ANNA UNIVERSITY, CHENNAI
UNIVERSITY DEPARTMENTS
M.E. COMMUNICATION AND NETWORKING
REGULATIONS – 2015
CHOICE BASED CREDIT SYSTEM

PROGRAMME EDUCATIONAL OBJECTIVES (PEOs):

I. To prepare students to excel in research or to succeed in Communication and Networking domain through global, rigorous post graduate education.
II. To provide students with a solid foundation in mathematical, scientific and engineering fundamentals required to solve problems in Communication and Networking.
III. To train students with good scientific and engineering knowledge so as to comprehend, analyze, design, and create novel products and solutions for the real life problems.
IV. To inculcate students in professional and ethical attitude, effective communication skills, teamwork skills, multidisciplinary approach, and an ability to relate issues in Communication and Networking to broader social context and life-long learning for a successful professional career.

PROGRAMME OUTCOMES (POs):

On successful completion of the programme,

1. Graduates will demonstrate knowledge of mathematics, science and engineering.
2. Graduates will demonstrate an ability to identify, formulate and solve engineering problems.
3. Graduate will demonstrate an ability to design and conduct experiments, analyze and interpret data.
4. Graduates will demonstrate an ability to design a system, component or process as per needs and specifications.
5. Graduates will demonstrate an ability to visualize and work on laboratory and multidisciplinary tasks.
6. Graduate will demonstrate skills to use modern engineering tools, software and equipment to analyze problems.
7. Graduates will demonstrate knowledge of professional and ethical responsibilities.
8. Graduate will be able to communicate effectively in both verbal and written form.
9. Graduate will show the understanding of impact of engineering solutions on the society and also will be aware of contemporary issues.
10. Graduate will develop confidence for self education and ability for life-long learning.

Programme Educational Objectives	Programme Outcomes									
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
I	✓	✓		✓						
II					✓	✓	✓			
III				✓	✓	✓	✓			
IV		✓	✓				✓	✓	✓	✓

			PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
YEAR 1	SEM 1	Applied Mathematics for Network Engineers	✓	✓								
		Communication Techniques	✓	✓	✓	✓		✓				
		Signal Processing and Base band Techniques	✓	✓			✓	✓				
		RF Engineering	✓	✓		✓		✓				
		High Performance Con Networks	✓	✓	✓	✓		✓				
		Networking Laboratory	✓	✓		✓	✓	✓				
	SEM 2	Communication Theory and Systems	✓	✓	✓	✓		✓				
		Next Generation Networks	✓	✓		✓		✓				
		Advanced Optical Communication	✓	✓		✓		✓				
		Wireless Mobile Communication	✓	✓	✓	✓		✓				
		Wireless Networks	✓	✓		✓		✓				
		Elective I										
		Communication and Signal Processing Laboratory	✓	✓		✓	✓	✓				
		Technical Seminar and Report Writing	✓	✓		✓	✓	✓				
YEAR 2	SEM 1	Elective II Elective III										
		Project Work Phase I		✓		✓			✓	✓	✓	✓
	SEM 2	Project Work Phase II		✓		✓			✓	✓	✓	✓

ANNA UNIVERSITY, CHENNAI
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CURRICULA AND SYLLABI I TO IV SEMESTERS

SEMESTER - I

SL. NO.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
THEORY								
1.	MA7157	Applied Mathematics for Network Engineers	FC	4	4	0	0	4
2.	NE7101	Communication Techniques	PC	5	3	0	2	4
3.	CU7152	Signal Processing and Baseband Techniques	PC	3	3	0	0	3
4.	NE 7151	RF Engineering	PC	3	3	0	0	3
5.	NE7102	High Performance Computer Networks	PC	5	3	0	2	4
PRACTICALS								
6.	NE7111	Networking Laboratory	PC	4	0	0	4	2
			TOTAL	**24**	**16**	**0**	**8**	**20**

II SEMESTER

SL. NO.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
THEORY								
1.	NE7202	Communication Theory and Systems	PC	5	3	0	2	4
2.	NE7203	Next Generation Networks	PC	3	3	0	0	3
3.	NE7201	Advanced Optical Communication	PC	4	4	0	0	4
4.	NE7204	Wireless Mobile Communication	PC	5	3	0	2	4
5.	NE7205	Wireless Networks	PC	3	3	0	0	3
6.		Elective I	PE	3	3	0	0	3
PRACTICALS								
7.	NE7211	Communication and Signal Processing Laboratory	PC	4	0	0	4	2
8.	NE7212	Technical Seminar and Report Writing	EEC	2	0	0	2	1
			TOTAL	**29**	**19**	**0**	**10**	**24**

III SEMESTER

SL. NO	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
THEORY								
1.		Elective II	PE	3	3	0	0	3
2.		Elective III	PE	3	3	0	0	3
3.		Elective IV	PE	3	3	0	0	3
PRACTICALS								
4.	NE7311	Project Work Phase I	EEC	12	0	0	12	6
			TOTAL	**21**	**9**	**0**	**12**	**15**

IV SEMESTER

SL. NO	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
PRACTICALS								
1.	NE7411	Project Work Phase II	EEC	24	0	0	24	12
			TOTAL	**24**	**0**	**0**	**24**	**12**

TOTAL NO. OF CREDITS:71

FOUNDATION COURSES (FC)

SL. NO	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1.		Applied Mathematics for Network Engineers	**FC**	4	4	0	0	4

PROFESSIONAL CORE (PC)

SL. NO	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1.		Communication Techniques	PC	5	3	0	2	4
2.		Signal Processing and Base band Techniques	PC	3	3	0	0	3
3.		High Performance Computer Networks	PC	5	3	0	2	4
4.		RF Engineering	PC	3	3	0	0	3
5.		Communication Theory and Systems	PC	5	3	0	2	4
6.		Next Generation Networks	PC	3	3	0	0	3
7.		Advanced Optical Communication	PC	4	4	0	0	4
8.		Wireless Mobile Communication	PC	5	3	0	2	4
9.		Wireless Networks	PC	3	3	0	0	3
10.		Networking Laboratory	PC	4	0	0	4	2
11.		Communication and Signal Processing Laboratory	PC	4	0	0	4	2

PROFESSIONAL ELECTIVES (PE)

