KERALA TECHNOLOGICAL UNIVERSITY

Master of Technology

Curriculum, Syllabus and Course Plan

Cluster	:	*1*
Branch	:	*Electronics & Communication*
Stream	:	*Microwave & Television Engineering*
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	01MA6033	Mathematical Methods for Communication	3-0-0	40	60	3	3
B	01EC6303	Random Processes & Applications	3-1-0	40	60	3	4
C	01EC6205	Advanced Digital Communication	3-1-0	40	60	3	4
D	01EC6207	RF Circuit Design	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	01EC6291	SeminarI	0-0-2	100			2
U	01EC6293	Communication Systems Lab	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
01EC6215	Advanced DSP Techniques
01EC6217	Microwave Imaging

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	01EC6206	Communication 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	01EC6292	Mini Project	0-0-4	100			2
U	01EC6294	RF Design and Simulation lab	0-0-2	100			1
		TOTAL	**15-1-6**	**400**	**300**	**-**	**19**

TOTAL CONTACT HOURS : 22
TOTAL CREDITS : 19

Elective II

01EC6212 Microwave Integrated Circuits
01EC6214 Radar Signal Processing
01EC6216 Digital Techniques in Television Engineering

Elective III

01EC6122 Design of VLSI Systems
01EC6224 Soft Computing
01EC6326 Optimization Techniques

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	01EC7291	Seminar II	0-0-2	100			2
W	01EC7293	Project (Phase 1)	0-0-12	50			6
		TOTAL	**6-0-14**	**230**	**120**	**-**	**14**

TOTAL CONTACT HOURS : 20
TOTAL CREDITS : 14

Elective IV

01EC7211 Computational Methods for Electromagnetics
01EC7213 Secure Communication
01EC7215 Wireless Communication
01EC7219 Multi Carrier and Spread Spectrum Systems

Elective V

01EC7221 Smart Antennas
01EC7223 Electromagnetic Interference and Compatibility
01EC7225 Information Hiding & Data Encryption
01EC7227 Advanced Coding Theory

SEMESTER 4

Examination Slot	Course Number	Name	L-T-P	Internal Marks	End Semester Examination		Credit
					Marks	Duration (hours)	
W	01EC7294	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
01MA6033	Mathematical Methods for Communication	**3-0-0**	**3**	**2015**

Course Objectives

1. The objective of this course is to prepare the students with some basic mathematical tools in number theory, special functions and algebraic structures, which have diverse applications in communication and other areas of engineering.
2. It aims to build a solid background of these topics which will also be essential for higher studies and research in engineering.

Syllabus

Basics of number theory-fundamental theorem of arithmetics, congruences, primitive roots. Special functions-Beta and gamma functions, Legendre polynomial, Bessel functions. Basic ideas of algebraic structures-groups,rings, integral domains and fields. Vector spaces- Basis and dimension, linear transformations and their matrix representations

Expected Outcome

On completion of the course, the students will have acquired knowledge and practical skills in the areas of basic number theory, special functions and algebraic structuresand transformations, which have applications in communicationand other areas of engineering. These topics are also essential for higher studies and research

References

1. J.B. Fraleigh, A First Course in Abstract Algebra, Pearson
2. D. M. Burton, Elementary number theory, TATA McGraw-Hill
3. T. M. Apostol, , Introduction to Analytic Number Theory, , Springer
4. Peter V. O' Neil, Advanced Engineering Mathematics, Thomson
5. R. Bronson and G.B. Costa, Linear Algebra-An introduction, Elsevier
6. David C Lay, Linear Algebra ,Pearson

COURSE PLAN			
Module	**Contents**	**Hours Allotted**	**% of Marks in End-Semester Examination**
I	Algebraic structures: Groups-subgroups-co-sets and Lagranges Theorem. Rings, Integral domain and Fields(definition, examples and basic properties only). Properties of congruences and the ring of congruence classes of integers.	7	15
II	Vector spaces over real numbers, subspaces, linear independence, basis and dimension,co-ordinate representation of vectors, change of basis,Linear transformations and their properties, Matrix representations, representation of linear transformations by diagonal matrices.Inner product and orthogonality, projections and approximations. Orthonormal bases, Gram-Schmidt orthogonalization, least-square approximations	7	15
FIRST INTERNAL EXAM			
III	Basics of Number theory. Prime numbers. Division Algorithm, Greatest Common Divisor. Euclidean algorithm, Fundamental theorem of arithmetic, The Sieve of Eratosthenese.	7	15
IV	Linear congruences and chinese remainder theorem, Fermat's theorem, Wilson's theorem, Euler's phi-function, Euler's theorem, primitive roots of numbers,index of numbers and their properties.(Discussion of these theorems may be based on group theoretic properties of ring of congruence classes of integers).	7	15
SECOND INTERNAL EXAM			
V	Special functions:Beta and Gamma functions and their properties, Legendre polynomials as solutions of Legendre differential equations-generatingfunction and recurrence relations for Legendre polynomials, orthogonality, Fourier-Legendre expansion of functions and computation of the expansion coefficients, zeroes of Legendre polynomials, Rodrigues formula.	7	20
VI	Bessel Functions of first and second kind as solutions of Bessels equation- Generating function, Bessel's integral, recurrence formula, zeroes of Bessel's function, orthogonality, Fourier-Bessel expansions and computation of the expansion coefficients	7	20
END SEMESTER EXAM			

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

yllabus

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 Examination**
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.	6	10
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.	12	20
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, Periodic and cyclostationary processes.	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, ARMA Models, 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 to various aspects of Digital Communication over various Channels, from design through performance issues to application requirement.
2. To have 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 and colored Gaussian noise channels. 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. Multiuser detectors.

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 multi user communication systems.
3. Understand various digital communication receivers, equalization and diversity techniques.

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.

COURSE PLAN			
Module	**Contents**	**Hours Allotted**	**% of Marks in End-Semester Examination**
I	Digital Communication over Additive Gaussian Noise Channels- Characterization of Communication Signals and Systems- Signal space representation- Connecting Linear Vector Space to Physical Waveform Space- Scalar and Vector Communication over Memory less Channels- Optimum waveform receiver in additive white Gaussian noise (AWGN) channels - Cross correlation receiver- Matched filter receiver and error probabilities.	10	15
II	Optimum Receiver for Signals with random phase in AWGN Channels- Optimum receiver for Binary Signals- Optimum receiver for M-ary orthogonal signals- Optimum waveform receiver for coloured Gaussian noise channels- KarhunenLoeve expansion approach- whitening.	8	15
FIRST INTERNAL EXAM			
III	Digital Communication over Band limited Channels- Optimum pulse shaping- Nyquist criterion for zero ISI- partial response signalling- Optimum receiver for channels with ISI and AWGN- Equalization Techniques- Zero forcing linear Equalization- Decision feedback equalization- Adaptive Equalization.	10	15
IV	Multichannel and Multicarrier Systems- FFT based multi carrier system- Spread Spectrum Signals- Model of Spread spectrum system- Direct sequence spread spectrum signals- Processing gain and jamming margin- Applications of DS-Spread spectrum- Generation of PN-Sequence- Frequency - Hopped spread spectrum signals- Performance of FH Spread spectrum in an AWGN channel- Synchronization of spread spectrum signals.	10	15
SECOND INTERNAL EXAM			
V	Frequency-non selective slowly fading channel- Digital signalling over a frequency-selective slowly fading channel.	8	20
VI	Diversity techniques- Multiuser Communications- Multiple access techniques- Capacity of multiple access methods- Code Division Multiple Access- Multi User Detectors- Decorrelating Detector- Minimum mean square error detector- Random access methods.	10	20
END SEMESTER EXAM			

Course No.	Course Name	L-T-P	Credits	Year of Introduction
01EC6207	RFCircuit Design	**3-0-0**	**3**	**2015**

