

ELECTRONICS AND COMMUNICATION ENGINEERING

COIMBATORE INSTITUTE OF TECHNOLOGY

VISION AND MISSION OF THE INSTITUTE

VISION

The Institute strives to inculcate a sound knowledge in engineering along with realized social responsibilities to enable its students to combat the current and impending challenges faced by our country and to extend their expertise to the global arena.

MISSION

The Mission of CIT is to impart high quality education and training to its students to make them world-class engineers with a foresight to the changes and problems and pioneers to offer innovative solutions to benefit the nation and the world at large.

ELECTRONICS AND COMMUNICATION ENGINEERING

COIMBATORE INSTITUTE OF TECHNOLOGY

VISION AND MISSION OF THE DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

VISION

The Vision of the department is to impart knowledge in the field of Electronics and Communication Engineering so as to nurture excellence in students, mould their capability to meet current and impending challenges and ignite aspirations to become innovators and entrepreneurs, thereby benefit the nation and world.

MISSION

The Mission of Electronics and Communication Engineering Department is

- M1** To impart high quality education and training to the students in the field of Electronics and Communication Engineering
- M2** To promote creation and dissemination of knowledge.
- M3** To provide a framework for innovation and collaborative research with industry.
- M4** To equip the graduate students with an attitude for professional career and continuous learning.

ELECTRONICS AND COMMUNICATION ENGINEERING

COIMBATORE INSTITUTE OF TECHNOLOGY

PROGRAMME EDUCATIONAL OBJECTIVES (PEOs) OF M.E. COMMUNICATION ENGINEERING

The following Programme Educational Objectives are designed for M.E. Communication Engineering programme in Electronics and Communication Engineering based on the Department Mission to provide higher engineering education and motivate research in the field of Communication Engineering

- PEO1** To develop outstanding technical and professional expertise that enable the students to develop competency for career in global industrial, academic and research domains
- PEO2** To develop communication skills, interpersonal skills, managerial skills, entrepreneurial skills and inculcate professional ethics and values needed for professional success in national and multinational companies, institutions and organizations.
- PEO3** To explore engineering solutions with good ethical standards and professional attitude for significant research in solving contemporary social and human issues within realistic constraints and acquire an aptitude for lifelong learning.

ELECTRONICS AND COMMUNICATION ENGINEERING

COIMBATORE INSTITUTE OF TECHNOLOGY

PROGRAMME OUTCOMES (POs) OF M.E. COMMUNICATION ENGINEERING

Students in the Department of Electronics and Communication Engineering M.E. Communication Engineering programme should at the time of their graduation are in possession of :

- PO1** an ability to apply knowledge acquired from undergraduate engineering to arrive solutions to complex technical problems related to communication systems and engineering.
- PO2** an ability to apply knowledge of Communication Engineering in a innovative way to develop software and design electronic hardware products useful to the society.
- PO3** an ability to apply advanced technical knowledge in multiple contexts to solve broad research contemporary problems.
- PO4** an ability to understand and design advanced state of art communication systems, conducting significant research and present their results in the field of Communication Engineering and its related domains
- PO5** an ability to use modern engineering tools, software and hardware necessary to design, evaluate and analyze an expert system in communication systems
- PO6** an ability to conduct and produce quality research in the diversified fields of engineering by applying the real time system knowledge of Communication systems.
- PO7** an ability to develop effective communication skills, leadership and teamwork spirit that contribute to the success of their organizations.
- PO8** an ability to develop solutions and make professional and ethical decisions with an understanding of the impact of Communication systems on societal, economic, global and environmental issues.
- PO9** an ability to acquire leadership qualities to function effectively as an individual and as a member or leader that contribute to the success of the organizations.
- PO10** an ability to develop self confidence and communication skill towards the professional competency to express their knowledge in Communication systems
- PO11** an ability to undertake industrial collaborated projects to make stronger in the industry institute relationship
- PO12** an ability to develop confidence for self-education and lifelong learning in the broadest context of technological change.

COIMBATORE INSTITUTE OF TECHNOLOGY

(Government Aided Autonomous Institution Affiliated to Anna University, Chennai)

DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

Curriculum from the Academic Year 2015 - 2016 onwards

Name of the degree : M. E. (Full Time)

Specialization : Communication Engineering

Semester I

Course Code	Course Name	L	T	P	C	CAT
	THEORY					
15MEC11	Advanced Engineering Mathematics	4	0	0	4	FC
15MEC12	Modulation and Coding Techniques	3	0	0	3	PC
15MEC13	RF System and Communication Link Design	3	0	0	3	PC
15MEC14	Statistical Digital Signal Processing	3	0	0	3	PC
15MEC15	Radiation Systems	3	0	0	3	PC
	Elective-I	3	0	0	3	PE
	PRACTICAL					
15MEC16	Signal Processing Laboratory	-	-	4	2	PC
15MEC17	Seminar and Technical Writing	-	-	2	1	EEC
	TOTAL CREDITS				22	

Semester II

Course Code	Course Name	L	T	P	C	CAT
	THEORY					
15MEC21	Advanced Wireless Communication Systems	3	0	0	3	PC
15MEC22	Optical Switching and Networking	3	0	0	3	PC
15MEC23	Communication Network Security	3	0	0	3	PC
15MEC24	Wireless Ad Hoc Networks	3	0	0	3	PC
	Elective-II	3	0	0	3	PE
	Elective-III	3	0	0	3	PE
	PRACTICAL					
15MEC25	Wireless Communication and Networking Laboratory	-	-	4	2	PC
15MEC26	Mini project	-	-	4	2	EEC
	TOTAL CREDITS				22	

Semester III

Course Code	Course Name	L	T	P	C	CAT
	THEORY					
	Elective-IV	3	0	0	3	PE-IV
	Elective-V	3	0	0	3	PE-V
	Elective -VI	3	0	0	3	PE-VI
	PRACTICAL					
15MEC41	Project Work & Viva Voce					EEC
	TOTAL CREDITS				9	

Semester IV

Course Code	Course Name	L	T	P	C	CAT
	PRACTICAL					
15MEC41	Project Work & Viva Voce				18	EEC
	TOTAL CREDITS				18	
	GRAND TOTAL CREDITS				71	

Note : L-Lecture, T-Theory, P-Practical, C-Credit

COIMBATORE INSTITUTE OF TECHNOLOGY

(Government Aided Autonomous Institution Affiliated to Anna University, Chennai)

DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

Curriculum from the Academic Year 2015 - 2016 onwards

Name of the degree : M.E (Part Time)

Specialization : Communication Engineering

Semester I

Course Code	Course Name	L	T	P	C
	THEORY				
15MEC11	Advanced Engineering Mathematics	4	0	0	4
15MEC12	Modulation and Coding Techniques	3	0	0	3
15MEC13	RF System and Communication Link Design	3	0	0	3
	PRACTICAL				
15MEC16	Signal processing Laboratory	-	-	4	2
	TOTAL CREDITS				12

Semester II

Course Code	Course Name	L	T	P	C
	THEORY				
15MEC21	Advanced Wireless Communication Systems	3	0	0	3
15MEC22	Optical Switching and Networking	3	0	0	3
15MEC23	Communication Network Security	3	0	0	3
	PRACTICAL				
15MEC25	Wireless Communication and Networking Laboratory	-	-	4	2
	TOTAL CREDITS				11

Semester III

Course Code	Course Name	L	T	P	C
	THEORY				
15MEC14	Statistical Digital Signal Processing	3	0	0	3
15MEC15	Radiation Systems	3	0	0	3
	Elective-I	3	0	0	3
	PRACTICAL				
15MEC17	Seminar & Technical Writing	-	-	2	1
	TOTAL CREDITS				10

Semester IV

Course Code	Course Name	L	T	P	C
	THEORY				
15MEC24	Wireless Ad Hoc Networks	3	0	0	3
	Elective-II	3	0	0	3
	Elective-III	3	0	0	3
	PRACTICAL				
15MEC28	Miniproject	-	-	4	2
	TOTAL CREDITS				11

Semester V

Course Code	Course Name	L	T	P	C
	THEORY				
	Elective-IV	3	0	0	3
	Elective-V	3	0	0	3
	Elective -VI	3	0	0	3
	PRACTICAL				
15MEC41	Project Work & Viva Voce				
	TOTAL CREDITS				9

Semester VI

Course Code	Course Name	L	T	P	C
	PRACTICAL				
15MEC41	Project Work & Viva Voce				18
	TOTAL CREDITS				18
	GRAND TOTAL CREDITS				71

Note : L-Lecture, T-Theory, P-Practical, C-Credit

LIST OF PROFESSIONAL ELECTIVES (PE)

Sl.No.	Course Code	Course Name	L	T	P	C	CAT
1.	15MECE01	Satellite Communication and Applications	3	0	0	3	PE
2.	15MECE02	Detection and Estimation Theory	3	0	0	3	PE
3.	15MECE03	Image and Video Processing	3	0	0	3	PE
4.	15MECE04	Computer Vision	3	0	0	3	PE
5.	15MECE05	Coding Theory for Wireless Channels	3	0	0	3	PE
6.	15MECE06	LTE Technology and Standards	3	0	0	3	PE
7.	15MECE07	Network Routing Algorithms	3	0	0	3	PE
8.	15MECE08	RF MEMS	3	0	0	3	PE
9.	15MECE09	Radio Frequency Integrated Circuit Design	3	0	0	3	PE
10.	15MECE10	Embedded and Real Time Systems	3	0	0	3	PE
11.	15MECE11	Electromagnetic Interference Measurements and Compliance Design	3	0	0	3	PE
12.	15MECE12	Speech Recognition Techniques	3	0	0	3	PE
13.	15MECE13	Wavelets and Subband Coding	3	0	0	3	PE
14.	15MECE14	Software Defined Radio and Cognitive Radio Technologies	3	0	0	3	PE
15.	15MECE15	Multimedia Compression and communication	3	0	0	3	PE
16.	15MECE16	Communication Network Modeling and Simulation	3	0	0	3	PE
17.	15MECE17	Advanced Fiber Optic Technologies	3	0	0	3	PE
18.	15MECE18	High Speed Switching Architecture	3	0	0	3	PE
19.	15MECE19	Wireless Sensor Networks	3	0	0	3	PE
20.	15MECE20	Space Time Wireless Communication	3	0	0	3	PE
21.	15MECE21	High Performance Computer Networks	3	0	0	3	PE
22.	15MECE22	Smart Antennas	3	0	0	3	PE
23.	15MECE23	Radar and Navigational Aids	3	0	0	3	PE
24.	15MECE24	Modern Antennas	3	0	0	3	PE
25.	15MECE25	3D Imaging Techniques	3	0	0	3	PE
26.	15MECE26	Modeling and Simulation of Wireless Systems	3	0	0	3	PE
27.	15MECE27	Next Generation Wireless Networks	3	0	0	3	PE
28.	15MECE28	Cross Layer Design	3	0	0	3	PE
29.	15MECE29	Information Coding Theory	3	0	0	3	PE

15MEC11 - ADVANCED ENGINEERING MATHEMATICS

L	T	P	C
4	0	0	4

ASSESSMENT : THEORY

COURSE OBJECTIVE

The First year students of M.E Communication Engineering will be able to acquire knowledge on

- i. Linear algebra & numerical methods, random variables & random processes and Markovian processes
- ii. Second order processes and special functions

COURSE OUTCOME

Upon completion of this course the students will demonstrate an ability to

CO1 : apply the concepts of linear algebra & numerical methods, random variables & random processes and Markovian processes for communication systems

CO2 : apply the concepts of second order processes and special functions for communication systems

LINEAR ALGEBRA

Vector spaces-subspaces-Linear dependence-Basis and Dimension-Inner product spaces Gram ? Schmidt Orthogonalization Procedure - Linear transformations - Kernels and Images - Matrix representation of linear transformation - Change of basis - Eigen values and Eigen vectors of linear operator -Quadratic form. **(12)**

RANDOM VARIABLES

Operations on random variables: Random Variables-Distributions and Density functions-Moments and Moment generating function-Multivariate distributions-Independent Random Variables, Marginal and Conditional distributions -Conditional Expectation, Transformation of Random Variables **(12)**

MARKOV PROCESSES

Markov Chains Definition, Examples, Transition Probability Matrices of a Markov Chain Classification of states and chains Basic limit theorem Limiting distribution of Markov chains -Continuous Time Markov Chains: General pure Birth processes and Poisson processes, Birth and death processes, Finite state continuous time Markov chains **(12)**

SECOND ORDER PROCESSES

Elements of stochastic processes - Classification - Second Order Stochastic Processes - Linear operations and second order calculus - Stationary and non-stationary processes Wide sense Stationary processes, Spectral density function - Low pass and band pass processes-White noise and white noise integrals. **(12)**

SPECIAL FUNCTIONS

Bessel's equation-Bessel functions - Legendre's equation - Legendre polynomials-Rodrigue's formula - Recurrence relations-generating functions and orthogonal property of Bessel functions-Legendre polynomials **(12)**

TOTAL : 60

REFERENCES

1. Larry C Andrews, Ronald L. Philips, "Mathematical Techniques for Engineers and Scientists", Prentice Hall of India, New Delhi, 2005.
2. Kenneth Hoffman and Ray Kunze, Linear Algebra, 2nd Edition, PHI, 1971.
3. Erwin Kreyszig, Introductory Functional Analysis with Applications, John Wiley & Sons, 10th edition, 2010.
4. S. Karlin & H.M Taylor, An introduction to Stochastic Modelling, 3rd edition, Academic Press, New York, 1998.
5. S. M. Ross, Introduction to Probability Models, Harcourt Asia Pvt. Ltd. and Academic Press, 1985.
6. A Papoulis, Probability, Random Variables and Stochastic Processes, 3rd Edition, McGraw Hill, 1991.

15MEC12 - MODULATION AND CODING TECHNIQUES

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

COURSE OBJECTIVE

The First year students of M.E Communication Engineering will acquire knowledge on signal space analysis, M-ary modulation schemes, performance of digital communication receivers in AWGN & fading channels, multicarrier systems and channel coding techniques.

COURSE OUTCOME

Upon completion of this course, the students will be able to demonstrate an ability to

CO1 : explain advanced modulation techniques, design digital communication receivers for AWGN and fading channels

CO2 : design multicarrier systems and error control codes

M-ary DIGITAL MODULATION TECHNIQUES

Base band and band pass communication; Signal space representation, Linear and nonlinear modulation techniques, M-ary modulation techniques Binary and M-ary, QAM, Carrier modulation - M-ary ASK, PSK, FSK, DPSK, Continuous phase modulation - QPSK and variants, MSK, GMSK, Comparison of Power spectral characteristics of digital modulation, Spread spectrum modulation techniques. **(10)**

RECEIVERS FOR AWGN AND FADING CHANNELS

Optimum receivers for AWGN channel -Correlation demodulator, matched filter, maximum likelihood sequence detector, envelope detectors for M-ary signals; Characterization of fading multipath channels, RAKE demodulator, Multiuser detection techniques. **(9)**

MULTICARRIER SYSTEMS

Data transmission using multiple carriers - Mitigation of subcarrier fading - OFDM - Generation of sub-carriers using the IFFT; Guard Time and Cyclic Extension; Challenges in multicarrier systems - Peak to Average Power reduction schemes. **(8)**

BINARY INFORMATION CHANNELS AND CHANNEL CODING

Entropy function -Mutual information - Channel capacity -Capacity of Binary channels BSC and BEC - Error Control Codes - Linear Block codes - Cyclic codes - Galois fields - Irreducible and primitive polynomials - BCH codes - Reed-Solomon codes - Decoding BCH and RS codes -Convolutional codes - Decoding convolutional codes - Turbo codes - Encoding Parallel Concatenated codes -Turbo code - LDPC codes - LDPC code construction - Encoding LDPC codes - Serial Concatenated codes - design of LDPC decoders. **(10)**

SPACE-TIME CODING

Diversity Transmission and Reception: the MIMO channel - Space-time block codes - complex orthogonal Designs - Trellis Coded Modulation -Four & eight state TCM for 8-PSK & QAM signal constellations-Decoding methods and implementation issues - Space-time trellis codes. **(8)**

TOTAL : 45

REFERENCES

1. Bernard Sklar, *"Digital Communications - Fundamentals and Applications"*, 2nd Edition, Prentice Hall, 2001.
2. John G. Proakis, *"Digital Communications"*, 5th Edition, McGraw-Hill International Editions, 2008.
3. Moon, T.K., *"Error Correction Coding: Mathematical Methods and Algorithms"*, Wiley-Interscience, 2005.
4. Andrea Goldsmith, *"Wireless Communications"*, Cambridge Univ. Press, 2005.
5. Theodore S. Rappaport, *"Wireless Communications: Principles and Practice"*, 2nd Edition, Prentice-Hall, 2002.
6. Heinrich Meyer, Mare Moeneclacy, Stefan.A.Fechtel, *"Digital communication receivers"*, Vol I & Vol II, John Wiley, New York, 1997.
7. Reza F M, *"An Introduction to Information theory"*, McGraw Hill, 2000.