SL. NO	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1.	NE7071	Adaptive Signal Processing	PE	3	3	0	0	3
2.	NE7001	Analysis and Design of CMOS Analog Integrated Circuits	PE	3	3	0	0	3
3.	NE7004	Electromagnetic for Communications	PE	3	3	0	0	3
4.	NE7076	Digital Image and Video Processing	PE	3	3	0	0	3
5.	NE7078	Information Theory and Coding	PE	3	3	0	0	3
6.	NE7008	Parallel Processing	PE	3	3	0	0	3
7.	NE7010	Principles of Cryptography and Network Security	PE	3	3	0	0	3
8.	NE7012	RF Integrated Circuits	PE	3	3	0	0	3
9.	NE7014	Speech Recognition and Synthesis	PE	3	3	0	0	3
10.	NE7016	VLSI Design Automation	PE	3	3	0	0	3
11.	NE7075	Detection and Estimation Theory	PE	3	3	0	0	3
12.	AP7252	Digital Image Processing	PE	3	3	0	0	3
13.	NE7073	Broadband Access Technologies	PE	3	3	0	0	3
14.	NE7002	Computational Electromagnetics	PE	3	3	0	0	3
15.	NE7003	Digital Audio and Video Broadcasting Technology	PE	3	3	0	0	3
16.	NE7005	Fundamentals of Cloud Computing	PE	3	3	0	0	3
17.	NE7077	Game theory for Wireless Communication and Networking	PE	3	3	0	0	3
18.	NE7006	Microwave Photonics	PE	3	3	0	0	3
19.	NE7007	Optical Networks	PE	3	3	0	0	3
20.	NE7011	Reconfigurable Computing	PE	3	3	0	0	3
21.	NE7013	Satellite Communication and Navigation Systems	PE	3	3	0	0	3
22.	NE7080	Space Time Wireless Communication	PE	3	3	0	0	3
23.	NE7015	Spread Spectrum Techniques	PE	3	3	0	0	3

24.	NE7017	Wireless Sensor Network Design	PE	3	3	0	0	3
25.	NE7009	Pattern Recognition and Machine Learning	PE	3	3	0	0	3
26.	NE7079	Microwaves and Radar	PE	3	3	0	0	3
27.	NE7251	Real Time Embedded System	PE	3	3	0	0	3
28.	VL7073	VLSI Signal Processing	PE	3	3	0	0	3
29.	IF7251	Advanced Operating Systems	PE	3	3	0	0	3
30.	NE7081	VLSI Design Techniques	PE	3	3	0	0	3
31.	NE7072	ASIC Design	PE	3	3	0	0	3
32.	NE7074	Computational Intelligence	PE	3	3	0	0	3

EMPLOYABILITY ENHANCEMENT COURSES (EEC)

SL. NO	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1.		Technical Seminar and Report Writing	EEC	2	0	0	2	1
2.		Project Work Phase I	EEC	12	0	0	12	6
3.		Project Work Phase II	EEC	24	0	0	24	12

MA7157 APPLIED MATHEMATICS FOR NETWORK ENGINEERS L T P C
4 0 0 4

OBJECTIVES:

To encourage students to develop a working knowledge of the central ideas of Linear Algebra
To develop the ability to use the concepts of Special Functions for solving problems related to Networks.
To analyze the Graph Theory algorithms and understand its applications in Networks.
To impart knowledge on Numerical Methods that will come in handy to solve numerically the problems that arise in engineering. This will also serve as a precursor for future research.
To acquire skills in analyzing Queuing Models.

UNIT I LINEAR ALGEBRA 12

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 SPECIAL FUNCTIONS 12

Bessel's equation – Bessel function – Recurrence relations - Generating function and orthogonal property for Bessel functions of first kind – Fourier-Bessel expansion.

UNIT III GRAPH THEORY AND ALGORITHMS 12

Graphs – Sub graphs – Complements – Graph isomorphism – Eulerian graphs –Hamiltonian graphs - Planar graphs– Kruskal's algorithm – Dijkstra's shortest path algorithm, Prim's algorithm – Transport Networks.

UNIT IV ALGEBRAIC EQUATIONS 12

Systems of linear equations: Gauss Elimination method, pivoting techniques, Thomas algorithm for tridiagonal system – Jacobi, Gauss Seidel, SOR iteration methods - Systems of nonlinear equations: Fixed point iterations, Newton Method, Eigenvalue problems: power method, inverse power method, Faddeev – Leverrier Method.

UNIT V QUEUEING MODELS 12

Markovian queues - Steady State analysis of Single and Multi-server Models - Little's formula - Machine Interference Model - Self Service queue

TOTAL: 60 PERIODS

OUTCOMES:

On successful completion of this course, all students will have developed knowledge and understanding in the fields of Linear Algebra, Special Functions, Graph Theory, Algebraic Equations and Queuing Models.

REFERENCES:

1. Richard Bronson, Gabriel B.Costa, "Linear Algebra", 2nd Edition, Academic Press, 2007.
2. Richard Bronson, "Matrix Operation", Schaum's outline series, 2nd Edition, McGraw Hill, 2011.
3. Glyn James, "Advanced Modern Engineering Mathematics", 3rd edition, Pearson/Prentice Hall, 2004.
4. Peter V.O'Neil, "Advanced Engineering Mathematics" , 7th Edition, Cengage Learning, 2011.
5. Erwin Kreyszig. "Advanced Engineering Mathematics", 10th Edition, John Wiley & Sons, 2010
6. R.Balakrishnan, K.Ranganathan, "A textbook of Graph theory". 2nd Edition, Springer 2012.
7. Adrian Bondy, U.S.R.Murthy, "Graph Theory", Springer 2008
8. Douglas Brent West, "Introduction to Graph Theory",3rd Edition, Prentice Hall , 2008.

NE7101 COMMUNICATION TECHNIQUES L T P C
3 0 2 4

OBJECTIVES:

- To understand the communication system techniques from end-to-end, i.e., from sampling to switching.
- To know the basic parameters that determine the noise performance of a receiver.
- To know the basic structure of various error control coding techniques.
- To understand the various transmission and switching techniques and their limitations.

UNIT I WAVEFORM CODING TECHNIQUES 9+6

Sampling- Quantization - PCM- DPCM – ADPCM- DM- ADM- LPC-CELP.

UNIT II NOISE FIGURE & LINK BUDGET 9+6

Thermal Noise –Power Spectral density - Noise temperature - Noise Figure -Link Budget calculations.

UNIT III ERROR CONTROL TECHNIQUES 9+6

Matrix Parity Check Codes-Linear Block Codes – Error Detection & Correction capability- Cyclic Codes – CRC-Hamming codes – Convolutional codes – Viterbi Decoding algorithm.

UNIT IV TRANSMISSON TECHNIQIUES 9+6

Subscriber Loop Transmission - xDSL, Trunk Transmission Line Coding / Framing / Multiplexing - Signaling- Timing Synchronization –-ARQ Protocols.

UNIT V SWITCHING TECHNIQUES 9+6

Blocking & Non-Blocking Switches- Multistage switches- Space Switching, Time Switching and Combination switching – Erlang B formula-& its applications - Complexity -Path finding times.

