UNIVERSITY DEPARTMENTS

ANNA UNIVERSITY, CHENNAI 600 025

REGULATIONS - 2013

M.E. COMMUNICATION SYSTEMS

CURRICULUM AND SYLLABUS I TO IV SEMESTERS (FULL TIME)

SEMESTER I

SL. NO	COURSE CODE	COURSE TITLE	L	T	P	C
THEORY						
1	CU8101	Advanced Modulation and Coding Techniques	3	0	0	3
2	CU8102	Advanced Radiation Systems	3	0	0	3
3	CU8103	Signal Processing and Baseband Techniques	3	0	0	3
4	CU8104	Wireless Communication Engineering	3	0	0	3
5	MA8163	Advanced Applied Mathematics	3	1	0	4
6		Elective I	3	0	0	3
PRACTICAL						
7	CU8111	Signal Processing and Wireless Communication Laboratory	0	0	4	2
		TOTAL	**18**	**1**	**4**	**21**

SEMESTER II

SL. NO	COURSE CODE	COURSE TITLE	L	T	P	C
THEORY						
1	CU8201	Microwave Integrated Circuits	3	0	2	4
2	CU8202	Optical Switching and Networking	3	0	0	3
3	CU8203	Wireless Networks	3	0	0	3
4	CU8204	Wireless Transceiver Design	3	0	0	3
5		Elective II	3	0	0	3
6		Elective III	3	0	0	3
PRACTICAL						
7	CU8211	RF, Optical and Networks Laboratory	0	0	4	2
		TOTAL	**18**	**0**	**6**	**21**

Attested

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SEMESTER III

SL. NO	COURSE CODE	COURSE TITLE	L	T	P	C
THEORY						
1		Elective IV	3	0	0	3
2		Elective V	3	0	0	3
3		Elective VI	3	0	0	3
PRACTICAL						
4	CU8311	Project Work Phase I	0	0	12	6
		TOTAL	**9**	**0**	**12**	**15**

SEMESTER IV

SL. NO	COURSE CODE	COURSE TITLE	L	T	P	C
PRACTICAL						
1	CU8411	Project Work Phase II	0	0	24	12
		TOTAL	**0**	**0**	**24**	**12**

TOTAL NO OF CREDITS : 69

UNIVERSITY DEPARTMENTS

ANNA UNIVERSITY, CHENNAI 600 025

REGULATIONS - 2013

CURRICULUM I TO VI SEMESTERS (PART TIME)

M.E. COMMUNICATION SYSTEMS

SEMESTER I

SL. NO	COURSE CODE	COURSE TITLE	L	T	P	C
THEORY						
1	MA8163	Advanced Applied Mathematics	3	1	0	4
2	CU8103	Signal Processing and Baseband Techniques	3	0	0	3
3	CU8102	Advanced Radiation Systems	3	0	0	3
		TOTAL	**9**	**1**	**0**	**10**

SEMESTER II

SL. NO	COURSE CODE	COURSE TITLE	L	T	P	C
THEORY						
1.	CU8202	Optical Switching and Networking	3	0	0	3
2.	CU8204	Wireless Transceiver Design	3	0	0	3
3.		Elective I	3	0	0	3
		TOTAL	**9**	**0**	**0**	**9**

SEMESTER III

SL. NO	COURSE CODE	COURSE TITLE	L	T	P	C
THEORY						
1.	CU8101	Advanced Modulation and Coding Techniques	3	0	0	3
2.	CU8104	Wireless Communication Engineering	3	0	0	3
3.		Elective II	3	0	0	3
PRACTICAL						
4.	CU8111	Signal Processing and Wireless Communication Laboratory	0	0	4	2
		TOTAL	**9**	**0**	**4**	**11**

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SEMESTER IV

SL. NO	COURSE CODE	COURSE TITLE	L	T	P	C
THEORY						
1.	CU8203	Wireless Networks	3	0	0	3
2.	CU8201	Microwave Integrated Circuits	3	0	2	4
3.		Elective III	3	0	0	3
PRACTICAL						
4.	CU8211	RF, Optical and Networks Laboratory	0	0	4	2
		TOTAL	**9**	**0**	**6**	**12**

SEMESTER V

SL. NO	COURSE CODE	COURSE TITLE	L	T	P	C
THEORY						
1.		Elective IV	3	0	0	3
2.		Elective V	3	0	0	3
3.		Elective VI	3	0	0	3
PRACTICAL						
4.	CU8311	Project Work Phase I	0	0	12	6
		TOTAL	**9**	**0**	**12**	**15**

SEMESTER VI

SL. NO	COURSE CODE	COURSE TITLE	L	T	P	C
PRACTICAL						
1.	CU8411	Project Work Phase II	0	0	24	12
		TOTAL	**0**	**0**	**24**	**12**

LIST OF ELECTIVES

ELECTIVE I

SL. NO.	COURSE CODE	COURSE TITLE	L	T	P	C
1.	CU8001	MEMS	3	0	0	3
2.	CU8002	Advanced Fiber Optic Technologies	3	0	0	3
3.	CU8003	Multimedia Communication	3	0	0	3

ELECTIVE II AND III

SL. NO.	COURSE CODE	COURSE TITLE	L	T	P	C
4.	AP8075	Electromagnetic Interference and Compatibility in System Design	3	0	0	3
5.	AP8252	Digital Image Processing	3	0	2	4
6.	CU8004	Communication Network Security	3	0	0	3
7.	CU8005	Network Routing Algorithms	3	0	0	3
8.	CU8006	Satellite Communication	3	0	0	3
9.	CU8007	Telecommunication System Modeling and Simulation	3	0	0	3

ELECTIVE IV, V AND VI

SL. NO.	COURSE CODE	COURSE TITLE	L	T	P	C
10.	AP8077	High Speed Switching Architectures	3	0	0	3
11.	AP8083	Signal Integrity for High Speed Design	3	0	0	3
12.	AP8084	Wireless Sensor Networks	3	0	0	3
13.	CU8008	Advanced Microwave Communication	3	0	0	3
14.	CU8009	Advanced Wireless Communication Techniques	3	0	0	3
15.	CU8010	Cognitive Radio Networks	3	0	0	3
16.	CU8011	Communication Network Design	3	0	0	3
17.	CU8012	Enterprise Cloud Computing	3	0	0	3
18.	CU8013	Mobile Adhoc Networks	3	0	0	3
19.	CU8014	Radar and Navigational Aids	3	0	0	3
20.	VL8251	Data Converters	3	0	0	3

TOTAL CREDITS TO BE EARNED FOR THE AWARD OF DEGREE: 69

Attested

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CU8101 ADVANCED MODULATION AND CODING TECHNIQUES L T P C
3 0 0 3

OBJECTIVES:

1. To enable the student to understand the role of the communication medium in the design approaches for coding and modulation techniques.
2. To enable the student to understand the trade-offs involved in the design of basic and advanced coding and modulation techniques.
3. To expose the student to the advanced baseband signal conditioning methods evolved for exploiting the channel and user application characteristics and to familiarize them on the system design approaches.

UNIT I REVIEW OF DIGITAL MODULATION TECHNIQUES 9

Base band and band pass communication; Signal space representation, Linear and nonlinear modulation techniques, M-ary modulation techniques; Spectral characteristics of digital modulation, Spread spectrum modulation techniques.

UNIT II RECEIVERS FOR AWGN AND FADING CHANNELS 9

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.

UNIT III MULTICARRIER SYSTEMS 9

OFDM- Generation of sub-carriers using the IFFT; Guard Time and Cyclic Extension; Windowing; Peak to Average Power reduction schemes; Multicarrier CDMA- System design, Performance parameters.

UNIT IV 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, Decoding methods and implementation issues.

UNIT V TURBO CODING 9

Introduction-Turbo Encoder, Turbo Decoder, Iterative Turbo Decoding Principles; Modifications of the MAP Algorithm-The Soft-Output Viterbi Algorithm(SOVA); Turbo Coding for AWGN channels, Turbo Coding for Rayleigh Channels, LDPC Codes.

TOTAL: 45 PERIODS

REFERENCES:

1. Bernard Sklar., 'Digital Communications', second edition, Pearson Education,2001.
2. John G. Proakis., 'Digital Communication', 4 th edition, Mc Graw Hill Publication, 2001
3. Theodore S.Rappaport., 'Wireless Communications', 2nd edition, Pearson Education, 2002.
4. Richard Van Nee & Ramjee Prasad., 'OFDM for Multimedia Communications' Artech House Publication,2001.
5. Heinrich Meyer, Mare Moeneclacy, Stefan.A.Fechtel, " Digital communication receivers ", Vol I & Vol II, John Wiley, New York, 1997.
6. Sergio Verdu, "Multiuser Detection", Cambridge University Press, 1998.
7. Andrea Goldsmith , "Wireless Communication ", Cambridge Univ. Press, 2006.

OUTCOMES:

1. The student would be able to demonstrate an understanding of the trade-offs involved in the design of basic and advanced coding and modulation techniques and the advanced baseband signal conditioning methods evolved for exploiting the channel and user application characteristics.
2. Given the user requirements and the type of channel over which the system has to function the student would be in a position to apply his knowledge for designing the baseband signaling waveforms that would address the channel impairments.

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CU8102 **ADVANCED RADIATION SYSTEMS** **L T P C**
3 0 0 3

OBJECTIVES:

- To enhance the students knowledge in the area of various antenna design and to make them understand their radiation mechanism.
- To impart knowledge about the state of art in antenna technology.

UNIT I ANTENNA FUNDAMENTALS **9**

Introduction –Types of Antennas – Radiation Mechanism – Current distribution on wire antennas – Maxwell's equations - 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, Balance to unbalance transformer, Review of Antenna Measurements.

UNIT II ANTENNA ARRAYS **9**

One Dimensional Arrays: Linear array –uniform array, end fire and broad side array, gain, beam width, side lobe level; Linear array synthesis techniques – Binomial and Chebyshev distributions; Two dimensional uniform arrays; smart antennas, switched beam and adaptive arrays, Mutual Coupling in Finite Arrays.

UNIT III RADIATION FROM APERTURES **9**

Field equivalence principle, Radiation from Rectangular and Circular apertures, Uniform aperture distribution on an infinite ground plane; Babinets principle, Slot antenna; Horn antenna; Reflector antenna, aperture blockage, and design consideration.

UNIT IV MICROSTRIP ANTENNA **9**

Radiation Mechanism and Excitation techniques : Microstrip dipole; Patch, 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; Reconfiguration Mechanisms; Computer Aided Design of Microstrip Antennas, Microstrip Reflectarray Antennas.

UNIT V MODERN ANTENNAS **9**

PIFA – Vivaldi Antennas - UWB Antennas - Antennas in Medicine – Leaky Wave Antennas – Plasma Antennas – Wearable Antennas – RFID Antennas - Automotive antennas, Reconfigurable antennas.

