Dr. Mahalingam College of Engineering and Technology

(An Autonomous Institution)

Pollachi - 642003

Curriculum and Syllabus for

M.E. COMMUNICATION SYSTEMS

Revision 0

REGULATIONS 2014

DR MAHALINGAM MCET

COLLEGE OF ENGINEERING AND TECHNOLOGY

Enlightening Technical Minds

Programme : M.E. – Communication Systems
Curriculum and Syllabus – Revision 0
Approved by Academic Council

Action	Responsibility	Signature of Authorized Signatory
Designed and Developed by	BoS Communication Systems	
Compiled by	Office of COE	
Approved by	Principal	

Department of Electronics and Communication Engineering

Curriculum for M.E. Communication Systems

Regulations 2014 - Revision 0

SEMESTER I

Course Code	Course Title	Hours/Week			Credits	Marks
		L	T	P		
THEORY						
140CM0101	Linear Algebra	3	1	0	4	100
140CM0102	Advanced Digital Communication Techniques	3	0	0	3	100
140CM0103	Advanced Digital Signal Processing	3	1	0	4	100
140CM0104	Microwave Circuit Design	3	0	0	3	100
140CM0105	Optical Communication Networks	3	0	0	3	100
xxx	Elective I	3	0	0	3	100
PRACTICAL						
140CM0107	Communication System Laboratory	0	0	3	2	100
TOTAL		**18**	**2**	**3**	**22**	**700**

SEMESTER II

Course Code	Course Title	Hours/Week			Credits	Marks
		L	T	P		
THEORY						
140CM0201	Wireless and Cellular Communication Engineering	3	0	0	3	100
140CM0202	Multimedia Compression	3	0	0	3	100
140CM0203	Advanced Radiation Systems	3	0	0	3	100
140CM0204	RF System Design	3	0	0	3	100
xxx	Elective II	3	0	0	3	100
xxx	Elective III	3	0	0	3	100
PRACTICAL						
140CM0207	RF and Networks Laboratory	0	0	3	2	100
TOTAL		**18**	**0**	**3**	**20**	**700**

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SEMESTER III

Course Code	Course Title	Hours/Week			Credits	Marks
		L	T	P		
THEORY						
xxx	Elective IV	3	0	0	3	100
xxx	Elective V	3	0	0	3	100
xxx	Elective VI	3	0	0	3	100
PRACTICAL						
140CM0307	Project Work Phase –I	0	0	12	6	200
TOTAL		**9**	**0**	**12**	**15**	**500**

SEMESTER IV

Course Code	Course Title	Hours/Week			Credits	Marks
		L	T	P		
140CM0407	Project Work Phase –II	0	0	24	12	400
TOTAL		-	-	**24**	**12**	**400**

Total Credits: 69

LIST OF ELECTIVES

Course Code	Course Title	Hours/Week			Credits	Marks
		L	T	P		
140CM9111	Wireless Systems and Standards	3	0	0	3	100
140CM9112	Wireless Security	3	0	0	3	100
140CM9113	DSP Processor Architecture and programming	3	0	0	3	100
140CM9114	Digital Speech Signal Processing	3	0	0	3	100
140CM9115	Network Routing Algorithms	3	0	0	3	100
140CM9116	Global Positioning Systems	3	0	0	3	100
140CM9117	Wireless Ad Hoc Networks	3	0	0	3	100
140CM9118	Soft Computing	3	0	0	3	100
140CM9119	Digital Communication Receivers	3	0	0	3	100
140CM9120	Wavelets and Subband Coding	3	0	0	3	100
140CM9121	VLSI Signal Processing	3	0	0	3	100
140CM9122	High Performance Computer Networks	3	0	0	3	100
140CM9123	Adaptive Signal Processing	3	0	0	3	100
140CM9124	High Speed Switching Architectures	3	0	0	3	100
140CM9125	LabVIEW Based Signal Processing	3	0	0	3	100
140CM9126	Microwave Integrated Circuits	3	0	0	3	100
140CM9127	Internetworking and Multimedia	3	0	0	3	100
140CM9128	Radar and Navigational Aids	3	0	0	3	100
140CM9129	Research Methodology	3	0	0	3	100
140CM9130	VLSI for Wireless Communication	3	0	0	3	100
140CM9131	Wireless Sensor Networks Technology	3	0	0	3	100
140CM9132	Multiuser Detection	3	0	0	3	100
140CM9133	Smart Antennas	3	0	0	3	100
140CM9134	Spread Spectrum Communication	3	0	0	3	100
140CM9135	FPGA Based System Design	3	0	0	3	100

