand the link design in satellite communication.
3. To understand the design of cellular system.
4. To familiarize wireless networks.

Syllabus

Propagation characteristics of radio waves, modulation and coding techniques for mobile radio, space time propagation and channel models, capacity and diversity of space time channels, cellular architecture and frequency allocation techniques for mobile radio, analysis of CDMA systems, satellite link and interference analysis, wireless networks and standards.

Expected Outcome

The students will be able to

1. Explain the radio propagation characteristics.
2. Explain the cellular concepts.
3. Design satellite link.
4. Compare wireless networks.

References

1. Andrea Goldsmith, “Wireless Communication”, Cambridge University Press.
2. T.S. Rappaport, Wireless Communications: Principles and Practice, Prentice Hall, 2002.
3. G.L. Stuber, Principles of Mobile Communications, Kluwer Academic, 1996.
4. Tri. T. Ha: , Digital Satellite Communication, 2nd Edn ,McGraw Hill, 2009
5. Kumar, D. Manjunath and J. Kuri, Communication Networking, an Analytical Approach, Elsever, 2004
6. Paulraj, R. Nabar& D. Gore, Introduction to Space Time Wireless Communications, Cambridge University Press, 2003
7. C Sivarama Murthy and B S Manoj, Ad-Hoc Wireless Networks, Architectures and Protocols, PH, 2004.

Course No.	Course Name	L-T-P	Credits	Year of Introduction

COURSE PLAN

Module	Contents	Hours Allotted	% of Marks in End-Semester
I	Radio Propagation Characteristics: Models for path loss, shadowing and multipath fading (delay spread, coherence band width, coherence time, Doppler spread), Jakes channel model, Linear and constant envelope digital modulation techniques for mobile radio, Block and Convolutional channel coding.	9	15
II	Space time propagation: Wireless channel as a space time random field, space time channel models, capacity of frequency flat deterministic MIMO channels, Transmit and receive antenna diversity.	8	15
FIRST INTERNAL EXAM			
III	The cellular concept: Frequency reuse, The basic theory of hexagonal cell layout, Capacity of cellular system, Channel allocation schemes, Frequency planning techniques, Cluster planned hierarchical architecture.	6	15
IV	Cellular CDMA system: reverse and forward link, Radio Resource Management: soft and hard handoffs, CDMA soft handoff analysis, GSM cellular standards.	6	15
SECOND INTERNAL EXAM			
V	Satellite link: Basic link and interference analysis, Rain induced attenuation and cross polarization interference – link design, Frequency Division Multiple Access – FDM – FM – FDMA, Single channel per carrier.	6	20
VI	Wireless networks: IEEE 802.11 – Physical layer – media access frame format –802.11b, High throughput WLAN (IEEE 802.11n), Quality of service support (IEEE 802.11e), Security enhancements (IEEE 802.11i). Bluetooth, Bluetooth protocol architecture, Operational states, Bluetooth security, Mobile IP-Address mobility, Tunnelling, Handoffs, IPV6 advancements.	7	20
END SEMESTER EXAM			

Course No.	Course Name	L-T-P	Credits	Year of Introduction
01EC6312	Adaptive Signal Processing	**3-0-0**	**3**	**2015**

Course Objectives

1. Introduction of basic concepts of adaptive systems and their applications.
2. Familiarize with various algorithms applicable for designing adaptive systems.
3. Get an overall picture about adaptive filter design in various fields.

Syllabus

Introduction to adaptive signal processing, Adaptive systems- definitions and characteristics. Smoothing and Prediction filtering, MSE predictors, Filtering, surface-stability and rate of convergence LMS and RLS algorithms and their tracking performance, Applications of adaptive signal processing.

Expected Outcome

1. Understand basic concepts of adaptive signal processing.
2. Design of various adaptive filters and compare the convergence issues, computational complexities and optimality.
3. Ability to develop adaptive systems for various applications.

References

1. Bernard Widrow and Samuel D. Stearns: “Adaptive Signal Processing”, Person Education, 2008.
2. Simon Haykin: “Adaptive Filter Theory”, Pearson Education, 2003.
3. John R. Treichler, C. Richard Johnson, Michael G. Larimore: “Theory and Design of Adaptive Filters”, Prentice-Hall of India, 2002. (Wiley and sons publications, 1987)
4. S. Thomas Alexander: “Adaptive Signal Processing - Theory and Application”, Springer-Verlag.
5. D. G. Manolokis, V. K. Ingle and S. M. Kogon: “Statistical and Adaptive Signal Processing”, McGraw Hill International Edition, 2000.

COURSE PLAN

Module	Contents	Hours Allotted	% of Marks in End-Semester
I	Goal of adaptive signal processing, some application scenarios, problem formulation. Adaptive systems - definitions and characteristics - applications – properties examples - adaptive linear combiner-input signal and weight vectors - performance function-gradient	7	15