TOTAL: 45+30:75 PERIODS

OUTCOMES:

- To acquire skills to design waveform coding techniques and implement the same.
- To acquire skills to design the various error control coding schemes and carry out their implementations.
- To design transmission and switching systems to meet out the required blocking probability.
- To design a receiver to meet out the required Noise performance
- Ability to carry out Link Budget Calculations for the design of communication system

REFERENCES:

1. J.Bellamy, “Digital Telephony”, John Wiley, 3rd Edition, 2003.
2. B.Sklar, “Digital Communications, Fundamentals and Applications”, 2nd Edition, Pearson Education 2007.
3. J.G.Proakis, M.Salehi, “Fundamentals of Communication Systems”, Pearson Education 2006.
4. B.P.Lathi, “Modern Digital and Analog Communication Systems”, 3rd Edition, Oxford University Press, 2007.
5. Andrew S.Tanenbaum, “Computer Networks”, Pearson Education, Inc., 2003.
6. Dimitri P. Bertsekas, Robert G. Gallager, “Data Networks”, Prentice Hall, 1992.
7. J.E.Flood, “Telecommunication Switching, Traffic and Networks”, Pearson, 2007.
8. Thiagarajan Viswanathan, “Telecommunication Switching Systems and Networks”, Prentice Hall India, 1992, Twenty - Sixth Reprint, 2006.

CU7152 SIGNAL PROCESSING AND BASE BAND TECHNIQUES L T P C
3 0 0 3

OBJECTIVES:

- To enable the student to understand the basic principles of random signal processing, spectral estimation methods and adaptive filter algorithms and their applications.
- 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, Kalman, 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

OUTCOMES:

- 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.
- 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.
- The student would be in a position to apply his knowledge for designing a baseband system addressing the channel impairments

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 and Applications, 2/E, Pearson Education India, 2009
5. John G. Proakis, Masoud Salehi, "Communication Systems Engineering", Prentice Hall, 1994.

NE7151 RF ENGINEERING L T P C
3 0 0 3

OBJECTIVES:

- To understand the basics of RF Engineering.
- To introduce the design of RF and microwave systems.
- To learn the basic simulation tools for the design and analysis of RF components and circuits.

UNIT I NETWORKS AND MATRICES 9

Scattering and chain scattering matrices, Generalized scattering matrix, Analysis of two port networks, Interconnection of networks. Positive real concepts, scattering matrix, representation of microwave components (directional coupler, circulators, hybrids and isolators).

UNIT II HIGH FREQUENCY CIRCUIT DESIGN 9

Tuned Circuits, Filter design- Butterworth filter, Chebyshev filter, impedance matching. High frequency amplifier, BJT and FET amplifier, Broadband Amplifiers RF Oscillators, Colpitts, Hartley Oscillators, PLL. High Frequency Integrated Circuits.

UNIT III MICROWAVE AMPLIFIER DESIGN 9

Types of amplifiers, Power gain equations. Introduction to narrow band amplifiers basic concepts, Maximum gain design, Low noise design. High power design, Negative resistance, reflection amplifiers – various kinds – stability considerations, Microwave transistor amplifier design – input and output matching networks – constant noise figure circuits.

UNIT IV MICROWAVE TRANSISTOR OSCILLATOR DESIGN 9

One port and two port negative resistance oscillators. Oscillator configurations, Oscillator design using large signal measurements, Introduction to Microwave CAD packages, Microwave integrated circuits, MIC design for lumped elements.

UNIT V RF AND MICROWAVE ANTENNAS 9

Radiation from surface current and line current distribution, Basic Antenna parameters, Feeding structure-Patch Antenna, Ring Antenna, Micro strip dipole, Micro strip arrays, Traveling wave Antenna, Antenna System for Mobile Radio-Antenna Measurements and Instrumentation. Propagation characteristics of RF and Microwave signals, Introduction to EBG structures.

TOTAL: 45 PERIODS

OUTCOMES:

- The ability to design RF amplifier, mixer and other related circuits.
- To be able to use Smith Chart to design amplifier and circuits for impedance transformation and transmission line matching.

REFERENCES:

1. Matthew M.Radmanesh, "RF and Microwave Design Essentials", Author House, Bloomington, 2007.
2. Daniel Dobkin, "RF Engineering for Wireless Networks", Elsevier, London, 2005.
3. Reinhold Ludwig and Gene Bogdanov, "RF Circuit Design – Theory and Applications", 2nd Edition, Pearson, 2012.
4. E.da Silva, "High Frequency and Microwave Engineering", Butterworth Heinmann Publications, Oxford, 2001.
5. David.M.Pozar, "Microwave Engineering", John Wiley and Sons ,Third Edition, 2005.
6. Kraus.J.D, Marhefka.R.J. Khan.A.S. "Antennas for All Applications", 3rd Edition, Tata McGraw Hill, 2006.
7. Balanis. A, "Antenna Theory Analysis and Design", John Wiley and Sons, New York, Third Edition, 2005.

NE7102 HIGH PERFORMANCE COMPUTER NETWORKS L T P C
3 0 2 4

OBJECTIVES:

- To ensure a comprehensive understanding of high speed computer network architectures
- To study mathematical models related to network performance analysis.
- To focus on current and emerging networking technologies.

UNIT I SWITCHING NETWORKS 9+6

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

UNIT II MULTIMEDIA NETWORKING APPLICATIONS 9+6

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

UNIT III ADVANCED NETWORKS CONCEPTS 9+6

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

UNIT IV PACKET QUEUES AND DELAY ANALYSIS 9+6

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

UNIT V NETWORK SECURITY AND MANAGEMENT 9+6

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

TOTAL: 45+30:75 PERIODS

OUTCOMES:

- To design High performance computer networks.
- To design and implement CAC protocols in multimedia networks.
- Design and implement network protocols in HPCN.
- Analyse performance of network related issues using mathematical models.
- Compare the various methods of providing connection-oriented services over an advanced network with reference to MPLS, VPN.

REFERENCES:

1. Aunurag Kumar, D. Manjunath, Joy Kuri, "Communication Networking", Morgan Kaufmann Publishers, 2011.
2. J.F. Kurose & K.W. Ross, "Computer Networking- A Top Down Approach Featuring the Internet", Pearson, 2nd Edition, 2003.
3. Nader F.Mir, "Computer and Communication Networks", Pearson Education, 2009.
4. Walrand .J. Varatya, "High Performance Communication Network", Morgan Kaufmann – Harcourt Asia Pvt. Ltd., 2nd Edition, 2000.
5. Hersent Gurle & Petit, "IP Telephony, Packet Pored Multimedia Communication Systems", Pearson Education 2003.
6. Fred Halsall and Lingana Gouda Kulkarni, "Computer Networking and the Internet", Fifth Edition, Pearson Education, 2012.
7. Larry L.Peterson & Bruce S.David, "Computer Networks: A System Approach"- Morgan Kaufmann Publisher, 1996.