TOTAL: 45 PERIODS

REFERENCES:

1. Balanis.A, "Antenna Theory Analysis and Design", 3rd Edition, John Wiley and Sons, New York, 1982.
2. Frank B. Gross, "Frontiers in Antennas", Mc Graw Hill, 2011.
3. S. Drabowitch, A. Papiernik, H.D.Griffiths, J.Encinas, B.L.Smith, "Modern Antennas", II Edition, Springer Publications, 2007.
4. Krauss.J.D, "Antennas", II edition, John Wiley and sons, New York, 1997.
5. I.J. Bahl and P. Bhartia," Microstrip Antennas", Artech House,Inc.,1980
6. W.L.Stutzman and G.A.Thiele, "Antenna Theory and Design", 2nd edition, John Wiley& Sons Inc.,1998.
7. Jim R. James,P.S.Hall ,"Handbook of Microstrip Antennas"IEE Electromagnetic wave series 28, Volume 2,1989

OUTCOMES:

- The students will be equipped from fundamentals to recent techniques in antenna technology. They will able to independently design and assess the performance of various antennas.

Attested

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CU8103 SIGNAL PROCESSING AND BASEBAND TECHNIQUES L T P C
3 0 0 3

OBJECTIVES:

1. To enable the student to understand the basic principles of random signal processing , spectral estimation methods and adaptive filter algorithms and their applications.
2. To enable the student to understand the different signal detection and estimation methods used in communication system design and the implications of proper synchronization methods for proper functioning of the system.

UNIT I DISCRETE RANDOM SIGNAL PROCESSING 9

Discrete Random Processes- Ensemble Averages, Stationary processes, Bias and Estimation, Autocovariance, 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

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 ADAPTIVE FILTERS 9

FIR adaptive filters – Steepest descent method- LMS algorithm, LMS algorithm, RLS adaptive algorithm – Application: channel equalization, noise cancellation, prediction.

UNIT IV DETECTION AND ESTIMATION 9

Detection criteria : Bayes detection techniques, MAP, ML,– detection of M-ary signals, Neyman Peason, minimax decision criteria. Estimation: linear estimators, non-linear estimators, Bayes, MAP,ML, properties of estimators, phase and amplitude estimation.

UNIT V SYNCHRONIZATION 9

Signal parameter estimation, carrier phase estimation, symbol timing estimator, joint estimation of carrier phase and symbol timing.

TOTAL: 45 PERIODS

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, 2002.
3. John G. Proakis., 'Digital Communication', 4 th edition, Mc Graw Hill Publication, 2001.
4. Bernard Sklar and Pabitra Kumar Roy, Digital Communications: Fundamentals & Applications, 2/E, Pearson Education India, 2009
5. John G. Proakis, Masoud Salehi, "Communication Systems Engineering", Prentice Hall, 1994.

OUTCOMES:

1. The student would be able to demonstrate an understanding of the basic principles of random signal processing, spectral estimation methods and adaptive filter algorithms and their applications.
2. The student would be able to demonstrate an understanding of the different signal detection and estimation methods used in communication system design and the implications of proper synchronization methods for proper functioning of the system.
3. The student would be in a position to apply his knowledge for designing a baseband system addressing the channel impairments.

CU8104 WIRELESS COMMUNICATION ENGINEERING L T P C
3 0 0 3

OBJECTIVES:

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

UNIT I WIRELESS CHANNEL PROPAGATION AND MODEL 9

Propagation of EM signals in wireless channel – Reflection, diffraction and Scattering-freespace, two ray. Small scale fading- channel classification- channel models – COST -231 Hata model, Longley-Rice Model, NLOS Multipath Fading Models: Rayleigh, Rician, Nakagami, Composite Fading – shadowing Distributions, Link power budget Analysis.

UNIT II CAPACITY OF WIRELESS CHANNELS 9

Capacity in AWGN, capacity of flat fading channel, capacity of frequency selective fading channels.

UNIT III DIVERSITY 9

Realization of independent fading paths, Receiver Diversity: selection combining, Threshold Combining, Maximum-ratio Combining, Equal gain Combining. Transmitter Diversity: Channel known at transmitter, channel unknown at the transmitter.

UNIT IV MIMO COMMUNICATIONS 9

Narrowband MIMO model, Parallel decomposition of the MIMO channel, MIMO channel capacity, MIMO Diversity Gain:Beamforming, Diversity-Multiplexing trade-offs, Space time Modulation and coding : STBC,STTC, Spacial Multiplexing and BLAST Architectures.

UNIT V MULTI USER SYSTEMS 9

Multiple Access: FDMA, TDMA, CDMA,SDMA, Hybrid techniques, Random Access: ALOHA,SALOHA,CSMA, Scheduling, power control, uplink downlink channel capacity, multiuser diversity, MIMO-MU systems.

TOTAL : 45 PERIODS

REFERENCES:

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

OUTCOME:

- The students understand the state of art techniques in wireless communication.

MA8163 **ADVANCED APPLIED MATHEMATICS** **L T P C**
3 1 0 4

OBJECTIVES:

- To encourage students to develop a working knowledge of the central ideas of linear algebra;
- To study and understand the concepts of probability and random variable of the various functions;
- To understand the notion of a Markov chain, and how simple ideas of conditional probability and matrices can be used to give a thorough and effective account of discrete-time Markov chains;
- To formulate and construct a mathematical model for a linear programming problem in real life situation;
- Introduce the Fourier Transform as an extension of Fourier techniques on periodic functions and to solve partial differential equations;

UNIT I LINEAR ALGEBRA (9+3)

Vector spaces – norms – Inner Products – Eigenvalues using QR transformations – QR factorization - generalized eigenvectors – Canonical forms – singular value decomposition and applications - pseudo inverse – least square approximations --Toeplitz matrices and some applications.

UNIT II ONE DIMENSIONAL RANDOM VARIABLES (9+3)

Random variables - Probability function – moments – moment generating functions and their properties – Binomial, Poisson, Geometric, Uniform, Exponential, Gamma and Normal distributions – Function of a Random Variable.

UNIT III RANDOM PROCESSES (9+3)

Classification – Auto correlation - Cross correlation - Stationary random process – Markov process –- Markov chain - Poisson process – Gaussian process.

UNIT IV LINEAR PROGRAMMING (9+3)

Formulation – Graphical solution – Simplex method – Two phase method - Transportation and Assignment Models

UNIT V FOURIER TRANSFORM FOR PARTIAL DIFFERENTIAL EQUATIONS (9+3)

Fourier transforms: Definitions, properties-Transform of elementary functions, Dirac Delta functions – Convolution theorem – Parseval's identity – Solutions to partial differential equations: Heat equations, Wave equations, Laplace and Poison's equations.

TOTAL: 45+15=60 PERIODS

REFERENCES:

1. Bronson, R.Matrix Operation, Schaum's outline series, Mc Graw Hill, Newyork (1989).
2. Oliver C. Ibe, "Fundamentals of Applied Probability and Random Processes, Academic Press, (An imprint of Elsevier), 2010.
3. Taha H.A. "Operations Research : An introduction" Ninth Edition, Pearson Education, Asia, New Delhi 2012.
4. Sankara Rao, K. "Introduction to partial differential equations" Prentice Hall of India, pvt, Ltd, New Delhi, 1997.
5. Andrews,L.C. and Philips.R.L. "Mathematical Techniques for engineering and scientists", Printice Hall of India,2006.
6. O'Neil P.V. "Advanced Engineering Mathematics", (Thomson Asia pvt ltd, Singapore) 2007, cengage learning India private limited.

OUTCOMES:

- On successful completion of this course, all students will have developed knowledge and understanding in the fields of linear algebra, probability, stochastic process, linear programming problem and fourier transform.

CU8111 SIGNAL PROCESSING AND WIRELESS COMMUNICATION LABORATORY

L T P C
0 0 4 2

OBJECTIVES:

1. To enable the student to verify the basic principles of random signal processing, spectral estimation methods, wireless and AWGN channel characterization, application of adaptive filter algorithms for communication system design, coding and modulation design, synchronization aspects and the overall baseband system design.
2. To design and conduct experiments, as well as to analyze and interpret data to produce meaningful conclusions and match with theoretical concepts.
3. To enable the student to appreciate the practical aspects of baseband system design and understand the associated challenges.

Sl. No.	Details of Experiment		Details of Equipment / Instrument Required for a batch of 25 Students	
	Name	Duration	Name	Quantity
1.	Spectral Characterisation of communication signals (using Spectrum Analyzer)	4	Spectrum Analyzer	2
2.	Wireless Channel simulation and characterization	4	SCILAB/MATLAB, CPU	2
3.	Pathloss Measurement and Characterization of Wireless Channels	4	Wireless transceiver modules	2
4.	Wireless Channel equalizer design using DSP (ZF / LMS / RLS)	4	DSP kits, CPU	2
5.	Design and analysis of digital modulation techniques on an SDR platform	4	SDR modules, MSO, CPU	1
6.	Carrier and Symbol timing Synchronization using SDR platform	4	SDR modules, CPU	2
7.	OFDM transceiver design using MATLAB/SIMULINK	4	SCILAB/MATLAB, CPU	1
8.	CDMA signal generation and RAKE receiver design using DSP/MATLAB/ SIMULINK	4	SCILAB/MATLAB, CPU	1
9.	Design and Analysis of Spectrum Estimators (Borlett , Welch)	4	SCILAB/MATLAB, CPU	1
10.	Simulation of MIMO systems	4	SCILAB/MATLAB, CPU	1
11.	Design and performance analysis of error control encoder and decoder (Block and Convolutional Codes)	4	SCILAB/MATLAB, CPU	1
12.	Simulation of Turbo coding and SOVA	4	SCILAB/MATLAB, CPU	1

TOTAL : 60 PERIODS

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OUTCOMES:

- The student would be able to design and conduct experiments to demonstrate the trade-offs involved in the design of basic and advanced coding and modulation techniques and the advanced baseband signal conditioning methods.
- The student would be capable of applying communication engineering principles and design tools and will be well practiced in design skills.
- The student would be able to comprehensively record and report the measured data, write reports, communicate research ideas and do oral presentations effectively.
- The student would be capable of analyzing and interpreting the experimental measurement data and produce meaningful conclusions.

CU8201 MICROWAVE INTEGRATED CIRCUITS L T P C
3 0 2 4

OBJECTIVES:

- To enhance the students knowledge in the area of planar microwave engineering and to make them understand the intricacies in the design of microwave circuits.
- To impart knowledge about the state of art in MIC technology.

UNIT I INTRODUCTION TO MICROWAVE CIRCUITS 9

Definitions – Frequency Bands – Lumped versus Distributed Circuits - Behavior of finite length transmission lines – General Characteristics of PC Boards – Transmission Lines on PC Boards – Passives made from Transmission Lines – Resonators - Combiners, Splitters and Couplers

UNIT II MATCHING NETWORKS AND FILTER DESIGN 9

Circuit Representation of two port RF/Microwave Networks: Low Frequency Parameters, High Frequency Parameters, Transmission Matrix, ZY Smith Chart, Design of Matching Circuits using Lumped Elements, Matching Network Design using Distributed Elements, Filter design.