Course Objectives

1. To use Smith chart
2. To design matching and biasing networks
3. To design microwave oscillators and amplifiers

Syllabus

Smith Chart. RF filter design. Micro strip filter design. Design of RF power divider circuit. Design matching and biasing networks. Design microwave oscillators and amplifiers

Expected Outcome

1. Understand the importance of Smith chart and ABCD parameters in RF circuit design
2. To design microwave oscillators and amplifiers
3. Understand the importance of stability circle

References

1. Reinhold Ludwig, Pavel Bretchko, RF Circuit Design-Theory and Application, - Pearson Education 2000
2. Mathew M .Radmanesh, "Radio Frequency and Microwave electronics"-Pearson Education Collins, "Foundation for Microwave Engineering",2nd Ed.McGraw Hill,Inc

COURSE PLAN

Module	Contents	Hours Allotted	% of Marks in End-Semester Examination
I	Transmission line section, Return loss and Insertion loss,Quarter wave transformer- Theory of small reflections, Multi section transformer, Binomial and Chebyshev transformer. ABCD parameters of simple Two –Port Networks - Impedance Element, T networks.	7	15
II	Smith Chart - Impedance Matching Using smith Chart, Finding unknown impedance and input impedance using Smith chart. Scattering Parameters - Chain Scattering Matrix, Signal Flow analysis using S Parameters.	7	15

FIRST INTERNAL EXAM			
III	RF filter design - First order low pass, high pass and band pass filter circuits. Frequency transformation and impedance transformation. Higher order filter design. Filter implementation –Unit elements, Kuroda's Identities, examples of Microstrip filter design, Coupled filter, Band pass filter section.Cascading band pass filter elements.	7	15
IV	RF power divider circuit – Wilkinson's power divider. Theory of PIN diode - Design of PIN switches and attenuators.	7	15
SECOND INTERNAL EXAM			
V	Design of simple matching and biasing networks -Power Relations for RF transistor and MESFET amplifiers, Stabilization Methods. Simple BJT and MESFET amplifier design examples.	7	20
VI	Microwave oscillators - High frequency oscillator configuration, Design of MESFET based oscillator Dielectric resonator Oscillator, gunn Oscillator, YIG Oscillator. Mixers- Design of simple RF mixer circuits based on BJT and MESFET.	7	20
END SEMESTER EXAM			

Course No.	Course Name	L-T-P	Credits	Year of Introduction
01EC6211	Optical Communication Systems	**3-0-0**	**3**	**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, Heterostructures- 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: Optic Communication System, John Wiley and Sons,2003
2. W J Diggonet, Rare earth Doped Fiber Lasres 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.Sam shanmugam, "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
01EC6215	Advanced DSP Techniques	**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.

Syllabus

Design of FIR and IIR Filters. Lowpass, Bandpass, Bandstop and High pass filters. Multi rate signal processing,, Filter banks, Continuous and Discrete wavelet transforms, Filterbank interpretation.

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

References

1. P. P. Vaidyanathan, Multirate Systems and Filterbanks, Prentice Hall 1993
2. Wavelet Transforms - Bopadikar and Rao, Pearson Education 1999
3. Insight into wavelets, K. P. Soman, Prentice Hall India 2/e
4. Digital signal Processing, By John G. Proakis, Dimitris G. Manolakis Pearson Education 2007
5. L. Cohen, Time Frequency Analysis, Prentice Hall 1995
6. Wavelets and Filterbank, G Strang& T Nguyen ,Wellesly-Cambridge 1996
7. Wavelets and subband coding, M Vetterli& J Kovacevic, Prentice Hall 1995

COURSE PLAN

Module	Contents	Hours Allotted	% of Marks in End-Semester Examination
I	Review of fundamentals of the Discrete Time Systems: Design of FIR Digital Filters- Window method,Park-McClellan' s method. Design of	7	15

	IIR Digital Filters-Butterworth, Chebyshev and Elliptic Approximations; Lowpass, Bandpass, Bandstop and High pass filters		
II	Effect of finite register length in FIR filter design. Basics of Multirate systems and its application, up sampling and Down - Sampling, Fractional Sampling rate converter.	7	15
FIRST INTERNAL EXAM			
III	Polyphase decomposition: Efficient realisation of Multirate systems. Uniform filter banks and its implementation using polyphase decomposition. Two channel Quadrature Mirror Filter Banks, Perfect Reconstruction.	7	15
IV	Time Frequency Analysis, Heisenberg's uncertainty principle. Short time fourier transform.	7	15
SECOND INTERNAL EXAM			
V	Continuous Wavelet Transform and its properties. Multi Resolution Analysis Discrete Wavelet Transform: Orthonormal Wavelet Analysis.	7	20
VI	Filter bank interpretation. Application of wavelet transform for data compression.	7	20
END SEMESTER EXAM			

Course No.	Course Name	L-T-P	Credits	Year of Introduction
01EC6217	Microwave Imaging	**3-0-0**	**3**	**2015**

Course Objectives

1. Awareness regarding the important fundamentals of image processing
2. Enable students to understand the concepts of electromagnetics with reference to imaging
3. Enable students to understand applications of microwave imaging and its use the in designs of practical systems

Syllabus

Fundamentals of image processing: Elements of virtual perception. Image sensing and acquisition. Electromagnetic radiation and electromagnetic spectrum: Radiation principles. Interaction of electromagnetic radiation with earth's surface. Principles of microwave remote sensing. Airborne and spaceborne radar systems. Target parameters. Radar image analysis. Synthetic Aperture Radar. Principles of thermal imaging. Applications of microwave imaging in medicine.

Expected Outcome

1. Understand various image processing systems
2. Understand concepts of electromagnetics with reference to imaging
3. Understand designs of practical microwave imaging systems

References

1. Floyd M. Handerson and Anthony J. Lewis "Principles and applications of Imaging RADAR", Manual of Remote sensing, Third edition, vol.2, Wiley
2. Philippe Lacomme, Jean-Claude Marchais, Jean-Philippe Hardange and Eric Normant, Air and spaceborne radar systems-An introduction, Elsevier publications, 2001
3. Iain H. Woodhouse, Introduction to microwave remote sensing, 2005
4. Roger J Sullivan, Knovel, Radar foundations for Imaging and Advanced Concepts, SciTech Pub, 2004
5. Ian Faulconbridge, Radar Fundamentals, Published by Argos Press, 2002
6. Eugene A. Sharkov, Passive Microwave Remote Sensing of the Earth: Physical Foundations, Published by Springer, 2003.
7. Digital Image Processing (3rd Edition) Rafael C. Gonzalez, Richard E. Woods Prentice Hall, 2007.
8. Margaret Cheny, Brett Borden, Fundamentals of radar imaging, Society for Industrial and Applied Mathematics (SIAM), 2009

COURSE PLAN

Module	Contents	Hours Allotted	% of Marks in End-Semester Examination
I	Fundamentals of image processing: Elements of virtual perception. Image sensing and acquisition	7	15
II	Image sampling and quantization: Image enhancement ,image restoration, image segmentation andImage recognition	7	15
FIRST INTERNAL EXAM			
III	Electromagnetic radiation and electromagnetic spectrum: Radiation principles, Planck law, Stephan Boltzmann law.	7	15
IV	Interaction of electromagnetic radiation with earth's surface, Wien's displacement law, spectral signature, reflectance characteristics of earth's surface types. Remote sensing systems.Principles of microwave remote sensing.	7	15
SECOND INTERNAL EXAM			
V	Airborne and spaceborne radar systems: system parameters: wavelength, polarisation, resolution. Target parameters: back scattering, volume scattering.	7	20
VI	Radar image analysis. Synthetic Aperture Radar, SAR Interferometry. SAR applications. Principles of thermal imaging. Applications of microwave imaging in medicine.	7	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 Examination
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 INTERNAL EXAM			
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 examination
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	
SECOND INTERNAL EXAM			
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 EXAM			

Course No.	Course Name	L-T-P	Credits	Year of Introduction
01EC6291	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
01EC6293	Communication system lab	**3-0-0**	**1**	**2015**

Course Objectives

1. Attain ability to do projects for digital communication
2. Familiarize the use of MATLAB for simulation of optical communication.
3. Familiarize with microwave bench setup and measurements

List of Exercises / Experiments

Communication Experiments: (MATLAB)

1. Simulation of Digital communication system.
2. Simulation of fading and multipath channels.
3. BER curves and eye patterns.
4. Simulation of a RADAR System
5. Simulation of Mobile Network

Fiber Optics Experiments:

6. Characteristics of optical transmitters and receivers
7. Study of Optical Spectrum Analyser.
8. Design and setting up a WDM system.
9. Link Analysis Using OTDR.