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SEMESTER I

140CM0101 **LINEAR ALGEBRA** **3 1 0 4**

AIM:

To describe the ideas of Linear algebra, and to apply the same in fields of signal analysis and processing and Communication and Networking.

OBJECTIVES:

- To introduce the fundamental ideas of linear algebra.
- To introduce the concepts of eigen values and eigen vectors which have the applications in the field of electrical and electronic circuits.
- To apply the concepts of Linear algebra in the fields of communication systems and Signal processing.

UNIT I LINEAR EQUATIONS **9+3**

System of linear equations - Row reduction and Echelon forms -Vector equations - The Matrix equation Ax=b - Solution sets of linear systems - Application of linear systems - Linear Independence - Introduction to linear transformations - The Matrix of linear transformation - Linear modeling in engineering.

UNIT II MATRIX ALGEBRA **9+3**

Matrix operations - Inverse of a matrix - Characteristics of invertible matrices - Partitioned matrices - Matrix factorizations - Subspaces of Rn - Dimension and rank - Introduction to determinants - Properties of determinants - Cramer's rule.

UNIT III VECTOR SPACES **9+3**

Vector spaces and subspaces - Null spaces, column spaces and linear transformations - Linearly independent sets; Bases - Coordinate systems - Dimension of a vector space – Rank - Change of basis.

UNIT IV EIGEN VALUES AND EIGEN VECTORS **9+3**

Eigenvectors & Eigen values - Characteristic equation – Diagonalization - Eigenvectors & linear transformations - Complex Eigen values - Applications to differential equations - Iterative estimates for Eigen values.

UNIT V ORTHOGONALITY, SYMMETRIC MATRICES AND QUADRATIC FORMS **9+3**

Inner product, length and Orthogonality - Orthogonal sets - Orthogonal projections –Gram - Schmidt process - Least square problems - Inner product spaces - Applications of inner product spaces. Diagonalization of symmetric matrices - Quadratic forms - Singular value decomposition-Applications to image processing.

L: 45, T: 15, Total: 60

REFERENCES:

1. David C Lay, "Linear Algebra and its Applications", Pearson Education Asia, New Delhi, 2003.
2. Gilbert Strang, "Linear Algebra and its Applications", Brooks/Cole Ltd., New Delhi, 3rd Edition, 2003.
3. Seymour Lipschutz and Marc Lipson, "Schaum's Outline of Linear Algebra", McGraw Hill Trade; New Delhi, 3rd Edition, 2000.
4. Howard A Anton "Elementary Linear Algebra", John Wiley & Sons, Singapore, 8th Edition 2000.

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140CM0102 ADVANCED DIGITAL COMMUNICATION TECHNIQUES 3 0 0 3

AIM:
The aim of this course is to familiarize the students to design a signal for band limited channels and various advanced digital modulation schemes.

OBJECTIVES:
Upon completion of the course, the students should be able to:

- Describe the constant envelope modulation schemes.
- Identify various OFDM schemes.
- Familiar with Trellis Coded modulation.
- Familiar with Turbo Coding.
- Understand the concepts of Space time coding.

UNIT I CONSTANT ENVELOPE MODULATION 9
Advantages of Constant Envelope Modulation, Binary Frequency Shift Keying-Coherent and Non-coherent Detection of BFSK, Minimum Shift Keying- Gaussian Minimum Shift Keying, M-ary Phase Shift Keying, M-ary Quadrature Amplitude Modulation, M-ary Frequency Shift Keying.