UNIT III AMPLIFIERS AND OSCILLATORS 9

Amplifiers: Stability considerations in active networks – Gain Consideration in Amplifiers – Noise Consideration in active networks – Broadband Amplifier design – Low Noise Amplifier Design, Oscillators: Oscillator versus Amplifier Design – Oscillation conditions – Design and stability considerations of Microwave Transistor Oscillators.

UNIT IV MIXERS AND CONTROL CIRCUITS 9

Mixer Types – Conversion Loss – SSB and DSB Mixers – Design of Mixers: Single Ended Mixers – Single Balanced Mixers - Sub Harmonic Diode Mixers ,Microwave Diodes , Phase Shifters – PIN Diode Attenuators

UNIT V MICROWAVE IC DESIGN AND MEASUREMENT TECHNIQUES 9

Microwave Integrated Circuits – MIC Materials- Hybrid versus Monolithic MICs – Multichip Module Technology - Fabrication Techniques, Miniaturization techniques, Introduction to SOC, SOP, Test fixture measurements, probe station measurements, thermal and cryogenic measurements, experimental field probing techniques.

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Sl. No.	Details of Experiment		Details of Equipment / Instrument Required for a batch of 25 Students	
	Name	Duration	Name	Quantity
1.	Design of Branch line couplers	2	MIC Trainer Kit, MSO	1
2.	Design of Directional couplers	2	MIC Trainer Kit, MSO	1
3.	Design of Power Dividers	2	MIC Trainer Kit, MSO	1
4.	Design of Impedance matching Networks	2	MIC Trainer Kit, MSO	1
5.	Design of Filters	2	MIC Trainer Kit, MSO	1
6.	Stability analysis using ZY Smith chart	2	MIC Trainer Kit, MSO	1
7.	Design of Phase shifters	2	MIC Trainer Kit, MSO	1
8.	Design of Mixers	2	MIC Trainer Kit, MSO	1

THEORY **45**
LABORATORY **15**

L +T: 45+30 = 75 PERIODS

REFERENCES:

1. Thomas H.Lee, “Planar Microwave Engineering”, Cambridge University Press, 2004
2. Matthew M. Radmanesh, “Radio Frequency and Microwave Electronics”, Pearson Education, II Edition 2002
3. “Microwave Transistor Amplifiers – Analysis and Design”, II Edition, Prentice Hall, New Jersy
4. Ravender Goyal, “Monolithic MIC; Technology & Design”, Artech House, 1989.
5. Gupta K.C. and Amarjit Singh, “ Microwave Integrated Circuits”, John Wiley, New York, 1975.
6. Hoffman R.K. “Handbook of Microwave Integrated Circuits”, Artech House, Boston, 1987.
7. Ulrich L. Rohde and David P.N., “ RF / Microwave Circuit Design for Wireless Applications”, John Wiley, 2000.
8. C. Gentili, “Microwave Amplifiers and Oscillators”, North Oxford Academic, 1986.
9. Samuel. Y. Liao, “Microwave Circuit Analysis and Amplifier Design”, Prentice Hall. Inc., 1987.

OUTCOMES:

- The students will be equipped from fundamentals to recent techniques in MIC technology.
- They will able to independently design and assess the performance of various planar configurations.

CU8202 **OPTICAL SWITCHING AND NETWORKING** **L T P C**
3 0 0 3

OBJECTIVES:

- To enable the student to understand the importance of the backbone infrastructure for our present and future communication needs and familiarize them with the architectures and the protocol stack in use.
- To enable the student to understand the differences in the design of data plane and the control plane and the routing , switching and the resource allocation methods and the network management and protection methods in vogue.
- To expose the student to the advances in packet switching in the optical domain, the associated challenges and the possible solution approaches.

UNIT I OPTICAL NETWORK ARCHITECTURES 9

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

UNIT II NETWORK CONNECTIONS AND THE CONTROL PLANE 9

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.

UNIT III ROUTING AND WAVELENGTH ASSIGNMENT 9

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,

UNIT IV OPTICAL PACKET SWITCHED NETWORKS 9

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

UNIT V NETWORK MANAGEMENT AND SURVIVABILITY 9

Control and Management – Network management functions, Configuration management, Performance management, Fault management, Optical safety, Service interface; network Survivability- Protection in SONET / SDH and IP Networks, Optical layer Protection, Interworking between layers.

TOTAL: 45 PERIODS

REFERENCES:

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

OUTCOMES:

- To enable the student to understand the importance of the backbone infrastructure for our present and future communication needs and familiarize them with the architectures and the protocol stack in use.
- To enable the student to understand the differences in the design of data plane and the control plane and the routing , switching and the resource allocation methods and the network management and protection methods in vogue.
- To expose the student to the advances in packet switching in the optical domain, the associated challenges and the possible solution approaches.

CU8203 **WIRELESS NETWORKS** **L T P C**
3 0 0 3

OBJECTIVES:

- To enhance the understanding of WI-fi, 3G systems such as UMTS, CDMA2000, 4G networks such as ad hoc and sensor, integration of WLAN and WWAN, Wimax and LTE

UNIT I WIRELESS LOCAL AREA NETWORKS 9

Introduction to wireless LANs - IEEE 802.11 WLANs - Physical Layer- MAC sublayer- MAC Management Sublayer- Wireless ATM - HIPERLAN- HIPERLAN-2

UNIT II 3G OVERVIEW & 2.5G EVOLUTION 9

Migration path to UMTS, UMTS Basics, Air Interface, 3GPP Network Architecture, CDMA2000 overview- Radio and Network components, Network structure, Radio network, TD-CDMA, TD-SCDMA.

UNIT III ADHOC & SENSOR NETWORKS 9

Characteristics of MANETs, Table-driven and Source-initiated On Demand routing protocols, Hybrid protocols, Wireless Sensor networks- Classification, MAC and Routing protocols.

UNIT IV INTERWORKING BETWEEN WLANS AND 3G WWANS 9

Interworking objectives and requirements, Schemes to connect WLANs and 3G Networks, Session Mobility, Interworking Architectures for WLAN and GPRS, System Description, Local Multipoint Distribution Service, Multichannel Multipoint Distribution system.

UNIT V 4G & BEYOND 9

4G features and challenges, Technology path, IMS Architecture, WiMAX, LTE, Convergent Devices, 4G technologies, Advanced Broadband Wireless Access and Services, Multimedia, MVNO.

TOTAL : 45 PERIODS

REFERENCES:

1. Clint Smith. P.E., and Daniel Collins, "3G Wireless Networks", 2nd Edition, Tata McGraw Hill, 2007.
2. Vijay. K. Garg, "Wireless Communication and Networking", Morgan Kaufmann Publishers, http://books.elsevier.com/9780123735805:, 2007.
3. Kaveth Pahlavan,. K. Prashanth Krishnamuorthy, "Principles of Wireless Networks", Prentice Hall of India, 2006.
4. William Stallings, "Wireless Communications and networks" Pearson / Prentice Hall of India, 2nd Ed., 2007.
5. Andrew Richadrson, "WCDMA design Handbook" Cambridge University Press,2007
6. Dharma Prakash Agrawal & Qing-An Zeng, "Introduction to Wireless and Mobile Systems", Thomson India Edition, 2nd Ed., 2007.
7. Gary. S. Rogers & John Edwards, "An Introduction to Wireless Technology", Pearson Education, 2007.
8. Sumit Kasera and Nishit Narang, " 3G Networks – Architecture, Protocols and Procedures", Tata McGraw Hill, 2007.

OUTCOMES:

- Students are enriched with the knowledge of present day technologies to enable them to face the world and contribute back as researchers.

Attested

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CU8204 **WIRELESS TRANSCEIVER DESIGN** **L T P C**
3 0 0 3

OBJECTIVES:

1. To enable the student to understand the basic principles of MOS based design
2. To enable the student to understand the importance of different performance measures in RF design and the pros and cons of the different RF transceiver architectures
3. To enable the student to understand the principles and trade-offs involved in the design of RF systems involving amplifiers, oscillators, mixers and synthesizers.

UNIT I INTRODUCTION TO MOS **9**

MOS PHYSICS: Long channel approximation, short channel physics, SPICE models, Biasing Techniques.

UNIT II RF PERFORMANCE METRICS **9**

RF performance metrics and impedance matching techniques: S parameters, Noise Figure, gain, impedance match, non-linearity, spurs – cascaded systems, impedance transformers.

UNIT III TRANSCEIVER ARCHITECTURE **9**

Transceiver architecture: Single tuned, heterodyne, Image reject receivers, low IF architecture, two port noise theory.

UNIT IV AMPLIFIER AND MIXER **9**

LNA: Single ended – CS, CG LNAs, inductive degenerated CS LNA, differential LNA Mixer: Single balanced, Gilber cell mixer, double balanced passive mixer, Mixer linearization techniques.
Power Amplifier: Class B,C,D, E, F, F^{-1} – Linearization.

UNIT V OSCILLATORS AND SYNTHESIZERS **9**

Oscillators: Colpitt's oscillators, Hartley oscillator, Clapp oscillators, Crystal oscillators, Negative resistance oscillator.
Synthesizes: PLL frequency synthesizer, Integer-N, Direct digital synthesizers.

TOTAL: 45 PERIODS

REFERENCES:

1. T.Lee, "Design of CMOS RF Integrated Circuits", Cambridge, 2004
2. B.Razavi, "RF Microelectronics", Pearson Education, 1997
3. Jan Crols, Michiel Steyaert, "CMOS Wireless Transceiver Design", Kluwer Academic Publishers, 1997
4. B.Razavi, "Design of Analog CMOS Integrated Circuits", McGraw Hill, 2001.
5. N. Weste, D. Harris, CMOS VLSI Design, Addison-Wesley, 3/e, 2004.
6. Behzad Razavi, Design of Analog CMOS Integrated Circuits, McGraw-Hill Science/Engineering/Math; 1 edition, 2000.
7. T.Lee, "Design of CMOS RF Integrated Circuits", Cambridge, 2004
8. B.Razavi, "RF Microelectronics", Pearson Education, 1997
9. Jan Crols, Michiel Steyaert, "CMOS Wireless Transceiver Design", Kluwer Academic Publishers, 1997.

OUTCOMES:

- The student would be able to demonstrate an understanding of the basic principles of RF system design.
- Given the user requirements and the type of channel over which the system has to function the student would be in a position to apply his knowledge to identify a suitable architecture and systematically design a system, component, or process to meet desired needs within realistic constraints and addressing the channel impairments.

CU8211 RF, OPTICAL AND NETWORKS LABORATORY

L	T	P	C
0	0	4	2

OBJECTIVES:

1. To enable the student to verify the basic principles and design aspects involved in high frequency bandpass communication system components design and the performance parameters for the components and the overall system.
2. To enable the student to appreciate the practical aspects of bandpass system design and understand the associated link power and risetime budgeting challenges.
3. To enable the students to understand the basics of communication protocol design for different functionalities
4. To expose the students to the different high frequency system and communication network design tools and enable them to design and conduct experiments, as well as to analyze and interpret data to produce meaningful conclusions and match with theoretical concepts.