NE7111 **NETWORKING LABORATORY** **L T P C**

(Experiments using NS2/ QUALNET /NS3/ OMNET/ equivalent) **0 0 4 2**

OBJECTIVES:

- To understand the functioning of various protocols in Wired and Wireless Environment.
- To perform real time experimentation using the existing infrastructure.
- To impart programming skill using NS2/QUALNET.
- Gain knowledge to construct LAN, WLAN, and VLAN in a real-time environment.

Sl. No.	Details of Experiment		Details of System/ software/Hardware Required for a batch of 25 Students	
	Name	Duration	Name	Quantity
1.	AODV/DSR routing	4 hours	NS2/ QUALNET	25
2.	Security algorithms in wired network	4 hours	NS2/ QUALNET	25
3.	MAC protocols Wired and wireless	8 hours	NS2/ QUALNET/Hardware	25
4.	Configuration of LAN	4 hours	Router, switches, (Hardware)	5+10
5.	Configuration of VLAN - Tunneling	8 hours	Router, switches, (Hardware)	5+10
6.	Configuration of WLAN	8 hours	Layer 3 switches, routers, Wifi Access Point, PDA (Hardware)	2+2+1+10
7.	MINI PROJECT	8 hours	NS2/QUALNET/NS3/OMNET	

TOTAL: 60 PERIODS

OUTCOMES

- Ability to design MAC and routing protocols in Wired and Wireless Environment using NS2/QUALNET.
- To acquire the technical competence to meet out the industry expectation on the state – of the art wired / wireless technologies.
- To acquire the ability to design WLAN/ LAN systems meeting out real time requirements.

NE7202 **COMMUNICATION THEORY AND SYSTEMS** **L T P C**

3 0 2 4

OBJECTIVES:

- To give strong fundamentals on Random process.
- To have a comprehensive knowledge of the various signalling schemes.
- To have an in depth knowledge of synchronization and equalization.
- To understand the theoretical limits set by the Information Theory.

UNIT I RANDOM PROCESS **9+6**

Random variables- Random Process- Covariance- Power Spectral Density – Stationary Process- Wide Sense Stationary - Ergodicity- Cyclo stationary Process.

UNI II SIGNALING SCHEMES **9+6**

Base band Signaling -Line Coding schemes & their Power spectra- band pass Signaling - Geometric Representation of signals – Principles of Binary ASK, PSK, FSK - QPSK& QAM-CPFSK, OQPSK, MSK, GMSK – BER & PSDs-ML Detection.

UNIT III SIGNAL ACQUISITION & SYNCHRONIZATION 9+6

Receiver structure for BPSK- QPSK-QAM- Carrier Synchronization- Bit synchronization.

UNIT IV EQUALIZATION 9+6

Channel Models- ISI-Eye Diagram-Receiver Front End-ML Sequence estimation-Linear Equalization-Decision Feedback Equalization.

UNIT V INFORMATION THEORETIC LIMITS 9+6

DMS-Entropy-Mutual information-Capacity of AWGN Channel- Hartley- Shannon Law-Source Coding theorem-Channel Coding Theorem.

TOTAL: 45+30:75 PERIODS

OUTCOMES:

- To be able to make a right choice on the signalling scheme based on their relative performance.
- To be able to arrive at detailed specification for the synchronization and equalization techniques.
- To design and implement Synchronization and Equalization systems.
- To apply the concepts of Random Process to communication system design.

REFERENCES:

1. J.G.Proakis, M.Salehi, " Fundamentals of Communication Systems", Pearson Education 2006.
2. B.Sklar, "Digital Communications, Fundamentals and Applications" , 2nd Edition, Pearson Education 2007.
3. B.P.Lathi, "Modern Digital and Analog Communication Systems", 3rd Edition, Oxford University Press, 2007.
4. U. Madhow, Fundamentals of Digital Communication, Cambridge, 2008.
5. S.Haykin, "Communication Systems". 3rd Edition, John Wiley, 2007.
6. Couch, "Digital & Analog Communication Systems", Pearson Education, India, 2008.

NE7203 NEXT GENERATION NETWORKS L T P C

3 0 0 3

OBJECTIVES:

- To learn the technical, economic and service advantages of next generation networks.
- To learn the basic architecture of a next generation network (NGN) with reference
- To understand NGN services
- To learn the role of P Multimedia Sub-system (IMS), network attachment and admission control functions.
- To learn and compare the various methods of providing connection-oriented services over a NGN with reference to MPLS, MPLS-TE and T-MPLS.

UNIT I INTRODUCTION 9

Evolution of public mobile services - motivations for IP based services, Wireless IP network architecture – 3GPP packet data network architecture. Introduction to next generation networks - Changes, Opportunities and Challenges, Technologies, Networks, and Services, Next Generation Society, future Trends.

UNIT II IMS AND CONVERGENT MANAGEMENT 9

IMS Architecture - IMS services, QoS Control and Authentication, Network and Service management for NGN, IMS advantages, Next Generation OSS Architecture - standards important to OSS architecture, Information framework, OSS interaction with IMS, NGN OSS function/ information view reference model, DMTF CIM.

UNIT III MPLS AND VPN 9

Technology overview –MPLS & QoS, MPLS services and components –layer 2 VPN, layer 2 internetworking, VPN services, signaling, layer 3 VPN –Technology overview, Remote Access and IPsec integration with MPLS VPN.

UNIT IV MULTICAST 9

MPLS Multicast VPN overview – Applications, examples, IPv6 and MPLS- Technology overview, Future of MPLS –Integrating IP and optical networks, Future layer 3 services, future layer 2 services.

UNIT V NGN MANAGEMENT 9

Network Management and Provisioning – Configuration, Accounting, performance, security, case study for MPLS, Future enhancements – Adaptive self healing networks.

TOTAL:45 PERIODS

OUTCOMES:

- To be able to design routing mechanism meeting the desired QoS in NGN.
- To be able to design network management protocols in NGN.
- To be able to compare various methods of providing connection-oriented services over a NGN with reference to MPLS, MPLS-TE and T-MPLS.
- To be able to compare various NGN virtual network services with reference to VPNs, VLANs, pseudo wires, VPLS and typical applications.

REFERENCES:

1. Thomas Plavyk, “Next generation Telecommunication Networks, Services and Management”, Wiley & IEEE Press Publications, 2002.
2. Neill Wilkinson, “Next Generation Network Services”, John Wiley Publications, 2002.
3. Monique J. Morrow, “Next Generation Networks”, CISCO Press, 2007.
4. Robert Wood, “MPLS and Next Generation Networks: Foundations for NGN and Enterprise Virtualization", CISCO Press, 2006.