15MEC13 - RF SYSTEM AND COMMUNICATION LINK DESIGN

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

COURSE OBJECTIVE

The First year students of M.E Communication Engineering will acquire knowledge on

- i. analysis, design and realization of RF transmission & micro-strip lines, passive microwave filters, impedance matching networks, RF amplifier and oscillators..
- ii. operating principles of oscillators, mixers and various sub-systems of RF Section of a Receiver.
- iii. link availability, fading and link budget design for a terrestrial Microwave link,

COURSE OUTCOME

Upon completion of this course, the students will be able to demonstrate an ability to

- CO1** : formulate, analyze and solve design problems in RF transmission lines, micro-strip lines, passive RF filters and impedance matching networks.
- CO2** :
- i. analyze and design RF amplifier.
 - ii. comprehend and explain operating principles and design concepts of RF oscillators, mixers and RF Section of Receiver.
 - iii. analyze and solve problems on microwave link availability, fade margin and link budget.

RF ISSUES, TRANSMISSION LINE ANALYSIS AND DESIGN

Issues in RF design - Electromagnetic Spectrum - RF behavior of passive components - Transmission line analysis - open ended, short circuited - Sourced and Loaded Transmission line - Smith Chart and applications - Micro strip Transmission line design - Scattering Parameters - Impedance Matching using Lumped Elements. **(10)**

RF FILTER DESIGN

Overview - Basic RLC Series and Parallel resonators - RF Filter design using Insertion Loss method: Butterworth, Chebyshev and Linear Phase: LPF, HPF, BPF, BSF- Normalisation for Frequency and Type - Impedance Normalisation- Filter implementations: Richard's transform, Kuroda's identities, Series to Parallel Element conversion. **(8)**

RF AMPLIFIER DESIGN, EFFECTS OF NON-LINEARITY

Two Port Power Gains - Stability considerations - Input and Output Stability circles - Unconditional Stability - Design for Maximum Gain and Specified Gain - LNA Design Issues in High power Amplifier design - Gain compression - Inter-Modulation products - Third order Intercept point - Dynamic Range - Intercept Point for cascaded systems. **(9)**

OSCILLATORS, MIXERS & RF FRONT END DESIGN

General Analysis of Oscillator- Oscillators using BJT and FET - Colpitts and Hartley Oscillator design - Crystal Oscillator - Microwave Oscillators - RF Front End and Tuner building blocks - Mixers - RF directional couplers and hybrid couplers - Complete RF Tuner design considerations. **(9)**

WIRELESS LINK AND NETWORK DESIGN

Microwave transmission - Point-to-Point link design - theoretical and practical aspects - Fade margin - Rain effects - protected and non protected microwave systems - link design and path calculations - design guidelines - MW lookup tables - Point to Multi-Point wireless networks - Cell site selection - Microwave Repeater site selection. **(9)**

TOTAL : 45

REFERENCES

1. David M. Pozar, *"Microwave Engineering"*, John Wiley and Sons, Fourth Edition, 2012.
2. Reinhold Ludwig and Gene Bogdanov, *"RF Circuit Design - Theory and Applications"*, Prentice Hall, 2009.
3. Harvey Lehpamer, *"Transmission System Design Handbook for Wireless Networks"*, Artech House, 2002.
4. David Pozar, *"Microwave and RF Wireless Systems"*, Wiley, 2001.
5. Stephan A Mass, *"Non-Linear Microwave and RF circuits"*, Artech House, Second Edition, 2003.
6. George D. Vendelin, Anthony M. Pavio, Ulrich L. Rohde, *"Microwave Circuit Design Using Linear and Nonlinear Techniques"*, John Wiley, 2005

15MEC14 - STATISTICAL DIGITAL SIGNAL PROCESSING

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

COURSE OBJECTIVE

The First year students of ME Communication Engineering will acquire knowledge on

- i. the fundamentals and principles of random signal processing and spectrum estimation techniques
- ii. Concepts and characteristics of adaptive filtering algorithms, their applications and architecture of DSP processor.

COURSE OUTCOME

Upon completion of this course the students will be able to demonstrate an ability to

CO1 : explain the concepts of random signal processing and analyze the spectrum estimation techniques

CO2 : design adaptive filters and analyze the features of DSP Processor

DISCRETE RANDOM SIGNAL PROCESSING

Discrete Time Signal Processing - Discrete Random Processes - Ensemble Averages - Gaussian Processes - Stationary processes - Autocovariance and Autocorrelation Matrices - Ergodicity - Parseval's Theorem - Wiener-Khintchine Relation - White Noise - Power Spectrum - Filtering Random Processes - Spectral Factorization. **(9)**

SPECTRAL ESTIMATION

Estimation of Spectra from Finite Duration Signals - Nonparametric Methods: Periodogram, Modified Periodogram, Bartlett, Welch and Blackman-Tukey Methods - Performance Comparisons - Parametric Methods: AR, MA and ARMA Model based Spectral Estimation - Yule-Walker Equations - Solution using Levinson-Durbin Algorithm. **(9)**

ADAPTIVE SYSTEMS

Definition - Characteristics - Properties - Wiener Filters - Wiener filters for linear prediction and noise cancellation - Kalman Filter - Minimum Mean Square Error (MMSE) - Gradient Search Methods - Newton's Method - Steepest Descent Technique. **(9)**

ADAPTIVE FILTERING ALGORITHMS AND APPLICATIONS

Least-Mean-Square (LMS) Algorithm - Recursive Least Squares (RLS) Algorithm - Exponentially Weighted RLS - Sliding Window RLS - Applications of Adaptive Filtering: Adaptive Noise Canceling - Adaptive Channel Equalization - Canceling Power Supply Interference in ECG. **(9)**

DSP ARCHITECTURE

Fixed Point and Floating Point DSPs - Features of Digital Signal Processing Architecture - Bus Architecture - DSP Computational Building Blocks - On-Chip Memory - TMS320C67XX, OMAPL138 Architecture - Addressing Modes - Special Function Instructions - Implementing FIR and IIR Filters in DSPs. **(9)**

TOTAL : 45

REFERENCES

1. *Monson H. Hayes, "Statistical Digital Signal Processing and Modeling", John Wiley and Sons, Inc., Singapore, 2009.*
2. *Sophocles J. Orfanidis , "Optimum Signal Processing", McGraw Hill, 2007.*
3. *Dimitris G.Manolakis, Vinay K. Ingle and Stephen M. Kogon, "Statistical and Adaptive Signal Processing", McGraw Hill, Newyork, 2000.*
4. *T. Adali and Simon Haykin, "Adaptive Signal Processing - Next Generation Solutions", Wiley India Pvt.Ltd., 2010*
5. *Emmanuel C. Ifeakor, Barrie W. Jervis, "Digital Signal Processing: A Practical Approach", Addison Wesley, 2002.*
6. *V. Udayashankara, "Real Time Digital Signal Processing: Fundamentals, Algorithms and Implementation using TMS Processors: Prentice Hall of India, New Delhi, 2010.*
7. <http://www.ti.com/lit/ds/symlink/omap-l138.pdf>

15MEC15 - RADIATION SYSTEMS

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

COURSE OBJECTIVE

The First year students of M.E. Communication Engineering will acquire knowledge on

- i. the principles used in radiating systems and analysis and design of antenna arrays
- ii. synthesis of antennas, analysis & design of special antennas and concepts of smart antennas

COURSE OUTCOME

After completion of this course the students will be able to demonstrate an ability to

CO1 : explain the concept of radiation, analyze and design antenna arrays

CO2 : design and synthesize antennas and explain the concepts of smart antennas

CONCEPTS OF RADIATION

Retarded vector potential- Heuristic approach and Maxwell's equation approach - Duality theorem - The Lorentz gauge condition - Fields radiated by an alternating current element and half wave dipole - Total power radiated and radiation resistance of alternating current element and half wave dipole - Power radiated in the far field - Linear, elliptical and circular polarization- Development of the Poincare sphere. **(9)**

ANTENNA ARRAY

N element linear array - uniform amplitude and spacing - Phased arrays - Directivity of Broadside and End fire arrays - Three dimensional characteristics - Pattern multiplication - Binomial arrays and Dolph-T chebycheff arrays - Circular array - Planar array - array factor, beam width, directivity. **(9)**

ANTENNA SYNTHESIS

Synthesis problem - line source based beam synthesis methods, Fourier transform and Woodward - Lawson sampling methods - Linear array shaped beam synthesis method- Low side lobe, narrow main beam synthesis methods - discretization of continuous sources. Schelkunoff polynomial method. **(9)**

SPECIAL ANTENNAS

Aperture antennas - Huygens Principle. Rectangular apertures - Circular apertures and their design considerations - Babinet's principle, Fourier transform in aperture antenna theory. Micro strip antennas: feeding methods - Rectangular patch - transmission line model - circular patch - Micro strip array and feed networks. **(9)**

SMART ANTENNAS

Beam steering - degree of freedom - optimal antenna - adaptive antennas - smart antennas - key benefits of smart antennas technology - wide band smart antennas - Narrow band processing: signal model, conventional beam former, null steering beam former, optimal beam former, optimization using reference signal and beam space processing. **(9)**

TOTAL : 45

REFERENCES

1. Balanis.A, "*Antenna Theory Analysis and Design*", John Wiley and Sons, New York, 3rd Edition, 2005.
2. Lal Chand Godara, "*Smart Antenna*", C.R.C Press, 2004.
3. John D Kraus, Ronald J Marhefka, Ahmad S Khan, "*Antennas for all applications*", 3rd Edition , John Wiley and Sons, New York, 2002.
4. Edward C. Jordan, Keith G. Balmain "*Electromagnetic Waves and Radiating Systems*", 2nd Edition, Prentice Hall of India, 1968.
5. Warren L. Stutzman and Gary A. Thiele, "*Antenna Theory and Design*", 3rd Edition, John Wiley and Sons, New York, 1998.
6. Theodore S. Rappaport, "*Smart Antennas: Adaptive Arrays, Algorithms, & Wireless Position Location*", IEEE Press, 1998.

15MEC16 - SIGNAL PROCESSING LABORATORY

L	T	P	C
0	0	4	2

ASSESSMENT : PRACTICAL

COURSE OBJECTIVE

The First year students of M.E Communication Engineering will acquire practical knowledge on implementation of FFT algorithm, spectral estimation algorithm, design of digital filters, equalizers and multirate systems.

COURSE OUTCOME

Upon completion of this course the students will be able to demonstrate an ability to

CO1 : implement FFT, power spectral estimation algorithm, design & implement digital filters, equalizers and multirate systems.

CO2 : develop skills to communicate effectively.

LIST OF EXPERIMENTS

- Implementation of FFT, Parametric/Non parametric Power Spectral Estimation algorithms.
- Digital filter design, FFT and power spectrum estimation using TMS320C6713 Processor and using OMAPL138 processor
- Design and Implementation of Digital filters
- Design and Implementation of equalization algorithms
- Design and implementation of multirate systems

REFERENCES

1. J. G. Proakis, D. G. Manolakis: *Digital Signal Processing: Principles, Algorithms, and Applications*, Prentice Hall, 2007, 4th edition
2. S. K. Mitra: *Digital Signal Processing: A Computer-Based Approach*, McGraw Hill Higher Education, 2006, 3rd edition
3. M. H. Hayes: *Statistical Signal Processing and Modeling*, John Wiley and Sons, 1996
4. Theodore S. Rappaport., 'Wireless Communications', 2nd edition, Pearson Education, 2002
5. Carey Bunks, Francis Delebecque, Georges Le Vey and Serge Steer, " Scilab Group INRIA Meta2 Project/ENPC Cergrene", *Signal Processing with Scilab*.
6. <http://www.ti.com/lit/ds/symlink/omap-l138.pdf>

15MEC17 - SEMINAR AND TECHNICAL WRITING

L	T	P	C
0	0	2	1

ASSESSMENT : PRACTICAL

COURSE OBJECTIVE

The First year M.E Communication Engineering students will acquire practical knowledge to identify, formulate, analyze/ solve basic design problems for human needs with the knowledge of contemporary issues and to work as individual or in teams to develop solutions using electronic hardware and /or software.

COURSE OUTCOME

Upon completion of this course the students will be able to demonstrate an ability to

CO1 : *use techniques, skills and modern engineering tools for developing solutions using electronic hardware and/or software for solving basic problems of societal needs with the knowledge of contemporary issues.*

CO2 : *Work as an individual or in teams to achieve goals and to communicate effectively.*

15MEC21 - ADVANCED WIRELESS COMMUNICATION SYSTEMS

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

COURSE OBJECTIVE

The First Year students of M.E Communication Engineering will acquire knowledge on multipath channel models, channel capacity, design of MIMO and multiuser systems and 4G wireless technologies

COURSE OUTCOME

Upon completion of the course, the students will be able to demonstrate an ability to

CO1 : model multipath channel, calculate capacity of wireless channels

CO2 : apply diversity techniques, explain MIMO communication, multi user systems and compare various wireless technologies

MULTIPATH CHANNEL MODELS AND CAPACITY

Radio wave propagation - Transmit and receive signal models - Free space path loss - Ray Tracing - Empirical path loss models - Shadow fading - Outage probability - Time varying channel Impulse response - Narrowband fading models - Wideband fading models - Capacity in AWGN, flat fading channels and frequency selective fading channels. (9)

DIVERSITY

Receiver Diversity: Selection Combining, Threshold Combining, Maximum - ratio Combining, Equal gain combining. Transmitter Diversity: Channel known at transmitter, channel unknown at the transmitter. (9)

MIMO COMMUNICATIONS

Narrowband MIMO model - Parallel decomposition of the MIMO channel - MIMO channel capacity- MIMO Diversity Gain: Beam forming - Diversity - Multiplexing trade-offs - Space -Time modulation and coding - Frequency selective MIMO Channels. (9)

MULTIUSER SYSTEMS

Multiuser Channels: Uplink & Downlink-Multiple access techniques: FDMA, TDMA, CDMA, SDMA, Hybrid Techniques - Random Access - Power control - Downlink and Uplink Channel Capacity - Uplink- Downlink Duality - Multiuser diversity - MIMO-Multiuser systems. (9)

4G AND BEYOND - WIRELESS TECHNOLOGIES

Overview of Wireless Network Generations from 2G to 4G - Standards - 4G Vision - 4G Technology: Features and Challenges - Application of 4G - LTE Architecture - Smart antenna techniques - Adaptive Modulation and Coding with Time-slot scheduler - Bell labs layered Space Time (BLAST) System - Software Defined Radio - Cognitive Radio. (9)

TOTAL : 45

REFERENCES

1. *Andrea Goldsmith, "Wireless Communications", Cambridge Univ. Press, 2005*
2. *Vijay. K. Garg, "Wireless Communication and Networking", Morgan Kaufmann Publishers, 2010.*
3. *Clint Smith. P.E., and Daniel Collins, "3G Wireless Networks", 2nd Edition, Tata McGraw Hill, 2007.*
4. *David Tse and Pramod Viswanath, "Fundamentals of Wireless Communication", Cambridge University Press, 2010.*
5. *Theodore S. Rappaport, Wireless Communications: Principles and Practice, 2nd Edition, Prentice-Hall, 2002*

15MEC22 - OPTICAL SWITCHING AND NETWORKING

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

COURSE OBJECTIVE

The First year students of M.E.Communication Engineering will acquire knowledge on optical network architecture, Network connection & control plane, Routing & wavelength assignment, optical packet switched networks and survivable WDM networks.