TOTAL: 60 PERIODS

LIST OF EXPERIMENTS

Sl. No.	Details of Experiment		Details of Equipment / Instrument Required for a batch of 25 Students	
	Name	Duration	Name	Quantity
1.	Measurement of Transmission line parameters	4	Network Analyzer	1
2.	Design and characterization of Antennas	8	ADS/IE3D/HFSS , CPU	2
3.	LNA / Mixer / VCO design and characterization	8	ADS/IE3D/HFSS , CPU	2
4.	Determination of Maximum bit rate of a digital fiber optic link	4	Digital Fiber Optic Link, MSO	1
5.	Signal transmission and reception using WDM and spectral characterization	4	WDM Module, Optical Spectrum Analyzer	1
6.	Characterization of Fiber Bragg Grating Filter (Reflectivity, Insertion loss & Crosstalk)	4	WDM Module with circulator, FBG and photo-detectors , MSO	1
7.	Simulation and performance evaluation of MAC protocols for wired and wireless networks	4	QUALNET /GLOMOSIM / NS2 , CPU	1
8.	Simulation and performance evaluation of Routing protocols for wired and wireless networks	4	QUALNET /GLOMOSIM / NS2 , CPU	1
9.	Simulation and performance evaluation of Cellular network technologies in terms of Blocking Probability and Spectral Efficiency	4	QUALNET /GLOMOSIM / NS2 , CPU	1
10.	Simulation and performance evaluation of Wireless Sensor Network technologies in terms of Throughput and Energy Efficiency (QUALNET /GLOMOSIM / NS2)	4	QUALNET /GLOMOSIM / NS2 , CPU	1

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OUTCOMES:

1. Given the user requirements and the type of channel over which the system has to function the student would be in a position to understand the challenges and apply his knowledge to identify a suitable architecture and systematically design an RF system or a communication network.
2. The student would be able to design and conduct experiments to demonstrate the trade-offs involved in the design of bandpass systems as well as high speed communication networks.
3. The student would be capable of applying communication engineering principles and design tools and will be well practiced in design skills.
4. The student would be able to comprehensively record and report the measured data, and would be capable of analyzing and interpreting the experimental measurement data and produce meaningful conclusions.

CU8001 MEMS L T P C
3 0 0 3

OBJECTIVES:

- To enable the student to understand the basic principles of sensors and actuators, materials and fabrication aspects of MEMS and Microsystems.
- To make the student familiar with the mechanical and the electrostatic design and the associated system issues.
- To introduce the student to the different MEMS applications , the design basics, the design tools and the performance issues.

UNIT I INTRODUCTION TO MEMS 9

MEMS and Microsystems, Miniaturization, Typical products, Micro sensors, Micro actuation, MEMS with micro actuators, Microaccelorometers and Micro fluidics, MEMS materials, Micro fabrication

UNIT II MECHANICS FOR MEMS DESIGN 9

Elasticity, Stress, strain and material properties, Bending of thin plates, Spring configurations, torsional deflection, Mechanical vibration, Resonance, Thermo mechanics – actuators, force and response time, Fracture and thin film mechanics.

UNIT III ELECTRO STATIC DESIGN AND SYSTEM ISSUES 9

Electrostatics: basic theory, electro static instability. Surface tension, gap and finger pull up, Electro static actuators, Comb generators, gap closers, rotary motors, inch worms, Electromagnetic actuators. bistable actuators. Electronic Interfaces, Feedback systems, Noise, Circuit and system issues,

UNIT IV MEMS APLLICATION 9

Case studies – Capacitive accelerometer, Peizo electric pressure sensor, Microfluidics application, Modeling of MEMS systems, CAD for MEMS.

UNIT V INTRODUCTION TO OPTICAL AND RF MEMS 9

Optical MEMS, - System design basics – Gaussian optics, matrix operations, resolution. Case studies, MEMS scanners and retinal scanning display, Digital Micro mirror devices. RF Memes – design basics, case study – Capacitive RF MEMS switch, performance issues.

TOTAL: 45 PERIODS

REFERENCES:

1. Stephen Santeria," Microsystems Design", Kluwer publishers, 2000.
2. N.P.Mahalik, "MEMS", Tata McGraw hill, 2007.
3. Nadim Maluf,"An introduction to Micro electro mechanical system design", Artech House, 2000.
4. Mohamed Gad-el-Hak, editor," The MEMS Handbook", CRC press Baco Raton,2000.
5. Tai Ran Hsu," MEMS & Micro systems Design and Manufacture" Tata McGraw Hill, New Delhi, 2002. Liu, "MEMS", Pearson education, 2007.

OUTCOMES:

1. The student would be able to demonstrate an understanding of the different aspects of microsystem design.
2. Given the user requirements and the functionality the student would be in a position to apply his knowledge for identifying a suitable MEMS structure, material and fabrication procedure.
3. The student would be capable of applying his knowledge and design tools and will be well practiced in design skills.

CU8002 ADVANCED FIBER OPTIC TECHNOLOGIES L T P C
3 0 0 3

OBJECTIVES:

- To enable the student to understand the basic principles of operation of optical system components, the different network architectures and issues associated with network design.
- To enable the student to understand the benefits of coherent system and the limitations and challenges in practical implementation**.**
- To enable the student to understand the differences in the design of TDM and CDM systems when implemented in the optical domain and the challenges involved.

UNIT I OPTICAL SYSTEM COMPONENTS AND NETWORK DESIGN 9

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.

UNIT II COHERENT SYSTEMS 9

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 polatization shift keying (POL SK); Demodulation schemes – Homodyne, Heterodyne - Synchronous and Non synchronous detection; Comparison; Carrier recovery in Coherent detection.

UNIT III OPTICAL NETWORK ARCHITECTURES 9

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

UNIT IV OPTICAL TDM AND SOLITON 9

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

UNIT V OPTICAL CDMA 9

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

TOTAL: 45 PERIODS

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.

OUTCOMES:

- The student would be able to demonstrate an understanding of the differences and challenges involved in the design of optical systems and networks.
- The student would be in a position to apply his knowledge for designing a fiber optic system addressing the channel impairments.
- The student would be familiar with the architectures and the protocol stack in use.in optical networks and would be able to identify a suitable backbone infrastructure for our present and future communication needs.

CU8003 MULTIMEDIA COMMUNICATION L T P C
3 0 0 3

OBJECTIVES:

1. To enable the student to understand the basic characteristics of multimedia components and the different methods for compressing audio, video, text and images.
2. To expose the students to the challenges of IP based transport and the solution approaches considering the example case of VoIP technology.
3. To enable the student to understand the different networking aspects with reference to multimedia transmission.

UNIT I MULTIMEDIA COMPONENTS 9

Introduction - Multimedia skills - Multimedia components and their characteristics - Text, sound, images, graphics, animation, video, hardware.

UNIT II AUDIO AND VIDEO COMPRESSION 9

Audio compression–DPCM-Adaptive PCM –adaptive predictive coding-linear Predictive coding-code excited LPC-perpetual coding Video compression –principles-H.261-H.263-MPEG 1, 2, 4.

UNIT III TEXT AND IMAGE COMPRESSION 9

Compression principles-source encoders and destination encoders-lossless and lossy compression-entropy encoding –source encoding -text compression –static Huffman coding dynamic coding – arithmetic coding –Lempel ziv-welsh Compression-image compression .

UNIT IV VoIP TECHNOLOGY 9

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.

UNIT V MULTIMEDIA NETWORKING 9

Multimedia networking -Applications-streamed stored and audio-making the best Effort service-protocols for real time interactive Applications-distributing multimedia-beyond best effort service-secluding and policing Mechanisms-integrated services-differentiated Services-RSVP.

TOTAL : 45 PERIODS

REFERENCES:

1. Fred Halshall, "Multimedia communication - applications, networks, protocols and standards", Pearson education, 2007.
2. Tay Vaughan, "Multideai: making it work", 7/e, TMH, 2007.
3. Kurose and W.Ross, "Computer Networking "a Top down approach, Pearson education, 3rd ed, 2005.
4. Marcus goncalves "Voice over IP Networks", McGraw Hill,
5. KR. Rao,Z S Bojkovic, D A Milovanovic, "Multimedia Communication Systems: Techniques, Standards, and Networks", Pearson Education 2007
6. R. Steimnetz, K. Nahrstedt, "Multimedia Computing, Communications and Applications", Pearson Education, First ed, 1995.
7. Ranjan Parekh, "Principles of Multimedia", TMH, 2006.

OUTCOMES:

- The student would be able to demonstrate an understanding of the challenges involved in multimedia signal processing and their transmission.
- The student would be in a position to apply his knowledge for identifying a suitable strategy for compression and communication based on the signal characterization and its needs.

AP8075 ELECTROMAGNETIC INTERFERENCE AND COMPATIBILITY IN SYSTEM DESIGN

L	T	P	C
3	0	0	3

OBJECTIVES:

- To enable the student to understand the basic concepts of EMI/EMC, coupling issues and control techniques.
- To make the student familiar with EMC design of PCBs and the measurements and standardization efforts.

UNIT I EMI/EMC CONCEPTS **9**

EMI-EMC definitions and Units of parameters; Sources and victim of EMI; Conducted and Radiated EMI Emission and Susceptibility; Transient EMI, ESD; Radiation Hazards.

UNIT II EMI COUPLING PRINCIPLES **9**

Conducted, radiated and transient coupling; Common ground impedance coupling ; Common mode and ground loop coupling ; Differential mode coupling ; Near field cable to cable coupling, cross talk ; Field to cable coupling ; Power mains and Power supply coupling.

UNIT III EMI CONTROL TECHNIQUES **9**

Shielding, Filtering, Grounding, Bonding, Isolation transformer, Transient suppressors, Cable routing, Signal control.

UNIT IV EMC DESIGN OF PCBS **9**

Component selection and mounting; PCB trace impedance; Routing; Cross talk control; Power distribution decoupling; Zoning; Grounding; VIAs connection; Terminations.

UNIT V EMI MEASUREMENTS AND STANDARDS **9**

Open area test site; TEM cell; EMI test shielded chamber and shielded ferrite lined anechoic chamber; Tx /Rx Antennas, Sensors, Injectors / Couplers, and coupling factors; EMI Rx and spectrum analyzer; Civilian standards-CISPR, FCC, IEC, EN; Military standards-MIL461E/462.

TOTAL: 45 PERIODS

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REFERENCES:

1. V.P.Kodali, “Engineering EMC Principles, Measurements and Technologies”, IEEE Press, New york, 1996.
2. Henry W.Ott.,”Noise Reduction Techniques in Electronic Systems”, A Wiley Inter Science Publications, John Wiley and Sons, Newyork, 1988.
3. Bemhard Keiser, “Principles of Electromagnetic Compatibility”, 3rd Ed, Artech house, Norwood, 1986.
4. C.R.Paul,”Introduction to Electromagnetic Compatibility” , John Wiley and Sons, Inc, 1992.
5. Don R.J.White Consultant Incorporate, “Handbook of EMI/EMC” , Vol I-V, 1988.

OUTCOMES:

1. The student would be able to demonstrate an understanding of the different aspects of EMI coupling and EMC in PCB design.
2. Given the user requirements the student would be in a position to apply his knowledge for identifying a suitable EMI testing and controlling technique.