UNIT II TRELLIS CODED MODULATION 9
Coded modulation for bandwidth-constrained channels-Trellis coded modulation, Set Partitioning, Four – state Trellis-coded modulation with 8-PSK signal constellation, Eight-state Trellis code for coded 8-PSK modulation, Eight-state Trellis for rectangular QAM signal constellations.

UNIT III TURBO CODING 9
Introduction-Turbo Encoder, Turbo Decoder, Iterative Turbo Decoding Principles, Modifications of the MAP Algorithm-The Soft-Output Viterbi Algorithm (SOVA), Turbo Coded BPSK Performance over Gaussian channels, Turbo Coding Performance over Raleigh Channels.

UNIT IV SPACE-TIME CODING 9
Maximum Ratio combining, Space-time Block codes, Space-time Trellis codes - The 4-state 4-PSK Space-time Trellis Encoder, The 4-state 4-PSK Space-time Trellis Decoder, MIMO-OFDM Systems.

UNIT V EQUALIZATION TECHNIQUES 9
Equalization algorithms, Linear equalizer, Decision feedback equalization, Adaptive equalization, Blind equalizer, BCJR equalizer, Turbo equalizer, Viterbi equalizer

L: 45, T: 0, Total: 45

REFERENCES:

1. Simon Haykin, "Digital communications", John Wiley and sons, 1998
2. Bernard Sklar., "Digital Communications", 2nd edition, Pearson Education,2001.
3. John G. Proakis., "Digital Communication", 4th edition, Mc Graw Hill Publication,2001
4. Stephen G. Wilson., "Digital Modulation and Coding", First Indian Reprint ,Pearson Education, 2003.

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BoS Chairman

140CM0103 **ADVANCED DIGITAL SIGNAL PROCESSING** **3 1 0 4**

(Common to AE and CM Programmes)

AIM:

To provide students with a solid understanding of a number of important and related advanced topics in digital signal processing such as filters, power spectrum estimation, signal modeling and adaptive filtering.

OBJECTIVES:

- Understand the concepts of discrete random processes.
- Compute the spectral estimation by non parametric methods.
- Apply various estimators and predictor to filters.
- Compare FIR and IIR adaptive filters.
- Know the concepts of multirate DSP.
- Application of sub–band coding.

UNIT I DISCRETE RANDOM SIGNAL PROCESSING **9+3**

Discrete Random Processes – Ensemble Averages, Stationary processes, Bias and Estimation, Auto covariance, Autocorrelation, Parseval's theorem, Wiener – Khintchine relation, White noise, Power Spectral Density, Spectral factorization, Filtering Random Processes, Special types of Random Processes – ARMA, AR, MA – Yule-Walker equations.

UNIT II SPECTRAL ESTIMATION **9+3**

Estimation of spectra from finite duration signals, Nonparametric methods – Periodogram, Modified periodogram, Bartlett, Welch and Blackman –Tukey methods, Parametric methods – ARMA, AR and MA model based spectral estimation, Solution using Levinson–Durbin algorithm.

UNIT III LINEAR ESTIMATION AND PREDICTION **9+3**

Linear prediction – Forward and Backward prediction, Solution of Prony's normal equations, Least mean squared error criterion, Wiener filter for filtering and prediction, FIR and IIR Wiener filters, Discrete Kalman filter.

UNIT IV ADAPTIVE FILTERS **9+3**

FIR adaptive filters – adaptive filter based on steepest descent method – Widrow-Hopf LMS algorithm, Normalized LMS algorithm, Adaptive channel equalization, Adaptive echo cancellation, Adaptive noise cancellation, RLS adaptive filters, Exponentially Weighted RLS, Sliding window RLS.

UNIT V MULTIRATE DIGITAL SIGNAL PROCESSING **9+3**

Mathematical description of change of sampling rate – Interpolation and Decimation, Decimation by an integer factor, Interpolation by an integer factor, sampling rate conversion by a rational factor, Polyphase filter structures, Multistage implementation of Multirate system, Application to subband coding – Wavelet transform.