NE7201 ADVANCED OPTICAL COMMUNICATION L T P C

3 2 0 4

OBJECTIVES:

- Understand the concepts of optical communications and various systems
- Know the recent developments in optical components and their applications
- Understand the non linearities and dispersion issues in optical transmission.
- Be able to identify the merits and demerits of different modulation and detection schemes

UNIT I REVIEW OF OPTICAL COMMUNICATIONS SYSTEMS 9+6

Optical fibers, dispersion, link budget, Time Division Multiplexing, Sub Carrier Multiplexing and code division multiplexing. Systems: Passive optical Network, Hybrid fiber coax architectures, Radio over fiber technologies, free space optics

UNIT II MODERN OPTICAL COMPONENTS 9+6

VCSEL, QW lasers, Multi section DFB lasers, Tunable lasers, Electro absorption modulator, Integrated transmitters and receivers, optical switches and routers, WDM components , Optical schemes for microwave generation

UNIT III NON LINEAR FIBER OPTICS AND APPLICATIONS 9+6

Non linear optics – basics, Brilluion, Raman effects, Four wave mixing, optical phase conjugation. Raman and Brilluion amplifiers, DRFA, fiber lasers, Solitons, Communication using solitons, WDM solitons

UNIT IV DISPERSION COMPENSATION SCHEMES 9+6

Pre, post and mixed compensation schemes, Optical filters for compensation, Delay line filters, Dispersion slope compensation, Dispersion and Non linearity, Dispersion maps, multichannel compensation schemes.

UNIT V ADVANCED MODULATION AND DETECTION TECHNIQUES 9+6

Limitations of direct modulation, ASK,PSK,FSK modulations in coherent systems, Analog schemes: QPSK, QAM, DQPSK, Carrier suppressed schemes. External modulators, single and Dual drive MZM, performance. Non coherent and coherent detection.

TOTAL: 45+30:75 PERIODS

OUTCOMES:

- A thorough knowledge of different optical communication systems
- A thorough knowledge of optical components and its performances
- Details of impairments in optical fiber links and schemes to mitigate them

REFERENCES:

1. G.P.Agrawal, " Fiber optic communication systems" ,4 ed ,John Wiley and Sons,New jersy, 2010.
2. G.P.Agrawal, "Lightwave technology: Components and devices", John Wiley and Sons,New jersy, 2004
3. G.P Agrawal," Applications of Non linear fiber optics", Academic press, Elsevier, Burlington.2007.

NE7204 WIRELESS MOBILE COMMUNICATION L T P C

3 0 2 4

OBJECTIVES

- To understand the issues involved in mobile communication system design and analysis.
- To understand the concept of frequency reuse.
- To understand the characteristics of wireless channels.
- To acquire knowledge in different modulation schemes and its error probability in wireless system.
- To know the fundamental limits on the capacity of wireless channels.
- To understand the diversity concepts.

UNIT I THE WIRELESS CHANNEL 10+6

Overview of wireless systems – Physical modeling for wireless channels – Time and Frequency coherence – Statistical channel models – Capacity of wireless Channel- Capacity of Flat Fading Channel — Channel Distribution Information known – Channel Side Information at Receiver – Channel Side Information at Transmitter and Receiver – Capacity with Receiver diversity – Capacity comparisons – Capacity of Frequency Selective Fading channels.

UNIT II PERFORMANCE OF DIGITAL MODULATION OVER WIRELESS CHANNELS 7+6

Fading– Outage Probability– Average Probability of Error — Combined Outage and Average Error Probability – Doppler Spread – Intersymbol Interference.

UNIT III MULTIANTENNA COMMUNICATION 9+6

Realization of Independent Fading Paths – Receiver Diversity – Selection Combing – Threshold Combing – Maximal-Ratio Combing – Equal - Gain Combing – Transmitter Diversity – Channel known at Transmitter – Channel unknown at Transmitter – The Alamouti Scheme– Transmit & Receive Diversity-MIMO Systems.

UNIT IV MULTICARRIER MODULATION 10+6

Data Transmission using Multiple Carriers – Multicarrier Modulation with Overlapping Subchannels – Mitigation of Subcarrier Fading – Discrete Implementation of Multicarrier Modulation – Peak to average Power Ratio- Frequency and Timing offset – Case study IEEE 802.11a

UNIT V CELLULAR CONCEPTS 9+6

Frequency Reuse – Channel Assignment Strategies – Hand off Strategies – Interference and system capacity- Co-Channel Interference- Adjacent Channel Interference – Trunking and Grade of service – Improving coverage & capacity in cellular systems-Cell Splitting- Sectoring-Repeaters for Range Extension-Microcell Zone Concept.

TOTAL: 45+30: 75 PERIODS

OUTCOMES:

- To apply diversity techniques in wireless systems.
- To design cellular systems to achieve a given GoS (Grade of Service) in coverage and blocking probability.
- To design digital radio links considering various analytical and empirical models.
- To carry out link budget calculations.
- To be able to design frequency reuse patterns for cellular communication.

REFERENCES:

1. David Tse and Pramod Viswanath, “Fundamentals of Wireless Communication”, Wiley Series in Telecommunications, Cambridge University Press, 2005.
2. Theodore.S. Rappaport, “Wireless Communications: Principles and Practice", 2nd Edition, Pearson Education, India, 2009.
3. Arogyaswami Paulraj, Rokit Nabar, Dhananjay Gore, “Introduction to Space-Time Wireless Communication”, 1st Edition, Cambridge University Press, 2008.
4. W.C.Y.Lee, “Mobile Cellular Telecommunications - Analog and Digital Systems”, 2nd Edition. Tata McGraw Hill, 2006.
5. Andrea Goldsmith, “Wireless Communications”, Cambridge University Press, 2005.

NE7205 WIRELESS NETWORKS L T P C

3 0 0 3

OBJECTIVES :

- To understand the fundamentals of wireless networks.
- To learn the concepts of various wireless technologies.
- To gain adequate exposure to the emerging technologies and their potential impact.

UNIT I WIRELESS LAN and PAN 9

Introduction, fundamentals of WLAN –technical issues, network architecture, IEEE 802.11-physical layer, Mac layer mechanism, CSMA/CA,RTS/CTS, Polling, Bluetooth- User scenarios, Architecture, Radio layer, Baseband layer, Link manager protocol, L2CAP, Security, SDP, IEEE 802.15.3.

UNIT II WIRELESS INTERNET 9

Introduction –wireless internet, address mobility, inefficiency of transport layer and Application layer protocol, mobile IP – simultaneous binding, route optimization, mobile IP variations, handoffs, IPv6 advancements, IP for wireless domain, security in mobile IP, TCP in wireless domain – TCP over wireless , TCPs -traditional, snoop, indirect, mobile, transaction- oriented, impact of mobility.