Microwave Experiments:

10. Calibration & Troubleshooting of Microwave measurement set up
11. Crystal Index measurement
12. Parameter measurements of H-plane, E-plane & Magic T.
13. Measurement of Dielectric Constant

Expected Outcome

1. Familiarization of Microwave measurements
2. Familiarization of digital and optical communication experiments

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	7	15

	match, baluns, gamma and omega match.		
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 and Biconical 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 – Field 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	20
END SEMESTER EXAM			

Course No.	Course Name	L-T-P	Credits	Year of Introduction
01EC6206	Communication Networks	**3-0-0**	**3**	**2015**

Course Objectives

1. Understand the basics of network communication.
2. Introduction to advanced networking concepts

Syllabus

General issues in the transport of data traffic over networks of digital transmission media. Architectural concepts in ISO's OSI layered model. Leyering in the Internet. Application layer; HTTP, SMTP, telnet, ftp. TCP/IP protocol stack. Transport layer; issues and standards, TCP, UDP. Network layer; IP, topology, routing, flow control, congestion control. Internetworking. Data link layer; ARQ schemes and their analysis. Multiple Access. LANs; IEEE LAN standards. Wirless LANs; IEEE 802.11. ATM Networks. Multimedia Networks. QoS issues in networks. Modelling and performance analysis of networks: Markov chain theory, queueing models: Little's Theorem, M/M/1, M/M/m, M/M/α, M/M/m/m, M/G/1 Queueing systems, Priority Queueing.

Expected Outcome

1. Identify the different types of network topologies and protocols
2. Identify the different types of network devices and their functions within a network

References

1. Kumar, D. Manjunath and J. Kuri, Communication Networking: An Analytical Approach, Morgan Kaufmann Publisher, 2004.
2. D. Bertsekas and R. Gallager, Data Networks, 2nd Edition,Prentice Hall of India, New Delhi, 2002.
3. J. K. Kurose and K. W. Ross, Computer Networking: A Top-Down Approach Featuring Internet, Pearson Education, 2012.
4. J. Walrand and P. Varaiya, High-Performance Communication Networks, 2nd Edition, Harcourt Asia, 2000

COURSE PLAN

Module	Contents	Hours Allotted	% of Marks in End-Semester Examination
I	General issues in the transport of data traffic over networks of digital transmission media. Architectural concepts in ISO's OSI layered model. Leyering in the Internet.	7	15

II	Application layer; HTTP, SMTP, telnet, ftp. TCP/IP protocol stack. Transport layer; issues and standards, TCP, UDP.	7	15
FIRST INTERNAL EXAM			
III	Network layer; IP, topology, routing, flow control, congestion control. Internetworking. Data link layer; ARQ schemes and their analysis.	7	15
IV	Multiple Access. LANs; IEEE LAN standards. Wirless LANs; IEEE 802.11.	7	15
SECOND INTERNAL EXAM			
V	ATM Networks. Multimedia Networks. QoS issues in networks.	7	20
VI	Modelling and performance analysis of networks: Markov chain theory, queueing models: Little's Theorem, M/M/1, M/M/m, M/M/α, M/M/m/m, M/G/1 Queueing systems, Priority Queueing.	7	20
END SEMESTER EXAM			

Course No.	Course Name	L-T-P	Credits	Year of Introduction
01EC6212	Microwave Integrated Circuits	**3-0-0**	**3**	**2015**

Course Objectives

1. To design microwave transmission lines
2. To design filters,phase shifters, circulators
3. Tofamiliarize with microwave integrated assemblies

Syllabus

Planar Transmission line – strip line, Microstrip line, suspended line, slot line, coplanar wave guide, coupled strip-lines, microstrip coupled lines. Distributed and lumped elements of integrated circuits. Filters –Filter synthesis, LPF, BPF, Diode control. Phase shifters. circulators and isolators. Microwave integrated subassemblies – L band multifunctional Transmit/Receive Module, Electrically tunable L band pre selector, Switchable balanced amplifier, C band multichannel receiver. Design and fabrication – RF/Microwave packages, 3 dimensional design-Horizontel-Vertical configurations, multilayer structures, fabrication aspects- HMICs, MMICs

Expected Outcome

1. Understand design microwave transmission lines
2. Should be able to design microwave phase shifters circulators and isolators
3. Understand the of design and fabrication of microwave circuits

References

1. Leo Maloratsky: Passive RF and Microwave Integrated Circuits, Elsevier, 2004
2. Bharathi Bhat and Shiban K. Koul: Stripline-like Transmission Lines for MIC, New Age International (P) Ltd, 2007
3. Yoshihiro Konishi: Microwave Integrated Circuits, CRC Press 1991
4. Ivan Kneppo: Microwave Integrated Circuits, Springer, 2013

COURSE PLAN

Module	Contents	Hours Allotted	% of Marks in End-Semester Examination
I	Planar Transmission line – strip line, Microstrip line, suspended line, slot line, coplanar wave guide, coupled strip-lines, microstrip coupled lines.	7	15

II	Distributed and lumped elements of integrated circuits - capacitors, inductors, resistors, terminations, attenuators, resonators and discontinuities	7	15
FIRST INTERNAL EXAM			
III	Filters – Filter synthesis, LPF, BPF, Diode control devices – switches, attenuators, limiters.	7	15
IV	Phase shifters - Diode phase shifter, ferrite and differential phase shifters, circulators and isolators. Distributed and lumped ferrite circulators and isolators.	7	15
SECOND INTERNAL EXAM			
V	Microwave integrated subassemblies – L band multifunctional Transmit/Receive Module, Electrically tunable L band pre selector, Switchable balanced amplifier, C band multichannel receiver	7	20
VI	Design and fabrication – RF/Microwave packages, 3 dimensional design-Horizontal-Vertical configurations, Multilayer structures, Fabrication aspects- HMICs, MMICs	7	20
END SEMESTER EXAM			

Course No.	Course Name	L-T-P	Credits	Year of Introduction
01EC6214	Radar signal processing	**3-0-0**	**3**	**2015**

Course Objectives

1. To introduce the student to the various aspect of radar signal processing
2. To introduce various aspects related to Doppler and MTI Radar signal processing
3. Tofamiliarize narrow band Direction of Arrival Estimation techniques

Syllabus

Introduction to Radar Signal Processing, Spectrum Analysis, Recovery from Samples, Synthesis of Complex Data From Magnitude Only, Digital Filter Fundamentals. Radar Detection. Doppler and Moving Target Indicator (MTI), Blind Doppler Shifts and PRF Stagger, De-Staggering and Processing, MTI and MTD with Moving Radars and Moving Clutter, CW, High PRF, and Medium PRF Doppler Processing. Array Processing in Radars. Narrowband Direction of Arrival Estimation.