COURSE OUTCOME

Upon completion of this course the students will be able to demonstrate an ability to

CO1 : explain the layered architecture of optical networks, connection management & control in static, wavelength routed networks and switching & routing using MPLS.

CO2 : explain the principles of routing, wavelength assignment, switching in networks and survivability of WDM networks

OPTICAL NETWORK ARCHITECTURES

Introduction to Optical Networks; Layered Architecture- Spectrum partitioning, Network Nodes, Network Access Stations, Overlay Processor, Logical network overlays. (9)

NETWORK CONNECTIONS AND THE CONTROL PLANE

Connection Management and Control; Static and Wavelength Routed Networks; Linear Lightwave Networks; Logically Routed Networks; Traffic Grooming; The Optical Control Plane- Architecture, Interfaces, Functions; Generalized Multiprotocol Label Switching - MPLS network and protocol stack, Link management, Routing and Signaling in GMPLS. (9)

ROUTING AND WAVELENGTH ASSIGNMENT

Static Multipoint network -Shared media and multiple access, Scheduling and Optical, Spectral Efficiency, Traffic constraints, Passive Optical Networks; Wavelength Routed Networks - Static and Dynamic Routing and Wavelength Assignment, Linear Lightwave networks - Static and Dynamic Routing and Wavelength Assignment. (9)

OPTICAL PACKET SWITCHED NETWORKS

Network Architectures- Unbuffered Networks, Buffering Strategies; OPS enabling technologies, Testbeds; Optical Burst Switching, Switching protocols, Contention Resolution, Optical Label Switching, OLS network testbeds. (9)

NETWORK SURVIVABILITY AND PROVISIONING

Failures and Recovery - Restoration schemes - Multiplexing Techniques - Provisioning Restorable Multi fiber Networks - Provisioning Restorable Single fiber Networks - Backup Multiplexing Based routing - Primary Backup Multiplexing Based Routine - Distributed Control Protocols - Survivability in WDM Ring networks (9)

TOTAL : 45

REFERENCES

1. *Thomas E. Stern, Georgios Ellinas, Krishna Bala, "Multiwavelength Optical Networks - Architecture, Design and control ", Cambridge University Press, 2nd Edition, 2009.*
2. *Biswanath Mukherjee, "Optical WDM Networks", Springer, 2006.*
3. *Rajiv Ramaswami and Kumar N. Sivarajan, "Optical Networks: A Practical Perspective", Harcourt Asia Pte Ltd., Second Edition 2006.*
4. *C. Siva Ram Moorthy and Mohan Gurusamy, "WDM Optical Networks: Concept, Design and Algorithms", Prentice Hall of India, 1st Edition, 2002.*
4. *P.E. Green, Jr., "Fiber Optic Networks", Prentice Hall, NJ, 1993.*

15MEC23 - COMMUNICATION NETWORK SECURITY

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

COURSE OBJECTIVE

The First Year M.E. Communication Engineering students will acquire knowledge on :

- i. broader aspects of Communication Network Security services, mechanisms and their applications.
- ii. threats, issues, solutions, algorithms and techniques applicable to various types of security mechanisms in practice at various OSI layers of wired and wireless networks.

COURSE OUTCOME

Upon completion of this course, the students will be able to demonstrate an ability to

- CO1** :
- i. explain the issues, scope and significance of various security mechanisms and services applicable to Communication networks.
 - ii. explain and analyze, algorithms and techniques of Block and Stream ciphers
- CO2** :
- i. explain and analyze mechanisms, algorithms and techniques of key exchange & distribution, authentication and integrity checks.
 - ii. analyze the concepts and explain the operating principles and applications of security protocols & security mechanisms used in Routing and Transport layers.
 - iii. explain and analyze Security related Issues, threats and solutions for various layers of wireless networks.

BASICS OF SECURITY

Security Goals - Types and Classification of Attacks - Passive, active - Classification of attacks based on OSI layers, Knowledge of attacker - Distributed DOS attack - Security services and mechanisms- Cryptography - Steganography - Revision on Mathematics for Cryptography - Modular Arithmetic - Fields: Galois Fields. **(9)**

BLOCK AND STREAM CIPHER ALGORITHMS

Substitutional Ciphers - Transposition Ciphers - Stream and Block Ciphers - Data Encryption Standard- Advanced Encryption Standard (AES) - Modes of Block Cipher operation - Asymmetric key algorithms : RSA Cryptosystem. - Stream Ciphers: RC4. **(9)**

INTEGRITY, AUTHENTICATION AND KEY MANAGEMENT

Message Integrity - Hash functions and their usage - Message Authentication Codes -HMAC, CMAC- Digital signatures - Entity Authentication - Key Distribution: Symmetric and Asymmetric Key Distribution methods - Diffie Hellman Key exchange. **(9)**

NETWORK SECURITY, FIREWALLS AND WEB SECURITY

Firewalls : Packet Filter Firewalls, Application Level Gateways, Firewall Configurations and Limitations - Tunneling - Virtual Private Networks - Mail Security - PGP - IP security Architecture - IP V4 and V6 Security features - AH and ESP protocols - Security Associations - Secure Sockets Layer - Transport layer security - Secure Electronic Transaction. **(10)**

WIRELESS NETWORK SECURITY

Security Attacks specific to Wireless systems : Worm hole, Tunneling - Counter Measures - DoS - WEP for Wi-Fi network - GSM security - GPRS Security - 3GPP Security - BlueTooth Security - Secure Ad hoc Network. **(8)**

TOTAL : 45

REFERENCES

1. *William Stallings, "Cryptography and Network security: Principles and practice", 6th Edition, Pearson Education, 2013.*
2. *Behrouz A. Forouzan , " Cryptography and Network security" Special Indian Edition, Tata McGraw-Hill, 2008.*
3. *Atul Kahate , " Cryptography and Network security", 3^d Edition, McGraw-Hill Education, 2013.*
4. *Christos Douligeris, Dimitrios N. Serpanos, "Network Security: Current Status and Future Directions", John Wiley, 2007.*
5. *Praphul Chandra, Dan Bensky et al, "Wireless Security: Know it all" Newnes, 2011.*
6. *R.K.Nichols, "Wireless Security" Tata Mc Graw Hill Education, 2006.*

15MEC24 - WIRELESS AD HOC NETWORKS

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

COURSE OBJECTIVE

The First year students of M.E Communication Engineering will acquire knowledge on Infrastructureless Network, MAC, Network and Transport layer protocols, QoS and Energy Management requirements for Wireless Ad Hoc Networks

COURSE OUTCOME

Upon completion of the course, students will be able to demonstrate an ability to

CO1 : elucidate the fundamental vision of wireless Ad Hoc Networks, MAC & Routing protocols for Wireless Ad Hoc Networks

CO2 : narrate the concepts of Multicast Routing & Transport layer protocols, QoS & energy management in Wireless Ad Hoc Networks

INTRODUCTION & MAC PROTOCOLS

AD HOC Wireless Networks - Issues, Challenges & Applications - Designing a MAC Protocol for Ad hoc Wireless Networks - Classification of MAC Protocols: Contention-Based, Contention-Based with Reservation Mechanisms, Contention-Based with Scheduling Mechanisms, MAC Protocols that Use Directional Antennas. (9)

ROUTING PROTOCOLS

Designing a Routing Protocol for Ad hoc Wireless Networks - Classifications of Routing Protocols: Table-Driven, On-Demand, Hybrid - Routing Protocols with Efficient Flooding mechanism Hierarchical - Power-Aware Routing Protocols. (9)

MULTICAST ROUTING

Designing a Multicast Routing Protocol, Operation of Multicast Routing Protocols, Classifications of Multicast Routing Protocols - Tree-Based, Mesh-Based, Energy-Efficient, Multicasting with Quality of Service Guarantees. (9)

TRANSPORT LAYER AND SECURITY PROTOCOLS

Designing a Transport Layer Protocol for Ad Hoc Wireless Networks, Classification of Transport Layer Solutions, TCP over Ad Hoc Wireless Networks, Security in Ad Hoc Wireless Networks, Secure Routing in Ad Hoc wireless Networks. (9)

QUALITY OF SERVICE & ENERGY MANAGEMENT SCHEMES

QoS in Ad Hoc Wireless Networks - Classifications of QoS Solutions: MAC Layer Solutions, Network Layer Solutions.

Energy Management in Ad Hoc Wireless Networks, Classification of Energy Management Schemes - Battery Management Schemes, Transmission Power Management Schemes, System Power Management Schemes. **(9)**

TOTAL : 45

REFERENCES

1. *C. Siva Ram Murthy and B.S. Manoj, "Ad Hoc Wireless Networks: Architectures and Protocols", Prentice Hall, June 2004.*
2. *Charles E. Perkins, "Ad Hoc Networking", Addison Wesley, 2001.*
3. *C.K. Toh, "Ad Hoc Mobile Wireless Networks: Protocols and Systems", Prentice Hall, 2001.*
4. *Mohammed Ilyas, "The Handbook of Ad hoc Wireless Networks", CRC Press, 2002.*
5. *Basagni S, Marco Conti, Silvia Giordano, Ivan Stojmenovi and Cacute, "Mobile Ad hoc Networking", John Wiley and sons, 2004.*

15MEC25 - WIRELESS COMMUNICATION AND NETWORKING LABORATORY

L	T	P	C
0	0	4	2

ASSESSMENT : PRACTICAL

COURSE OBJECTIVE

The First year students of M.E Communication Engineering will acquire practical knowledge on design and development of digital communication systems, wireless communication systems and networks.

COURSE OUTCOME

Upon completion of this course the students will be able to demonstrate an ability to

CO1 : model & analyze various types of digital communication techniques and wireless communication systems, implement OFDM systems and analyze the performance of wireless networks.

CO2 : develop skills to communicate effectively.

LIST OF EXPERIMENTS

- Design and performance analysis of error control encoder and decoder
- Design and analysis of Digital communication techniques on an SDR platform
- Wireless Channel emulation and characterization
- Performance analysis of wireless communication systems
- Design and implementation of OFDM system
- Simulation of Wireless Networks and their performance analysis

REFERENCES

1. Theodore S.Rappaport., 'Wireless Communications', 2nd edition, Pearson Education, 2002
2. John Proakis, Masoud Saleh, "Contemporary Communication Systems Using MATLAB", 3rd Edition, Cengage learning.
3. Robert W Heath, "Digital Wireless communication: Physical layer exploration Lab using NI USRP", 2014.

15MECE01 - SATELLITE COMMUNICATION AND APPLICATIONS

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

COURSE OBJECTIVE

The students of M.E. Communication Engineering will acquire knowledge on the elements and subsystems of satellite communication system, satellite link design, modulation, multiplexing techniques for satellite systems, digital satellite links and applications of satellite systems.

COURSE OUTCOME

Upon completion of the course, the students will be able to demonstrate an ability to

CO1 : explain the elements and subsystems of satellite communication systems.

CO2 : apply and analyze satellite link design, modulation and multiplexing techniques for satellite systems, digital satellite links and applications of satellite systems

ELEMENTS OF SATELLITE COMMUNICATION SYSTEM

Basic satellite system - orbits - Geosynchronous and Geostationary orbits - Non-geostationary orbits - Transfer orbits - Orbital slots - Frequencies - Foot prints and coverage - Launch vehicles and bases - Orbital effects in Communication system performance - Earth eclipse of satellites - Sun transit outages - Doppler shift and range variations- Limits of visibility - orbital perturbations. **(10)**

SPACE CRAFT AND EARTH STATION TECHNOLOGY

Space craft subsystems - AOCS - TT&C -Power systems - Communication subsystems - Space craft antennas. Earth stationsubsystems - Antennas - Tracking - Equipment for Earth station - FDM & TDM systems - Receive only systems - Transmit -Receive Earth stations- Direct to Home systems. **(9)**

LINK, MODULATION & MULTIPLEXING TECHNIQUES FOR SATELLITE SYSTEMS

Transmission theory - Design of Down links - Uplink design - Calculation of Noise power budget - Analog Telephone Transmission - Video Transmission - FDM/FM/FDMA system- TDMA system - CDMA - Demand Access systems - Random Access. **(9)**

DIGITAL SATELLITE LINKS

Digital modulation and demodulation- Digital transmission of voice - Digital TV and BW compression - T1 24 channel TDM system - DVB satellites - Encoding and error correction for Digital satellite links - Digital speech interpolation - SPEC - Satellite switched TDMA. **(9)**

SATELLITES IN NETWORKS, MOBILES & SPECIALIZED SERVICES

ATM networks and interfaces, Satellite mobile services - VSATs - Radarsat - Orbcomm - GPS-Indian Meteorological satellites- Indian Navigational satellites - INTELSAT systems. **(8)**

TOTAL : 45

REFERENCES

1. *Timothy Pratt, Charles W.Bostan, " Satellite Communication", John Wiley & sons (Asia) Pvt. Ltd.,2003*
2. *Dennis Roddy, "Satellite Communication", 4th Edition, McGraw Hill Publishers, 2006.*
3. *Bruce R.Elbert, "Introduction to Satellite Communication", Artech House Inc., 1999.*
4. *Wilbur L.Pritchard, HendriG.Suyderhood, Robert A.Nelson, "Satellite Communication Systems Engineering", Prentice Hall, New Jersey, 2006.*
5. *Tri T.Ha, "Digital Satellite Communication", 2nd Edition, McGraw Hill, New york.1990.*

15MECE02 - DETECTION AND ESTIMATION THEORY

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

COURSE OBJECTIVE

The students of M.E., Communication Engineering will acquire knowledge on hypothesis testing, signal detection and estimation, Bayesian estimation, and distribution free estimation.

COURSE OUTCOME

Upon completion of the course, the students will be able to demonstrate an ability to

CO1 : apply hypothesis testing and signal detection methods.

CO2 : apply parametric estimation, bayesian estimation, distribution free estimation.