L: 45, T: 15, Total: 60

REFERENCES:

1. Monson H. Hayes, "Statistical Digital Signal Processing and Modeling", John Wiley and Sons, Inc, Singapore, 2002.
2. John J. Proakis, Dimitris G. Manolakis, "Digital Signal Processing", Pearson Education, 2007.
3. Rafael C. Gonzalez, Richard E. Woods, "Digital Image Processing", Pearson Education Inc., 2nd Edition, 2004 (For Wavelet Transform Topic).

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140CM0104 **MICROWAVE CIRCUIT DESIGN** **3 0 0 3**

AIM:

To familiarize the students with the design of microwave circuits and components like resonators, dividers, filters amplifiers and oscillators.

OBJECTIVES:

On completion of the course, the student will be able to:

- Understand the concepts of scattering matrix
- Understand the operation of couplers
- Match the impedance with lumped elements
- Design the microwave filters
- Design microwave amplifiers
- Understand the designing of microwave oscillators

UNIT I MICROWAVE NETWORK ANALYSIS **9**

Impedance and Equivalent Voltages and Currents, Impedance and Admittance Matrices, The Scattering Matrix, The Transmission (ABCD) Matrix, Signal Flow Graphs.

UNIT II IMPEDANCE MATCHING AND TUNING **9**

Matching with Lumped Elements, Single-stub Tuning, Double-stub Tuning,. The Quarter-wave Transformer – Microwave Resonators: Series and Parallel Resonant Circuits, Transmission Line Resonators.

UNIT III POWER DIVIDERS AND DIRECTIONAL COUPLERS **9**

Basic Properties of Dividers and Couplers, the T-Junction Power Divider, The Quadrature (90°) Hybrid, Coupled Line Directional Couplers. The Lange Coupler, the 180° Hybrid.

UNIT IV MICROWAVE FILTERS **9**

Periodic Structures, Filter Design by the Insertion Loss Methods, Filter Transforms, Filter Implementation. Stepped – Impedance Low-pass filters– Theory and Design of Ferromagnetic components: Ferrite Isolators, Ferrite Phase Shifters, Ferrite Circulators, Active Microwave Circuits: Detectors and Mixers.

UNIT V DESIGN OF MICROWAVE AMPLIFIERS AND OSCILLATORS **9**

Characteristics of RF Transistors, Gain and Stability, Single- Stage Transistor Amplifier Design, Oscillator Design.

L: 45, T: 0, Total: 45

REFERENCES:

1. David M Pozar, "Microwave Engineering", 3rd Edition John Wiley and Sons, Inc., 2005.
2. Collin R E, "Foundations Microwave Engineering", McGraw Hill International Education, 1992.
3. Gonzalez G, "Microwave Transistor amplifiers – Analysis & Design", Prentice Hall, 2nd Edition, 1997.
4. Bahl. I. J., Bhartia. P., "Microwave solid state circuit design" Wiley-Interscience, 2003

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140CM0105 **OPTICAL COMMUNICATION NETWORKS** **3 0 0 3**

AIM:
To understand the new networking revolution within a revolution called Optical Communication Networks.

OBJECTIVES:

- To study the Optical network components for Optical Network communication.
- To study various Network architecture and topologies for optical networks.
- To study the issues in the network design and operation for wavelength routing in optical networks

UNIT I OPTICAL SYSTEM COMPONENTS **9**
Light propagation in optical fibers – Loss & bandwidth, System limitations, Non-Linear effects; Solitons; Optical Network Components – Couplers, Isolators & Circulators, Multiplexers & Filters, Optical Amplifiers, transmitters and receivers, Switches, Wavelength Converters.