Expected Outcome

1. Understand the fundaments of radar signal processing
2. Understand the working of Doppler and MTI Radar processing .
3. Understand the various aspects of Narrow Band Direction of Arrival Estimation.

References

1. Radar : Principles, Technology and Applications ; Byron Edde ; PEARSON, 1995
2. Radar signal analysis and processing using MATLAB 3rd e/d; Bassem R Mahafza ; CRC Press
3. Optimum Array Processing ; Harry L Van Trees ; Wiley – Interscience, 2002

COURSE PLAN

Module	Contents	Hours Allotted	% of Marks in End-Semester Examination
I	Introduction to radar signal Processing : Systems Fundamentals and Definitions, Signal Integration , Correlation , Convolution , Spectrum Analysis	7	15
II	Fast Algorithms : FFT, Fast Convolution, Fast Correlation, Windows and Resolution, Recovery from Samples – Interpolation, Synthesis of Complex Data From Magnitude Only, Digital Filter Fundamentals	7	15
FIRST INTERNAL EXAM			
III	Radar Detection – Introduction , Detection in Noise , Signal Integration and Target Fluctuation, Coherent Integration , Target Fluctuation and coherent Integration	7	15

IV	Doppler and Moving Target Indicator (MTI) Fundamentals, MTI Principles and Methods , Blind Doppler Shifts and PRF Stagger, De-Staggering and Processing, MTI and MTD with Moving Radars and Moving Clutter, CW, High PRF, and Medium PRF Doppler Processing.	7	15
SECOND INTERNAL EXAM			
V	Array Processing in Radars: General Arrays, Linear Arrays, Uniformly Weighted Linear Arrays ,Conventional Beam former	7	20
VI	Narrowband Direction of Arrival Estimation – Classical Methods – Delay and Sum Method, Capons Minimum Variance Distortionless Response Method Subspace Methods for DOA Estimation – MUSIC, Min Norm and ESPIRIT technique	7	20
END SEMESTER EXAM			

Course No.	Course Name	L-T-P	Credits	Year of Introduction
01EC6216	Digital Techniques in Television Engineering	**3-0-0**	**3**	**2015**

Course Objectives

1. To understand the various technical components in digital television broadcasting.

Syllabus

Basic principles of Digital TV broadcasting - Review of current television standards PAL, SECAM , NTSC - Digitization of video signals. Compression of video signals – MPEG-2, H.264/MPEG-4 Part 10 AVC, AVS standards. Compression artifacts. Compression of audio signals –AC-3, AAC, HE- AAC standards. Common scrambling algorithm, Source multiplexing, Conditional access, Conditional access management systems. DVB Modulation, DVB Channel Coding, DVB Channel Capacity, DVB teletext, DVB subtitling system. ATSC 8-VSB Modulation, ATSC Data Framing, ATSC Concatenated Channel Coder, ATSC Channel Capacity

Expected Outcome

1. Understand audio and video compression standards used for digital TV.
2. Understand the different digital television systems.
3. Understand the modulation schemes used in digital TV.

References

1. Understanding Digital Television: An Introduction to DVB Systems with Satellite, Cable, Broadband and Terrestrial TV, Lars-Ingemar Lundström, Focal Press – Elsevier 2006
2. Coding and Modulation for Digital Television (Multimedia Systems and Applications Volume 17) Gordon M. Drury, Garik Markarian, Keith Pickavance,Garik Markarian, Keith Pickavance,2002
3. Digital Television: Technology and Standards, . John F. Arnold, Michael R. Frater, Mark R. Pickering, 2007, John Wiley & Sons
4. Digital Television Satellite, Cable, Terrestrial, IPTV, Mobile TV in the DVB Framework, Hervé Benoit, Focal Press-Elsevier 3/e
5. Digital video broadcasting: technology, standards and regulations, Ronald de Bruin, Jan Smits. Artech house inc,1998

COURSE PLAN

Module	Contents	Hours Allotted	% of Marks in End-Semester Examination
I	Basic principles of Digital TV broadcasting - Review of current television standards PAL, SECAM, NTSC - Digitization of video	7	15

	signals- Digitization formats.		
II	Compression of video signals – MPEG-2, H.264/MPEG-4 Part 10 AVC, AVS standards. Compression artifacts.	7	15
FIRST INTERNAL EXAM			
III	Compression of audio signals –AC-3, AAC, HE- AAC standards.	7	15
IV	Source multiplexing, Conditional access, Conditional access management systems.	7	15
SECOND INTERNAL EXAM			
V	DVB Common scrambling algorithm. DVB Modulation, DVB Channel Coding, DVB Channel Capacity, DVB teletext, DVB subtitling system.	7	20
VI	ATSC 8-VSB Modulation, ATSC Data Framing, ATSC Concatenated Channel Coder, ATSC Channel Capacity.	7	20
END SEMESTER EXAM			

Course No.	Course Name	L-T-P	Credits	Year of Introduction
01EC6122	Design of VLSI systems	**3-0-0**	**3**	**2015**

Course Objectives

1. Understand the basics of CMOS Inverter and other Logic Design Techniques
2. Get a feel of current design technology
3. In-depth knowledge about various memory elements

Syllabus

CMOS Inverter - Behaviour and Performance, CMOS Circuit and Logic Design, Advanced techniques in CMOS Logic Circuits, Arithmetic Circuits in CMOS VLSI- Adders, High speed adders, Multipliers, Low power design, Designing Memory and Array Structures, Addressable or Associative Memories, Sense Amplifier

Expected Outcome

1. Understand the basics of VLSI Design
2. Understand the working of high speed adders and multipliers
3. Understand , various methods in the design of memory elements

References

1. John P. Uyemura, Introduction to VLSI Circuits and Systems, John Wiley & Sons 2002
2. Keshab K. Parthi, VLSI DIGITAL SIGNAL PROCESSING SYSTEMS, John Wiley & Sons 2002
3. Neil H. E. Weste, Kamran Eshranghian, Principles of CMOS Design, Pearson Education Asia 2000
4. Jan M. Rabaey and et al, DIGITAL INTEGRATED CIRCUITS, Pearson Edn. Inc. 2003

COURSE PLAN

Module	Contents	Hours Allotted	% of Marks in End-Semester Examination
I	CMOS Inverter - Static Behaviour, Performance of CMOS Inverter - Dynamic Behaviour, Power Energy and Energy Delay, CMOS Circuit and Logic Design-CMOS Logic structures.	7	15
II	Advanced techniques in CMOS Logic Circuits-Mirror circuits, Pseudo nMOS, Tri-state circuits, Clocked CMOS, Dynamic CMOS Logic circuits, Dual Rail Logic Networks.	7	15
FIRST INTERNAL EXAM			
III	Arithmetic Circuits in CMOS VLSI-Bit Adder Circuits, Ripple Carry Adder, Carry Look Ahead Adders, Other High speed adders-	7	15

	Multiplexer based fast binary adders.Multipliers-Parallel multiplier, Wallace Tree and Dadda multiplier		
IV	Low power design- Scaling Versus Power consumption, Power reduction techniques	7	15
SECOND INTERNAL EXAM			
V	Designing Memory and Array Structures - Memory classification, Memory Core - Read Only Memories, Non-volatile Read Write Memories	7	20
VI	Content - Addressable or Associative Memories, Memory Peripheral Circuits - Address Decoders, Sense Amplifiers.	7	20
END SEMESTER EXAM			

Course No.	Course Name	L-T-P	Credits	Year of Introduction
01EC6224	Soft Computing	**3-0-0**	**3**	**2015**

Course Objectives

1. To familiarize various components of soft computing.
2. To give an overview of fuzzy Logic
3. To give a description on artificial neural networks with its advantages and application

Syllabus

Basics of Fuzzy Sets, Fuzzy relations, Concepts of Artificial Neural Networks, Integration of Fuzzy and Neural Systems, Types of Neural Fuzzy Controllers, Survival of the Fittest, Predicate calculus, Semantic networks, Applications