AP8252 DIGITAL IMAGE PROCESSING

L	T	P	C
3	0	2	4

OBJECTIVES

- To understand the techniques for image enhancement.
- To understand techniques for image segmentation.
- To understand the techniques for compression.

OUTCOMES:

- To be able to design and implement image enhancement schemes.
- To be able to design and implement compression schemes.
- To be able to design and implement restoration schemes.
- To be able to design and implement segmentation schemes.

UNIT I IMAGE REPRESENTATION 9+6

Image representation-Image Basis Functions- Two dimensional DFT- Discrete Cosine Transform-Walsh- Hadamard transform-Wavelet transform- Principal component analysis.

UNIT II IMAGE ENHANCEMENT AND RESTORATION 9+6

Gray level transformation techniques- Spatial domain techniques - Half toning, Median filtering, contrast stretching, Histogram Equalization- Frequency domain techniques - Weiner filtering-Homomorphic filtering- PSFs for different forms of blur - noise models- color image processing.

UNIT III IMAGE SEGMENTATION 9+6

Segmentation - Similarity and dissimilarity methods- Thresholding - Edge based and Region based methods- Hough transform- Morphological operations - Clustering methods.

UNIT IV IMAGE COMPRESSION 9+6

Source coding techniques - Run length coding - Shannon- Fano coding- Huffman coding- Arithmetic coding- LZW coding - Transform and Predictive compression methods - Vector quantization- case studies - JPEG-MPEG.

UNIT V SIMULATION 9+6

Implementation of Image processing algorithms - Image Enhancement - Restoration- Segmentation-Coding techniques- Applications.

TOTAL: 45 +30 = 75 PERIODS

REFERENCES:
1. Gonzalez R. C. and Woods R.E., "Digital Image Processing", 3rd Edition, Prentice-Hall, 2008.
2. Jain A.K., "Fundamentals of Digital Image Processing", PHI Learning Private Ltd., 1989.
3. William K. Pratt, "Digital Image Processing", John Wiley, 4th Edition, 2007.
4. Sonka M, "Image Processing, Analysis and Machine Vision", Vikas Publishing Home (Thomson) 2001.
5. Schalkoff R.J., "Digital Image Processing & Computer Vision", John Wiley & Sons, 1992.
6. Richard O. Duda, Peter E. Hart and David G. Stork., "Pattern Classification", Wiley, 2001.
7. J.W. Woods, "Multidimensional Signal, Image, Video Processing and Coding", 2nd Edition, Academic Press, 2012.

CU8004 COMMUNICATION NETWORK SECURITY L T P C
3 0 0 3

OBJECTIVES:
1. To make the student understand the importance and goals of communication network and information security and introduce him to the different types of attacks.
2. To expose the student to the different approaches to handling security and the algorithms in use for maintaining data integrity and authenticity.
3. To enable the student to appreciate the practical aspects of security features design and their implementation in wired and wireless internetworking domains.

UNIT I INTRODUCTION ON SECURITY 9

Security Goals, Types of Attacks: Passive attack, active attack, attacks on confidentiality, attacks on Integrity and availability. Security services and mechanisms, Techniques: Cryptography, Substitution Ciphers, Transposition Ciphers, Stream and Block Ciphers- Steganography- Revision on Mathematics for Cryptography.

UNIT II SYMMETRIC & ASYMMETRIC KEY ALGORITHMS 9

Data Encryption Standards (DES), Advanced Encryption Standard (AES), RC4, principle of asymmetric key algorithms, RSA Cryptosystem

UNIT III INTEGRITY, AUTHENTICATION AND KEY MANAGEMENT 9

Message Integrity, Hash functions: **SHA 512, Whirlpool**, Digital signatures: Digital signature standards. Authentication: Entity Authentication: Biometrics, Key management Techniques.

UNIT IV NETWORK SECURITY, FIREWALLS AND WEB SECURITY 9

Introduction on Firewalls, Types of Firewalls, Firewall Configuration and Limitation of Firewall. IP Security Overview, IP security Architecture, authentication Header, Security payload, security associations, Key Management. E-mail security: PGP, MIME,S/MIME. Web security requirement, secure sockets layer, transport layer security, secure electronic transaction, dual signature

UNIT V WIRELESS NETWORK SECURITY 9

Security Attack issues specific to Wireless systems: Worm hole, Tunneling, DoS. WEP for Wi-Fi network, Security for Broadband networks: Secure Ad hoc Network, Secure Sensor Networks

TOTAL : 45 PERIODS

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REFERENCES:

1. Behrouz A. Fourcuzan ," Cryptography and Network security" Tata McGraw- Hill, 2008
2. William Stallings,"Cryptography and Network security: principles and practice", 2nd Edition, Prentice Hall of India, New Delhi, 2002
3. Atul Kahate ," Cryptography and Network security", 2nd Edition, Tata McGraw-Hill, 2008.
4. R.K.Nichols and P.C. Lekkas ," Wireless Security"
5. H. Yang et al., Security in Mobile Ad Hoc Networks: Challenges and Solution, IEEE Wireless Communications, Feb. 2004.
6. Securing Ad Hoc Networks," IEEE Network Magazine, vol. 13, no. 6, pp.24-30, December 1999.
7. "Security of Wireless Ad Hoc Networks," http://www.cs.umd.edu/~aram/wireless/survey.pdf
8. David Boel et.al (Jan 2008) "Securing Wireless Sensor Networks – Security Architecture " Journal of networks , Vol.3. No. 1. pp. 65 -76.
9. Perrig, A., Stankovic, J., Wagner, D. (2004), "Security in Wireless Sensor Networks", Communications of the ACM, 47(6), 53-57.

OUTCOMES:

- The student would be able to demonstrate an understanding of the ways in which communication network security may get compromised and the basic principles of security algorithm design.
- The student would be able to implement and analyse the different algorithms and compare their performances.
- The student would be in a position to apply his knowledge for designing or modifying existing algorithms and implementing them atleast by simulation.

CU8005 NETWORK ROUTING ALGORITHMS L T P C
3 0 0 3

OBJECTIVES:

1. To expose the students to the layered architecture for communication networks and the specific functionality of the network layer.
2. To enable the student to understand the basic principles of routing and the manner this is implemented in conventional networks and the evolving routing algorithms based on Internetworking requirements, optical backbone and the wireless access part of the network.
3. To enable the student to understand the different routing algorithms existing and their performance characteristics.

UNIT I INTRODUCTION 7

ISO OSI Layer Architecture, TCP/IP Layer Architecture, Functions of Network layer, General Classification of routing, Routing in telephone networks, Dynamic Non hierarchical Routing (DNHR), Trunk status map routing (TSMR), real-time network routing (RTNR), Distance vector routing, Link state routing, Hierarchical routing.

UNIT II INTERNET ROUTING 10

Interior protocol : Routing Information Protocol (RIP), Open Shortest Path First (OSPF), Bellman Ford Distance Vector Routing. Exterior Routing Protocols: Exterior Gateway Protocol (EGP) and Border Gateway Protocol (BGP). Multicast Routing: Pros and cons of Multicast and Multiple Unicast Routing, Distance Vector Multicast Routing Protocol (DVMRP), Multicast Open Shortest Path First (MOSPF), MBONE, Core Based Tree Routing.

UNIT III ROUTING IN OPTICAL WDM NETWORKS 10

Classification of RWA algorithms, RWA algorithms, Fairness and Admission Control, Distributed Control Protocols, Permanent Routing and Wavelength Requirements, Wavelength Rerouting-Benefits and Issues, Lightpath Migration, Rerouting Schemes, Algorithms- AG, MWPG.

UNIT IV MOBILE - IP NETWORKS 9

Macro-mobility Protocols, Micro-mobility protocol: Tunnel based : Hierarchical Mobile IP, Intra domain Mobility Management, Routing based: Cellular IP, Handoff Wireless Access Internet Infrastructure (HAWAII).

UNIT V MOBILE AD –HOC NETWORKS 9

Internet-based mobile ad-hoc networking communication strategies, Routing algorithms – Proactive routing: destination sequenced Distance Vector Routing (DSDV), Reactive routing: Dynamic Source Routing (DSR), Ad hoc On-Demand Distance Vector Routing (AODV), Hybrid Routing: Zone Based Routing (ZRP).

TOTAL: 45 PERIODS

REFERENCES:

1. William Stallings, ' High speed networks and Internets Performance and Quality of Service', IInd Edition, Pearson Education Asia. Reprint India 2002
2. M. Steen Strub, ' Routing in Communication network, Prentice –Hall International, Newyork,1995.
3. S. Keshav, 'An engineering approach to computer networking' Addison Wesley 1999.
4. William Stallings, 'High speed Networks TCP/IP and ATM Design Principles, Prentice- Hall, New York, 1995
5. C.E Perkins, 'Ad Hoc Networking', Addison – Wesley, 2001
6. Ian F. Akyildiz, Jiang Xie and Shantidev Mohanty, " A Survey of mobility Management in Next generation All IP- Based Wireless Systems", IEEE Wireless Communications Aug.2004, pp16-27.
7. A.T Campbell et al., " Comparison of IP Micromobility Protocols," IEEE Wireless Communications Feb.2002, pp 72-82.
8. C.Siva Rama Murthy and Mohan Gurusamy, " WDM Optical Networks – Concepts, Design and Algorithms", Prentice Hall of India Pvt. Ltd, New Delhi –2002.

OUTCOMES:

- Given the network and user requirements and the type of channel over which the network has to operate, the student would be in a position to apply his knowledge for identifying a suitable routing algorithm, implementing it and analyzing its performance.
- The student would also be able to design a new algorithm or modify an existing algorithm to satisfy the evolving demands in the network and by the user applications.

CU8006 SATELLITE COMMUNICATION L T P C
3 0 0 3

OBJECTIVES:

1. To enable the student to understand the necessity for satellite based communication, the essential elements involved and the transmission methodologies.
2. To enable the student to understand the different interferences and attenuation mechanisms affecting the satellite link design.
3. To expose the student to the advances in satellite based navigation, GPS and the different application scenarios.

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UNIT I ELEMENTS OF SATELLITE COMMUNICATION 8

Satellite Systems, Orbital description and Orbital mechanics of LEO, MEO and GSO, Placement of a Satellite in a GSO, Satellite – description of different Communication subsystems, Bandwidth allocation.

UNIT II TRANSMISSION, MULTIPLEXING, MODULATION, MULTIPLE ACCESS AND CODING 12

Different modulation and Multiplexing Schemes, Multiple Access Techniques – FDMA, TDMA, CDMA, and DAMA, Coding Schemes.

UNIT III SATELLITE LINK DESIGN 9

Basic link analysis, Interference analysis, Rain induced attenuation and interference, Ionospheric characteristics, Link Design with and without frequency reuse.

UNIT IV SATELLITE NAVIGATION AND GLOBAL POSITIONING SYSTEM 8

Radio and Satellite Navigation, GPS Position Location Principles, GPS Receivers and Codes, Satellite Signal Acquisition, GPS Receiver Operation and Differential GPS.