UNIT II OPTICAL NETWORK ARCHITECTURES **9**
Introduction to Optical Networks; SONET / SDH, Metropolitan-Area Networks, Layered Architecture; Broadcast and Select Networks – Topologies for Broadcast Networks, Media-Access Control Protocols, Testbeds for Broadcast & Select WDM; Wavelength Routing Algorithms

UNIT III WAVELENGTH ROUTING NETWORKS **9**
The optical layer, Node Designs, network design and operation, Optical layer cost tradeoff, Routing and wavelength assignment, Virtual topology design, Wavelength Routing Test beds, Architectural variations.

UNIT IV PACKET SWITCHING AND ACCESS NETWORKS **9**
Photonic Packet Switching – OTDM, Multiplexing and Demultiplexing, Synchronization, Broadcast OTDM networks, Switch-based networks; OTDM test beds, Access Networks – Network Architecture overview, Future Access Networks, Optical Access Network Architectures; OTDM networks.

UNIT V NETWORK DESIGN AND MANAGEMENT **9**
Transmission System Engineering – System model, Power penalty - transmitter, receiver, Optical amplifiers, crosstalk, dispersion; Wavelength stabilization ; Overall design considerations; Control and Management – Network management functions, Configuration management, Performance management, Fault management, Optical safety, Service interface.

L: 45, T: 0, Total: 45

REFERENCES:

1. Rajiv Ramaswami and Kumar N. Sivarajan, "Optical Networks : A Practical Perspective", HarcourtAsia Pte Ltd., 2nd Edition 2004.
2. Siva Ram Moorthy. C. and Mohan Gurusamy, "WDM Optical Networks : Concept, Design and Algorithms", Prentice Hall of India, Ist Edition, 2002.
3. Green. P.E., Jr., "Fiber Optic Networks", Prentice Hall, NJ, 1993.
4. Walter goral ski.," Optical Networks and WDM ",Tata Mc Graw Hill, 2001

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140CM0107 **COMMUNICATION SYSTEM LABORATORY** **0 0 3 2**

AIM:
To familiarize the students with different communication applications.

OBJECTIVES:
On completion of the Lab, the student will be able to
- Gain knowledge on compression Technique.
- Draw Radiation pattern of Antennas.
- Write MATLAB code for OFDM Transceiver, Channel Equalizer.
- Analyze the performance of routing protocols.

LIST OF EXPERIMENTS:
1. Channel equalizer design using MATLAB (LMS, RLS).
2. Transform based compression techniques.
3. Antenna Radiation Pattern measurement.
4. Transmission line parameters.
5. Performance Evaluation of digital modulation schemes.
6. Implementation of Linear and Cyclic Codes.
7. OFDM transceiver design using MATLAB.
8. Convolutional encoder and Viterbi decoder.
9. Simulation and performance evaluation of entity mobility models using QUALNET / NS2.
10. Simulation and performance evaluation of Ad-hoc routing protocols using QUALNET / NS2.

REFERENCES:

1. Lab Manual prepared by the Department.
2. NS2 & QUALNET Manual.

Total: 45

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SEMESTER II

140CM0201 WIRELESS AND CELLULAR COMMUNICATION ENGINEERING

3 0 0 3

AIM:
Introduce the student to wireless communications by covering the key technical attributes of wireless and basic wireless systems and system architectures.

OBJECTIVES:
The objectives of the course Wireless and Cellular Communications are

- To enable the student to synthesis and analyze wireless and cellular communication systems over a stochastic fading channel
- To provide the student with an understanding of advanced multiple access techniques
- To provide the student with an understanding of diversity reception techniques
- To give the student an understanding digital cellular systems (GSM, cdmaOne, GPRS, EDGE, cdma2000, and W-CDMA)

UNIT I OVERVIEW OF WIRELESS COMMUNICATIONS 9
History of Wireless Communications, Wireless Vision, Technical Issues, Current Wireless Systems, Cellular Telephone Systems, Cordless Phones, Wireless LANs, Wide Area Wireless Data, Fixed Wireless Access, Paging Systems, Satellite Networks, Bluetooth, Other Wireless Systems and Applications, The Wireless Spectrum, Methods for Spectrum Allocation, Spectrum Allocations for Existing Systems, The cellular concept system design fundamentals.