Expected Outcome

1. Identify and describe soft computing techniques and their roles in building intelligent machines
2. Recognize the feasibility of applying a soft computing methodology for a particular problem
3. Apply fuzzy logic and reasoning to handle uncertainty and solve engineering problems

Reference

1. Chin –Teng Lin and C.S. George Lee, (1996) "Neural Fuzzy Systems" – A neuro fuzzy synergism to intelligent systems, Prentice Hall International.
2. JyhShing Roger Jang, Chuen-Tsai Sun, EijiMizutani, (1997), Neuro-Fuzzy and Soft Computing: A Computational Approach to Learning and Machine, Prentice Hall.
3. Yanqing Zhang and Abraham Kandel (1998), Compensatory Genetic Fuzzy Neural Network and Their Applications, World Scientific.
4. T. J. Ross (1995)-Fuzzy Logic with Engineering Applications, McGraw-Hill, Inc.
5. NihJ.Nelsson, "Artificial Intelligence - A New Synthesis", Harcourt Asia Ltd., 1998.
6. D.E. Goldberg, "Genetic Algorithms: Search, Optimization and Machine Learning", Addison Wesley,N.Y, 1989

COURSE PLAN

Module	Contents	Hours Allotted	% of Marks in End-Semester Examination
I	Basics of Fuzzy Sets: Fuzzy Relations. Fuzzy logic and approximate reasoning – Design.Methodology of Fuzzy Control Systems – Basic structure and operation of fuzzy logic control systems.	8	15

II	Concepts of Artificial Neural Networks: Basic Models and Learning rules of ANN's. Single layer perceptron networks – Feedback networks – Supervised and unsupervised learning approaches – Neural Networks in Control Systems.	8	15
FIRST INTERNAL EXAM			
III	Integration of Fuzzy and Neural Systems: Neural Realization of Basic fuzzy logic operations – Neural Network based fuzzy logic inference – Neural Network based Fuzzy Modelling.	7	15
IV	Types of Neural Fuzzy Controllers. Data clustering algorithms - Rule based structure identification-Neuro-Fuzzy controls - Simulated annealing.	6	15
SECOND INTERNAL EXAM			
V	Survival of the Fittest - Fitness Computations - Cross over - Mutation - Reproduction - Rank method–Rank space method AI search algorithm	6	20
VI	Predicate calculus - Rules of interference – Semantic networks - Frames - Objects - Hybrid models-Applications.	7	20
END SEMESTER EXAM			

Course No.	Course Name	L-T-P	Credits	Year of Introduction
01EC6326	Optimization techniques	**3-0-0**	**3**	**2015**

Course Objectives

1. To familiarize the students with the need of optimization in engineering
2. To introduce the students with the different types of optimization algorithms
3. To enable the students to select the suitable optimization technique for the particular problem

Syllabus

One dimensional- necessary and sufficient conditions, Search methods, Gradient methods, Multivariable- Search methods, Gradient based methods, Linear programming, Theory of Simplex method, Two phase method, Non Linear Programming, search method, Meta-heuristic optimization Techniques, Differential Evolution, Harmony Search Algorithm, Artificial Bee Colony Algorithm

Expected Outcome

1. Understand the role of optimization in engineering design.
2. Understand the working principle of optimization algorithms.
3. Understand the formulation of the problem and usage of optimization algorithms

Reference

1. Optimization for Engineering Design, Algorithms and Examples. -PHI, ISBN -978-81-203-0943-2, Kalyanmoy Deb, IIT Kanpur.

COURSE PLAN

Module	Contents	Hours Allotted	% of Marks in End-Semester Examination
I	One dimensional – necessary and sufficient conditions, Search methods- Fibonacci search, golden section search, Gradient methods- Newton-Raphson method, cubic search.	7	15
II	Multivariable- necessary and sufficient conditions, Search methods- Evolutionary method, Hook-Jeevs pattern search, Gradient based methods- steepest descent, Newton's method, conjugate gradient method.	7	15
FIRST INTERNAL EXAM			

III	Linear Programming - Systems of linear equations & inequalities, Formulation of linear programming problems, Theory of Simplex method, Simplex Algorithm, Two phase method-Duality, Dual Simplex method.	7	15
IV	Non Linear Programming- Kuhn-Tucker conditions- Necessary and Sufficiency theorem – transformation method – penalty function method, search method –random search method, linearized search - Frank-Wolf method.	7	15
SECOND INTERNAL EXAM			
V	Meta-heuristic optimization Techniques- (Principle and implementation steps for examples related to engineering (signal processing, communication, control system) optimization of the following)	7	20
VI	Differential Evolution (DE), Harmony Search Algorithm (HSA), Artificial Bee Colony Algorithm (ABC).	7	20
END SEMESTER EXAM			

Course No.	Course Name	L-T-P	Credits	Year of Introduction
01EC6292	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 mini project, 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
01EC6294	RF design and simulation lab	**3-0-0**	**1**	**2015**

Course Objectives

1. Attain ability to do measurements using network analyzer and spectrum anlyzer
2. Familiarize the use of CAD methods for RF circuit and antenna analysis

List of Exercises / Experiments

1. Study of analog modulated signals using Spectrum Analyzer.
2. Study of digital modulated signals.
3. S ¨C Parameter measurement of 2 PORT RF circuits using Network Analyzer.
4. Simulation of Dipole, Yagi and Log Periodic Antenna using 4NEC2
5. Design of RF amplifier using Microwave CAD packages (Microwave Office / HFSS)
6. Design of oscillators using Microwave CAD packages
7. Design of filters using Microwave CAD packages
8. Design and simulation of Patch Antenna using HFSS.
9. Design and Simulation of 1D arrays using Matlab / HFSS.
10. Design and Simulation of 2D arrays using Matlab / HFSS.

Expected Outcome

1. Familiarization of network analyzer and spectrum analyzer
2. Familiarization of CAD software for RF circuit design and antenna analysis

SEMESTER – III

Syllabus and Course Plan

Course No.	Course Name	L-T-P	Credits	Year of Introduction
01EC7211	Computational Methods for Electromagnetics	**3-0-0**	**3**	**2015**

Course Objectives

1. To give idea about Numerical methods for solving complex Electromagnetic problems.

Syllabus

Introduction to Numerical Methods for solution of partial differential equation, Richardson's extrapolation formula. Green's Function and it's Numerical Integration and use of Richardson's extrapolation. Finite Difference Method. Finite Difference Time Domain (FDTD) method -Yee's Algorithm - Solution of Maxwell's Equation in 1,2 and 3 dimension. Finite Element Method for Electromagnetic Problems.Method of Moments - Application of Method of Moments to waveguides and Microstrip transmission lines. Application of Method of moments for analysis of antenna characteristics. Spectral Analysis of Microstrip circuits-Quasi TEM Spectral Analysis of Shielded and unshielded micrssrip circuits, Full wave Solution of unshielded microwave circuits.