ELEMENTS OF HYPOTHESIS TESTING

Bayesian Hypothesis Testing - Likelihood Ratio Tests - Minimax Hypothesis Testing - Neyman Pearson Hypothesis Testing - Composite Hypothesis Testing - M'ary Hypothesis Testing. **(9)**

SIGNAL DETECTION IN DISCRETE TIME

Deterministic Signals - Stochastic Signals - Models and Detector Structures - Performance Evaluation - Chernoff Bounds - Applications of Detection in Signal Processing. **(8)**

PARAMETER ESTIMATION

Fundamentals of Estimation Theory - Minimum Variance Unbiased Estimation - Cramer Rao Lower bound - Best Linear Unbiased Estimators - Linear Least Squares Estimation - Nonlinear Least Squares Estimation - Maximum Likelihood Estimation. **(10)**

BAYESIAN ESTIMATION

Bayesian philosophy - General Bayesian Estimators - Minimum Mean Square Error Estimators - Maximum A Posteriori Estimators - Linear MMSE Estimation **(9)**

DISTRIBUTION-FREE ESTIMATION

Orthogonality Principle - Autoregressive Techniques - Discrete Wiener Filter, Continuous Wiener Filter, Generalization of Discrete and Continuous Filter Representations, Kalman Filter, Extended Kalman Filter - Applications of Estimation in Signal Processing. **(9)**

TOTAL : 45

REFERENCES

1. Poor H V, *"An Introduction to Signal Detection and Estimation"*, Springer-Verlang, 1994.
2. Harry L. Van Trees, Kristine L. Bell with Zhi Tian, *"Detection Estimation and Modulation Theory"*, Willey, 2013
3. Thomas Schonhoff and Arthur A Giordano, *"Detection and Estimation Theory"*, Prentice Hall, 2007.
4. Kay S M, *"Fundamentals of Statistical Signal Processing, Volume 1: Estimation Theory"*, Prentice Hall, 1993.
5. Kay S M, *"Fundamentals of Statistical Signal Processing, Volume 2: Detection Theory"*, Prentice Hall, 1998.

15MECE03 - IMAGE AND VIDEO PROCESSING

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

COURSE OBJECTIVE

The students of M.E. Communication Engineering will acquire knowledge on

- i. the concepts of image fundamentals, transforms, image enhancement and restoration techniques.
- ii. Image compression, image analysis techniques and fundamentals of video processing.

COURSE OUTCOME

Upon completion of this course the students will be able to demonstrate an ability to

- CO1** : explain the fundamentals of image processing, transforms, image enhancement and restoration in spatial and frequency domains
- CO2** : explain various compression, segmentation, representation and description techniques, fundamentals of video processing and video compression standards.

DIGITAL IMAGE FUNDAMENTALS AND TRANSFORMS

Elements of digital image processing systems - Image sampling and quantization- Basic relationships between pixels - Need for transforms - Introduction to Fourier transform - DFT- Properties of 2D FFT - Discrete Cosine Transform - Walsh transform- Hadamard transform- Slant transform- Haar Transform - Karhunen Loeve Transform- Singular Value Decomposition - Wavelet transform. **(9)**

IMAGE ENHANCEMENT AND RESTORATION

Image Enhancement: Basic intensity transformation functions - Histogram processing: Specification, Equalization - Smoothing and Sharpening spatial filters - Image smoothing and sharpening frequency domain filters. Image restoration: degradation/ restoration model- Noise model- Spatial Filtering: Mean, Order statistics, Adaptive Filters - Frequency Domain Filtering: Band pass, Band reject, Notch/ filters - Inverse filtering - Wiener filtering - Constrained least square filtering - Geometric Transformations. **(9)**

IMAGE SEGMENTATION AND COMPRESSION

Edge detection - Edge linking and boundary detection: Local processing, Global processing - Thresholding - Region based segmentation: Region growing - Region splitting and merging Image compression: Fundamentals- Lossless Compression : Huffman coding, Arithmetic coding, LZW coding, Bit plane coding Lossy compression: Vector Quantization- Wavelet based compression - Block Truncation Coding. **(9)**

IMAGE REPRESENTATION, DESCRIPTION AND RECOGNITION

Representation : Chain codes, Polygonal approximations-signature- boundary segments - skeletons - boundary descriptors: shape numbers - Fourier descriptors - Regional descriptors - simple descriptors - topological descriptors - texture - Object recognition :pattern and pattern class - Object Recognition : Minimum distance classifiers - Neural Networks. **(9)**

VIDEO PROCESSING

Digital Video basics : Spatial-temporal sampling- video sampling rate conversion- motion estimation techniques- motion compensation techniques - video compression standards- H.261, H.263, MPEG.

(9)

TOTAL : 45

REFERENCES

1. *Rafael C.Gonzalez & Richard E.Woods, "Digital Image Processing", 3rd Edition, Pearson Education, 2009*
2. *Jayaraman S, Esakkirajan S & Veerakumar T, "Digital image Processing", Tata McGraw Hill, reprint 2010*
3. *Fred Halsall, James F. Kurose, "Multimedia communication-Applications, Networks, Protocols and standards", Pearson Education Limited, 2004*
4. *William K.Pratt, "Digital Image Processing", John Wiley, 4th edition, 2006*
5. *Anil.K.Jain, "Fundamentals of Digital image Processing", prentice Hall of India, 1989*
6. *Sid Ahmed M.A., "Image Processing - Theory, Algorithm and Architecture", McGraw Hill, 2009.*

15MECE04 - COMPUTER VISION

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

COURSE OBJECTIVE

The students of M.E. Communication Engineering will acquire knowledge on the principles, design, and implementation of vision-based systems.

COURSE OUTCOME

Upon completion of this course the students will be able to demonstrate an ability to

CO1 : explain the low-level image processing and the framework of 3-D reconstruction.

CO2 : explain the feature extraction, clustering & reduction techniques for pattern and motion analysis, concepts of shape from X and its applications.

DIGITAL IMAGE FORMATION AND LOW-LEVEL PROCESSING

Overview and State-of-the-art, Fundamentals of Image Formation, Transformation: Orthogonal, Euclidean, Affine, Projective, etc; Fourier Transform, Convolution and Filtering, Image Enhancement, Restoration, Histogram Processing. (9)

DEPTH ESTIMATION AND MULTI-CAMERA VIEWS

Perspective, Binocular Stereopsis: Camera and Epipolar Geometry; Homography, Rectification, DLT, RANSAC, 3-D reconstruction framework; Auto-calibration. (9)

FEATURE EXTRACTION

Edges - Canny, LOG, DOG; Line detectors (Hough Transform), Corners - Harris and Hessian Affine, Orientation Histogram, SIFT, SURF, HOG, GLOH, Scale-Space Analysis- Image Pyramids and Gaussian derivative filters, Gabor Filters and DWT. (9)

PATTERN AND MOTION ANALYSIS

Clustering: K-Means, K-Medoids, Mixture of Gaussians, Classification: Discriminant Function, Supervised, Un-supervised, Semi-supervised; Classifiers: Bayes, KNN, ANN models; Dimensionality Reduction: PCA, LDA, ICA; Non-parametric methods; Background Subtraction and Modeling, Optical Flow, KLT, Spatio-Temporal Analysis, Dynamic Stereo; Motion parameter estimation. (9)

SHAPE FROM X AND APPLICATIONS

Light at Surfaces; Phong Model; Reflectance Map; Albedo estimation; Photometric Stereo; Use of Surface Smoothness Constraint; Shape from Texture, color, motion and edges.

Applications: CBIR, CBVR, Activity Recognition, computational photography, Biometrics, stitching and document processing; Modern trends - super-resolution; GPU, Augmented Reality; cognitive models, fusion and SR&CS. (9)

TOTAL : 45

REFERENCES

1. *Richard Szeliski, "Computer Vision: Algorithms and Applications", Springer-Verlag London Limited, 2011.*
2. *Forsyth D A and Ponce J, "Computer Vision: A Modern Approach", Prentice Hall, 2003.*
3. *Richard Hartley, and Andrew Zisserman "Multiple View Geometry in Computer Vision", 2nd Edition, Cambridge University Press, 2004.*
4. *K. Fukunaga; Introduction to Statistical Pattern Recognition, Second Edition, Academic Press, Morgan Kaufmann, 1990.*
5. *Rafael C. Gonzalez & Richard E. Woods, "Digital Image Processing", 3rd Edition, Pearson Education, 2009.*

15MECE05 - CODING THEORY FOR WIRELESS CHANNELS

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

COURSE OBJECTIVE

The students of M.E Communication Engineering will be able to acquire knowledge on the basics of Galois field, the construction of block codes, cyclic codes, BCH & RS codes and learn about the various coding standards used in wireless channels.

COURSE OUTCOME

Upon completion of this course the students will demonstrate an ability to

CO1 : apply the Galois field arithmetic for designing block codes and cyclic codes, BCH & RS codes

CO2 : apply coding algorithms and analyze coding gain for various wireless channels

GALOIS FIELDS

Groups, fields and Vector spaces - Elementary properties of Galois fields - Primitive polynomials and Galois fields of Order pm - Zech's algorithms-Euclidean domains and Euclid's algorithm - Minimal polynomials and Conjugate elements -Factoring $X^n - 1$. (9)

LINEAR BLOCK CODES & CYCLIC CODES

Block error control codes - Linear block codes - Standard array and syndrome-table decoding -Weight distribution of block codes - Hamming codes - Modified linear codes-General theory of linear cyclic codes - Shift register encoders and decoders for cyclic codes -Shortened cyclic codes and CRC error detection. (9)

BCH AND REED SOLOMON CODES

Generator polynomial approach to BCH codes - Weight distribution for some binary BCH codes -Basic properties of Reed Solomon codes - Decoding algorithms for binary BCH codes, non-binary BCH codes, Reed Solomon codes (Berlekamp's algorithm) - Binary and non-binary erasure decoding. (9)

CODING OVER AWGN CHANNELS

AWGN channels-Coding gain-Encoding and decoding in AWGN channels-ML and MAP decoding for Repetition codes- Coding gain performances -Density Parity check (LDPC) codes, Regular LDPC codes, Gallager construction of LDPC codes. LDPC codes -Socket construction of regular LDPC codes, Tanner Graphs- Gallager decoding-Irregular LDPC codes-Degree optimisation to achieve higher thresholds-Soft-decision Message Passing Decoder for AWGN channels-Density evolution for AWGN channels (9)

LDPC/TURBO CODES IN THE WIRELESS STANDARDS

Turbo Encoders & Decoders- Turbo codes in the WiMax/3GPP standards- permutation polynomial interleavers- LDPC codes in the WiMax standard-protograph LDPC codes and their properties-Implementation aspects of turbo codes: MAP decoder and MAXLOGMAP decoder for convolutional

codes, design and architecture- Implementation aspects of LDPC codes: tanh processing versus minsum decoder-design and architecture-Outlook and the future of the world of error control codes - coding for multi-terminal communication problems. (9)

TOTAL : 45

REFERENCES

1. *Shu Lin, Daniel Costello, "Error control coding - Fundamentals and Applications", 2nd Edition, Prentice Hall, Upper Saddle River, NJ, 2004.*
2. *Rudiger Urbanke and Thomas Richardson, "Modern coding theory "Cambridge University Press, 2008.*
3. *Stephen B. Wicker, "Error control systems for Digital communication and storage", Prentice Hall, Upper Saddle River, NJ, 1995.*
4. *Todd K Moon, "Error Correction Coding - Mathematical methods and Algorithms", John Wiley & Sons, 2005.*
5. *Bernard Sklar, "Digital Communications, Fundamentals and Applications", 2nd Edition, 2001.*

15MECE06 - LTE TECHNOLOGY AND STANDARDS

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

COURSE OBJECTIVE

The students of M.E Communication Engineering will acquire knowledge on LTE standards, protocols, functions, downlink physical data and control channels, multiple antenna techniques, scheduling and cell search.

COURSE OUTCOME

Upon completion of the course, the students will be able to demonstrate an ability to

CO1 : explain LTE standards, protocols and its functions.

CO2 : compare data, transport and control channels and analyze multiple antenna techniques, resource scheduling and cell search techniques in different networks.

LTE STANDARDS

LTE Standards - LTE Network Architecture - Network Elements and Functions - Requirements and Targets for the Long Term Evolution - Technologies for the Long Term Evolution. (9)

LTE PROTOCOLS AND FUNCTIONS

User Equipment Categories - QoS Architecture - LTE Security - Radio Interface Basics - Multiple Access in OFDM - OFDMA - LTE Network Protocol Architecture. (9)

DOWNLINK PHYSICAL DATA AND CONTROL CHANNELS

Downlink Data - Transporting Channels- Downlink Control Channels - Link Adaptation and CQI Feedback - Channel Coding. (9)

MULTIPLE ANTENNA TECHNIQUES

Multiple Antenna Theory - MIMO Signal Model - Single User MIMO Techniques - Multi-User Techniques - MIMO Schemes in LTE - Practical Considerations - Single-User Schemes, Multi-User Schemes - Physical Layer MIMO Performance. (9)

SCHEDULING AND CELL SEARCH

General Considerations for Resource Allocation Strategies Scheduling Algorithms - Considerations for Resource Scheduling in LTE - Interference Coordination and Frequency Reuse, LTE Cell Search - UMTS Cell Search - GSM Cell Search - Measurements on Campedon LTE - LTE Measurements - Handover to LTE - Handover to UMTS - Handover to GSM. (9)

TOTAL : 45

REFERENCES

1. *Stefania Sesia, Issam Toufik and Matthew Baker, "LTE - The UMTS Long Term Evolution: From Theory to Practice", John Wiley & Sons, 2011.*
2. *Ralf Kreher and Karsten Gaenger, "LTE Signaling, Trouble shooting and Optimization", John Wiley & Sons, 2011.*
3. *Erik Dahlman, Stefan Parkvall, Johan Skold, "4G:LTE/LTE - Advanced for mobile broadband", Elsevier Ltd.,2014.*
4. *Christopher Cox, "An Introduction to LTE:LTE,LTE - Advanced SAE and 4G Mobile communication", John Wiley & Sons,2013.*
5. *Houman Zarrinkouk, "Understanding LTE with MATLAB from Mathematical Modeling to simulation and Prototyping", John Wiley & Sons,2014.*

15MECE07 - NETWORK ROUTING ALGORITHMS

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

COURSE OBJECTIVE

The students of M.E.Communication Engineering will acquire knowledge on concepts of networking and routing, routing algorithms, IP routing.

COURSE OUTCOME

Upon completion of this course the students will be able to demonstrate an ability to

CO1 : explain the concepts of networking and network routing & various routing algorithms

CO2 : explain the principles of IP routing, OSPF, IGRP and EGRP.

NETWORKING AND NETWORK ROUTING

Addressing and Internet Service- Network Routing- IP Addressing- Classful Addressing Scheme - Subnetting/Netmask - Classless Interdomain Routing - On Architectures- Service Architecture - Protocol Stack Architecture- OSI Reference Model- IP Protocol Stack Architecture - Router Architecture- Network Topology Architecture- Network Management Architecture. **(8)**

ROUTING ALGORITHMS: SHORTEST PATH AND WIDEST PATH

Bellman-Ford Algorithm and the Distance Vector Approach - Dijkstra's Algorithm - Comparison of the Bellman-Ford Algorithm and Dijkstra's Algorithm - Shortest Path Computation with Candidate Path Caching - Widest Path Computation with Candidate Path Caching - Widest Path Algorithm - Dijkstra-Based Approach - Bellman-Ford-Based Approach - k-Shortest Paths Algorithm. **(10)**

IP ROUTING AND DISTANCE VECTOR PROTOCOL FAMILY

Routing Table - Routing Information Protocol, Version 1 (RIPv1) - Routing Information Protocol, Version 2 (RIPv2)- Interior Gateway Routing Protocol (IGRP) 1- Packet Format - Computing Composite Metric- Enhanced Interior Gateway Routing Protocol (EIGRP) - Packet Format - Route Redistribution. **(9)**

OSPF AND INTEGRATED IS-IS

OSPF: Protocol Features - OSPF Packet Format- Examples of Router LSAs and Network LSAs - Integrated IS-IS - Similarities and Differences Between IS-IS and OSPF. **(9)**

PACKET QUEUEING AND SCHEDULING

Packet Scheduling - First-In, First-Out Queueing - Priority Queueing - Round-Robin and Fair Queueing - Weighted Round-Robin and Weighted Fair Queueing - Deficit Round-Robin Queueing - Modified Deficit Round-Robin Queueing - TCP Congestion Control - Slow Start - Additive Increase, Multiplicative Decrease - Fast Retransmit and Fast Recovery - Implicit Feedback Schemes. **(9)**

TOTAL : 45

REFERENCES

1. *Deepankar Medhi and Karthikeyan Ramasamy, "Network Routing: Algorithms, Protocols, and Architectures", Elsevier, 2007.*
2. *Martha Steen Strup, "Routing in Communication Networks", Prentice Hall, 1995.*
3. *William Stallings, "Data and Computer Communications", Pearson Education, 2006.*

15MECE08 - RF MEMS

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

COURSE OBJECTIVE

The students of M.E Communication Engineering will be able to acquire knowledge on the concepts of micro electromechanical systems and its fabrication techniques. Acquire knowledge on MEMS switches, micromachined filters & phase shifter and microstrip antenna

COURSE OUTCOME

Upon completion of the course, students will be able to demonstrate an ability to

CO1 : define the concepts of micro electromechanical systems and its fabrication techniques.