UNIT II PATH LOSS, SHADOWING 10
Radio Wave, Transmit and Receive Signal, Free-Space Path Loss, Two-Ray Model, Simplified Path Loss, Shadow Fading, Path Loss and Shadowing, Outage Probability under Path Loss and Shadowing, Cell Coverage Area. Statistical Multipath Channel Models: Time-Varying Channel Impulse, Narrowband fading models, Autocorrelation, Cross Correlation, and Power Spectral Density, Envelope and Power Distributions, Level Crossing Rate and Average Fade Duration, Wideband Fading Models.

UNIT III CAPACITY OF WIRELESS CHANNELS 8
Power Delay Profile, Coherence Bandwidth, Doppler Power Spectrum and Channel Coherence, Capacity of Wireless Channels: Capacity in AWGN, Capacity of Frequency-Selective Fading Channels.

UNIT IV DIGITAL MODULATION AND DETECTION 9
Signal Space Analysis, Pass band Modulation Principles, Amplitude and Phase Modulation, Pulse Amplitude Modulation (MPAM), Phase Shift Keying (MPSK), Quadrature Amplitude Modulation (MQAM) Differential Modulation, Constellation, Quadrature Offset, Frequency Modulation, Frequency Shift Keying (FSK) and Minimum Shift Keying (MSK), Spread Spectrum and Multiuser Systems.

UNIT V CELLULAR SYSTEMS AND INFRASTRUCTURE-BASED WIRELESS NETWORKS 9
Cellular System Design, Frequency Reuse in Cellular Systems, Frequency Reuse in Code-Division Systems, Frequency Reuse in Time and Frequency Division Systems, Dynamic Resource Allocation in Cellular Systems, Area Spectral Efficiency

L: 45, T: 0, Total: 45

REFERENCES:

1. Andrea Goldsmith, "Wireless Communications", Cambridge University Press, 2007.
2. William C Y Lee, "Mobile Communications Engineering, Theory and Applications", 2nd Edition, McGraw Hill International editions, 1998.
3. David Tse and Pramod Viswanath, "Fundamentals of Wireless Communication", Prentice Hall, 2003.
4. Theodore S Rappaport, "Wireless Communications", Pearson Education, Asia , New Delhi, 2nd Edition, 2002.

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BoS Chairman

140CM0202 **MULTIMEDIA COMPRESSION** **3 0 0 3**

AIM:

To introduce the Fundamental Concepts in Multimedia and its compression techniques and standards for transmission and storage.

OBJECTIVES:

- To study the fundamental concepts and features for multimedia applications.
- To study the text, Audio, image and video compression techniques and standards.

UNIT I INTRODUCTION **9**

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 source coding, source models, scalar and vector quantization theory – Evaluation techniques – Error analysis and methodologies

UNIT II TEXT COMPRESSION **9**

Compaction techniques – Huffmann coding – Adaptive Huffmann Coding – Arithmetic coding – Shannon-Fano coding – Dictionary techniques – LZW family algorithms.

UNIT III AUDIO COMPRESSION **9**

Audio compression techniques - μ- Law and A- Law companding. Frequency domain and filtering – Basic sub-band coding – Application to speech coding – G.722 – Application to audio coding – MPEG audio, progressive encoding for audio – Silence compression, speech compression techniques – Formant and CELP Vocoders

UNIT IV IMAGE COMPRESSION **9**

Predictive techniques – DM, PCM, DPCM: Optimal Predictors and Optimal Quantization – Contour based compression – Transform Coding – JPEG Standard – Sub-band coding algorithms: Design of Filter banks – Wavelet based compression: Implementation using filters – EZW, SPIHT coders – JPEG 2000 standards - JBIG, JBIG2 standards.

UNIT V VIDEO COMPRESSION **9**

Video compression techniques and standards – MPEG Video Coding I: MPEG – 1 and 2 – MPEG Video Coding II: MPEG – 4 and 7 – Motion estimation and compensation techniques – H.261 Standard – DVI technology – PLV performance – DVI real time compression – Packet Video.