Expected Outcome

1. Understand the Numerical methods for Electromagnetic problems
2. Understand the Finite Difference Method and Finite Difference Time Domain Method for Electromagnetic Analysis.
3. Understand Finite Element Method for Electromagnetic Problems.
4. Understand use of Method of Moments and Spectral Analysis

Reference

1. Richard C Bootan, Computational Methods for Electro Magnetics and Microwaves. Wiley Series in Microwave and Optical Engineering 1992
2. R.F Harrington, Time Harmonic Electromagnetic Fields, McGraw Hill, Newyork 1961
3. Andrew F. Peterson, Computational Methods for Electromagnetics, IEEE press 2001
4. Anders Bondeson , Thomas Rylander ,Computational Electromagnetics, Par ngelström Springer 2005, 1/e Springer 2005, 1/e

COURSE PLAN

Module	Contents	Hours Allotted	% of Marks in End-Semester Examination
I	Introduction to Numerical Methods for solution of partial differential equation, Richardson's extrapolation formula. Green's Function and it's	7	15

	Numerical Integration and use of Richardson's extrapolation		
II	Finite Difference Method. Solution of one dimensional two dimensional differential equations with simple example. Application to waveguides.	7	15
FIRST INTERNAL EXAM			
III	Finite Difference Time Domain (FDTD) method -Yee's Algorithm - Solution of Maxwell's Equation in 1,2 and 3 dimension . Finite Element Method for Electromagnetic Problems	7	15
IV	Method of Moments - Application of Method of Moments to waveguides and Microstrip transmission lines.	7	15
SECOND INTERNAL EXAM			
V	Application of Method of moments for analysis of antenna characteristics - Radiation Pattern , Antenna Impedance, Mutual Coupling and antenna arrays.	7	20
VI	Spectral Analysis of Microstrip circuits-Quasi TEM Spectral Analysis of Shielded and unshielded microstrip circuits, Full wave Solution of unshielded microwave circuits	7	20
END SEMESTER EXAM			

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

Course Objectives

1. As a graduate level course on secure communication, this course assure to deliver the students, a sound understanding of the number theoretic methods and algorithms used in classical and modern cryptography and their cryptanalysis.

Syllabus

Introduction to cryptography - stream and block ciphers- symmetric and public keys.

Expected Outcome

1. Learn theorems on the number and abstract algebra and develops the mathematical proof writing 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 incryptology

TextBook

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	Basics Mathematical proofs and methods. Complexity theory: Computational Complexity Classes P, NP- NP-Complete, NP-Hard, BPP .Number theory: primes, divisibility, linear Diophantine equations, congruences, systems of congruence equation, quadratic congruences. Wilson theorem, Fermat's little theorem, Euler's theorem. Multiplicative functions, Primitive roots, Quadratic residues,Legendre symbol, Continued fractions.	8	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.	7	15
IV	Public key Cryptography: One way functions, Hash functions, Knapsack cryptosystems, RSA, Deffie Helman 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.	7	20
END SEMESTER EXAM			

Course No.	Course Name	L-T-P	Credits	Year of Introduction
01EC7215	Wireless Communication	**3-0-0**	**3**	**2015**

Course Objectives

1. To give idea about modern digital communication methods and systems.

.

Syllabus

Fading and Diversity Wireless Channel Models. Statistical fading models, Narrow band and wideband fading models. Diversity, Performance gains, Combining methods. Performance analysis for Rayleigh fading channels. Direct sequence spread spectrum (DS-SS), Frequency hopping spread spectrum (FH-SS), ISI and Narrow band interference rejection, PN Sequences. Rake Receiver. Interference Analysis for Broadcast and Multiple Access Channels, Capacity of cellular CDMA networks, Reverse link power control. Capacity of Wireless Channels. Cellular Wireless Communication. Overview of second generation cellular wireless systems: GSM and IS-95 standards, 3G systems: UMTS & CDMA 2000 standards and specifications, vision of 4G standards. OFDM.

Expected Outcome

1. Understand the modern digital communication systems.
2. Understand multicarrier and multiuser communication systems and their performance.
3. Understand spread spectrum systems and their performance, use of Method of Moments and Spectral Analysis

Reference

1. T. S. Rappaport, "Wireless Communication, principles & practice", PHI, 2002
2. Simon Haykin and Michael Moher, " Modern Wireless Communications", Person Education,2005.
3. G.L Stuber, "Principles of Mobile Communications", 2nd edition, Kluwer Academic
4. Publishers, 2001.
5. R.L Peterson, R.E. Ziemer and David E. Borth, "Introduction to Spread SpectrumCommunication", Pearson Education, 1995.
6. A.J.Viterbi, "CDMA- Principles of Spread Spectrum", Addison Wesley, 1995.
7. Andrea Goldsmith, "Wireless Communications", Cambridge University press, 2005

COURSE PLAN

Module	Contents	Hours Allotted	% of Marks in End-Semester Examination
I	Fading and Diversity Wireless Channel Models- Path loss and Shadowing models, Statistical fading models, Narrow band and wideband fading models, Review of performance of digital modulation schemes over wireless channels.	7	15

II	Diversity- Time diversity, Frequency and Space diversity, Receive diversity, Concept of diversity branches and signal paths, Performance gains, Combining methods- Selective combining, Maximal ratio combining, Equal gain combining, performance analysis for Rayleigh fading channels, Transmit Diversity-Alamouti Scheme.	7	15
FIRST INTERNAL EXAM			
III	Spread spectrum and CDMA: Motivation- Direct sequence spread spectrum (DS-SS), Frequency hopping spread spectrum (FH-SS), ISI and Narrow band interference rejection, Code design- Maximal length sequences, Gold codes- Walsh codes, Diversity in DS-SS systems- Rake Receiver- Performance analysis.	7	15
IV	CDMA Systems- Interference Analysis for Broadcast and Multiple Access Channels, Capacity of cellular CDMA networks, Reverse link power control. Capacity of Wireless Channels- Capacity of flat and frequency selective fading channels	7	15
SECOND INTERNAL EXAM			
V	Cellular Wireless Communication: Cellular concept, Interference, Trunking and grade of service, Improving coverage and capacity in cellular systems. Overview of second generation cellular wireless systems: GSM and IS-95 standards, 3G systems: UMTS & CDMA 2000 standards and specifications, vision of 4G standards.	7	20
VI	OFDM: Introduction to OFDM, Multicarrier Modulation and Cyclic Prefix, Channel model and SNR performance, OFDM Issues – PAPR, Frequency and Timing Offset Issues.	7	20
END SEMESTER EXAM			

Course No.	Course Name	L-T-P	Credits	Year of Introduction
01EC7217	Multicarrier and Spread Spectrum Systems	**3-0-0**	**3**	**2015**

Course Objectives

1. To introduce the student to the various aspects of multicarrier communication
2. Important aspects related to OFDM and CDMA are discussed
3. Receiver structures for CDMA and MC-CDMA systems are discussed

Syllabus

The concept of multicarrier transmission: OFDM as a multicarrier transmission, Sensitivity of OFDM signals against nonlinearities, Time and frequency synchronisation for OFDM Systems. Requirement of the mobile Radio Channel, Time and frequency interleavers, OFDM system with convolutional coding and QPSK. General Principles of CDMA. Cellular mobile radio networks. Methods for handling interference in CDMA Mobile radio networks. Discrete channel model. Receiver Structures for Synchronous Transmission.

Expected Outcome

1. Understand the concepts of multicarrier communication
2. Understands the important aspects of OFDM and CDMA systems
3. Understand the working of receiver structures for CDMA and MC-CDMA systems

Reference

1. Theory and applications of OFDM and CDMA; Henrik Schulze ; John Wiley & Sons, Ltd; 2005
2. OFDM for Wireless Communications Systems; Ramjee Prasad ; Artech House ; 2004
3. Introduction to CDMA Wireless Communication; Mosa Ali Abu-Rgheff ; Elsevier; 2007

COURSE PLAN

Module	Contents	Hours Allotted	% of Marks in End-Semester Examination
I	The concept of multicarrier transmission: OFDM as a multicarrier transmission, Implementation by FFT, OFDM with guard interval, Spectral shaping for OFDM Systems, Sensitivity of OFDM signals against nonlinearities	7	15
II	Time and frequency synchronisation for OFDM Systems, OFDM with pilot symbols for channel estimation. Requirement of the mobile Radio Channel, Time and frequency interleavers, OFDM system with convolutional coding and QPSK	7	15
FIRST INTERNAL EXAM			