II	MMSE predictors, LMMSE predictor, orthogonality theorem. Introduction to filtering-smoothing and prediction - linear optimum filtering - orthogonality - Wiener – Hopf equation-performance surface, Least square filters.	8	15
FIRST INTERNAL EXAM			
III	Searching performance surface-stability and rate of convergence - learning curve-gradient search - Newton's method - method of steepest descent - comparison - gradient estimation - performance penalty - variance - excess MSE and time constants	7	15
IV	Convergence of weight vector-LMS/Newton algorithm - properties - sequential regression algorithm - lattice structure - adaptive filters with orthogonal signals– mis-adjustments.	6	15
SECOND INTERNAL EXAM			
V	Adaptive recursive filters - RLS recursions - assumptions for RLS - convergence of RLS coefficients and MSE.LMS and RLS filters using lattice filters - Levinson Durbin algorithm -reverse Levinson Durbin algorithm. Tracking performance of LMS and RLS filters - Degree of stationarity and misadjustment - MSE derivations.	6	20
VI	Adaptive modelling of Multipath Communication channel - Adaptive equalization of telegraph channels - Adaptive interference cancellation - Techniques used in Adaptive removal of noise in speech signals and echoes in long distance telephone circuits.	8	20
END SEMESTER EXAM			

Course No.	Course Name	L-T-P	Credits	Year of Introduction
01EC6514	Digital Microwave Communication	**3-0-0**	**3**	**2015**

Course Objectives

1. To familiarize the digital microwave systems and their structures.
2. To understand different multiplexing techniques.
3. To get an overview about different waveguide components and accessories.

Syllabus

Overview of Digital Microwave Communication systems. Structure of MUX equipments. Signalling in Telecommunication. Equalization techniques in DMR-770 Digital Microwave radio. Bit Stream integration in Digital Transmission systems. Waveguide components and accessories.

Course No.	Course Name	L-T-P	Credits	Year of Introduction

Expected Outcome

1. Understand the structure of digital microwave systems.
2. Understand digital transmission systems.
3. Understand the working of waveguide components and accessories

References

1. P V Sreekanth: Digital Microwave Communication Systems, Universities Press, 2003
2. Robert E. Collin: Foundation for Microwave Engineering,2nd edition, McGraw Hill,1992
3. David M. Pozar: Microwave Engineering, 3rd Edition, John Wiley & Sons, 2004.

COURSE PLAN

Module	Contents	Hours Allotted	% of Marks in End-Semester
I	Digital Microwave Communication systems - general block diagram, interconnections, 34+2Mb Digital microwave radio equipment – arrangement of modules – DMR 770, signal flow, modules and sub modules, Transmitter – Receiver sub system, Channel Primary MUX – Data frame	7	15
II	Structure of 30 channel Primary MUX, Signalling in Telecommunication, R2 Signalling, and PDM 30B exchange. III order multiplexing equipment – 2/34 MUX equipment, overview of 2/8 card, 8/34 card (No detailed functional description), alarms and consequent action.	8	15
FIRST INTERNAL EXAM			
III	Equalization techniques in DMR-770 Digital Microwave radio – Delay equalizer, Transversal equalizer, line equalizer.	6	15
IV	Bit Stream integration in Digital Transmission systems – Multiplexing of synchronous data signals, multiplexing asynchronous signals, retiming by justification, perforated Clock, Integration of 2Mb streams in II order digital MUX, Integration of digital streams of different data rates.	6	15
SECOND INTERNAL EXAM			
V	Waveguide components – bands, corners, taper, twist, flexible wave guide, loading elements, ferrite devices	7	20
VI	Waveguide Accessories – clamps, earthing pit, flanges and coupling, bending tools, Precautions while hoisting waveguide.	8	20

Course No.	Course Name	L-T-P	Credits	Year of Introduction
END SEMESTER EXAM				

Course No.	Course Name	L-T-P	Credits	Year of Introduction
01EC6516	Embedded Systems For Communication	**3-0-0**	**3**	**2015**

Course Objectives

1. To give a brief introduction to microcontrollers
2. To introduce the concept and basics of embedded systems
3. To give an overview of the different communication buses and protocols.
4. To give an in depth knowledge in RTOS

Syllabus

Review of the microcontrollers- Memory Organization, Interrupts. Introduction to Embedded Systems - Characteristics, software, I/O devices, Interrupt Servicing mechanisms. Overview of Communication Buses and protocols. Hardware Software Co-design and Program Modelling. Real Time Operating Systems. Study of - VX works, MicroC/OS-II RTOS.

Expected Outcome

1. Program a microcontroller.
2. Understand the basics of embedded systems
3. Get an understanding of the different protocols
4. To be able to program using RTOS

References

1. Ajay V. DeshMukh: “Microcontrollers -Theory and Applications”, Tata McGraw Hill Publications, 2005
2. Rajkamal: “Embedded Systems Architecture; Programming and Design”, 2nd Edition; Tata McGraw Hill Publications, 2008.
3. Michael Predko, MykePredko: Programming and Customizing the 8051 microcontroller, 1st Edition; McGraw Hill International, 1999.
4. Ayala, Kenneth J: 8051 microcontroller: Architecture, Programming & Applications, 3rd Edition, Cengage Learning, 2004
5. J.R.Gibson,: ARM Assembly Language –An Introduction, Lulu Press, 2007
6. Jane.W.S. Liu: Real-time Systems, PHI 2000
7. Phillip A Laplante: Real-Time Systems Design and Analysis : An Engineer's Handbook , 3rd edition, Wiley-IEEE,2004
8. Paul T Ward & Stephen J Mellor: Structured Development for Real - Time Systems V1 : Introduction and Tools, 9th edition,Yourdon Press, 1985