CO2 : explain the properties of the RF Switches, micromachined transmission lines, filters, phase shifters and antenna

MICROELECTROMECHANICAL SYSTEMS(MEMS) AND RADIO FREQUENCY MEMS

Introduction -Microfabrication for MEMS - Electromechanical transducers - Microsensing for MEMS - Materials for MEMS. (7)

MEMS MATERIALS AND FABRICATION TECHNIQUES

Metals - Semiconductors - Thin films for MEMS and their deposition techniques - Materials for polymer MEMS - Bulk micromachining for silicon-based MEMS - Silicon surface micromachining - Microstereolithography for polymer MEMS. (7)

RF MEMS SWITCHES

Introduction - Switch parameters - Basics of switching - Switches for RF and microwave applications - Electrostatic switching - Approaches for low-actuation -voltage switches - thermal switching -MEMS switch design, modeling and evaluation -MEMS switch design considerations. (7)

MEMS INDUCTORS AND MICROMACHINED TRANSMISSION LINES

Introduction - MEMS inductors - MEMS capacitors - Micromachined transmission lines and components - Design, fabrication and measurements - Modeling of mechanical filters - Micromechanical filters. (12)

MICROMACHINED PHASE SHIFTER AND ANTENNA

Micromachined phase shifters: Introduction - Types of phase shifters and their limitations - MEMS phase shifters - Overview of microstrip antenna - Micromachining techniques to improve antenna performance - Micromachining as a fabrication process for small antenna - Micromachined reconfigurable antenna (12)

TOTAL : 45

REFERENCES

1. *Vijay K Varadan, Vinoy K J and Jose K A, "RF MEMS and Their Applications", John Wiley & Sons Ltd, England, 2003.*
2. *Gabriel M Rebeiz, "RF MEMS Theory, Design and Technology ", John Wiley & Sons Ltd, New Jersey, 2004.*
3. *Hector J De Los Santos, "RF MEMS Circuit Design for Wireless communications", Artech House, 2002.*
4. *Julian W.Gardner Vijay, K.Varadan, "Micro Sensors, MEMS, and Smart Devices", John Wiley & Sons, Ltd, 2001.*
5. *Stephen Beeby, Graham Ensell, "MEMS, Mechanical Sensors", Artech House Publishers, 2004.*

15MECE09 - RADIO FREQUENCY INTEGRATED CIRCUIT DESIGN

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

COURSE OBJECTIVE

The students of M.E.Communication Engineering will acquire broad knowledge on design and analysis of passive elements, mixers, Low noise amplifiers, power amplifiers and realization methods in RF Integrated Circuits.

COURSE OUTCOME

Upon completion of this course, the students will be able to demonstrate an ability to

CO1 : determine the impedance levels and dynamic range in RF circuits

CO2 : i) comprehend and explain operating principles and design concepts of RF passive elements for implementation in RF integrated circuits.

ii) analyze and design RF LNA and power amplifier

iii) comprehend and explain operating principles and design concepts of mixers for implementation in RF ICs.

RFIC DESIGN FUNDAMENTALS, NOISE AND LINEARITY

Lower frequency analog design and microwave design versus radio frequency integrated circuit design - Impedance levels for microwave and low-frequency analog design- noise - linearity and distortion in RF Circuits - dynamic range - filtering issue. **(9)**

REVIEW OF TECHNOLOGY

Small -signal model of bipolar transistor - high frequency effects - noise in bipolar transistors - base shot noise - noise sources in the transistor model - bipolar transistor design considerations-CMOS transistor.- impedance matching - tapped capacitors and inductors - the concept of mutual inductance - tuning a transformer - bandwidth of an impedance transformation network-quality factor of an LC resonator. **(8)**

DESIGN OF PASSIVE CIRCUIT ELEMENTS IN IC TECHNOLOGIES

Technology backend and metallization in IC technologies - sheet resistance and skin effect -parasitic capacitance and inductance -current handling in metal lines-design of inductors and transformers - characterization of inductor-layout of spiral inductors - on-chip transmission lines - high frequency measurements of on-chip passives and common De-Embedding techniques-packaging. **(9)**

LNA AND POWER AMPLIFIER

Basic amplifiers - amplifiers with feed back - noise in amplifiers - linearity in amplifiers - differential pair and other differential amplifiers-low-voltage topologies for LNAs and the use of on-chip transformers - DC bias networks - temperature effects - broad band LNA design. Power amplifier: power capability - efficiency calculations - matching considerations - Class E,F,G,H and S amplifiers -summary of amplifier

classes for RF Integrated circuits - AC load line - matching to achieve desired power - packaging -effects and implications of non linearity - linearization techniques - CMOS power-amplifier design. **(10)**

MIXERS

Mixing with nonlinearity - basic mixer operation - controlled transconductance mixer - double- balanced mixer - mixer with switching of upper quad - analysis of switching modulator-mixer noise - linearity - improving isolation - image reject and single -sideband mixers-alternative mixer designs general design comments - CMOS mixers. **(9)**

TOTAL : 45

REFERENCES

1. *John Rogers and Calvin Plett, "Radio Frequency Integrated Circuit Design", Artech House, 2nd Edition 2014.*
2. *Stephan A Mass, "Practical Microwave Circuits", Artech House, 2014.*
3. *Ferri Losee, "RF Systems, Components and Circuits handbook", Artech house, 2nd Edition 2005..*
4. *Ulrich L. Rohde, Matthias Rudolph, "RF / Microwave Circuit Design for Wireless Applications" John Wiley and Sons, 2012.*
5. *Gabriele Manganaro, Domine M. W. Leenaerts, "Advances in Analog and RF IC Design for Wireless Communication Systems", Academic Press, 2013.*

15MECE10 - EMBEDDED AND REAL TIME SYSTEMS

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

COURSE OBJECTIVE

The students of M.E Communication Engineering will acquire knowledge on the architecture of embedded system hardware, peripheral devices, communication buses, device drivers, real time operating systems and tools for developing embedded systems.

COURSE OUTCOME

Upon completion of this course the students will be able to demonstrate an ability to

CO1 : describe the architecture of embedded system hardware and the concepts of interfacing peripheral devices and communication buses

CO2 : describe the concepts of device drivers and model real-time applications using embedded system concepts

INTRODUCTION TO EMBEDDED SYSTEMS

Embedded Systems-Applications of Embedded Systems-Processors in the System-Other Hardware Units-Software Embedded into a System-Examples of Embedded Systems-Embedded System-on-Chip (SOC) and use of VLSI Design technology. **(8)**

DEVICES AND BUSES FOR DEVICES NETWORK

I/O Devices-Timer and Counting Devices-Serial Communication using I2C, CAN and USB. Parallel Communication using PCI, PCIX and Advanced Parallel High Speed Buses. **(9)**

DEVICE DRIVERS AND INTERRUPTS SERVICING MECHANISM

Device Drivers-Parallel Port Device Drivers in a System, Serial Port Device Drivers in a System, Device Drivers for Internal Programmable Timing Devices - Interrupt Servicing Mechanism-Context and the Periods for Context Switching, Deadline and Interrupt Latency. **(9)**

EMBEDDED SOFTWARE DEVELOPMENT USING IDE

Introduction to Integrated Development Environment (IDE)- Programming Concepts and Embedded Programming in Assembly and C- Creating a New Project - Adding Files to a Project-Building a Project-Debugging and Simulating the application- Host and Target machines - Linking and Locating software - Getting Embedded Software into the Target System - Issues in Hardware - Software design and co-design. **(9)**

REAL TIME SYSTEMS

Real time specifications - Real time Kernels - Intertask communication and Synchronization. REAL TIME OPERATING SYSTEMS (RTOS): Tasks and Task States, Tasks and Data, Semaphores and Shared Data, Message Queues, Mailboxes and Pipes, Timer functions, Events, Memory Management, Interrupt

Routines in RTOS Environment - Case study of Embedded System Design and coding for an Automatic chocolate vending machine (ACVM) using RTOS

CASE STUDY OF PROGRAMMING WITH RTOS

(10)

TOTAL : 45

REFERENCES

1. *Rajkamal, "Embedded Systems: Architecture, Programming and Design", 2nd Edition, Tata McGraw-Hill, 2008.*
2. *David E Simon, "An Embedded Software Primer", Pearson Education Asia, 7th Edition, 2009.*
3. *Phillip A. Laplante, "Real Time Systems Design and Analysis: An Engineer's Hand book" 3rd Edition, Wiley-Blackwell,2004.*
4. *Arnold Berger, "Embedded System Design: An Introduction to Processes, Tools, and Techniques", CMP Books, 1st Edition, 2002.*
5. *Wayne Wolf, "Computers as Components" 3rd Edition, Morgan Kaufmann Publishers, 2012.*

15MECE11 - ELECTROMAGNETIC INTERFERENCE MEASUREMENTS AND COMPLIANCE DESIGN

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

COURSE OBJECTIVE

The students of M.E Communication Engineering will acquire knowledge on the fundamentals of Electromagnetic Interference, its measurements, control techniques and design of EMC in PCBs.

COURSE OUTCOME

Upon completion of this course the students will demonstrate ability to

CO1 : explain EMI/EMC concepts, various coupling principles and standards

CO2 : explain various EMI measurement methods, control techniques and perform EMC design for PCBs.

EMI ENVIRONMENT

EMI/ EMC concepts and definitions, Sources of EMI, conducted and radiated EMI, Transient EMI, Time domain Vs Frequency domain EMI, Units of measurement parameters. (9)

EMI COUPLING PRINCIPLES AND STANDARDS

Conducted, Radiated and Transient Coupling, Common Impedance Ground Coupling, Radiated Common Mode and Ground Loop Coupling, Radiated Differential Mode Coupling, Near78 Field Cable to Cable Coupling, Power Mains and Power Supply coupling. Units of specifications, Civilian standards - FCC, CISPR, IEC, EN, Military standards - MIL STD 461D/462. (9)

EMI MEASUREMENTS

EMI Test Instruments/ Systems, EMI Shielded Chamber, Open Area Test Site, TEM Cell, Sensors/ Injectors/ Couplers, Test beds for ESD and EFT. (9)

EMI CONTROL TECHNIQUES

Shielding, Filtering, Grounding, Bonding, Isolation Transformer, Transient Suppressors, Cable Routing, Signal Control, Component Selection and Mounting. (9)

EMC DESIGN OF PCBS

PCB Traces Cross Talk, Impedance Control, Power Distribution Decoupling, Zoning, Motherboard Designs and Propagation Delay Performance Models. (9)

TOTAL : 45

REFERENCES

1. V.P.Kodali, *"Engineering EMC Principles, Measurements and Technologies"*, s.Chand & Co., New Delhi,2000.
2. Clayton R.Paul, *"Introduction to Electromagnetic compatibility"*, John Wiley & Sons, 2nd edition, 2006.
3. Henry W.Ott, *"Noise Reduction Techniques in Electronic Systems"*, John Wiley and Sons, New York, 1988.
4. *"Electromagnetic Interference and Compatibility"*, IIT-Delhi, IMPACT Series, Modules 1-9.
5. Bernhard Keiser, *"Principles of Electromagnetic Compatibility"*, Artech house, 3rd edition, 1986.

15MECE12 - SPEECH RECOGNITION TECHNIQUES

L	T	P	C
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ASSESSMENT : THEORY

COURSE OBJECTIVE

The students of M.E Communication Engineering will acquire knowledge on concepts of speech signal processing and its recognition techniques.

COURSE OUTCOME

Upon completion of this course the students will be able to demonstrate an ability to

CO1 : acquire knowledge on the physiological and mathematical model of speech production mechanism and basic speech signal processing concepts.

CO2 : acquire knowledge on features, distance measures, and statistical models for speech recognition

SPEECH PRODUCTION MECHANISM

Physiological and Mathematical Model. Relating the physiological and mathematical model. Categorization of Speech Sounds based on the source-system and the articulatory model. (9)

SPEECH SIGNAL PROCESSING CONCEPTS

Discrete time speech signals, relevant properties of the fast Fourier transform and Z-transform for speech recognition, convolution, linear and non linear filter banks. Spectral estimation of speech using the Discrete Fourier transform. Pole-zero modeling of speech and linear prediction (LP) analysis of speech. Homomorphic speech signal de convolution, real and complex cepstrum, application of cepstral analysis to speech signals. (9)

SPEECH RECOGNITION FRONT END

Feature extraction for speech recognition, Static and dynamic features for speech recognition, robustness issues, discrimination in the feature space, feature selection. Mel frequency cepstral co-efficients (MFCC), Linear prediction cepstral coefficients (LPCC), Perceptual LPCC. (9)

DISTANCE MEASURES FOR COMPARING SPEECH PATTERNS

Log spectral distance, cepstral distances, weighted cepstral distances, distances for linear and warped scales. Dynamic Time Warping for Isolated Word Recognition. (9)

STATISTICAL MODELS FOR SPEECH RECOGNITION

Vector quantization models and applications in speaker recognition - Gaussian mixture modeling for speaker and speech recognition - Discrete and Continuous Hidden Markov modeling for isolated word and continuous speech recognition. (9)

TOTAL : 45

REFERENCES

1. *Thomas.E. Quatieri, "Discrete-Time Speech Signal Processing: Principles and Practice" Thomas 2001.*
2. *L. Rabiner and B. Juang, "Fundamentals of Speech Recognition" Prentice-Hall Signal Processing Series, 1993.*
3. *B. Gold and N. Morgan, "Speech and Audio Signal Processing: Processing and perception of speech and music", Wiley, Second edition,2011.*
4. *J.R. Deller, J.G.Proakis, JH Hansen, "Discrete Time Processing of Speech Signals", Wiley-IEEE press,1999.*
5. *L.R.Rabiner and R.W.Schafer, "Digital Processing of Speech Signals", Pearson Education, 2004.*

15MECE13 - WAVELETS AND SUBBAND CODING

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

COURSE OBJECTIVE

The students of M.E.Communication Engineering will acquire knowledge on the concepts of Continuous and Discrete Wavelet Transforms and its applications.

COURSE OUTCOME

Upon completion of this course the students will be able to demonstrate an ability to

CO1 : acquire knowledge on the limitations of standard Fourier analysis, and Continuous Wavelet Transform.