UNIT III AD-HOC SENSOR NETWORK 9

Wireless Sensor Network – Applications, design Challenges, Protocol stack, comparisons with MANET node architecture, network architecture, MAC protocols-requirements, IEEE 802.15.4 MAC protocol, Routing Protocol –energy aware routing, Location based routing, clustering, aggregation, QoS, security protocol, Zigbee standard.

UNIT IV 3G NETWORKS 9

Evolution from GSM, 3G Services and Applications - UMTS network structure - Core network - UMTS Radio access - HSPA – HSUPA- HSDPA- CDMA 1X - EVDO Rev -0, Rev-A, Rev-B, Rev-C Architecture- Protocol stack, Cognitive Radio network, Spectrum Sensing.

UNIT V 4G - LTE 9

Overview of LTE Networks - Need for LTE- From LTE to LTE-Advanced SAE :- LTE Architecture, Radio Protocol stack , Interfaces, Concept of HetNET, Quality of Service and Bandwidth Reservation - QoS metrics, Signaling for Bandwidth Requests and Grants, Bandwidth Allocation and Traffic Handling, Mobility Management, Security Protocols.

TOTAL: 45 PERIODS

OUTCOMES:

- To design the various wireless networks.
- To be able to design the 4G and LTE networks.
- To design application sensor networks.
- To design Heterogeneous networks.

REFERENCES:

1. Jochen Schiller, “Mobile Communication”, Pearson education, 2nd edition 2005.
2. Holger Karl and Andreas Willing, “Protocols and Architecture for Wireless Sensor Network”, John Wiley & Sons, 2007.
3. Juha Korhonen, “Introduction to 3G Mobile Communication”, Artech House, 2003.
4. Harri Holma and Antti Toskala, “HSDPA/HSUPA for UMTS”, John Wiley & Sons, 2006.
5. Abd-Elhamid M. Taha and Hossam S. Hassanein and Najah Abu Ali, “LTE, LTE-Advanced and Wimax towards IMT-advanced networks” John Wiley & Sons , 2012**.**
6. Vijay. K. Garg, “Wireless Communication and Networking”, Morgan Kaufmann Publishers, 2007.
7. Larry J. Greenstein, Andrea J. Goldsmith, “Principles of Cognitive Radio”, Cambridge University press, 2013.

NE7211 COMMUNICATION AND SIGNAL PROCESSING LABORATORY L T P C

(SDR platform based) **0 0 4 2**

OBJECTIVE:

- To develop skills for implementing various modulations, coding and equalization schemes on a SDR platform.

Sl. No.	Details of Experiment		Details of Equipment / Instrument Required for a batch of 25 Students	
	Name	Duration	Name	Quantity
1.	Pulse Shaping, Timing & Frequency Synchronization	4 Hours	Set - PC + SDR Board	12 sets
2.	BPSK Modulation and Demodulation	4 Hours	Set - PC + SDR Board	12 sets
3.	Differential BPSK	4 Hours	Set - PC + SDR Board	12 sets
4.	QPSK Modulation and Demodulation	4 Hours	Set - PC + SDR Board	12 sets
5.	16-QAM	4 Hours	Set - PC + SDR Board	12 sets
6.	LMS based linear Channel Equalization	4 Hours	Set - PC + SDR Board	12 sets
7.	Decision Feedback Equalizer	4 Hours	Set - PC + SDR Board	12 sets
8.	OFDM -Synchronization & Channel estimation	4 Hours	Set - PC + SDR Board	12 sets
9.	Mini Project	4 Hours	Set - PC + SDR Board	12 sets

TOTAL: 60 PERIODS

OUTCOMES:

- To be able to design and implement synchronization schemes for communication system. To be able to design and implement equalization schemes.
- To be able to design and implement various digital modulation schemes. To be able to design and implement OFDM systems.
- To be able to use SDR platform for design of communication systems.

NE7071 ADAPTIVE SIGNAL PROCESSING L T P C
3 0 0 3

OBJECTIVES:

- To provide an in-depth coverage of the adaptive filter theory.
- To provide the mathematical framework for the understanding of adaptive statistical signal processing.
- To know the basic tools of vector spaces and discrete-time stochastic process.
- To understand the various issues involved in adaptive filtering.
- To Various types of adaptive filters will be introduced and their properties will be studied, specifically convergence, tracking, robustness and computational complexity.
- Learn to apply adaptive filter theory using prescribed case studies.

UNIT I STOCHASTIC PROCESSES AND SPECTRUM ESTIMATION 9

Statistical characteristics of a stochastic process-Non-Parametric methods - Correlation method - Co-variance estimator - Performance analysis of estimators – Unbiased consistent estimators - Periodogram estimator - Barlett spectrum estimation - Welch estimation - Model based approach - AR, MA, ARMA Signal modeling - Parameter estimation using Yule-Walker method.

UNIT II WIENER FILTERS 9

Optimum Filtering-The normal equations and the Wiener filter-Minimum mean square error estimation and the orthogonality principle-Wiener-Hopf equations- Linear prediction-forward Linear Prediction-Backward linear prediction-Levinson-Durbin algorithm.

UNIT III GRADIENT-BASED ADAPTIVE FILTERS 9

Basic idea of the steepest descent algorithm- The steepest descent algorithm applied to wiener filter – Stability of the steepest descent algorithm- The LMS algorithm-LMS adaptive algorithm-Method of Least Squares-Data windowing-Properties of LS Estimates-MVDR spectrum estimation. Recursive Least Squares (RLS)-Exponentially weighted RLS-Convergence analysis-Sliding window RLS.

UNIT IV KALMAN FILTERS & TRACKING 9

Statement of the kalman filtering problem-The innovation process- Estimation– Filtering -Initial conditions. Variants of the kalman filter-The Extended kalman filter-Criteria for tracking assessment-Tracking performance of the LMS and RLS algorithms- Comparison.

UNIT V APPLICATIONS 9

Channel equalization-Echo cancellation- Deconvolution- Adaptive noise cancellation-Adaptive interference cancellation. Case study.

TOTAL: 45 PERIODS

OUTCOMES:

- To be able to solve the problems related to optimal design, convergence, and recursiveness.
- To carry out time/frequency domain implementations of adaptive filters.
- To be able to apply the concepts of stochastic processes to adaptive filters.
- To be able design adaptive filter algorithms.
- To be able to apply adaptive filter theory to applications such as echo cancelation, noise cancellation and channel equalization.