III	General Principles of CDMA: The concept of spreading, Cellular mobile radio networks, Spreading codes and their properties – Pseudonoise sequences, Gold codes, Kasami codesand Barker codes. Methods for handling interference in CDMA Mobile radio networks – Power control, Soft handover.	7	15
IV	Representation of CDMA signals, The discrete channel model for synchronous transmission in a frequency flat channel, The discrete channel model for synchronous wideband MC-CDMA transmission	7	15
SECOND INTERNAL EXAM			
V	Receiver Structures for Synchronous Transmission: The single user matched filter receiver, Optimal receiver structures, Suboptimal linear receiver structures, Suboptimal nonlinear receiver structures.	7	20
VI	Receiver Structures For MC-CDMA and Asynchronous Wideband CDMA Transmission – The RAKE receiver, Optimal receiver structures. Example of a CDMA System – Wireless LAN.	7	20
END SEMESTER EXAM			

Course No.	Course Name	L-T-P	Credits	Year of Introduction
01EC7221	Smart Antennas	**3-0-0**	**3**	**2015**

Course Objectives

1. To give idea about Numerical methods for solving complex Electromagnetic problems.

Syllabus

Introduction to Smart Antenna, smart antenna arrays for Mobile Communications, Antenna arrays and spatial filters. Narrow beam former. Uniform linear array. Beam pattern design algorithm. Array steering. Adaptive antenna arrays. Implementation of adaptive beam forming. The generalized side lobe canceller. Propagation Models for Mobile Communication. Smart antenna arrays using diversity combining techniques. Introduction to Wideband Smart Antennas

Expected Outcome

1. Understand the basics of smart antennas and it's applications
2. Understand the theory of beam forming and adaptive beam forming.
3. Understand the use of smart antennas for wireless application

Reference

1. Harry L Van Trees, Optimum Array Processing , Part IV of Detection, Estimation and Modulation Theory, Wiley Interscience, 2002.
2. Dimitris G. Manolakis, Vinay K. Ingle, Stephen M. Kogan , Statistical and Adaptive Signal Processing, Artech House, 2000.
3. T.S. Rappaport and J.C. Liberti, Smart Antennas for Wireless Communications, Prentice Hall, NJ: Prentice Hall,1999
4. Rajeswari Chatterjee - Antennas for Information Super Skyways, PHI, 2008

COURSE PLAN

Module	Contents	Hours Allotted	% of Marks in End-Semester Examination
I	Introduction to Smart Antenna benefits and smart antenna arrays for Mobile Communications: Antenna arrays and spatial filters – Frequency wave number response of the array. Narrow beam former. Uniform linear array (ULA) – visible range . Beam pattern parameters and Grating lobes.	7	15
II	Concept of co -array , redundancy and holes – relationship with side lobe level. Minimum redundancy and minimum holes arrays. Beam pattern design algorithm. Array steering , array polynomial and array	7	15

	design using Schelkunoff's method. Review of beam forming using Fourier series and Butler matrix beam forming.		
FIRST INTERNAL EXAM			
III	Adaptive antenna arrays: Optimum beam forming using MVDR beam former-Interference cancellation performance. Implementation of adaptive beam forming using sample matrix inversion (SMI). Linearly Constraint Minimum variance beam former. The generalized side lobe canceller.	7	15
IV	Survey of Various Propagation Models for Mobile Communication.- Lee cell model , time varying vector channel model, Gaussian wide sense stationary model and time varying vector channel model. Smart antenna arrays using diversity combining techniques. Direction of Arrival (DOA) estimation using MUSIC algorithm.	7	15
SECOND INTERNAL EXAM			
V	Channel model and the Vector Channel Impulse Response of the array . Brief survey of channel models – Lee's model and Rayleigh model.	7	20
VI	Smart antenna array design using Diversity Combining. Antenna arrays fixed Beamforming Networks and Switched Beam forming. Introduction to Wideband Smart Antennas	7	20
END SEMESTER EXAM			

Course No.	Course Name	L-T-P	Credits	Year of Introduction
01EC7223	Electromagnetic Interference and Compatibility	**3-0-0**	**3**	**2015**

Course Objectives

1. The ability to identify the sources of Electro-magnetic Interference.
2. Should be able to design EMC circuits and systems.
3. Ability to apply EMI detection circuits.

Syllabus

Introduction to Electro-magnetic Interference (EMI). Electrostatic discharge (ESD), Electro-magnetic pulse (EMP), Lightning, and Mechanism of transferring Electro-magnetic Energy. Introduction to EMC. Different Mitigation Techniques for preventing EMI. Grounding. Shielding. Shielding effectiveness (S.E). Cross-talks & Coupling. Filtering & decoupling. Non-ideal behaviour of different electronic components. EMC in healthcare environment. Characteristics of antennas. Time-domain Reflectrometry (TDR) basics for determining the properties of a transmission line. System Design For EMC. Digital and Analogue circuit design: Design for emission control and design for immunity. Radiated and conducted interference measurements and ESD. Measurements of radiated emission in open test range & in Anechoic chamber, Conducted emission testing by Line Impedance Stabilization network (LISN).

Expected Outcome

1. Understand the basics of smart antennas and its applications
2. Understand the theory of beam forming and adaptive beam forming.
3. Understand the use of smart antennas for wireless application

Reference

1. Engineering Electromagnetic Compatibility - V. Prasad Kodali, IEEE Publication, Printed in India by S. Chand & Co. Ltd., New Delhi, 2000.
2. EMC for Product Designers –Tim Williams, B.H. Newnes, Oxford, 3/e.
3. EMC Analysis Methods & Computational Models-Frederick M Tesche, Michel V.Ianoz,Torbjorn Karlsson, John Willey & Sons, Inc, 1996
4. Introduction to Electromagnetic compatibility - Clayton R. Paul, John wiley & Sons, 2/e
5. EMI/EMC Computational modelling Hand Book- Archambeault, Springer, 2001
6. Applied Electromagnetic Compatibility- Dipak L Sengupta & Valdis V Liepa, John Wiley & Sons Inc. 2005.
7. Bernhard Keiser, Principles of Electromagnetic Compatibility, Artech house, 3rd Edn, 1986.

COURSE PLAN			
Module	**Contents**	**Hours Allotted**	**% of Marks in End-Semester Examination**
I	Introduction to Electro-magnetic Interference (EMI) - Definitions, Different Sources of EMI, Electrostatic discharge (ESD), Electro-magnetic pulse (EMP), Lightning, and Mechanism of transferring Electro-magnetic Energy: Radiated emission, radiated susceptibility, conducted emission, and conducted susceptibility, Differential & common mode currents. Introduction to EMC - Concepts of EMC, EMC units. EMC requirements for electronic systems - World regulatory bodies- FCC, CISPR etc. Class-A devices, class-B devices.	7	15
II	Different Mitigation Techniques for preventing EMI. Grounding: Fundamental grounding concepts, Floating ground, Single-point & Multi-point ground, advantages & disadvantages of different grounding processes. Shielding: Basic concepts of shielding, Different types of shielding, Shielding effectiveness(S.E), S.E of a conducting barrier to a normal incident plane wave, multiple reflection within a shield, mechanism of attenuation provided by shield, shielding against magnetic field & Electric field, S.E for Electronic metal & Magnetic metal, Skin-depth, S.E for far-field sources, shield seams. Cross-talks & Coupling, Measurement set for measuring Cross-talk. Filtering & decoupling.	7	15
FIRST INTERNAL EXAM			
III	Non-ideal behaviour of different electronic components - Examples: Communication equipment, Microwave oven, Personal Computers, Health Hazards limits, EMC in healthcare environment. Antennas - Characteristics of antennas, fields due to short electric dipole & small magnetic pole, near field & Far-field sources & their characteristics. Broadband antenna measurements, antenna factor.	7	15
IV	Time-domain & Frequency-domain Analysis of Different Signals - identifying the frequency, phase & power spectrum of different signals. Time-domain Reflectrometry (TDR) basics for determining the properties of a transmission line. System Design For EMC - Simple susceptibility models for wires & PCB, Simplified lumped model of the pick-up of incident field for a very short two-conductor line.	7	15
SECOND INTERNAL EXAM			