CO2 : acquire knowledge on Discrete Wavelet Transform, Multidimensional wavelets and the applications of wavelets in speech and image processing.

INTRODUCTION

Signal spaces - concept of Convergence - Hilbert spaces for energy signals. Fourier basis & Fourier Transform - Limitations of standard Fourier analysis - Need for Time-Frequency Analysis, Spectrogram plot - Windowed Fourier transform Tiling of the Time-Frequency Plane for STFT - Heisenberg's Uncertainty principle - Short time Fourier transform (STFT) Analysis- short comings of STFT- Need for Wavelets.

(8)

CONTINUOUS WAVELET TRANSFORMS (CWT)

Introduction, Continuous Time wavelets, Definition of CWT, The CWT as a correlation, Constant Q-Factor Filtering Interpolation and time frequency resolution, the CWT as an operator, inverse CWT. **(8)**

DISCRETE WAVELET TRANSFORM (DWT) AND MRA

Introduction, Approximation of vectors in nested linear vector spaces, example of an MRA-Bases for the approximations subspaces and Haar scaling function, Bases for detail subspaces and Haar wavelet, Formal definition of an MRA, Construction of a general orthonormal MRA, A wavelet basis for MRA, Interpreting orthonormal MRAs for Discrete time signals, Daubechies Wavelets, Relationship between Filter banks and wavelet basis, Important wavelets: Haar, Mexican hat, Meyer, Shannon, Daubechies

(13)

ADVANCED TOPICS

Wavelet packets, Non - separable multidimensional wavelets, Bi-orthogonal basis-B-Splines, Lifting scheme of wavelet generation, Multiwavelets, Ridgelets, Curvelets. **(9)**

APPLICATIONS OF WAVELETS

Signal Denoising - Sub-band coding of Speech and music- Image Compression using 2-D DWT- JPEG 2000 standard - Fractal Signal Analysis. **(7)**

TOTAL : 45

REFERENCES

1. *Soman K P and Ramachandran K I, "Insight into Wavelets from Theory to Practice", Prentice Hall India, Third Edition, 2010*
2. *Jaideva C Goswami and Andrew K Chan, "Fundamentals of Wavelets - Theory, Algorithms and Applications", John Wiley and Sons, Inc., Singapore, 1999.*
3. *Vetterli M, and Kovacevic J, "Wavelets and Subband Coding," Prentice Hall, 1995.*
4. *Fliege. N J, "Multirate Digital Signal Processing", John Wiley and Sons, Newyork, 1994.*
5. *Wavelet Transforms - Introduction to Theory & Applications, Raguhuveer M.Rao & Ajit S. Bopardikar - Pearson Education Asia New Delhi -2003*
6. *Stephane G Mallat, "A Wavelet Tour of Signal Processing", Academic Press, Second Edition, 1999.*
7. *Wornell G W, "Signal Processing with Fractals: A Wavelet based Approach", Prentice Hall, 1995.*

15MECE14 - SOFTWARE DEFINED RADIO AND COGNITIVE RADIO TECHNOLOGIES

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

COURSE OBJECTIVE

The students of M.E Communication Engineering will acquire knowledge on Software defined radio, Cognitive radio technology, Cognitive radio technical challenges and Spectrum sensing.

COURSE OUTCOME

Upon completion of the course, the students will be able to demonstrate an ability to

CO1 : *explain the architecture of Software defined radios and cognitive radios.*

CO2 : *analyze the technical challenges in cognitive radio and spectrum sensing methods.*

SOFTWARE DEFINED RADIO

Basic SDR - Software and Hardware Architecture of an SDR - Spectrum Management - Managing unlicensed spectrum - Noise Aggregation. **(9)**

SDR AS PLATFORM FOR COGNITIVE RADIO

Introduction - Hardware and Software architecture - SDR development process and Design - Application software - Component development - Waveform development - cognitive waveform development. **(9)**

COGNITIVE RADIO TECHNOLOGY

Introduction - Radio flexibility and capability - Aware - Adaptive - Comparison of Radio capabilities and Properties - Available Technologies - IEEE 802 Cognitive Radio related activities - Application. **(9)**

CR- TECHNICAL CHALLENGES

Design Challenges associated with CR - Hardware requirements - Hidden primary user problem - detecting spread spectrum primary users - sensing duration and frequency - security. **(9)**

SPECTRUM SENSING

Overview - Classification - Matched filter - waveform based sensing - cyclo stationary based sensing - Energy detector based sensing - Radio Identifier - Cooperative sensing- other sensing methods. **(9)**

TOTAL : 45

REFERENCES

1. Bruce A Fette, "Cognitive Radio Technology", Academic Press, 2009.
2. Huseyin Arslan, "Cognitive Radio, Software Defined Radio and Adaptive wireless system, Springer, 1st edition, 2007.

3. *Mitola, J. and J. Maguire, G. Q., "Cognitive radio: making software radios more personal," IEEE Personal Commun. Mag., vol. 6, no. 4, pp. 13-18, Aug. 1999.*
4. *Tevfik Yucek and Huseyin Arslan, "A Survey of Spectrum Sensing Algorithms for Cognitive Radio Applications", IEEE Communications Surveys & Tutorials, Vol. 11, No.1, First Quarter 2009, pp. no.: 116-130.*
5. *Alexander M. Wyglinski, Maziar Nekovee, And Y. Thomas Hou, " Cognitive Radio Communications And Networks - Principles And Practice", Elsevier Inc., 2010.*

15MECE15 - MULTIMEDIA COMPRESSION AND COMMUNICATION

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

COURSE OBJECTIVE

The students of M.E. Communication Engineering will acquire knowledge on various compression techniques for multimedia applications and VOIP protocols.

COURSE OUTCOME

Upon completion of the course, students will be able to demonstrate an ability to

CO1 : describe information theory and apply different techniques to text and audio compression.

CO2 : apply various compression techniques to image and video and analyze VOIP protocols

INTRODUCTION AND TEXT COMPRESSION

Special features of Multimedia - Graphics and Image Data Representations - Fundamental Concepts in Video and Digital Audio - Storage requirements for Multimedia Applications -Need for Compression - Taxonomy of compression techniques - Overview of information theory - Static Huffman coding - Dynamic Huffman coding - Lempel-Ziv coding - Lempel-Ziv Welsh coding. **(9)**

AUDIO COMPRESSION

Audio compression techniques - Frequency domain and filtering - Basic sub band coding - Application to speech coding - G.722 - Application of audio coding: MPEG audio - Silence compression - Speech compression techniques - Vcoders - Linear predictive coder. **(9)**

IMAGE COMPRESSION

Approaches to image compression - Graphics interchange format, Tagged image file format, Digitized documents - Digitized pictures - JPEG - Quad trees - DCT coding - Wavelet methods - Filter banks - EZW coding - SPIHT coding - JPEG 2000 standards. **(9)**

VIDEO COMPRESSION

Video signal representation - Video compression techniques - MPEG1,2,4 - Motion estimation - H.261, H.263 - Overview of wavelet based compression - PLV performance Real time compression. **(9)**

VOIP TECHNOLOGY

Basics of IP transport, VoIP challenges, H.323/ SIP Network Architecture, Protocols, Call establishment and release, VoIP and SS7, Quality of Service- CODEC Methods- VOIP applicability. **(9)**

TOTAL : 45

REFERENCES

1. Fred Halsall, James F. Kurose, "Multimedia communication-Applications, Networks, Protocols and standards", Pearson Education Limited, 2004.

2. Sayood Khaleed, *"Introduction to Data Compression"*, Morgan Kaufman, 4th Edition, 2012.
3. Tay Vaughan, *"Multideai: making it work"*, 7th Edition, TMH 2007
4. Marcus goncalves *"Voice over IP Networks"*, Mcgaraw hill, 1999
5. Jerry D. Gibson, *"Multimedia Communications: Directions and Innovations"*, Morgan Kaufmann, 2nd Edition, 2001
6. David Solomon, *"Data Compression the complete reference"*, Springer, 4th Edition, 2007.

15MECE16 - COMMUNICATION NETWORK MODELING AND SIMULATION

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

COURSE OBJECTIVE

The students of M.E. Communication Engineering will acquire knowledge on modeling and simulation platforms, discrete simulation, physical and link layer modeling, channel modeling, mobility modeling, higher layer and network topology modeling.

COURSE OUTCOME

Upon completion of the course, the students will be able to demonstrate an ability to

- CO1** : model networks for simulation and apply the techniques to lower layer and link layer models.
- CO2** : apply modeling techniques for channel models, mobility models, higher layer and network topology.

INTRODUCTION TO MODELING AND SIMULATION

Introduction, Discrete-event Simulation, Modeling for Computer Simulation, Tools and Methods for Network Simulation, The Simulation Platform, Simulation Framework, Tools and Modeling Approaches for Simulating Hardware.

MONTE CARLO SIMULATION-Application to communication systems, Monte Carlo integration, Semi-analytic techniques, Case study: Performance estimation of a wireless system. **(9)**

PHYSICAL LAYER & LINK LAYER WIRELESS MODELING

Physical Layer Modeling, Description of the Main Components of the PHY Layer, Accurate Simulation of Physical Layers, Physical Layer Modeling for Network Simulations, Link Layer Modeling, Medium Access Control (MAC) Protocols, Logical Link Control, Forward Error Detection and Correction, Backward Error Detection and Correction, Queuing and Processing Delay. **(9)**

CHANNEL MODELING

Radiation physics, Classification of Propagation Models, Deterministic Approaches by Classical Field Theory, Deterministic Geometric Optical Approaches, Empirical Path Loss Approaches, Stochastic Shadowing Models, Stochastic Fading Models, MIMO Channel Models-Hybrid Models-Noise interference-Antenna Impact. **(9)**

MOBILITY MODELING-Categorization of Mobility Models, Mobility Models -Selection of Appropriate Mobility Models-Modeling Hand-off-Methodology-Application examples-handover approaches. **(9)**

HIGHER LAYER MODELING & MODELING THE NETWORK TOPOLOGY

Modeling the Network Layer and Routing Protocols, Modeling Transport Layer Protocols, Modeling Application Traffic - Abstraction of Network Topologies by Graphs, Characterizing Graphs, Common Topology Models, Modeling the Internet. **(9)**

TOTAL : 45

REFERENCES

1. *K.Wehrle. Gunes, J.Gross, "Modeling and Tools for Network simulation", Springer, 2010.*
2. *Irene Karzela, "Modeling and Simulating Communications Networks", Prentice Hall India, 1999.*
3. *William.H.Tranter, K. Sam Shanmugam, Theodore. S. Rappaport, Kurt L. Kosbar, "Principles of Communication Systems Simulation", Pearson Education (Singapore) Pvt. Ltd, 2004.*
4. *M.C. Jeruchim, P.Balaban and K. Sam Shanmugam, "Simulation of Communication Systems: Modeling, Methodology and Techniques", Plenum Press, New York, 2001.*
5. *Nejat, Bragg, Arnold, "Recent Advances in Modeling and Simulation Tools for Communication Networks and Services", Springer, 2007*

15MECE17 - ADVANCED FIBER OPTIC TECHNOLOGIES

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

COURSE OBJECTIVE

The students of M.E.Communication Engineering will acquire knowledge on basic principles of operation of optical system components, coherent system, optical network architecture, TDM and CDMA.

COURSE OUTCOME

Upon completion of this course the students will be able to demonstrate an ability to

CO1 : explain the principles of optical system components and network design & Coherent Systems

CO2 : explain the principles of optical network architecture, TDM, Solitons and CDMA

OPTICAL SYSTEM COMPONENTS AND NETWORK DESIGN

Optical System Components - MZIM, Multiplexers; filters; switches; wavelength converters; optical amplifiers - EDFA, Raman Amplifiers and hybrid; Transmission system Engineering - System Model, Aimer penalty - transmitter, receiver, cross talk, dispersion compensation, wavelength stabilization, FWM.

(9)

COHERENT SYSTEMS

Basic principles of Coherent detections - Practical constraints - Injection laser line width state of polarization, local oscillator power, fiber limitations; Modulation formats - ASK, FSK, PSK, DPSK and polarization shift keying (POL SK); Demodulation schemes - Homodyne, Heterodyne - Synchronous and Non synchronous detection; Comparison; Carrier recovery in Coherent detection.

(9)

OPTICAL NETWORK ARCHITECTURE

Introduction: First Generation optical networks -SONET / SDH Network, Second Generation (WDM) Optical Networks - Broad Cast and select, wavelength routing architectures - Media - Access Control protocols.

(9)

OPTICAL TDM AND SOLITON

Optical Time division Multiplexing - Interleaving, Packet Interleaving - Multiplexer and Demultiplexers; AND Gates - Non linear optical loop Mirror, Soliton - trapping AND Gate, Synchronization.

(9)

OPTICAL CDMA

Prime codes and its properties, Generalized and Extended prime codes, Synchronization of Optical CDMA Networks, Multiwavelength Optical CDMA Networks.

(9)

TOTAL : 45

REFERENCES

1. *Max Ming-Kang Liu, "Principles and Applications of Optical Communication", Tata McGraw Hill Education Pvt., Ltd., New Delhi.*
2. *Le Ngyyen Binh, "Digital Optical Communications", CRC Press - Taylor and Francis Group -Indian reprint 2012.*
3. *Rajiv Ramaswami and Kumar N. Sivarajan, "Optical Networks : A Practical Perspective", Harcourt Asia Pte Ltd., Second Edition 2006.*
4. *P.E. Green, Jr., "Fiber Optic Networks", Prentice Hall, NJ, 1993.*
5. *Guu-Chang Yang, "Prime Codes with Application to Optical and Wireless Networks", Artech House, Inc., 2002.*

15MECE18 - HIGH SPEED SWITCHING ARCHITECTURE

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

COURSE OBJECTIVE

The students of M.E. Communication Engineering will acquire knowledge on basic switching concepts and switching architectures.

COURSE OUTCOME

Upon completion of this course the students will be able to demonstrate an ability to

CO1 : explain the concepts of LAN switching and ATM switching architecture

CO2 : explain the concepts and performance analysis of queues in ATM switches, architecture of Packet switching and IP switching concepts.

LAN SWITCHING TECHNOLOGY

Switching Concepts, LAN Switching, switch forwarding techniques - cut through and store and forward, Layer 3 switching, Loop Resolution, Switch Flow control, virtual LANs. (9)

ATM SWITCHING ARCHITECTURE

Blocking networks - basic - and- enhanced banyan networks, sorting networks - merge sorting, rearrangeable networks - full-and- partial connection networks, non blocking networks - Recursive network construction, comparison of non-blocking network, Switching with deflection routing - shuffle switch, tandem banyan switch. (9)

QUEUES IN ATM SWITCHES

Internal Queueing -Input, output and shared queueing, multiple queueing networks - combined Input, output and shared queueing - performance analysis of Queued switches. (9)

PACKET SWITCHING ARCHITECTURE

Architectures of Internet Switches and Routers- Bufferless and buffered Crossbar switches, Multistage switching, Optical Packet switching; Switching fabric on a chip; Internally buffered Crossbars. (9)

IP SWITCHING

Addressing model, IP Switching types - flow driven and topology driven solutions, IP Over ATM address and next hop resolution, multicasting, Ipv6 over ATM. (9)

TOTAL : 45

REFERENCES

1. Achille Pattavina, "Switching Theory: Architectures and performance in Broadband ATM networks", John Wiley & Sons Ltd, New York. 1998

2. Rich Siefert, Jim Edwards, *"The All New Switch Book - The Complete Guide to LAN Switching Technology"*, Wiley Publishing, Inc., Second Edition, 2008.
3. Elhanany M. Hamdi, *"High Performance Packet Switching architectures"*, Springer Publications, 2007.
4. Christopher Y Metz, *"Switching protocols & Architectures"*, McGraw - Hill Professional Publishing, New York. 1998.
5. Rainer Handel, Manfred N Huber, Stefan Schroder, *"ATM Networks - Concepts Protocols, Applications"*, 3rd Edition, Addison Wesley, New York. 1999.