REFERENCES:

1. Simon Haykin, “Adaptive Filter Theory”, Pearson Education, Fourth Edition, 2003.
2. Monson H. Hayes, “Statistical Digital Signal Processing and Modeling”, Wiley, 2008.
3. Ali.H.Sayed, “Fundamentals of Adaptive Filtering”, John Wiley & Sons, 2003.
4. Paulo S. R. Diniz, “Adaptive Filtering Algorithms and Practical Implementation”, Springer, 2011.
5. Lino Garcia, “Adaptive Filtering Applications”, InTech, Published, 2011.
6. Kong-Aik Lee, Woon-Seng Gan, Sen M. Kuo, “Subband Adaptive Filtering: Theory and Implementation”, Wiley, 2009.

NE7001 ANALYSIS AND DESIGN OF CMOS ANALOG INTEGRATED CIRCUITS **L T P C 3 0 0 3**

OBJECTIVES:

- To understand the behaviour of MOS Transistor.
- To learn the concepts of amplifiers, current mirrors and reference generator circuits.
- To understand data converters.
- To study the feedback and frequency compensation techniques.

UNIT I MODELS FOR IC ACTIVE DEVICES 9

Introduction- Large signal behavior of MOS transistor- small signal behavior of the MOS transistor – Short channel effect in MOS transistor – Weak inversion in MOS transistor – Large signal and small signal analysis of single stage MOS amplifiers (CS, CG and CD) - SPICE simulation for MOS circuits.

UNIT II CMOS OPERATIONAL TRANSCODUCTANCE AMPLIFIER 9

Introduction –Difference between Op-Amp and OTA- Differential OTA – slew rate, PSRR, CMRR and Dynamic range of the OTA-Design of Telescopic Cascode and Folded Cascode OTAs. Design of two-stage amplifier- Miller compensation method for two-stage OTA- Noise in feedback OTAs- SPICE frequency simulation for CMOS OTA.

UNIT III CURRENT MIRROR AND REFERENCES 9

Introduction- Simple MOS current Mirror – Current Mirror with Degeneration – Cascode Current Mirror- Wilson Current Mirror – MOS Widlar current source – Supply insensitive biasing – Constant settling time biasing - Temperature insensitive biasing- Start-up circuit for biasing circuits - SPICE simulation for biasing circuits.

UNIT IV ANALOG COMPARATORS AND OUTPUT STAGES 9

Introduction – OTA based comparator – Drawbacks of OTA based comparator – Regenerative latch comparator – Resistive divider comparator- Output stages - SPICE simulation for comparators and output stages.

UNIT V ANALOG DESIGN WITH MOS TECHNOLOGY 9

Design of 8-bit flash type ADC- Design of 10-bit successive approximation (SAR) & pipelined ADC- A Systematic Design approach of DAC- SPICE simulations for the above designs – Introduction to concepts of power integrity, substrate noise, and reliability.

TOTAL: 45 PERIODS

OUTCOMES:

- To be able to design various OTAs.
- To be able to design different kinds of data converters.
- To be able to carry out SPICE simulation of various analog circuits.

REFERENCES:

1. Gray, Meyer, Lewis, Hurst, “Analysis and design of Analog IC’s”, 5th Edition, Willey International, 2009.
2. Behzad Razavi, “Design of Analog CMOS Integrated Circuits”, Tata McGraw Hill, 2000.
3. Rudy J. Van De Plassche, “CMOS Integrated Analog-to-Digital and Digital-to-Analog Converters”, Springer, 2010.
4. Behzad Razavi, “Principles of Data Conversion System Design”, Wiley IEEE Press; 1st Edition, 1994.
5. Phillip E.Allen Douglas R. Holberg, “CMOS Analog Circuit Design”, Second Edition, Oxford University Press, 2011.
6. David A. Johns and Ken Martin, “Analog Integrated Circuit Design”, John Wiley International Publications, 2008.

NE7004 ELECTROMAGNETICS FOR COMMUNICATIONS L T P C
3 0 0 3

OBJECTIVES:

- To revise the concepts of electromagnetic wave theory, Maxwell's equations, electromagnetic fields, charges, currents.
- To understand the fundamentals of applied electromagnetism by emphasizing physical and practical applications in modern communication systems.

UNIT I FUNDAMENTALS OF ELECTROMAGNETIC THEORY REVISITED 9

Electric and magnetic fields; Maxwell's equations in integral form; Maxwell's equations in differential form; Boundary conditions; Poynting's vector and energy storage; Static fields and circuit elements; Quasi- static fields and frequency behaviour of circuit elements.

UNIT II ELECTROMAGNETIC INTERFERENCE 9

Electromagnetic Environment, Practical concerns, Frequency spectrum conservation, Sources of EMI: Lightning, ESD, EMP, EMI from apparatus and circuits. Modelling of Interferences, Test sites and measurements.

UNIT III ELECTROMAGNETIC COMPATIBILITY 9

Methods of solution of EMC problems; Capacitive and inductive couplings; Crosstalk on transmission lines; Common impedance coupling; EMI filters, Grounding and Shielding; Cables and connectors, EMC standards.

UNIT IV ELECTROMAGNETIC WAVE PROPAGATION 9

EM Waves and Radiation. Overview of propagation effects; Ground wave, Sky wave Tropospheric Ionospheric propagation effects; Propagation prediction models for satellite and Mobile links.

UNIT V ELECTROMAGNETICS FOR LIGHTWAVE & RADAR SYSTEMS 9

Reflection, refraction, Interference and diffraction of plane waves; Dielectric slab waveguide; Pulse broadening in a dispersive medium. RADAR, LIDAR range equations, Radar cross section (RCS). Introduction to electromagnetic field computation.

TOTAL: 45 PERIODS

OUTCOMES:

- To be able to apply Maxwell's equations for electromagnetic systems.
- To able to design systems to mitigate the effects of Electromagnetic Interference.
- To design systems with Electromagnetic compatibility

REFERENCES:

1. N.N.Rao, "Fundamentals of Electromagnetics for Engineering", Pearson Education, 2008.
2. Henry Ott, "Electromagnetic Compatibility Engineering", John Wiley, New Jersey, 2009.
3. Abdollah Gasemi, Ali Abedi,Farshid Gashemi, "Propagation Engineering in Wireless Communication". Springer Verlag, Newyork, 2012.
4. Dennis Roddy, "Satellite Communications", Fourth Edition, McGraw Hill, 2006.
5. Andrea Goldsmith, "Wireless Communications", Cambridge University Press, 2005.
6. G. Keiser, "Optical Fiber Communications", 4th Edition, Tata McGraw-Hill, New Delhi, 2008.
7. Michael. O. Kolawole, "Radar Systems, Peak Detection and Tracking", Elsevier, Burlington, 2006.