COURSE PLAN

Course No.	Course Name	L-T-P	Credits	Year of Introduction

Module	Contents	Hours Allotted	% of Marks in End-Semester
I	Brief review of the microcontrollers – 8051/PIC/ARM - Programming, CPU Block diagram, Memory Organization, Interrupts, ADC, PWM, Timers, Watch Dog Timer, Serial Port, I/O Port.	7	15
II	Introduction to Embedded Systems: Characteristics of Embedded systems, Software embedded into a system - General ideas of Processor and Memory organization - Processor and memory selection, Interfacing to Memory and I/O devices- Devices and Buses- Device Drivers and Interrupt Servicing mechanisms.	8	15
FIRST INTERNAL EXAM			
III	Overview of Communication Buses and protocols – Serial Bus Communication Protocols, Parallel Bus Protocols, Internet Embedded Systems - Network Protocols, Wireless and Mobile System Protocols.	6	15
IV	Hardware Software Co-design and Program Modelling – Program Models, Multiprocessor Systems, UML Modelling, Inter-process Communication and Synchronization of Processes, Tasks and ThreadsMultiple Processes in an Application - Data sharing by multiple tasks and routines- Inter Process Communication.	6	15
SECOND INTERNAL EXAM			
V	Real Time Operating Systems - Operating System Services, I/O Subsystems- Network Operating Systems - Real Time and Embedded System Operating systems -Interrupt routines in RTOS Environments - RTOS Task Scheduling models, Interrupt Latency and response Times - Standardization of RTOS - Ideas of Embedded Linux.	8	20
VI	Study of VX works, MicroC/OS-II RTOS, Case Studies of programming with RTOS and Case study /design using 8051/PIC microcontroller/ARM processor for applications in Telecommunications.	7	20
END SEMESTER EXAM			

Course No.	Course Name	L-T-P	Credits	Year of Introduction
01EC6518	Information Theory	**3-0-0**	**3**	**2015**

Course No.	Course Name	L-T-P	Credits	Year of Introduction

Course Objectives

1. To get an overview about entropy, its properties and significance in source coding.
2. Familiarize the concept of channel capacity, its computation and different channel properties.
3. Get an idea about rate distortion theory.

Syllabus

Entropy for discrete and continuous random variables and its properties, source coding theorem and its significance, Importance of typical set in source coding techniques, computation of channel capacity, Channel coding theorem, Different channels, Introduction to rate distortion and its properties.

Expected Outcome

1. Understand the importance of entropy calculation and its application in source coding.
2. Should be able to design channels with different channel capacity.
3. Understand rate distortion properties.

References

1. Robert Gallager: “Information Theory and Reliable Communication”, John Wiley & Sons.
2. T. Cover and Thomas: “Elements of Information Theory”, 2nd edition, John Wiley & Sons 2006.
3. Shu Lin and Daniel. J. Costello Jr.: “Error Control Coding: Fundamentals and applications”, 2nd edition, Prentice Hall Inc, 2002.
4. T. Bergu: “Rate Distortion Theory a Mathematical Basis for Data Compression” PH Inc. 1971.
5. Special Issue on Rate Distortion Theory, IEEE Signal Processing Magazine, Vol. 15, No. 6, November 1998.
6. R. J. McEliece: “The theory of information & coding”, Addison Wesley Publishing Co.1982

COURSE PLAN

Module	Contents	Hours Allotted	% of Marks in End-Semester
I	Entropy- Memory less sources- Markov sources- Entropy of a discrete Random variable- Joint, conditional and relative entropy- Mutual Information and conditional mutual information- Chain relation for entropy, relative entropy and mutual Information.	7	15

II	Lossless source coding- Uniquely decodable codes- Instantaneous codes- Kraft's inequality - Optimal codes- Huffman code- Shannon's Source Coding Theorem, Lempel Ziv Coding.	8	15
FIRST INTERNAL EXAM			
III	Asymptotic Equipartition Property (AEP) - High probability sets and typical sets- Properties of typical set - Data compression.	6	15
IV	Channel Capacity- Capacity computation for some simple channels, Jointly Typical Sequences, Fano's inequality- Shannon's Channel Coding Theorem, Converse- Channels with feedback- Joint source channel coding Theorem.	7	15
SECOND INTERNAL EXAM			
V	Differential Entropy- Joint, relative and conditional differential entropy- Mutual information. Gaussian channels- Band limited channels- Shannon limit- Parallel Gaussian Channels- Water filling.	6	20
VI	Rate distortion theory - Introduction, Quantization, Rate distortion function, calculation, continuous sources and rate distortion measure, Rate distortion theorem, converse, information transmission theorem.	8	20
END SEMESTER EXAM			

Course No.	**Course Name**	**L-T-P**	**Credits**	**Year of Introduction**
01EC6522	Image And Video Processing	**3-0-0**	**3**	**2015**

Course Objectives

1. To enhance the knowledge of 2D-transforms and filtering.
2. To develop the skills for processing of images and videos.
3. To enhance the knowledge of image and video compression formats.

Syllabus

Basics of Image processing, Image transforms, Image enhancement, Image Restoration, Image Segmentation, Image texture analysis, Image Reconstruction from projections, Basic Steps of Video Processing, Motion Estimation, Video processing operations, Image compression and standards, Video compression and standards.

Expected Outcome

1. Familiarized with the performances of different types of transforms and filtering operations.

Course No.	Course Name	L-T-P	Credits	Year of Introduction

2. Familiarized with the processing of images and videos.
3. Understand the different types of image and video compression techniques.