L: 45, T: 0, Total: 45

REFERENCES:

1. Khalid Sayood : "Introduction to Data Compression", Morgan Kauffman Harcourt India, 2nd Edition, 2000.
2. David Salomon : "Data Compression – The Complete Reference", Springer Verlag New York Inc., 2nd Edition, 2001.
3. Yun Q.Shi, Huifang Sun : "Image and Video Compression for Multimedia Engineering - Fundamentals, Algorithms & Standards", CRC press, 2003.
4. Peter Symes : "Digital Video Compression", McGraw Hill Pub., 2004.
5. Mark Nelson : "Data compression", BPB Publishers, New Delhi,1998.
6. Mark S.Drew, Ze-Nian Li : "Fundamentals of Multimedia", PHI, 1st Edition, 2003.
7. Watkinson,J : "Compression in Video and Audio", Focal press,London.1995.
8. Jan Vozer : "Video Compression for Multimedia", AP Profes, NewYork, 1995

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BoS Chairman

140CM0203 **ADVANCED RADIATION SYSTEMS** **3 0 0 3**

AIM:
The purpose of introducing this course is to describe the advanced design principles used in the radiating systems. By undergoing this course, the student will learn to analyze and design different types of antennas.

OBJECTIVES:
To impart:

- Understanding of the different types of antennas and sources of radiation
- Knowledge of the concepts of antenna synthesis techniques
- Understanding of the concept of microstrip antennas
- Learning the various methods of antenna measurements
- Studying Smart antennas for wireless systems and the concept of EMC measuring antenna.

UNIT I ANTENNA FUNDAMENTALS **9**
Antenna fundamental parameters , . Radiation integrals ,Radiation from surface and line current distributions – dipole, monopole, loop antenna; Mobile phone antenna- base station, hand set antenna; Image; Induction reciprocity theorem, Broadband antennas and matching techniques, Balance to unbalance transformer, Introduction to numerical techniques

UNIT II RADIATION FROM APERTURES **9**
Field equivalence principle, Radiation from Rectangular and Circular apertures, Uniform aperture distribution on an infinite ground plane; Slot antenna; Horn antenna; Reflector antenna, aperture blockage, and design consideration.

UNIT III ARRAY ANTENNA **9**
Linear array –uniform array, end fire and broad side array, gain, beam width, side lobe level; Two dimensional uniform array; Phased array, beam scanning, grating lobe, feed network,; Linear array synthesis techniques – Binomial and Chebyshev distributions.

UNIT IV MICRO STRIP ANTENNA **9**
Radiation Mechanism from patch; Excitation techniques; Microstrip dipole; Rectangular patch, Circular patch, and Ring antenna – radiation analysis from cavity model; input impedance of rectangular and circular patch antenna; Microstrip array and feed network; Application of microstrip array antenna.

UNIT V EMC ANTENNA AND ANTENNA MEASUREMENTS **9**
Concept of EMC measuring antenna; Rx and Tx antenna factors; Log periodic dipole, Biconical,Ridge guide, Multi turn loop; Antenna measurement and instrumentation – Gain, Impedance and antenna factor measurement; Antenna test range Design.

L: 45, T: 0, Total: 45

REFERENCES:

1. Balanis.A, "Antenna Theory Analysis and Design", John Wiley and Sons, NewYork, 1982.
2. Krauss.J.D, "Antennas", 2nd Edition, John Wiley and sons, New York, 1997.
3. Bahl. I.J. and Bhartia. P. ,"Microstrip Antennas", Artech House,Inc.,1980
4. Stutzman. W.L. and Thiele. G.A., "Antenna Theory and Design", 2nd Edition,John Wiley & Sons Inc.,1998.

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BoS Chairman

140CM0204 | **RF SYSTEM DESIGN** | **3 0 0 3**

AIM:

To familiarize the students with the concepts and design of impedance matching circuits, power amplifiers, frequency synthesizers and mixers used in RF system.