UNIT V APPLICATIONS 8

Satellite Packet Communications , Intelsat series – INSAT series –VSAT, mobile satellite services, INMARSAT, Remote Sensing, Satellite and Cable Television, DBS (DTH), VSAT, Satellite Phones.

TOTAL: 45 PERIODS

REFERENCES:

1. Wilbur L. Pritchard, H.G. Suyderhoud ,Robert A.Nelson, Satellite Communication Systems Engineering, Prentice Hall, New Jersey, 2006.
2. Timothy Pratt and Charles W.Bostain, Satellite Communications, John Wiley and Sons, 2003.
3. D.Roddy, Satellite Communication, McGrawHill, 2006.
4. Tri T Ha, Digital Satellite Communication, McGrawHill,1990.
5. B.N.Agarwal, Design of Geosynchronous Spacecraft, Prentice Hall, 1993.

OUTCOMES:

- The student would be able to demonstrate an understanding of the basic principles of satellite orbits , placement and control, satellite link design and the communication system components.
- The student would be able to demonstrate an understanding of the different communication, sensing and navigational applications of satellite and their implementation.

CU8007 TELECOMMUNICATION SYSTEM MODELING AND SIMULATION

L	T	P	C
3	0	0	3

OBJECTIVES:

- To enable the student to understand the various aspects of simulation methodology and performance, appreciate the significance of selecting sampling frequency and modelling different types of signals and processing them.
- To expose the student to the different simulation techniques, their pros and cons and enable him to understand and interpret results using case studies.

UNIT I SIMULATION METHODOLOGY 8

Introduction, Aspects of methodology, Performance Estimation, Simulation sampling frequency, Low pass equivalent simulation models for bandpass signals, Multicarrier signals, Non-linear and time-varying systems, Post processing – Basic graphical techniques and estimations.

UNIT II RANDOM SIGNAL GENERATION & PROCESSING 8

Uniform random number generation, Mapping uniform random variables to an arbitrary pdf, Correlated and Uncorrelated Gaussian random number generation, PN sequence generation, Random signal processing, Testing of random number generators.

UNIT III MONTE CARLO SIMULATION 9

Fundamental concepts, Application to communication systems, Monte Carlo integration, Semianalytic techniques, Case study: Performance estimation of a wireless system.

UNIT IV ADVANCED MODELS & SIMULATION TECHNIQUES 10

Modeling and simulation of non-linearities : Types, Memoryless non-linearities, Non-linearities with memory, Modeling and simulation of Time varying systems : Random process models, Tapped delay line model, Modelling and simulation of waveform channels, Discrete memoryless channel models, Markov model for discrete channels with memory.

UNIT V EFFICIENT SIMULATION TECHNIQUES 10

Tail extrapolation, pdf estimators, Importance Sampling methods, Case study: Simulation of a Cellular Radio System.

TOTAL: 45 PERIODS

REFERENCES:

1. William.H.Tranter, K. Sam Shanmugam, Theodore. S. Rappaport, Kurt L. Kosbar, Principles of Communication Systems Simulation, Pearson Education (Singapore) Pvt. Ltd, 2004.
2. M.C. Jeruchim, P.Balaban and K. Sam Shanmugam, Simulation of Communication Systems: Modeling, Methodology and Techniques, Plenum Press, New York, 2001.
3. Averill.M.Law and W. David Kelton, Simulation Modeling and Analysis, McGraw Hill Inc., 2000.
4. Geoffrey Gorden, System Simulation, Prentice Hall of India, 2nd Edition, 1992.
5. Jerry Banks and John S. Carson, Discrete Event System Simulation, Prentice Hall of India, 1984.

OUTCOMES:

- The student would be able to mathematically model a physical phenomena and simulate the phenomena so as to depict the characteristics that may be observed in a real experiment.
- The student would be in a position to apply his knowledge of the different simulation techniques for designing a communication system or channel and show the performance so as to match a realistic scenario.

AP8077 HIGH SPEED SWITCHING ARCHITECTURES L T P C
3 0 0 3

OBJECTIVES:

1. To enable the student to understand the basics of switching technologies and their implementation LANs, ATM networks and IP networks.
2. To enable the student to understand the different switching architectures and queuing strategies and their impact on the blocking performances.
3. To expose the student to the advances in packet switching architectures and IP addressing and switching solutions and approaches to exploit and integrate the best features of different architectures for high speed switching.

OUTCOMES:

1. The student would be able to identify suitable switch architectures for a specified networking scenario and demonstrate its blocking performance.
2. The student would be in a position to apply his knowledge of switching technologies, architectures and buffering strategies for designing high speed communication networks and analyse their performance.

UNIT I LAN SWITCHING TECHNOLOGY 9

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

UNIT II ATM SWITCHING ARCHITECTURES 9

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

UNIT III QUEUES IN ATM SWITCHES 9

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

UNIT IV PACKET SWITCHING ARCHITECTURES 9

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

UNIT V IP SWITCHING 9

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

TOTAL : 45 PERIODS

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, NewYork.1998.
5. Rainer Handel, Manfred N Huber, Stefan Schroder, “ATM Networks - Concepts Protocols, Applications”, 3rd Edition, Addison Wesley, New York. 1999.

AP8083 SIGNAL INTEGRITY FOR HIGH SPEED DESIGN L T P C
3 0 0 3

OBJECTIVES:

- To identify sources affecting the speed of digital circuits.
- To introduce methods to improve the signal transmission characteristics

UNIT I SIGNAL PROPAGATION ON TRANSMISSION LINES 9

Transmission line equations, wave solution, wave *vs*. circuits, initial wave, delay time, Characteristic impedance , wave propagation, reflection, and bounce diagrams Reactive terminations – L, C , static field maps of micro strip and strip line cross-sections, per unit length parameters, PCB layer stackups and layer/Cu thicknesses, cross-sectional analysis tools, Zo and Td equations for microstrip and stripline Reflection and terminations for logic gates, fan-out, logic switching , input impedance into a transmission-line section, reflection coefficient, skin-effect, dispersion

UNIT II MULTI-CONDUCTOR TRANSMISSION LINES AND CROSS-TALK 9

Multi-conductor transmission-lines, coupling physics, per unit length parameters, Near and far-end cross-talk, minimizing cross-talk (stripline and microstrip) Differential signalling, termination, balanced circuits ,S-parameters, Lossy and Lossles models

UNIT III NON-IDEAL EFFECTS 9

Non-ideal signal return paths – gaps, BGA fields, via transitions , Parasitic inductance and capacitance , Transmission line losses – Rs, tanδ , routing parasitic, Common-mode current, differential-mode current , Connectors

UNIT IV POWER CONSIDERATIONS AND SYSTEM DESIGN 9

SSN/SSO, DC power bus design, layer stack up, SMT decoupling, Logic families, power consumption, and system power delivery , Logic families and speed Package types and parasitic, SPICE, IBIS models ,Bit streams, PRBS and filtering functions of link-path components, Eye diagrams, jitter , inter-symbol interference Bit-error rate ,Timing analysis

UNIT V CLOCK DISTRIBUTION AND CLOCK OSCILLATORS 9

Timing margin, Clock slew, low impedance drivers, terminations, Delay Adjustments, canceling parasitic capacitance, Clock jitter.

TOTAL : 45 PERIODS

REFERENCES:

1. H. W. Johnson and M. Graham, High-Speed Digital Design: A Handbook of Black Magic, Prentice Hall, 1993.
2. Douglas Brooks, Signal Integrity Issues and Printed Circuit Board Design, Prentice Hall PTR , 2003.
3. S. Hall, G. Hall, and J. McCall, High-Speed Digital System Design: A Handbook of Interconnect Theory and Design Practices, Wiley-Interscience, 2000.
4. Eric Bogatin, Signal Integrity – Simplified , Prentice Hall PTR, 2003.

TOOLS REQUIRED:

1. SPICE, source - http://www-cad.eecs.berkeley.edu/Software/software.html
2. HSPICE from synopsis, www.synopsys.com/products/ mixedsignal/hspice/hspice.html
3. SPECCTRAQUEST from Cadence, http://www.specctraquest.com

OUTCOMES:

- Ability to identify sources affecting the speed of digital circuits.
- Able to improve the signal transmission characteristics.

AP8084 WIRELESS SENSOR NETWORKS L T P C
3 0 0 3

OBJECTIVES:

1. To enable the student to understand the role of sensors and the networking of sensed data for different applications.
2. To expose the students to the sensor node essentials and the architectural details, the medium access and routing issues and the energy constrained operational scenario.
3. To enable the student to understand the challenges in synchronization and localization of sensor nodes, topology management for effective and sustained communication, data management and security aspects.

UNIT I OVERVIEW OF WIRELESS SENSOR NETWORKS 9

Challenges for Wireless Sensor Networks-Characteristics requirements-required mechanisms, Difference between mobile ad-hoc and sensor networks, Applications of sensor networks- case study, Enabling Technologies for Wireless Sensor Networks.

UNIT II ARCHITECTURES 9

Single-Node Architecture - Hardware Components, Energy Consumption of Sensor Nodes, Operating Systems and Execution Environments, Network Architecture - Sensor Network Scenarios, Optimization Goals and Figures of Merit, Gateway Concepts. Physical Layer and Transceiver Design Considerations

UNIT III MAC AND ROUTING 9

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.

UNIT IV INFRASTRUCTURE ESTABLISHMENT 9

Topology Control, Clustering, Time Synchronization, Localization and Positioning, Sensor Tasking and Control.

UNIT V DATA MANAGEMENT and SECIRUTY 9

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.

TOTAL: 45 PERIODS

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 Networks-s Technology, Protocols, And Applications", John Wiley, 2007.
6. Anna Hac, "Wireless Sensor Network Designs", John Wiley, 2003.
7. Bhaskar Krishnamachari, "Networking Wireless Sensors", Cambridge Press,2005.
8. Mohammad Ilyas And Imad Mahgaob,"Handbook Of Sensor Networks: Compact Wireless And Wired Sensing Systems", CRC Press,2005.
9. Wayne Tomasi, "Introduction To Data Communication And Networking", Pearson Education, 2007.

OUTCOMES:

1. The student would be able to appreciate the need for designing energy efficient sensor nodes and protocols for prolonging network lifetime.
2. The student would be able to demonstrate an understanding of the different implementation challenges and the solution approaches.

CU8008 ADVANCED MICROWAVE COMMUNICATION L T P C
3 0 0 3

OBJECTIVES:

- To enable the student to understand the basic principles of microwave amplifiers and oscillators, passive component characteristics, resonators and filters , antennas and microwave radio link characterization.

UNIT I MICROWAVE AMPLIFIERS AND OSCILLATORS 10

Klystron Amplifier – Reflex Klystron Amplifier –Travelling wave tube Amplifier – Magnetron Oscillator and Modulator-Varactor diode – Solid State Broad band Amplifiers – diode detector and mixer-- YIG tuned Oscillators– Comb generators. GUNN, Tunnel IMPATT diode oscillators.