References

1. Anil K Jain: “Fundamentals of Digital Image Processing,”, PHI, 1989.
2. Gonzalez and Woods: “Digital Image Processing”, 3rd edition, PHI, 2008.
3. Yao wang, JoemOstarmann and Yaquin Zhang, ”Video processing and communication” 1st edition , PHI
4. BhabatoshChanda, D. DuttaMajumder: “Digital Image Processing and Analysis ,PHI, 2004.
5. W Pratt: Digital Image Processing, 4th edition, Wiley, 2007.
6. M. Tekalp, “Digital video Processing”, Prentice Hall International
7. Al Bovik: Handbook of Image and Video, 2nd edition, Academic Press, 2005.
8. Keith Jack: Video Demystified, 5th edition, LLH, 2007.

COURSE PLAN

Module	Contents	Hours Allotted	% of Marks in End-Semester
I	Basics of Image processing, RGB and HSV colour model, 2D sampling theorem and Nyquist criteria, Interpolation, Moire Effect and flat field response. Image transforms - DFT, DCT, Sine, Hadamard, Haar, Slant, KL transform, Wavelet transform.	7	15
II	Image enhancement**:-** Point processing, Spatial filtering, Histogram techniques, Pseudo colouring and false colouring, Frequency filtering. Image Restoration:- Image observation models, Sources of degradation, inverse filtering and wiener filtering.	8	15
FIRST INTERNAL EXAM			
III	Image Segmentation**: -** region growing, region merging and split and merge, watershed segmentation. Image texture analysis - co-occurence matrix, measures of textures, statistical models for textures.	6	15
IV	Hough Transform, boundary detection, chain coding.Image Reconstruction from projections: - Random transform, Back- projection operator, Back projection algorithm, Fan beam and algebraic restoration technique.	6	15
SECOND INTERNAL EXAM			

Course No.	Course Name	L-T-P	Credits	Year of Introduction
V	Basic Steps of Video Processing: Analog video, Digital Video, Time varying Image Formation models: 3D motion models, Geometric Image formation, Photometric Image formation, sampling of video signals, filtering operations 2-D Motion Estimation: Optical flow, general methodologies, Block matching algorithm, global Motion Estimation. Application of motion estimation in video coding.	8		20
VI	Video processing operations– display enhancement, video mixing, video scaling, scan rate conversion, Image compression – lossless and lossy compression techniques, standards for image compression – JPEG, JPEG2000. Video compression- intra and interframe prediction, perceptual coding, standards - MPEG, H.264	7		20
END SEMESTER EXAM				

Course No.
Course Name
L-T-P
Credits
Year of Introduction

01EC6524

High Performance Communication Networks

3-0-0
3
2015

Course Objectives

1. To understand the convergence of the telephone, computer networking, cable TV, and wireless industries.
2. To familiarize network architectures, protocols, control and performance.
3. To understand the core networking principles and technologies from a system perspective

Syllabus

Principles of High speed networking. Service Integration - architecture, characterization and mechanisms. Packet Switched Networks. Internet and TCP/IP Networks. Circuit switched networks. ATM and Wireless Networks.

Expected Outcome

1. Explain the principles of high speed communication.
2. Derive the most important mathematical results of network performance.
3. Explain the core networking principles and technologies from a system perspective.
4. Identify the essential tools for analyzing, designing, and managing high performance networks.

References

1. Jean Walrand and PravinPratapVaraiya: "High Performance Communication Networks", 2nd Edition, Harcourt and Morgan Kauffman, London, 2000.
2. SumitKasera "ATM Networks ", Tata McGraw-Hill, New Delhi, 2006.
3. Behrouz.a. Forouzan: "Data Communication and Networking ", Tata McGraw-Hill, New Delhi, 2001.
4. C.SivaramMurty and M.Guruswamy: “WDM Optical Networks, Concepts, Design and Algorithms”, PHI,2002.
5. A.LeonGracia,I. Widjaja: "Communication networks ", Tata McGraw-Hill, 2nd edition,New Delhi, 2006.
6. Rajiv Ramaswamy,KumarSivarajan: “Optical Networks:a practical perspective”, 2nd edition,Morgan Kaufmann, 2002

COURSE PLAN

Module	**Contents**	**Hours Allotted**	**% of Marks in End-Semester Examination**
I	Basics of Networks:-Principles of High speed networking. Integration of -Telephone, computer, Cable television and Wireless network.	7	15
II	Digitalization: Service integration, network services and layered architecture, traffic characterization and QoS, networks, services: network elements and network mechanisms.	8	15
	FIRST INTERNAL EXAM		
III	Packet Switched Networks:-OSI and IP models: Ethernet (IEEE 802.3); token ring (IEEE 802.5), FDDI, DQDB, frame relay, SMDS: Internet working with SMDS.	6	15
IV	Internet and TCP/IP Networks:-Overview; Internet protocol; TCP and VDP; performance of TCP/IP networks. Circuit switched networks: SONET; DWDM, Fibre to home, DSL, Intelligent networks, CATV.	6	15
	SECOND INTERNAL EXAM		
V	ATM and Wireless Networks:-Main features-addressing, signaling and routing; ATM header structure-adaptation layer, management and control; BISDN; Internet-working with ATM, Wireless channel, link level design, channel access; Network design and wireless networks.	7	20
VI	Optical Networks and Switching:-Optical links- WDM systems, cross-connects, optical LAN's, optical paths and networks; TDS and SDS: modular switch designs-Packet switching, distributed, shared, input		

and output buffers.