V	Cables, connectors, components: EMI suppression cables, EMC connectors, EMC gaskets, Isolation transformers, optoisolators. Choice of capacitors, inductors, transformers and resistors. Digital and Analogue circuit design: Design for emission control and design for immunity, Radiation from logic circuits, analogue circuits and SMPS. Microprocessor watchdog, defensive programming.	7	20
VI	Radiated and conducted interference measurements and ESD: Anechoic chamber, TEM cell, GH TEM Cell, characterization of conduction currents / voltages, conducted EM noise on power lines, conducted EMI from equipment, Immunity to conducted EMI detectors and measurements. ESD, Electrical fast transients / bursts, electrical surges. Measurements of radiated emission in open test range & in Anechoic chamber, Conducted emission testing by Line Impedance Stabilization network (LISN).	7	20
END SEMESTER EXAM			

Course No.	Course Name	L-T-P	Credits	Year of Introduction
01EC7225	Information Hiding and Data Encription	**3-0-0**	**3**	**2015**

Course Objectives

1. The ability to do Cryptography, watermarking and Steg analysis
2. Should be able to use various Data Hiding techniques
3. Ability to apply encryption techniques in data for various applications

Syllabus

Introduction to Complexity theory, Elementary Number theory, Algebraic Structures- Groups, Rings and Finite Fields, Polynomials over Finite Fields (Fq). Classical Cryptography, Stream Ciphers, Public Key Cryptography: based on Knapsack problem, AES. Digital Signature, Zero Knowledge Proofs. Information Hiding: Watermarking, Steganography. Parameters and metrics. Applications: Authentication, annotation, tamper detection and Digital rights management. Hiding text and image data, mathematical formulations. Hiding in 1D signals: Time and transform techniques-hiding in Audio, biomedical signals, HAS Adaptive techniques. Hiding in 2D signals: Spatial and transform techniques-hiding in images, ROI images, HVS Adaptive techniques. Hiding in video: Temporal and transform domain techniques, Bandwidth requirements. Steg analysis: Statistical Methods, HVS based methods, SVM method, Detection theoretic approach

Expected Outcome

1. Understand Cryptography, watermarking and Steg analysis
2. Understand capabilities of encryption techniques in data for various applications
3. Understand, Analyse various Data Hiding techniques.

Reference

1. Neal Koblitz, A Course in Number Theory and Cryptography, 2nd Edition, Springer
2. Stefan Katzenbeisser, Fabien A. P. Petitcolas, Information Hiding Techniques for
3. Steganography and Digital Watermarking, Artech House Publishers, 2000.
4. Neil F Johnson et al Kluwer, Information hiding: Steganography and Watermarking-Attacks and Countermeasures,Springer, 2001.
5. Ingemar J Cox, Digital Watermarking, The Morgan Kaufman Series in Multimedia Information and Systems, 2001
6. Ira S Moskowits, Information Hiding, Proceedings, 4th International Workshop, IH 2001, Pittsburg, USA, April 2001, Eds:2. AVISPA package homepage, http:/www.avispaproject.org/
7. Handbook of Applied Cryptography, AJ Menezes, CRC Press, 2001.

COURSE PLAN

Module	Contents	Hours Allotted	% of Marks in End-Semester Examination
I	Introduction to Complexity theory, Elementary Number theory, Algebraic Structures- Groups, Rings and Finite Fields, Polynomials over Finite Fields (Fq).	7	15
II	Classical Cryptography, Stream Ciphers, Public Key Cryptography: based on Knapsack problem, AES. Digital Signature, Zero Knowledge Proofs.	7	15
FIRST INTERNAL EXAM			
III	Information Hiding: Watermarking, Steganography. Objectives, difference, requirements, types (Fragile and robust).Parameters and metrics (BER, PSNR, WPSNR, Correlation coefficient, MSE, Bit per pixel). LSB, additive, spread spectrum methods.	7	15
IV	Applications: Authentication, annotation, tamper detection and Digital rights management. Hiding text and image data, mathematical formulations.	7	15
SECOND INTERNAL EXAM			
V	Hiding in 1D signals: Time and transform techniques-hiding in Audio, biomedical signals, HAS Adaptive techniques. Hiding in 2D signals: Spatial and transform techniques-hiding in images, ROI images, HVS Adaptive techniques.	7	20
VI	Hiding in video: Temporal and transform domain techniques, Bandwidth requirements. Steg analysis: Statistical Methods, HVS based methods, SVM method, Detection theoretic approach.	7	20
END SEMESTER EXAM			

Course No.	Course Name	L-T-P	Credits	Year of Introduction
01EC7227	Advanced Coding Theory	**3-0-0**	**3**	**2015**

Course Objectives

1. To systematically builds up the coding theory aspects from mathematical fundamentals to the state of the art methods

Syllabus

Review of modern algebra. Galois fields. Construction and basic properties of Finite fields, Vector Space. Linear block codes; properties, minimum distance, error detection and correction. Standard Array, syndrome decoding. Cyclic codes, encoding and decoding, Non-binary codes. Convolutional codes. Generator sequences. Structural properties. ML decoding. Viterbi decoding. Sequential decoding. Practical applications of convolutional codes. Modulation codes. Trellis coded modulation. Lattice type Trellis codes. Geometrically uniform trellis codes. Decoding of modulation codes. Turbo codes. Turbo decoder. Interleaver. Turbo decoder. MAP and log MAP decoders. Iterative turbo decoding. Optimum decoding of turbo codes. Space-time codes. MIMO systems. Space-time block codes (STBC) – decoding of STBC..

Expected Outcome

1. Understand the algebraic aspects to the coding theory.
2. Understand to the level of state of the art methods and algorithms in coding.
3. Enable the students to take up coding theory problems for their thesis work.

Reference

1. S. Lin & D. J. Costello, Error Control Coding, Prentice-Hall 2/e
2. R. E. Blahut , Theory and Practice of Error Control coding Addison-Wesley Pub. Co. 1983
3. Stephen B.Wicker, Error Control System for Digital Communication & Storage, PHI4 1995
4. Bernard Sklar & Pabitra Kumar, Digital Communication: Fundamentals and Applications, 2/e Pearson Education

COURSE PLAN

Module	Contents	Hours Allotted	% of Marks in End-Semester Examination
I	Review of modern algebra. Galois fields. Construction and basic properties of Finite fields, Vector Space.	7	15
II	Linear block codes; properties, minimum distance, error detection and correction. Standard Array, syndrome decoding. Cyclic codes, encoding and decoding, Non-binary codes.	7	15

FIRST INTERNAL EXAM			
III	Convolutional codes. Generator sequences. Structural properties. ML decoding. Viterbi decoding. Sequential decoding. Practical applications of convolutional codes	7	15
IV	Modulation codes. Trellis coded modulation. Lattice type Trellis codes. Geometrically uniform trellis codes. Decoding of modulation codes.	7	15
SECOND INTERNAL EXAM			
V	Turbo codes. Turbo decoder. Interleaver. Turbo decoder. MAP and log MAP decoders. Iterative turbo decoding. Optimum decoding of turbo codes.	7	20
VI	Space-time codes. MIMO systems. Space-time block codes (STBC) – decoding of STBC.	7	20
END SEMESTER EXAM			

Course No.	Course Name	L-T-P	Credits	Year of Introduction
01EC7291	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
01EC7293	Project (Phase I)	**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
01EC7294	Project (Phase II)	**0-0-23**	**12**	**2015**

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.