UNIT II MICROWAVE PASSIVE COMPONENTS 8

Scattering parameters-S-Matrix – Attenuator –Phase shifters – T Junctions – Hybrid T Junctions – Directional couplers – Isolater, Properties of ferrite devices – YIG devices—Step recovery Diodes – Gyrator – Circulator – Scattering parameter measurement.

UNIT III MICROWAVE RESONATORS AND FILTERS 9

Review of resonant circuits – principle of Microwave resonators – field analysis of cavity resonators – Characteristics of filters –YIG tuned filters – Filter and resonant applications – SRD Frequency multipliers and frequency Discriminators.

UNIT IV MICROWAVE ANTENNAS 8

Characteristics of Microwave Antennas – Half Wave Dipole –Array – Horn – Paraboloidal Reflector – feeds – Lens and slot Antennas – Leaky and surface wave Antennas – Broad band Antennas – Micro strip Antennas – Antenna measurements.

UNIT V MICROWAVE RADIO SYSTEM 10

Types of propagation – Line of sight transmission – Radio horizon – Broadband Microwave Surveillance Receivers—ELINT and Electronic support measures--Microwave links- Repeaters – Diversity – frequency and space diversity systems – Fading – System gain and path losses - Noise and Absorption in Microwave links**.**

TOTAL : 45 PERIODS

REFERENCES:

1. Roddy.D., “Microwave Technology” Reston Publications.1986.
2. Chatterjee R. “Microwave Engineering “East West Press. 1988.
3. Rizzi.P.”Microwave Engineering Passive circuits”. Prentice Hall.1987
4. Tomasi.W “Advanced Electronic communication systems “Prentice Hall.1987.
5. Clock.P.N. “Microwave Principles and Systems” Prentice Hall.1986.
6. Combes, Graffewil and Sauterean “Microwave Components, Devices and Active
7. Circuits”. John wiley.1987.
8. Annapurana Das.Sisir.K.Das,”Microwave Engineering” Tata Mc Graw Hill, 2000.

OUTCOMES:

1. The student would be able to design a microwave system taking into account the path losses and fading channel characteristics, carry out measurements and interpret results obtained.

CU8009 ADVANCED WIRELESS COMMUNICATION TECHNIQUES L T P C
3 0 0 3

OBJECTIVES:

1. To enable the student to understand the evolving paradigm of cooperative and green wireless communication concepts and the challenges and trade-offs involved in such networks.
2. To enable the student to understand the different power saving strategies and energy efficient signal, system and network design.
3. To expose the student to the energy saving techniques adopted in existing wireless components, protocols and networks and the evolution of green future wireless communication technologies.

UNIT I COOPERATIVE COMMUNICATIONS AND GREEN CONCEPTS 9

Network architectures and research issues in cooperative cellular wireless networks ; Cooperative communications in OFDM and MIMO cellular relay networks: issues and approaches; Fundamental trade-offs on the design of green radio networks, Green modulation and coding schemes, Cooperative techniques for energy efficiency.

UNIT II COOPERATIVE BASE STATION TECHNIQUES 9

Cooperative base station techniques for cellular wireless networks; Turbo base stations ; Antenna architectures for cooperation; Cooperative communications in 3GPP LTE-Advanced, Partial information relaying and Coordinated multi-point transmission in LTE-Advanced.

UNIT III RELAY-BASED COOPERATIVE CELLULAR NETWORKS 9

Distributed space-time block codes ; Collaborative relaying in downlink cellular systems ; Radio resource optimization; Adaptive resource allocation ; Cross-layer scheduling design for cooperative wireless two-way relay networks ; Network coding in relay-based networks

UNIT IV GREEN RADIO NETWORKS 9

Base Station Power-Management Techniques- Opportunistic spectrum and load management, Energy-saving techniques in cellular wireless base stations , Power-management for base stations in smart grid environment , Cooperative multicell processing techniques for energy-efficient cellular wireless communications , Green communications in cellular networks with fixed relay nodes.

UNIT V ACCESS TECHNIQUES FOR GREEN RADIO NETWORKS 9

Cross-layer design of adaptive packet scheduling for green radio networks; Energy-efficient relaying for cooperative cellular wireless networks ; Energy performance in TDD-CDMA multihop cellular networks ; Resource allocation for green communication in relay-based cellular networks ; Green Radio Test-Beds and Standardization Activities.

TOTAL: 45 PERIODS

REFERENCES:

1. Ekram Hossain, Dong In Kim, Vijay K. Bhargava , “Cooperative Cellular Wireless Networks”, Cambridge University Press, 2011.
2. Ekram Hossain, Vijay K. Bhargava(Editor), Gerhard P. Fettweis (Editor), “Green Radio Communication Networks”, Cambridge University Press, 2012.

OUTCOMES:

1. The student would be able to appreciate the necessity and the design aspects of cooperative and green wireless communication.
2. The student would be able to evolve new techniques and demonstrate their feasibility using mathematical validations and simulation tools.
3. The student would be able to demonstrate the impact of the green engineering solutions in a global, economic, environmental and societal context.

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CU8010 **COGNITIVE RADIO NETWORKS** **L T P C**
3 0 0 3

OBJECTIVES:

1. To enable the student to understand the evolving paradigm of cognitive radio communication and the enabling technologies for its implementation.
2. To enable the student to understand the essential functionalities and requirements in designing software defined radios and their usage for cognitive communication.
3. To expose the student to the evolving next generation wireless networks and their associated challenges.

UNIT I INTRODUCTION TO SDR **9**

Definitions and potential benefits, software radio architecture evolution – foundations, technology tradeoffs and architecture implications, Antenna for Cognitive Radio.

UNIT II SDR ARCHITECTURE **9**

Essential functions of the software radio, architecture goals, quantifying degrees of programmability, top level component topology, computational properties of functional components, interface topologies among plug and play modules, architecture partitions.

UNIT III INTRODUCTION TO COGNITIVE RADIOS **9**

Marking radio self-aware, the cognition cycle, organization of congnition tasks, structuring knowledge for cognition tasks, Enabling location and environment awareness in cognitive radios – concepts, architecture, design considerations.

UNIT IV COGNITIVE RADIO ARCHITECTURE **9**

Primary Cognitive Radio functions, Behaviors, Components, A–Priori Knowledge taxonomy, observe – phase data structures, Radio procedure knowledge encapsulation, components of orient, plan, decide phases, act phase knowledge representation, design rules.

UNIT V NEXT GENERATION WIRELESS NETWORKS **9**

The XG Network architecture, spectrum sensing, spectrum management, spectrum mobility, spectrum sharing, upper layer issues, cross – layer design.

TOTAL: 45 PERIODS

REFERENCES:

1. Alexander M. Wyglinski, Maziar Nekovee, And Y. Thomas Hou, “Cognitive Radio Communications And Networks - Principles And Practice”, Elsevier Inc. , 2010.
2. Kwang-Cheng Chen and Ramjee Prasad, ” Cognitive Radio Networks” , John Wiley & Sons, Ltd, 2009.
3. Khattab, Ahmed, Perkins, Dmitri, Bayoumi, Magdy, “Cognitive Radio Networks - From Theory to Practice”, Springer Series: Analog Circuits and Signal Processing, 2009.
4. J. Mitola, “ Cognitive Radio: An Integrated Agent Architecture for software defined radio”, Doctor of Technology thesis, Royal Inst. Technology, Sweden 2000.
5. Simon Haykin, “Cognitive Radio: Brain –empowered wireless communications”, IEEE Journal on selected areas in communications, Feb 2005.
6. Ian F. Akyildiz, Won – Yeol Lee, Mehmet C. Vuran, Shantidev Mohanty, “ NeXt generation / dynamic spectrum access / cognitive radio wireless networks: A Survey Elsevier Computer Networks, May 2006.

OUTCOMES:

1. The student would be able to appreciate the motivation and the necessity for cognitive radio communication strategies.
2. The student would be able to evolve new techniques and demonstrate their feasibility using mathematical validations and simulation tools.
3. The student would be able to demonstrate the impact of the evolved solutions in future wireless network design.

CU8011 COMMUNICATION NETWORK DESIGN L T P C
3 0 0 3

OBJECTIVES:

1. To expose the student to the functional elements and evolution of networking, the multiplexing, switching and routing related issues and some case studies of wired and wireless network design process.
2. To enable the student to analyse the various aspects of a protocol and implement it using a network simulation tool.

UNIT I INTRODUCTION 9

Importance of Quantitative Modeling in Engineering of Telecommunication Networks, The Functional Elements of Networking, Evolution of Networking in the Wired and Wireless Domain.

UNIT II MULTIPLEXING 9

Performance Measures and Engineering Issues Network performance and source characterization, Circuit multiplexed Networks, packet Multiplexing over wireless networks, Events and processes in packet multiplexer models, Deterministic traffic Models and network calculus, stochastic traffic models, LRD traffic, Link Scheduling and network capacity in wireless networks.

UNIT III SWITCHING 9

Performance Measures of packet switches and circuit switches, queuing in packet switches, delay Analysis in Output Queued Switch, Input Queued Switch and CIOQ Switch with Parallelism, Blocking in Switching Networks, Closed Networks.

UNIT IV ROUTING 9

Algorithms for Shortest Path Routing - Dijkstra's Algorithm, Bellman Ford Algorithm, Generalized Dijkstra's Algorithm, Optimal Routing, Routing Protocols-Distance Vector, Link State and Exterior gateway protocols, Formulations of the Routing Problem-minimum interference Routing, MPLS, QoS Routing, Nonadditive and Additive metrics

UNIT V CASE STUDIES 9

Design of a wireless network and a wired network, prototype implementation to be simulated in a network simulator.

TOTAL : 45 PERIODS

REFERENCES:

1. Anurag Kumar, D. Manjunath and Joy "Communication Networking", Morgan Kaufan Publishers,2005.
2. A.Lean Garica and Indra Widjaja,"Communications Networks", Tata Mc Graw Hill,2004.
3. Thomas G.Robertazzi, "Computer Networks and Systems", Third Edition, Springer,2006.
4. Keshav.S., "An Engineering Approach to Computer Networking", Addison – Wesley, 1999.

OUTCOMES:

- Given the specifications of an application, the student would be able to break up the communication network design problem into a number of sub-problems, identify suitable protocol solutions, implement using any simulator tool and carry out performance characterization.

CU8012 ENTERPRISE CLOUD COMPUTING L T P C
3 0 0 3

OBJECTIVES:

- To introduce the basics of cloud computing, the architectural and storage needs and the challenges.
- To enable the student to understand the different aspects of developing cloud services, storage and sharing of data and the deployment tools.

UNIT I INTRODUCTION TO CLOUD COMPUTING 9

Cloud Computing – History of Cloud Computing – Cloud Architecture – Cloud Storage – Why Cloud Computing Matters – Disadvantages of Cloud Computing – Microsoft Azure and Elastic Computing – Cloud Services .

UNIT II DEVELOPING CLOUD SERVICES 9

Web-Based Application – Pros and Cons of Cloud Service Development – Types of Cloud Service Development – Software as a Service – Platform as a Service – Web Services – On-Demand Computing – Discovering Cloud Services Development Services and Tools – Amazon Ec2 – Google App Engine – IBM Clouds .