	8	
	20	
	END SEMESTER EXAM	

Course No.	Course Name	L-T-P	Credits	Year of Introduction
01EC6592	Mini Project	**0-0-4**	**2**	**2015**

Course Objectives

To make students

Design and develop a system or application in the area of their specialization.

Approach

The student shall present two seminars and submit a report.The first seminar shall highlight the topic, objectives, methodology, design and expected results. The second seminar is the presentation of the work / hardwareimplementation.

Expected Outcome

Upon successful completion of the miniproject, the student should be able to

1. Identify and solve various problems associated with designing and implementing a system or application.
2. Test the designed system or application.

Course No.	Course Name	L-T-P	Credits	Year of Introduction
01EC6594	Telecommunication Lab II	**0-0-2**	**1**	**2015**

Course Objectives

List of Exercises / Experiments

Pre-requisite: Nil

Tools: Numerical Computing Environments – GNU Octave, - MATLAB, Communication Blockset, RF Blockset and signal processing Blockset, NS2/OPNET.

Channel Coding: Linear Block code and Convolutional codes -Viterbi Decoding – Majority Logic Decoders- CRC-32.

Modeling and Simulation of Radio Channels - Multipath Fading Channels- Jake‟s Model. Spread Spectrum Communication Systems

Scheduling and Queuing Disciplines in Packet Switched Networks: FIFO, Fair Queuing.

RED- TCP Performance: with and without RED.

Antenna simulation: using ANSYS, IE3D and Microsoft office. OMNET++.

Wireless Medium Access Control: MAC layer 802.11: CSMA/CA, RTS/CTS mode.
Simple Ad hoc/Sensor Networks: Simulation and Evaluation.

SEMESTER - III

Syllabus and Course Plan

Course No.	Course Name	L-T-P	Credits	Year of Introduction
01EC7511	Neuro Fuzzy Systems	**3-0-0**	**3**	**2015**

Course Objectives

1. Explore the basic principles underlying the analysis and synthesis of fuzzy neural integrated systems with models and case studies.
2. Focuses on the usage of heuristic learning strategies derived from the domain of neural network theory to support the development of a fuzzy system.
3. Deals with the fundamentals of genetic algorithms for neural-net training and structure optimization, issues involved and their applications in a variety of different areas of engineering and science.

Syllabus

Learning processes, Single layer and Multi layerPerceptrons, Principal Component Analysis, Independent Component Analysis, Stochastic Machines, Neurodynamics, Neuroprogramming, Fuzzy systems, Neuro-fuzzy systems, Genetic Algorithms, Convergence rate, case studies.

Expected Outcome

1. Provides a framework for unification, construction and development of neuro-fuzzy systems.
2. Reflects theoretical and practical issues in a balanced way, effective development of models in any field can be made.
3. Enables to implement and experiment with genetic algorithms on their own for any problems

References

1. Simon Haykin, Neural Networks, a comprehensive foundation, 2/e, Pearson Education.
2. Timothy J Ross, Fuzzy logic with Engineering Applications" 2/e, McGraw Hill
3. John Yen, Reza Langari, Fuzzy Logic-Intelligence, Control and Instrumentation, Pearson Education, 2002
4. YegnaNarayana B, Artificial Neural Networks– PHI

Course No.	Course Name	L-T-P	Credits	Year of Introduction

5. AhamadM.Ibrahim, Introduction to Applied Fuzzy Electronics, PHI
6. S. Rajasekharan, G.AVijayalakshmiPai , Neural Networks, Fuzzy Logic and Genetic Algorithams, PHI .

COURSE PLAN

Module	Contents	Hours Allotted	% of Marks in End-Semester
I	Introduction to Neuro-Fuzzy systems – models of neuron, Neural network architectures, Learning processes – algorithms. Learning paradigms. Single layer perceptrons, Perceptron Convergence theorem.	6	15
II	Multilayer perceptrons – architecture, back-propagation algorithm. XOR problem. Principles of self organized learning. Principal Component analysis – data representation, dimensionality reduction. Independent Component analysis.	7	15
FIRST INTERNAL EXAM			
III	Stochastic Machines – Metropolis algorithm, Simulated annealing, Gibbs sampling, Boltzmann machine. Neurodynamics – Hopfield models, Cohen-Grossberg theorem, Brain-state-in-a-box model	8	15
IV	Fuzzy systems, operations on fuzzy sets, fuzzy relations, Fuzzy tolerance and equivalence relations, Fuzzification and Defuzzification – centroid method	6	15
SECOND INTERNAL EXAM			
V	Classical and fuzzy predicate logic, Fuzzy rule-based systems, fuzzy pattern recognition, Fuzzy control systems, Case study – inverted pendulum	8	20
VI	Genetic Algorithms and Fuzzy Logic, Basics, Design issues, Improving the Convergence rate, Genetic Algorithm methods, Case studies	7	20
END SEMESTER EXAM			

Course No.	01EC7213
Course Name	Secure Communication
L-T-P	**3-0-0**
Credits	**3**
Year of Introduction	**2015**

Course Objectives

1. To familiarize with the theoretic methods and algorithms used in classical and modern cryptography
2. To familiarize with different cryptanalysis procedures.