OBJECTIVES:

On completion of the course, the student will be able to:

- Understand the basics of MOSFET physics
- Know the importance of impedance matching network
- Design RF amplifiers
- Classify power amplifiers
- Understand the concepts of different types of mixers
- Describe the functions of oscillator

UNIT I CMOS PHYSICS, TRANSCEIVER SPECIFICATIONS AND ARCHITECTURES 9

CMOS: Introduction to MOSFET Physics – Noise: Thermal, shot, flicker, popcorn noise Transceiver Specifications: Two port Noise theory, Noise Figure, THD, IP2, IP3, Sensitivity, SFDR, Phase noise - Specification distribution over a communication link Transceiver Architectures: Receiver: Homodyne, Heterodyne, Image reject, Low IF Architectures – Transmitter: Direct up conversion, Two step up conversion.

UNIT II IMPEDANCE MATCHING AND AMPLIFIERS 9

S-parameters with Smith chart – Passive IC components - Impedance matching networks Amplifiers: Common Gate, Common Source Amplifiers – OC Time constants in bandwidth estimation and enhancement – High frequency amplifier design Low Noise Amplifiers: Power match and Noise match – Single ended and Differential LNAs – Terminated with Resistors and Source Degeneration LNAs.

UNIT III FEEDBACK SYSTEMS AND POWER AMPLIFIERS 9

Feedback Systems: Stability of feedback systems: Gain and phase margin, Root-locus techniques – Time and Frequency domain considerations – Compensation Power Amplifiers: General model – Class A, AB, B, C, D, E and F amplifiers – Linearisation Techniques – Efficiency boosting techniques – ACPR metric – Design Considerations.

UNIT IV PLL AND FREQUENCY SYNTHESIZERS 9

PLL: Linearised Model – Noise properties – Phase detectors – Loop filters and Charge pumps Frequency Synthesizers: Integer-N frequency synthesizers – Direct Digital Frequency synthesizers.

UNIT V MIXERS AND OSCILLATORS 9

Mixer: characteristics – Non-linear based mixers: Quadratic mixers – Multiplier based mixers: Single balanced and double balanced mixers – subsampling mixers Oscillators: Describing Functions, Colpitts oscillators – Resonators – Tuned Oscillators – Negative resistance oscillators – Phase noise.

L: 45, T: 0, Total: 45

REFERENCES:

1. Lee. T.H., "Design of CMOS RF Integrated Circuits", Cambridge, 2004
2. Razavi. B., "RF Microelectronics", Pearson Education, 1997
3. Jan Crols, Michiel Steyaert, "CMOS Wireless Transceiver Design", Kluwer Academic Publishers, 1997
4. Razavi. B., "Design of Analog CMOS Integrated Circuits", McGraw Hill, 2001

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BoS Chairman

140CM0207 **RF AND NETWORKS LABORATORY** **0 0 3 2**

AIM:

To familiarize the students with designing of RF circuits, performance evaluation of communication protocols.

OBJECTIVES:

On completion of the Lab, the student will be able to

- Design RF circuits using ADS software.
- Analyze the performance of Network protocols.
- Gain knowledge on GPS / Blue tooth

LIST OF EXPERIMENTS:

1. Design of Impedance matching Network using ADS.
2. Design of Branch line couplers using ADS.
3. Simulation of Microstrip Antennas.
4. S-parameter estimation of Microwave devices.
5. Study of Global Positioning System.
6. Design of Directional coupler and Filter using ADS.
7. Design and testing of a Microstrip coupler.
8. Characteristics of $\lambda/4$ and $\lambda/2$ transmission lines.
9. Simulation and performance evaluation of Wireless MAC protocols using QUALNET / NS2
10. Design and budget analysis of communication links using ADS/IE3D/HFSS
11. Simulation and performance evaluation of Wi-Fi LAN.
12. Study of ZIGBEE / Blue tooth.

REFERENCES:

1. Lab Manual prepared by the Department.
2. NS2 & QUALNET Manual.

Total: 45

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BoS Chairman