UNIT III CLOUD CREATION 9

SOAP and REST services – Virtualization Technology – Multitenant software and Data access control for Enterprise applications – Algorithms and Map Reduce analogy.

UNIT IV STORAGE AND BIG DATA 9

Collaborating on Calendars, Schedules and Task Management – Exploring Online Scheduling Applications – Big Table – Hbase and Dynamo – Collaborating on Databases – Storing and Sharing Files m.

UNIT V DEPLOYING TOOLS 9

Cloud Middleware and Mobile Cloud Computing – Eucalyptus – Open nebula – Apache Virtual Computing Lab – Virtualization techniques KVM, XEN and Implementation – Cloudsim Toolkit IaaS Simulator.

TOTAL : 45 PERIODS

REFERENCES:

1. Enterprise Cloud Computing by Gautam Shroff,Cambridge
2. Cloud Computing for Dummies by Judith Hurwitz, R.Bloor, M.Kanfman, F.Halper (Wiley India Edition).
3. Cloud Security by Ronald Krutz and Russell Dean Vines, Wiley-India
4. Michael Miller, Cloud Computing: Web-Based Applications That Change the Way
5. You Work and Collaborate Online, Que Publishing, August 2008.
6. Haley Beard, Cloud Computing Best Practices for Managing and Measuring Processes for
7. On-demand Computing, Applications and Data Centers in the Cloud with SLAs, Emereo Pvt Limited, July 2008.

OUTCOMES:

1. The student would be able to demonstrate an understanding of the development, deployment and management of cloud services and the associated challenges.
2. The student would be capable of setting up cloud applications and cloud resources using open source simulation tools, measure performance data, analyze and interpret results, and appropriately modify algorithms.

CU8013 **MOBILE AD HOC NETWORKS** **L T P C**
3 0 0 3

OBJECTIVES:

- To introduce the characteristic features of adhoc wireless networks and their applications to the students.
- To enable the student to understand the functioning of different access and routing protocols that can be used for adhoc networks.
- To enable the student to understand the need for security and the challenges and also the role of crosslayer design in enhancing the network performance.

UNIT I INTRODUCTION **9**

Introduction to Ad Hoc networks – definition, characteristics features, applications. Characteristics of Wireless channel, Adhoc Mobility Models: - entity and group models.

UNIT II MEDIUM ACCESS PROTOCOLS **9**

MAC Protocols: design issues, goals and classification. Contention based protocols, reservation based protocols, scheduling algorithms, protocols using directional antennas. IEEE standards: 802.11a, 802.11b, 802.11g, 802.15. HIPERLAN.

UNIT III NETWORK PROTOCOLS **9**

Addressing issues in ad hoc network, Routing Protocols: Design issues, goals and classification. Proactive Vs reactive routing, Unicast routing algorithms, Multicast routing algorithms, hybrid routing algorithm, Power/ Energy aware routing algorithm, Hierarchical Routing, QoS aware routing.

UNIT IV END -TO - END DELIVERY AND SECURITY **9**

Transport layer: Issues in designing- Transport layer classification, adhoc transport protocols. Security issues in adhoc networks: issues and challenges, network security attacks, secure routing protocols.

UNIT V CROSS LAYER DESIGN AND INTEGRATION **9**

Cross layer Design: Need for cross layer design, cross layer optimization, parameter optimization techniques, Cross layer cautionary perspective, Co-operative networks:- Architecture, methods of co-operation, co-operative antennas, Integration of ad hoc network with other wired and wireless networks.

TOTAL : 45 PERIODS

REFERENCES:

1. C.Siva Ram Murthy and B.S.Manoj, “Ad hoc Wireless Networks Architectures and protocols”, 2nd edition, Pearson Education. 2007
2. Charles E. Perkins, “Ad hoc Networking”, Addison – Wesley, 2000
3. Stefano Basagni, Marco Conti, Silvia Giordano and Ivan stojmenovic, “Mobile adhoc networking”, Wiley-IEEE press, 2004.
4. Mohammad Ilyas, “The handbook of adhoc wireless networks”, CRC press, 2002.
5. T. Camp, J. Boleng, and V. Davies “A Survey of Mobility Models for Ad Hoc Network Research,” Wireless Communication and Mobile Comp., Special Issue on Mobile Ad Hoc Networking Research, Trends and Applications, vol. 2, no. 5, 2002, pp. 483–502.
6. Fekri M. Abduljalil and Shrikant K. Bodhe , “A survey of integrating IP mobility protocols and Mobile Ad hoc networks”, IEEE communication Survey and tutorials, v 9.no.1 2007.
7. Erdal Çayırcı and Chunming Rong c, “ *Security in Wireless Ad Hoc and Sensor Networks* 2009, John Wiley & Sons, Ltd. ISBN: 978-0-470-02748-6

OUTCOMES:

1. The student would be able to demonstrate an understanding of the trade-offs involved in the design of adhoc networks
2. The student would be able to design and implement protocols suitable to adhoc communication scenario using design tools and characterize them.
3. The student is exposed to the advances in adhoc network design concepts.

CU8014 RADAR AND NAVIGATIONAL AIDS L T P C
3 0 0 3

OBJECTIVES:

1. To enable the student to understand the basic principles of radar operation and the different types of radars an applications.
2. To enable the student to understand the different systems involved in radar configuration, the signal processing aspects to accurately detect and interpret signals and the antenna systems for signal capture.
3. To enable the student to understand the role of radar systems as navigational and landing aid.

UNIT I RANGE EQUATION AND TYPES OF RADAR 9

Basic Radar, Radar equation, Radar parameters, Block diagram, Radar frequencies. Types of Radar: CW, Doppler, MTI, FMCW, Pulsed, Tracking Radar. DSP in Radar (MTD1).

UNIT II RADAR SYSTEM CONCEPTS 9

Different type of Noise, Noise figure, LNA. False alarm & Missed detection, Radar cross section, TR, ATR, Types of Displays -Color CRT, Bright displays, synthetic video displays, A scope, PPI.

UNIT III SIGNAL PROCESSING AND ANTENNAS 9

Detection of radar signals in Noise and clutter, detection of non fluctuating target in noise, Matched filter, Matched filter response to delayed Doppler shifted signals, Radar measurements.
Types of Antennas: Parabolic, Cassegrain and Electronically steered phased array antennas.

UNIT IV RADIO NAVIGATION AND LANDING AIDS 9

General principles, Radio compass (NDB), ADF, VOR, DME., Hyperbolic Navigation DECCA, OMEGA, LORAN, Mechanics of Landing: Instrument Landing System, Microwave Landing System.

UNIT V SATELLITE NAVIGATION AND HYBRID NAVIGATION SYSTEM 9

Basics of Satellite Navigation, Introduction to Global Positioning System., System Description, Basic principles, position, velocity determination, Signal structure- DGPS, Integration of GPS & INS.

TOTAL : 45 PERIODS

REFERENCES:

1. M.I.Skolnik ,"Introduction to Radar Systems", Tata McGraw Hill 2006.
2. Myron Kyton and W.R.Fried "Avionics Navigation Systems" John Wiley & Sons 1997.
3. Nagaraja "Elements of Electronic Navigation" Tata McGraw Hill, 2nd ed, 2000.
4. Albert Helfrick. D, 'Principles of Avionics', Avionics communications Inc., 2004
5. Nathansan, "Radar design principles-Signal processing and environment", 2/e, PHI, 2007.
6. Hofmann-Wellenhof, Hlichlinegger and J.Collins, "GPS Theory and Practice", 5/e Springer International Edition, 2007.
7. Roger J.Sullivan, "Radar foundations for Imaging and advanced concepts", PHI,2004.

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OUTCOMES:

- The student would demonstrate an understanding of the basic principles of radar design.
- The student would be able to identify suitable navigation systems and their usage for a given application scenario.
- The student would be familiar with the use of navigational systems for estimating and measuring the parameters and analyzing and interpreting them.

VL8251 DATA CONVERTERS L T P C
3 0 0 3

OBJECTIVES:

- Analog to Digital (AD) and Digital to Analog (DA) converters constitute a very important building block in all electronics systems. It is these blocks which provide the crucial interface between the primarily analog real world signals and the predominantly digital electronic systems.
- These are critical blocks which are utilized in all major industrial sectors including computers, wireless communication, audio and video systems, biomedical systems, aerospace and automotive systems and so on. There are a few established circuit architectures and principles for design of AD and DA converters.
- The performance limits of both these blocks have been continuously and rapidly improved upon over the last thirty years and this trend is expected to continue at the same pace in the foreseeable future too.
- The present course will explain the basic operational and design principles of the most important CMOS AD and DA converter architectures.

UNIT I INTRODUCTION AND CHARACTERISTICS OF AD/DA CONVERTER CHARACTERISTICS 9

Evolution, types and applications of AD/DA characteristics, issues in sampling, quantization and reconstruction, oversampling and antialiasing filters.

UNIT II SWITCH CAPACITOR CIRCUITS AND COMPARATORS 9

Switched-capacitor amplifiers, switched capacitor integrator, switched capacitor common mode feedback. Single stage amplifier as comparator, cascaded amplifier stages as comparator, latched comparators. offset cancellation, Op Amp offset cancellation, Calibration techniques

UNIT III NYQUIST RATE D/A CONVERTERS 9

Current Steering DACs, capacitive DACs, Binary weighted versus thermometer DACs, issues in current element matching, clock feedthrough, zero order hold circuits, DNL, INL and other performance metrics of ADCs and DACs

UNIT IV PIPELINE AND OTHER ADCs 9

Performance metrics, Flash architecture, Pipelined Architecture, Successive approximation architecture, Time interleaved architecture.

UNIT V SIGMA DELTA CONVERTERS 9

STF, NTF, first order and second order sigma delta modulator characteristics, Estimating the maximum stable amplitude, CTDSMs, Opamp nonlinearities,

TOTAL:45 PERIODS

Attested

DIRECTOR
Centre For Academic Courses
Anna University, Chennai-600 025.

REFERENCES:

1. Behzad Razavi, “Principles of data conversion system design”, IEEE press, 1995.
2. M. Pelgrom, Analog-to-Digital Conversion, Springer, 2010.
3. Rudy van de Plassche, “CMOS Integrated Analog-to-Digital and Digital-to-Analog Converters” Kluwer Acedamic Publishers, Boston, 2003.
4. R. Schreier, G. Temes, Understanding Delta-Sigma Data Converters, Wiley-IEEE Press, 2004.
5. J. G. Proakis, D. G. Manolakis, Digital Signal Processing,Prentice Hall, 1995
6. VLSI Data Conversion Circuits EE658 recorded lectures available at http://www.ee.iitm.ac.in/~nagendra/videolecture

OUTCOME:

- The student who undergoes this course will be able to carry out the design calculations for developing the various blocks associated with a typical CMOS AD or DA converter, select an appropriate configuration as per the required specifications on overall converter, and eventually arrive at the dimensions and bias conditions of all the MOS transistors involved in the design.