15MECE19 - WIRELESS SENSOR NETWORKS

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

COURSE OBJECTIVE

The students of M.E Communication Engineering will acquire knowledge on sensor node architecture, the medium access and routing issues, infrastructure establishment, data management and security and tools for WSN.

COURSE OUTCOME

Upon completion of the course, students will be able to demonstrate an ability to

CO1 : narrate the concepts of Sensor Node Architecture, various MAC and Routing protocols

CO2 : analyze different implementation challenges and the solution approaches in WSN

ARCHITECTURES

Challenges for Wireless Sensor Networks - Characteristics requirements - Difference between mobile Ad-Hoc and sensor networks, Applications of sensor networks- Sensor Node Architecture - Hardware Components, Energy Consumption of Sensor Nodes, Network Architecture - Sensor Network Scenarios, Optimization Goals and Figures of Merit, Gateway Concepts - Physical Layer and Transceiver Design Considerations. (9)

MAC AND ROUTING

MAC Protocols for Wireless Sensor Networks, IEEE 802.15.4, Zigbee, Low Duty Cycle Protocols and Wakeup Concepts - S-MAC, The Mediation Device Protocol, Wakeup Radio Concepts, Address and Name Management, Assignment of MAC Addresses, Routing Protocols- Energy-Efficient Routing, Geographic Routing. (9)

INFRASTRUCTURE ESTABLISHMENT

Topology Control - Clustering - Time Synchronization - Localization and Positioning - Sensor Tasking and Control. (9)

DATA MANAGEMENT AND SECURITY

Data management in WSN - Storage and indexing in sensor networks - Query processing in sensor - Data aggregation - Directed diffusion - Tiny aggregation - greedy aggregation - security in WSN. (9)

TOOLS FOR WSN

TinyOS - Introduction, NesC, Interfaces, modules, configuration, Programming in TinyOS using NesC, TOSSIM, Contiki - Structure, Communication Stack, Simulation environment - Cooja simulator. (9)

TOTAL : 45

REFERENCES

1. *Ian F. Akyildiz, Mehmet Can Vuran, " Wireless Sensor Networks" John Wiley, 2010.*
2. *Yingshu Li, My T. Thai, Weili Wu, " Wireless Sensor Networks and Applications" Springer 2008.*
3. *Holger Karl & Andreas Willig, "Protocols And Architectures for Wireless Sensor Networks", John Wiley, 2005.*
4. *Feng Zhao & Leonidas J. Guibas, "Wireless Sensor Networks- An Information Processing Approach", Elsevier, 2007.*
5. *Kazem Sohraby, Daniel Minoli, & Taieb Znati, "Wireless Sensor Network Technology, Protocols And Applications", John Wiley, 2007.*
6. *Anna Hac, "Wireless Sensor Network Designs", John Wiley, 2003.*

15MECE20 - SPACE TIME WIRELESS COMMUNICATION

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

COURSE OBJECTIVE

The students of M.E.Communication Engineering will acquire knowledge on multipath fading channel models, capacity, bit error rate analysis, spatial diversity, channel estimation, synchronization, OFDM and spread spectrum modulation.

COURSE OUTCOME

Upon completion of the course, the students will be able to demonstrate ability to

CO1 : model multipath channel and analyze capacity of wireless channels.

CO2 : apply diversity techniques, estimate channels and analyze OFDM & Spread Spectrum modulation.

SAMPLED SIGNAL AND MULTIPATH FADING CHANNEL MODELS

Physical scattering models - Extended channel models -Signal model for SISO - SIMO - MISO and MIMO- ITU Channel Models - 3GPP Channel Models - Extended ITU Models- Spatial Channel Model SCM Extension Channel Model - WINNER Channel Model. (9)

CAPACITY ANALYSIS & BIT ERROR RATE ANALYSIS

Capacity in Frequency Flat Fading channel - Capacity in Frequency Selective Fading Channel- BER Analysis for Space Time Coding -Transmit Beam forming - Receiver Selection Combining - Receiver Equal Combining - Receiver Maximal Ratio Combining. (9)

SPATIAL DIVERSITY AT TRANSMITTER AND RECEIVER

Diversity gain - Transmit and receive Antenna diversity - Diversity order and performance - Combined space and path diversity - Indirect transmit diversity - space time coding for frequency flat channels - frequency selective channels - Receivers - frequency flat and selective channels in SISO, SIMO and MIMO. (9)

CHANNEL ESTIMATION AND TIMING & FREQUENCY SYNCHRONIZATION

LS Estimation - MMSE Estimation - Robust MMSE Estimation -Coarse Time Synchronization - Fine Time Synchronization - Coarse Frequency Synchronization - Fine Frequency Synchronization. (9)

OFDM AND SPREAD SPECTRUM MODULATION

SISO-OFDM - MIMO OFDM - SISO SS modulation - MISO SS modulation - Model - capacity and receiver gain of MIMO MAC - MIMO BC - MIMO MU. (9)

TOTAL : 45

REFERENCES

1. A. Paulraj, R. Nabar and D Gore, "Introduction to Space-Time Wireless Communications", Cambridge University Press, 2003.
2. E. Biglieri, R. Calderbank, A. Constantinides, A. Goldsmith, A. Paulraj, "MIMO Wireless Communications", Cambridge University press, 2007
3. Erik. G. Larsson, "Space Time Block Coding for Wireless Communications", Cambridge University Press, 2003.
4. Y.S.Cho, J.Kim, Won Young Yang, Chung G. Kang, " MIMO OFDM Wireless Communications with MATLAB" John Wiley & sons(Asia) private Ltd, 2010.
5. L. Hanzo, Y.A. Li Wang, M. Jiang "MIMO-OFDM for LTE, Wi-Fi and WiMAX ", John Wiley & Sons Ltd, 2011.
6. T.M. Duman, A. Ghayeb "Coding for MIMO Communication Systems" John Wiley & Sons Ltd, 2007.

15MECE21 - HIGH PERFORMANCE COMPUTER NETWORKS

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

COURSE OBJECTIVE

The students of M.E Communication Engineering will acquire knowledge on switching networks, multimedia networking applications, advanced network concepts, packet queues and delay analysis and network security & management

COURSE OUTCOME

Upon completion of the course, students will be able to demonstrate ability to

CO1 : explain the concepts of switching networks and multimedia networking applications

CO2 : elucidate the concepts of advanced networks, packet queues, delay analysis and network security & management

SWITCHING NETWORKS

Switching - Packet switching - Ethernet, Token Ring, FDDI, DQDB, Frame Relay, SMDS, Circuit Switched - SONET, DWDM, DSL, Intelligent Networks - CATV, ATM - Features, Addressing Signaling & Routing, Header Structure, ATM Adaptation layer, Management control, BISDN, Internetworking with ATM. (9)

MULTIMEDIA NETWORKING APPLICATIONS

Streaming stored Audio and Video, Best effort service, protocols for real time interactive applications, Beyond best effort, scheduling and policing mechanism, integrated services, RSVP- differentiated services. (9)

ADVANCED NETWORKS CONCEPTS

VPN-Remote-Access VPN, site-to-site VPN, Tunneling to PPP, Security in VPN.MPLS-operation, Routing, Tunneling and use of FEC, Traffic Engineering, and MPLS based VPN, overlay networks- P2P connections.-IPv4 vs. V6. (9)

PACKET QUEUES AND DELAY ANALYSIS

Little's theorem, Birth and Death process, queuing discipline- Control & stability -, Markovian FIFO queuing system, Non-markovian - Pollaczek-Khinchin formula and M/G/1, M/D/1, self-similar models and Batch-arrival model, Networks of Queues - Burke's theorem and Jackson Theorem. (9)

NETWORK SECURITY AND MANAGEMENT

Principles of cryptography - Elliptic-AES- Authentication - integrity - key distribution and certification- Access control and: fire walls - DoS-attacks and counter measures - security in many layers. Infrastructure for network management - the internet standard management framework - SMI, MIB, SNMP, Security and administration - ASN.1. (9)

TOTAL : 45

REFERENCES

1. *Aunurag Kumar, D. Manjunath, Joy Kuri, "Communication Networking", Morgan Kaufmann Publishers, 2011.*
2. *J.F. Kurose & K.W. Ross, "Computer Networking- A Top Down Approach Featuring the Internet", Pearson, 3rd Edition, 2005.*
3. *Nader F.Mir, "Computer and Communication Networks", Pearson Education, 2009.*
4. *Walrand.J. Varatya, "High Performance Communication Network", Morgan Kaufmann - Harcourt Asia Pvt. Ltd., 2nd Edition, 2000.*
5. *Hersent Gurle & petit, "IP Telephony, Packet Pored Multimedia Communication Systems", Pearson Education 2003.*
6. *Fred Halsall and Lingana Gouda Kulkarni, "Computer Networking and the Internet", Fifth Edition, Pearson Education, 2012.*

15MECE22 - SMART ANTENNAS

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

COURSE OBJECTIVE

The students of M.E Communication Engineering will acquire knowledge on basics of smart antennas, spatial temporal characteristics for different channel models and DOA estimation techniques.

COURSE OUTCOME

Upon completion of this course the students will demonstrate an ability to

CO1 : explain smart antenna concepts and perform signal processing for wireless channels.

CO2 : perform signal processing for CDMA systems and Estimate Direction of Arrival.

INTRODUCTION TO SMART ANTENNAS

Antenna gain, Phased array antenna, power pattern, beam steering, degree of freedom, optimal antenna, adaptive antennas, smart antenna - key benefits of smart antenna technology, wide band smart antennas (9)

SPATIAL PROCESSING FOR WIRELESS SYSTEMS

Spatial processing for wireless systems. Adaptive antennas. Beam forming networks, Digital radio receiver techniques and software radios. (9)

SPATIAL PROCESSING FOR CDMA SYSTEMS

Coherent and non-coherent CDMA spatial processors. Dynamic re-sectoring, Range and capacity extension - multi-cell systems. (9)

SPATIO - TEMPORAL CHANNEL MODELS:

Environment and signal parameters. Geometrically based single bounce elliptical model. Optimal spatial filtering - adaptive algorithms for CDMA. Multitarget decision - directed algorithm. (9)

DIRECTION OF ARRIVAL ESTIMATION METHODS

DOA estimation - conventional and subspace methods. ML estimation techniques. Estimation of the number of sources using eigen decomposition. Direction finding and true ranging PL systems. Elliptic and hyperbolic PL systems. TDOA estimation techniques. (9)

TOTAL : 45

REFERENCES

1. Warren L Stutzman, Gary A.Thiele, " Antenna Theory and Design" Mc Graw Hill, 3rd edition, ", John

Wiley & Sons, 2013.

2. *T.S.Rappaport & J.C.Liberti, Smart Antennas for Wireless Communication, Prentice Hall (PTR), 1999.*
3. *R.Janaswamy, Radio Wave Propagation and Smart Antennas for Wireless Communication, Kluwer, 2001.*
4. *John.L.Volakis, "Antenna Engineering Handbook", Fourth Edition, McGraw Hill, 2007.*
5. *Constantine A.Balanis, "Modern Antenna Handbook", John Wiley and Sons, 2008*

15MECE23 - RADAR AND NAVIGATIONAL AIDS

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

COURSE OBJECTIVE

The students of M.E., Communication Engineering will acquire knowledge on basics of Radars and RADAR antenna, transmitter and receiver & mti and pulse doppler radar

COURSE OUTCOME

Upon completion of this course the students will demonstrate an ability to

CO1 : comprehend and explain the fundamental principles of radar system and signals

CO2 : explain the concept of mti and pulse doppler radar

INTRODUCTION TO RADAR

Basics of radar, EM Waves & properties- applications of radar, radar frequencies-radar block diagram, Radar Coordinates, Radar equation for hard targets and the SNR-radar cross section of targets, Radar Resolution Elements, Pulse, CW and FMCW Radars-configurations, transmitter power- pulse repetition frequency, Duty Ratio, Pulse Compression, Coding. **(9)**

DETECTION OF SIGNALS IN NOISE AND RADAR SIGNALS

Introduction to Noise in detail, probability density functions - probabilities of detection and false alarm-matched filter receiver-detection criteria - integration of radar pulses - constant-false alarm rate receivers - Radar Wave forms, Pulse Compression, Ambiguity Diagram. **(9)**

RADAR TRANSMITTER AND RECEIVER

Introduction- Types of Transmitters - linear-beam power tubes- solid-state RF power sources- magnetron-Klystron, crossed-filed amplifier- radar receiver- receiver noise figure- super heterodyne receiver, Digital Receivers, duplexers and receiver protectors- radar displays-Human Machine Interface (HMI). **(9)**

RADAR ANTENNA

Functions of radar antenna- antenna parameters- antenna radiation pattern and aperture illumination - reflector antennas- electronically steered phased array antennas- phase shifters - frequency - scan arrays-- architectures for phased arrays, radiators for phased arrays- mechanically steered planar array antennas- radiation pattern synthesis -effect of errors on radiation patterns - low side lobes antennas. **(9)**

MTI AND PULSE DOPPLER RADAR

Introduction to Doppler and MTI radar- delay -line cancellers- staggered pulse repetition frequencies-doppler filter banks- digital MTI processing - Moving target detector- limitations to MTI performance-pulse Doppler radar-MTD, Tracking radar- monopulse tracking- conical scan and sequential lobing-comparison of trackers. tracking accuracy- low-angle tracking- Atmospheric & Weather Radars: Precipitation Radars, Doppler Weather Radar, Polarimetric Radar, Clear Air Radars **(9)**

TOTAL : 45

REFERENCES

1. *Merril I Skolnik "Introduction to Radar Systems", Mc Graw-Hill, 3rd Edition 2008.*
2. *Richard J Doviak and Dusan S Zrnic, "Doppler Radar and Weather Observations", Dover Publications, 1993.*
3. *Bringi V N and Chandrasekar V, "Polarimetric Doppler Weather Radar", Cambridge University Press, 2001.*
4. *Richards M A, Scheer J A and Holm W A, "Principles of Modern Radar", Yes Dee Publishing Pvt. Ltd., 2012.*

15MECE24 - MODERN ANTENNAS

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

COURSE OBJECTIVE

The students of M.E Communication Engineering will acquire knowledge on microstrip patch antennas, active integrated antennas, reconfigurable array antennas and their design requirements.

COURSE OUTCOME

Upon completion of this course the students will demonstrate an ability to

CO1 : design, develop and analyze the characteristics of microstrip and fractal antennas

CO2 : analyze, design and implement reconfigurable array antennas for personal communication and medical applications.