Syllabus

Introduction to cryptography - classification, Computational Complexity theory - Classes, Number theory, congruences and related theorems- Linear Diophantine equations, Quadratic residues, Legendre symbol, Elementary Algebraic Structures, Elliptic Curves, Classical Cryptographic techniques, Public key Cryptographic techniques, Cryptographic standards, Cryptanalysis Algorithms, Primality test, Integer Factorization, Algorithms for Discrete Logarithms

Expected Outcome

1. Learn theorems on the number and abstract algebra and develops the mathematical proof witting skills.
2. Learn mathematics behind the cryptography and the cryptographic standards.
3. Learn the algorithms used in cryptanalysis and their merits.
4. Initiate the talented students to propose and analyze new algorithms and methods in cryptology.

Text Book

1. A Course in Number Theory and Cryptography, Neal Koblits, Springer, 2e.
2. Number Theory for Computing, Song Y Yan, Springer, 2e.
3. Elementary Number Theory with Applications, Thomas Koshy, Elsivier, 2e.

References

1. Fundamentals of Cryptology, Henk CA van Tilborg, Kluwer Academic Publishers.
2. Primality Testing and Integer Factorization in Public Key Cryptography, Song Y Yan, Springer,

2e.
3. Public Key Cryptography, ArtoSalomaa, Springer, 2e.
4. An Introduction to Theory of Numbers, I Niven, HS zuckerman etc.., John Wiley and Sons, 5e.
5. How to Prove it- A structured Approach, Daniel J Velleman, Cambridge UniversitPress, 2e.

COURSE PLAN

Module	**Contents**	**Hours Allotted**	**% of Marks in End-Semester Examination**
I	Introduction to cryptography - stream and block ciphers- symmetric and public keys. Basics -Mathematical proofs and methods. Complexity theory: Computational Complexity Classes P, NP- NP-Complete, NP-Hard, BPP. Number theory: primes, divisibility, congruences, systems of congruence equation, quadratic congruences. Linear Diophantine equations, Wilson theorem, Fermat's little theorem, Euler's theorem. Multiplicative functions, Primitive roots, Quadratic residues, Legendre symbol, Continued fractions.	7	15
II	Elementary Algebraic Structures: Groups- subgroups, order, homomorphism, cyclic groups, generators. Rings- characteristics, Finite Fields. Polynomial Rings and their algebra over finite fields, multiplicative inverses. Discrete logarithm over groups. Elliptic Curves: as a group defined over finite field, number of points, order and algebra of rational points on elliptic curves.	8	15
	FIRST INTERNAL EXAM		
III	Classical Cryptography: Affine ciphers, hill ciphers, digraphs, enciphering matrices.; Linear Feedback Shift Registers for PN sequences. Public key Cryptography: One way functions, Hash functions, Knapsack cryptosystems.	7	15
IV	RSA, DeffieHelman Key Exchange system, El Gamal's Public key crypto system. Elliptic curve crypto system. Cryptographic standards: DES, AES, MD5, Digital Signature, Zero Knowledge Protocol.	6	15

SECOND INTERNAL EXAM

V

Cryptanalysis. Algorithms : Modular exponentiation, Fast group operations on Elliptic curves. Primality test- Fermat's pseudo primality test, Strong prime test, Lucas Pseudo prime test, Elliptic curve test.

6
20

VI

Integer Factorization**-** Trial division, Fermat's method, CFRAC. Quadratic and Number Field Sieves. Algorithms for Discrete Logarithms: Baby-step Giant-step alg. Algorithms for Discrete Logarithm on Elliptic curves.

8
20

END SEMESTER EXAM

Course No.
Course Name
L-T-P
Credits
Year of Introduction

01EC7313
Space Time Coding and MIMO Systems
3-0-0
3
2015

Course Objectives

1. To introduce diversity techniques, space time coding and receiver design.

Syllabus

Review of SISO communication, MIMO channels, Multidimensional channel modelling, Capacity of MIMO channels, Diversity, Diversity methods, Combining methods, Space-time code design criteria, Orthogonal space, Maximum-likelihood decoding and maximum ratio combining, Quasi-orthogonal space-time block codes, Space time trellis codes, Spatial multiplexing and receiver design, Using equalization techniques in receiver design, Combined spatial multiplexing and space-time coding, MIMO OFDM

Expected Outcome

1. Understand channel models and diversity techniques
2. Understand space time coding
3. Understand receiver design

References

1. H. Jafarkhani,"Space Time Coding Theory and Practice" Cambridge University Press.
2. E. G. Larsson and P. Stoica, "Space Time Block coding for wireless communication". Cambridge University Press.
3. C. Oesteges and B. Clerckx, MIMO wireless communications from real world propogation to space time code design. Academic press.

COURSE PLAN

Module	Contents	Hours Allotted	% of Marks in End-Semester Examination
I	Review of SISO communication- MIMO channel models Transmission model for MIMO channels, Multidimensional channel modeling, Capacity of MIMO channels, Outage capacity.	8	15
II	Diversity-Principle, array and diversity gains, Diversity methods, Combining methods-maximum ratio combining, selection combining	8	15
	FIRST INTERNAL EXAM		
III	Space-time code design criteria - Rank and determinant criteria, Trace criterion, Maximum mutual information criterion. Orthogonal space-time block codes - Alamouticode.	7	15
IV			

Maximum-likelihood decoding and maximum ratio combining, orthogonal designs. Quasi-orthogonal space-time block codes- Pairwise decoding, Rotated QOSTBCs, Space time trellis codes.