MICROSTRIP ANTENNAS

Advantages and trade-off-material consideration-methods of analysis & design-Excitation methods-Dual polarization & circular polarization techniques-broadband & dual band techniques-antenna miniaturization techniques (9)

FRACTAL ANTENNAS

Fractal antenna geometries-iterated function systems-fractal antenna elements-fractal antenna arrays-antenna arrays based on fractal and aperiodic tilings (9)

MOBILE HANDESET ANTENNAS

Impact on antenna design-cellular handset antenna design issues-helical wire antennas and variants-evolution of the PIFA-ceramic chip and resonator antennas-SAR measurement and minimization-provision for GPS and Bluetooth-Measurement of handset antennas-future trends. (9)

BROADBAND PLANAR ANTENNA

Introduction-suspended plate antennas-techniques for broad impedance bandwidth-techniques for enhanced radiation performance-applications in high speed wireless communication-planar monopole antennas - applications in high speed UWB wireless communication. (9)

ANTENNAS FOR MEDICAL APPLICATIONS

Environment-Antennas for medical imaging-heating-bio-telemetry-pulsed electromagnetic fields-sensing-future directions. (9)

TOTAL : 45

REFERENCES

1. John.L.Volakis, "Antenna Engineering Handbook", Fourth Edition, McGraw Hill, 2007.
2. Constantine A.Balanis, "Modern Antenna Handbook", John Wiley and Sons, 2008.
3. Debatosh Guha, Yahia M.M. Antar, "Microstrip and Printed Antennas", 1st Edition, John Wiley & Sons, 2011.
4. S.Drabowitch, A.Papiernik,et.al, "Modern Antennas", Springer, Second edition,2005.
5. Zhi Ning Chen, "Antennas for Portable Devices", John Wiley & Sons, 2007.

15MECE25 - 3D IMAGING TECHNIQUES

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

COURSE OBJECTIVE

The students of M.E Communication Engineering will acquire knowledge on the concepts of 3D image modeling, texture mapping, depth cues, 3D reconstruction and stereo correspondence algorithms.

COURSE OUTCOME

Upon completion of this course the students will be able to demonstrate an ability to

CO1 : develop 3D model of objects and to explain the concept of texture mapping

CO2 : explain depth cues, disparity & stereo correspondence algorithms and perform 3D reconstruction of images.

INTRODUCTION TO 3D IMAGE MODELING

Images model and geometry-3D rendering pipeline, 3D Geometry primitives - Bezier, B-splines, NURBS, fractals, Particles systems, 3D transforms - Deform modifiers, Solid modeling - poly modeling, Surface modeling - tessellation Extruded shapes - Mesh approximations to smooth objects - sphere, cylinder Hierarchical modeling -Physically based modeling. (9)

TEXTURE MAPPING

Procedural and Bitmap textures -Texture mapping an image-Bump mapping - Environment mapping - Interpolation - Magnification and Minification, Mipmapped texture-Adding texture on to curved surfaces-Animated texture, Tiling -rendering textures. (9)

DEPTH CUES AND DISPARITY

Basics issues and terms in depth perception-Recovering three dimensions - Monocular and Binocular information -Extra retinal sources of depth information-Depth analysis using real aperture camera-Depth from defocused images -Depth cues-Disparity Stereograms and other 3D correspondence problem.(9)

3D OBJECT RECOGNITION

3D reconstruction -Epipolar geometry -stereo calibration -Rectification of stereo images -Modeling and Recognizing Classes of Shapes- 3D Object Recognition from stereo images data-3D object recognition from range data. (9)

STEREO CORRESPONDENCE ALGORITHMS

Colour SAD window-based technique - disparity range estimation-pyramid level reduction-Zero Mean Normalized cross correlation (ZNCC) - similarity measure - Vergence angle control -Speed issues - Power issues. (9)

TOTAL : 45

REFERENCES

1. *Bernd Girod, Gunther Greiner, Heinrich Niemann, "Principles of 3D Images Analysis and Synthesis", Kluwer academic Publishers, 2000.*
2. *Mark Giambruno, "3D Graphics and Animation", 2nd Edition, New Riders Publishing, 2002. John F. Hughes, Andries van Dam, Morgan McGuire, et al., "Computer Graphics, Principles and Practice", Pearson Education, 3rd Edition, 2013.*
3. *S. Chaudhuri and A.N. Rajagopalan, "Depth from Defocus: A Real aperture imaging approach", Springer Verlag, 1999.*
4. *Boguslaw Cyganek, J. Paul Siebert, "An Introduction to 3D Computer Vision Techniques and Algorithms", Wiley Publications, January 2009.*
5. *Nick Pears, Yonghuai Lui, Peter Bunting, "3D imaging, Analysis and Applications" Springer-Verlag, 2012.*
6. *B.K.P. Horn, "Robot Vision", MIT Press, 1986.*

15MECE26 - MODELING AND SIMULATION OF WIRELESS SYSTEMS

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

COURSE OBJECTIVE

The students of M.E Communication Engineering will acquire knowledge on simulation of random variables and random process, modeling of communication systems & channels and estimation of performance measures.

COURSE OUTCOME

Upon completion of the course, the students will be able to demonstrate an ability to

CO1 : model and simulate communication systems

CO2 : model communication channels, estimate the parameters and performance measures of communication systems

SIMULATION OF RANDOM VARIABLES AND RANDOM PROCESS

Univariate and multi-variate models, Transformation of random variables, Bounds and approximation, Random process models-Markov and ARMA sequences, Sampling rate for simulation, Computer generation and testing of random numbers. (9)

MODELING OF COMMUNICATION SYSTEMS

Information Sources, Formatting/Source Coding, Digital Waveforms, Line Coding, Channel Coding, Radio frequency and Optical Modulation, Demodulation and Detection, Filtering, Multiplexing/Multiple Access, Synchronization, Calibration of Simulations. (9)

COMMUNICATION CHANNELS & MODELS

Fading & Multipath Channels, Almost Free-Space Channels, Finite State Channel Models, Methodology for Simulating Communication Systems Operating over Fading Channels, Reference Models for Mobile Channels: GSM, UMTS-IMT-2000. (9)

ESTIMATION OF PARAMETERS IN SIMULATION

Quality of an estimator, Estimating the Average Level of a Waveform, Estimating the Average power of a waveform, Estimating the Power Spectral Density of a process, Estimating the Delay and Phase. (9)

ESTIMATION OF PERFORMANCE MEASURES FROM SIMULATION

Estimation of SNR, Performance Measures for Digital Systems, Importance sampling method, Efficient Simulation using Importance Sampling, Quasianalytical Estimation. Case Studies: 16-QAM Equalized Line of Sight Digital Radio Link, CDMA Cellular Radio System. (9)

TOTAL : 45

REFERENCES

1. *M.C. Jeruchim, Philip Balaban and K.Sam Shanmugam, "Simulation of Communication Systems Modeling, Methodology and Techniques", Kluwer Academic/Plenum Publishers, New York, 2000.*
2. *C. Britton Rorabaugh, "Simulating Wireless Communication Systems: Practical Models In C++", Prentice Hall, 2004.*
3. *William H. Tranter, K. Sam Shanmugan, Theodore S. Rappaport, Kurt L. Kosbar, "Principles of Communication Systems Simulation with Wireless Applications", Prentice Hall PTR, 2002.*
4. *John G. Proakis, Masoud Salehi, Gerhard Bauch, Bill Stenquist, Tom Zoiolkowski, "Contemporary Communication Systems Using MATLAB" Thomson -Engineering, 2nd Edition, 2002.*

15MECE27 - NEXT GENERATION WIRELESS NETWORKS

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

COURSE OBJECTIVE

The students of M.E Communication Engineering will acquire knowledge on wireless IP network architectures, Multimedia subsystems, Mobility management, Security and Quality of service.

COURSE OUTCOME

Upon completion of the course, the students will be able to demonstrate an ability to

CO1 : comprehend and explain network architectures, IP Multimedia Systems and its Applications.

CO2 : explain mobility management, security and analyze Quality of service.

WIRELESS IP NETWORK ARCHITECTURES

3GPP Packet data networks - 3GPP2 Packet data networks - 3GPP2 Network Architecture - 3GPP2 Packet Data Network Architecture - Protocol Reference Model -Access to 3GPP2 Packet Data - User Packet Routing and Transport - Protocol Stacks for Packet Data Services - MWIF All-IP Mobile Networks - Network Architectures- Access to MWIF Networks - Session Management. (9)

IP MULTIMEDIA SUBSYSTEMS AND APPLICATION - LEVEL SIGNALING

Signaling in IP Networks -Session Initiation Protocol (SIP) -Session Description Protocol (SDP) -3GPP IP Multimedia Subsystem (IMS) - IMS Architecture - Mobile Station Addressing for Accessing the MS -Reference Interfaces - Service Architecture - Registration with the IMS - Deregistration with the IMS - End- to -End Signaling Flows for Session Control -3GPP2 IP Multimedia Subsystem (IMS). (9)

MOBILITY MANAGEMENT

Basic Issues in Mobility Management - Mobility Management in IP Networks- Mobility Management in 3GPP Packet Networks - Mobility Management in 3GPP Packet Data -Mobility Management in MWIF Networks - Comparison of Mobility Management in IP, 3GPP, and 3GPP2 (9)

SECURITY

Introduction - Internet Security - Security in Wireless Networks -Security in IS-41 - Security in GSM - Security in GPRS- Security in 3GPP - Security in 3GPP2 - Principles - Security Architecture, Network Access Security, Network Domain Security. (9)

QUALITY OF SERVICE

Internet QoS - QoS Challenges in Wireless IP Networks - QoS in 3GPP - UMTS QoS Architecture, UMTS QoS Management -UMTS QoS Classes - QoS Attributes - Management of End-to End IP QoS- QoS in 3GPP2 - 3GPP2 QoS Architecture - 3GPP2 QoS Management - Classes -QoS Attributes - Management of End-to -End IP QoS. (9)

TOTAL : 45

REFERENCES

1. *Jyh - Cheng Chen, Tao Zhang, "IP - Based Next Generation Wireless Networks (Systems, Architectures and Protocols)" , John Wiley & Sons, 4th edition, 2004.*
2. *Hsiao-Hwa Chen, Mohsen Guizani, "Next Generation Wireless Systems and Networks", John Wiley and Sons, 2006.*
3. *Naveen Chilamkurti, Sherali Zeadally, Hakima Chaouchi, "Next Generation Wireless technologies:4G and beyond", Springer, 2013.*
4. *Byrav Ramamurthy, George N. Rouskas, Krishna Moorthy Sivalingam, "Next Generation Internet: Architectures and Protocols", Cambridge University press, 2011.*

15MECE28 - CROSS LAYER DESIGN

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

COURSE OBJECTIVE

The students of M.E Communication Engineering will acquire knowledge on OSI network model, impact of signal processing techniques, Cross layer techniques, Interference Management and Data Accessibility.

COURSE OUTCOME

Upon completion of the course, the students will be able to demonstrate an ability to

CO1 : analyze challenges in cross layer optimization and signal processing techniques.

CO2 : comprehend and explain cross layer QoS, analyzes Interference in multi access communication and MANET.

INTRODUCTION

Review of OSI network model - Various layer functionalities - Conventional protocols Need for cross layer design - Cross layer adaptability- Challenges to cross layer optimization. (9)

IMPACT OF SIGNAL PROCESSING TECHNIQUES

Adaptive modulation- Optimal coding - Diversity- Multi-user detection -Channel estimation- Impact on throughput, delay and design and performance of upper layer protocol stack. (9)

CROSS LAYER TECHNIQUES

Adaptive QoS - Adaptive resource allocation - Access prioritization- Joint link power and rate adaptation- Joint link power and admission control -Energy efficient transmission. (9)

INTERFERENCE MANAGEMENT IN MULTI ACCESS COMMUNICATION

Adaptive cross layer design in CDMA mobile networks and opportunistic communication systems- Multimedia bursty traffic- Multi Access Interference temporal structure- MAI prediction- Adaptive rate and admission control- Join Shortest Queue Scheduling -Perfetching protocol-Loss probabilities. (9)

DATA ACCESSIBILITY IN MANET

Cross layer design for multimedia information access- Middleware data accessibility Advertising, lookup and replication services - Predictive location based QoS routing protocol - Optimization of Update protocol- Energy efficient scheduling and protocol design. (9)

TOTAL : 45

REFERENCES

1. William Stallings, "Data and Computer Communication", 5th Edition, PHI, 1997.

2. *T.S.Rappaport, "Wireless Communications: Principles and practice", PHI, NJ 1996.*
3. *Klara Nahrstedt, et.al., " Cross Layer Design for Data Accessibility in MANET" Wireless personal Communication, Kluwer Academic Publishers, 2002.*
4. *Prasant Mohapatra, Srikanth Krishnamurthy, "Ad-Hoc networks technologies and protocols", springer, 2005.*

15MECE29 - INFORMATION CODING THEORY

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

COURSE OBJECTIVE

The students of M.E Communication Engineering will acquire knowledge on BCH, Reed-Solomon codes, LDPC codes & decodes and space-time coding.

COURSE OUTCOME

Upon completion of this course the students will demonstrate an ability to

CO1 : analyze various source coding and decoding techniques.

CO2 : analyze BER performance and design LDPC coders & decoders and solve problems in MIMO using Space-time codes.

BCH AND REED-SOLOMON CODES

BCH codes - Reed-Solomon codes - Decoding BCH and RS codes - finding the Error Locator Polynomial - Non-binary BCH and RS Decoding - Erasure decoding for Non-binary BCH and RS codes - Galois field Fourier Transform method - variations and extensions of Reed-Solomon codes. (9)

ITERATIVELY DECODED CODES

Construction and Notation - Tanner Graphs - Transmission through Gaussian Channel - Decoding LDPC codes - The iterative decoder on General Block Codes - Density Evolution - EXIT charts for LDPC codes - Irregular LDPC codes- LDPC code construction - Encoding LDPC codes - Low-Density Generator Matrix codes - Serial Concatenated codes- Repeat - Accumulate codes - Irregular RA codes. (9)

LOW DENSITY PARITY CHECK CODES

EG-LDPC codes - PG-LDPC codes - Shortened finite geometry LDPC codes - Gallager LDPC codes - Masked EG-Gallager LDPC codes - Quasi-cyclic codes by circulant decomposition - Random LDPC codes - Graph - Theoretic LDPC codes - Construction of LDPC codes based on Balanced incomplete block designs - Concatenations with LDPC and Turbo codes. (9)

DESIGN OF LDPC DECODERS

An Overview of Trellis - coded Modulation - Capacity of Two-dimensional Signal Sets-Bit-interleaved Trellis Coded Modulation Based on Turbo and -LDPC Codes - Design of Flexible Interleavers and Parity - check Matrices - Puncturing Strategies - Parallel Architectures for High-speed Decoders and Their Implementation. (9)

SPACE-TIME CODING

Introduction - Fading Channels - Diversity Transmission and Reception: the MIMO channel - Space-time block codes - complex orthogonal Designs - Space-time trellis codes. (9)

TOTAL : 45

REFERENCES

1. Todd K Moon, *"Error Correction Coding:Mathematical methods and Algorithms"*,Wiley, 2005.
2. Richard B.Wells, *"Applied Coding and information theory for Engineers"*, Prentice Hall,1999.
3. Peter Sweeney, *"Error Control Coding : from theory to practice"*, Wiley,2002.
4. Shu Lin, Daniel J. Costello, *"Error control coding"*, 2nd edition, Pearson,2005.

COIMBATORE INSTITUTE OF TECHNOLOGY

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DIAMOND JUBILEE

(1956 - 2016)



DEPARTMENT OF
ELECTRONICS AND COMMUNICATION ENGINEERING
M.E. COMMUNICATION ENGINEERING
CURRICULUM AND SYLLABI
UNDER CHOICE BASED CREDIT SYSTEM

(For the students admitted during the academic year 2015 - 2016 and onwards)

INDEX

S.No	Contents	Page No.
1.	Vision and Mission of the Institute	1
2.	Vision and Mission of the Department of Electronics and Communication Engineering	2
3.	Programme Educational Objectives of (PEOs) of M.E. Communication Engineering	3
4.	Programme Outcomes (POs) of M.E. Communication Engineering	4
5.	Curriculum	5
6.	Syllabi for Semester - I	10
7.	Syllabi for Semester - II	22
8.	Syllabi for Electives	31