6
15

V

Spatial multiplexing and receiver design-Introduction, Spatial multiplexing, Sphere decoding, Using equalization techniques in receiver design, V-BLAST , D-BLAST, Turbo-BLAST

6
20

VI

Combined spatial multiplexing and space-time coding, MIMO OFDM

7
20

END SEMESTER EXAM

Course No.	Course Name	L-T-P	Credits	Year of Introduction
01EC7515	WDM Optical Network and Optical switching	**3-0-0**	**3**	**2015**

Course Objectives

1. To familiarize about components of optical network.
2. To familiarize different optical networks.
3. To familiarize control management.

Syllabus

Introduction to Optical Networks. Basics of optical Packet Switching and transmission. Networks: Client Layers of the Optical Layer. Introduction to WDM Network Elements. Control Management: Optical Layer services and Interfacing. Access Network: Photonic Packet Switching.

Expected Outcome

1. Understand WDM optical network and its features

References

1. Ramaswami, Sivarajan Optical Networks, Elsevier – 2004
2. C. Sivaramamurthy & M. Gurusamy: WDM optical Networks, PHI, 2002.
3. E.A.Saleh, M.C.Teich, Fundamentals of photonocs, Wiley Interscience, 1991.
4. J. Singh, Optoelectronics: an introduction to materials and devices, McGraw Hill, 1996.
5. J. Wilson and J. F. B. Hawkes, Optoelectronics: an introduction, Prentice Hall India,1998

COURSE PLAN

Module	Contents	Hours Allotted	% of Marks in End-Semester
I	Introduction to Optical Networks: The Optical Layer, Transparency and All-Optical Networks. Optical Packet Switching, Transmission Basics, Propagation of Signals in Optical Fiber: Nonlinear Effects	7	15
II	Components: Isolators and Circulators, Multiplexers and Filters, Optical Amplifiers, Transmitters, Detectors, Switches, Wavelength Convertors, Transmission System Engineering: System Model	8	15
FIRST INTERNAL EXAM			
III	Networks: Client Layers of the Optical Layer: SONET / SDH, ATM, IP, Storage Area Networks.	6	15

Course No.	Course Name	L-T-P	Credits	Year of Introduction
IV	WDM Network Elements: Optical Cross connects, WDM Network Design, LTD and RWA Problems, Dimensioning Wavelength Rooting Networks, Statistical Dimensioning Models, Maximum Load Dimensioning Model, DWDM networks.	6		15
SECOND INTERNAL EXAM				
V	Control Management: Optical Layer services and Interfacing, Performance and Fault Management, Configuration Management. Network Survivability: Protection in SONET / SDH, Protection in IP Network, Optical Layer Protection Scheme	8		20
VI	Access Network: Photonic Packet Switching, Optical TDM, Synchronisation, Header Processing, Buffering, Burst switching, Deployment considerations, Designing transmission Layer.	7		20
END SEMESTER EXAM				

Course No.	Course Name	L-T-P	Credits	Year of Introduction
01EC7517	RF MEMS	3-0-0	3	2015

Course Objectives

1. To enhance the knowledge of Microelectromechanical systems
2. To impart the knowledge of RF MEMS passive, active devices
3. To develop the skills to design and model and analyse systems like RF MEMS switches

Syllabus

Introduction to RF MEMS- application, fabrication. Introduction to Microfabrication Technique. RF MEMS switches and applications. Introduction to MEMS switch design and its analysis. Different types of inductors, capacitors and resonators. Introduction to Micromachined antennas and RF NEMS

Expected Outcome

1. Understand the processes in MEMS fabrication
2. Understand RF MEMS design, modelling issues
3. Understand the working of different types of RF MEMS devices

References

1. "RF MEMS: Theory, Design, and Technology", Gabriel M. Rebeiz, Wiley, 2003
2. "RF MEMS Circuit Design for Wireless Applications", Hector J. De Los Santos, Artech House, 2002
3. "RF MEMS and Their Applications", Vijay Varadan, K. J. Vinoy, K. A. Jose, Wiley, 2003.

COURSE PLAN

Module	Contents	Hours Allotted	% of Marks in End-Semester
I	Introduction to RF MEMS, application in wireless communications; Overview of RF MEMS fabrication, design and testing.	7	15
II	Introduction to Micro fabrication Techniques- Materials properties, Bulk and surface micromachining, Wet and dry etching, Thin-film depositions; Actuation Mechanisms in MEMS- Piezoelectric, Electrostatic, Thermal, Magnetic	8	15
FIRST INTERNAL EXAM			

Course No.	Course Name	L-T-P	Credits	Year of Introduction
III	RF MEMS switches and applications, Integration and biasing issues for RF switches.	6		15
IV	MEMS switch design, modelling and analysis- Electromechanical finite element analysis, RF design.	6		15
SECOND INTERNAL EXAM				
V	Inductors and capacitors - micro machined inductors, variable inductors, polymer based inductors, gap-tuning and area tuning capacitors, dielectric tunable capacitors	7		20
VI	Resonators –applications in oscillators and filters. Micromachined antennas. RF NEMS-overview	8		20
END SEMESTER EXAM				

Course No.	Course Name	L-T-P	Credits	Year of Introduction
01EC7519	Radio Frequency System Design	**3-0-0**	**3**	**2015**

Course Objectives

1. To familiarize how to use Smith chart for impedance matching.
2. To get an overview of two-port networks
3. To provide an overview of RF filter design.
4. To familiarize high frequency equivalent circuits of various diodes.
5. To get an overview about the microwave oscillators.

Syllabus

Review of transmission lines-Binomial and Chebyshev transformer. RF Filter Design- First order low pass, high pass and band pass filter circuits. Review of BJT and MESFET. Analysis of Tunnel Diode, Gunn Diode, Varactor Diode. Design of simple matching and biasing networks. Microwave Oscillators. Mixers-Design of simple RF Mixer Circuit based on BJT and MESFET.

Expected Outcome

1. Design transmission lines with impedance matching.
2. Design various RF filters.
3. Design BJT and MESFET amplifiers.
4. Should be able to design microwave oscillators.

References

1. Reinhold Ludwig, PavelBretchko: "RF Circuit Design-Theory and Application ", Pearson Education, New Delhi, 2000.
2. Matthew M Radmanesh, "Radio Frequency and Microwave Electronics", Pearson Education, Asia 2006.
3. Collins, “Foundation for Microwave Engineering”, 2nd edition. McGrawHill,Inc, 1992.
4. David M Pozar,”Microwave Engineering” 3rd edition. Wiley, 2009.

COURSE PLAN

Module	Contents	Hours Allotted	% of Marks in End-Semester
I	Review of transmission lines-Binomial and Chebyshev transformer. Return loss and Insertion loss. Smith chart -Impedance matching using smith chart. ABCD parameters of simple Two Port Networks-Impedance Element, T networks, Transmission line section (analysis not required). Scattering parameters – Chain scattering matrix, Signal flow analysis using S parameters.	7	15

Course No.	Course Name	L-T-P	Credits	Year of Introduction
II	RF Filter Design- First order low pass, high pass and band pass filter circuits. Frequency transformation and Impedance Transformation. Higher order filter design concepts	8		15
FIRST INTERNAL EXAM				
III	Review of BJT and MESFET. V-I Characteristics and High Frequency equivalent circuits. High Frequency equivalent circuits of Tunnel Diode, Gunn Diode, Varactor Diode. PIN Diode as an attenuator, Computation of transducer loss.	6		15
IV	Design of simple matching and biasing networks. Power relations for RF transistor and MESFET Amplifiers, Stabilization methods. Simple BJT and MESFET Amplifier Design Examples	6		15
SECOND INTERNAL EXAM				
V	Microwave Oscillators –High frequency Oscillator configuration, Design of MESFET based Oscillator, Dielectric resonator Oscillator, Gunn Oscillator, YIG Oscillator.	8		20
VI	Mixers-Design of simple RF Mixer Circuit based on BJT and MESFET.	7		20
END SEMESTER EXAM				

Course No.	Course Name	L-T-P	Credits	Year of Introduction
01EC7591	Seminar II	**0-0-2**	**2**	**2015**

Course Objectives

To make students

1. Identify the current topics in the specific stream.
2. Collect the recent publications related to the identified topics.
3. Do a detailed study of a selected topic based on current journals, published papers and books.
4. Present a seminar on the selected topic on which a detailed study has been done.
5. Improve the writing and presentation skills.

Approach

Students shall make a presentation for 20-25 minutes based on the detailed study of the topic and submit a report based on the study.

Expected Outcome

Upon successful completion of the seminar, the student should be able to

1. Get good exposure in the current topics in the specific stream.
2. Improve the writing and presentation skills.
3. Explore domains of interest so as to pursue the course project.

Course No.	Course Name	L-T-P	Credits	Year of Introduction
01EC7593	Project (Phase 1)	**0-0-12**	**6**	**2015**

Course Objectives

To make students

1. Do an original and independent study on the area of specialization.
2. Explore in depth a subject of his/her own choice.
3. Start the preliminary background studies towards the project by conducting literature survey in the relevant field.
4. Broadly identify the area of the project work, familiarize with the tools required for the design and analysis of the project.
5. Plan the experimental platform, if any, required for project work.

Approach

The student has to present two seminars and submit an interim Project report. The first seminar would highlight the topic, objectives, methodology and expected results. The first seminar shall be conducted in the first half of this semester. The second seminar is the presentation of the interim project report of the work completed and scope of the work which has to be accomplished in the fourth semester.

Expected Outcome

Upon successful completion of the project phase 1, the student should be able to

1. Identify the topic, objectives and methodology to carry out the project.
2. Finalize the project plan for their course project.

SEMESTER - IV

Syllabus and Course Plan

Course No.	Course Name	L-T-P	Credits	Year of Introduction
01EC7594	Project (Phase II)	**0-0-23**	**12**	**2015**

Cluster: *1* Branch: *Electronics & Communication Engineering* Stream: *Telecommunication*

Course Objectives

To continue and complete the project work identified in project phase 1.

Approach

There shall be two seminars (a mid term evaluation on the progress of the work and pre submission seminar to assess the quality and quantum of the work). At least one technical paper has to be prepared for possible publication in journals / conferences based on their project work.

Expected Outcome

Upon successful completion of the project phase II, the student should be able to

1. Get a good exposure to a domain of interest.
2. Get a good domain and experience to pursue future research activities.