NE7076 DIGITAL IMAGE AND VIDEO PROCESSING L T P C
3 0 0 3

OBJECTIVES:

- To provide the basic concepts of image & pattern recognition.
- To give an exposure to basic image processing and modeling techniques.
- To provide an understanding of various concepts related to video object extraction.
- To prepare students for development and implementation of algorithms

UNIT I IMAGE FUNDAMENTALS AND TRANSFORMS 9

Image Representation- Sampling and Quantization - Two dimensional DFT- Discrete cosine Transform - Walsh - Hadamard transform - Wavelet transform - Construction of Wavelets-Types of wavelets - principal component analysis.

UNIT II PROCESSING AND MODELING OF IMAGES 9

Pre-processing -Point operations – contrast stretching – Histogram - Histogram equalization - Image segmentation- pixel based, edge based, region based segmentation - Morphological image processing - Edge and texture models - Image registration - Colour Image Processing

UNIT III SPATIAL FEATURE EXTRACTION 9

Feature selection - Localized feature extraction- Boundary Descriptors - Moments - Texture Descriptors - Co-occurrence features

UNIT IV CLASSIFIERS 9

Kernel based approaches - clustering methods - Maximum Likelihood Estimation- Bayesian approach- Pattern Classification

UNIT V VIDEO OBJECT EXTRACTION 9

Back ground subtraction – Frame difference - Static and dynamic background modeling - optical flow techniques-Handling occlusion- scale and appearance changes - Shadow removal

TOTAL: 45 PERIODS

OUTCOMES:

- To be able to design pattern recognition systems.
- To design and implement feature extraction techniques for a given application.
- To design a suitable classifier for a given application.

REFERENCES:

1. A.K.Jain, “Fundamentals of Digital Image Processing”, Prentice-Hall, 2002.
2. R.C.Gonzalez and R.E.Woods, ‘Digital Image Processing’, Second Edition, Pearson Education, 2002.
3. A.Bovik, “Handbook of Image and Video Processing”, 2nd Edition, Academic Press, 2005.
4. Mark Nixon and Alberto Aguado, “Feature Extraction and Image Processing”, Academic Press, 2008.
5. John C.Russ, “The Image Processing Handbook”, CRC Press, 2007.
6. Richard O. Duda, Peter E. Hart and David G. Stork., “Pattern classification”, Wiley, 2001

NE7078 INFORMATION THEORY AND CODING L T P C
3 0 0 3

OBJECTIVES :

- To understand the concepts of Information theory and Coding.
- To understand the fundamental limits prescribed by the information theory.
- To learn the various coding schemes in detail.

UNIT I QUANTITATIVE STUDY OF INFORMATION 9

Basic inequalities, Entropy, Kullback-Leibler distance, Mutual information, Bounds on entropy, Fisher information , Cramer Rao inequality, Second law of thermodynamics,Sufficient statistic, Entropy rates of a Stochastic process .

UNIT II CAPACITY OF NOISELESS CHANNEL 9

Fundamental theorem for a noiseless channel, Data compression, Kraft inequality, Shannon-Fano codes , Huffman codes , Asymptotic equipartition, Rate distortion theory .

UNIT III CHANNEL CAPACITY 9

Properties of channel capacity, Jointly typical sequences, Channel Coding Theorem, converse to channel coding theorem, Joint source channel coding theorem.

UNIT IV DIFFERENTIAL ENTROPY AND GAUSSIAN CHANNEL 9

AEP for continuous random variables, relationship between continuous and discrete entropy, properties of differential entropy, Gaussian channel definitions, converse to coding theorem for Gaussian channel, channels with colored noise, Gaussian channels with feedback.

UNIT V CHANNEL CODING TECHNIQUES 9

Galois Fields, Fundamental Theorem of Galois Theory (FTGT), Reed-Solomon Codes, Turbo Codes, LDPC Codes, TCM.

TOTAL: 45 PERIODS

OUTCOMES

- The student will be in a position to quantify information.
- To be able to design and implement various coding schemes.
- To be able to apply coding techniques to information sources like video, audio and so on.

REFERENCES:

1. Thomas Cover, Joy Thomas, “Elements of Information Theory “, Wiley, 2005.
2. David Mackay , “Information Theory, Interference & Learning Algorithms”, Cambridge University Press, 1st edition, 2002.

NE7008 PARALLEL PROCESSING L T P C
3 0 0 3

OBJECTIVES:

- To understand the architectures for parallel processing.
- To learn the concepts of pipelining and multithreading.

UNIT I THEORY OF PARALLELISM 9

Parallel computer models- the state of computing, Multiprocessors and multi computers and multivectors and SIMD computers, PRAM and VLSI models, Architecture development tracks Program and network properties.

UNIT II PARALLEL PROCESSING APPLICATIONS 9

Conditions of parallelism, Program partitioning and scheduling, Program flow mechanisms, system interconnect architectures. Principles of scalable performance, performance metrics and measures, Data Flow Machine Language- Architecture of Data Flow Machines.

UNIT III HARDWARE TECHNOLOGIES 9

Processor and memory hierarchy- advanced processor technology, superscalar and vector processors, memory hierarchy technology, virtual memory technology, bus cache and shared memory, backplane bus systems, cache memory organizations, shared memory Organizations, sequential and weak consistency models.

UNIT IV INSTRUCTION LEVEL PARALLEL PROCESSING 9

Pipelining in processing elements- delays in Pipeline execution- difficulties in Pipelining- Superscalar Processors- Vector Processor – Very Long Instruction Word Processor (VLIW)- Commercial Processor-Power PC 620 RISC Processor- Two Instruction Superscalar RISC Processor- Multithreaded Processors- Future Processor Architecture- Trace Processor, Multiscalar Processor, Superflow Architecture.

UNIT V PARALLEL ALGORITHMS 9

Classification of Parallel Algorithms: Synchronized and Asynchronized parallel algorithms, Performance of Parallel algorithms- Elementary parallel algorithms: Searching, Sorting, Matrix Operations

TOTAL: 45 PERIODS

OUTCOMES:

- Apply the problem solving techniques in parallel computing.
- To be able to solve problems related to memory management.
- To be able to design efficient parallel algorithms.

REFERENCES:

1. Kai Hwang & Naresh Jotwani, “Advanced Computer Architecture”, Tata McGraw Hill, Second Edition.
2. William Stallings, “Computer Organization and Architecture”, Indian Edition, Pearson Education, 2010.
3. V.Rajaraman, C.Siva Ram Murthy,”Parallel Computers” Architecture and Programming, Prentice Hall of India Private Limited, 2006.
4. Hwang.K.Briggs F.A., “Computer Architecture and Parallel Processing”, Tata McGraw H
5. Quinn M.J, “Designing Efficient Algorithm for Parallel Computers”, Mc Graw Hill, 2003.

NE7010 PRINCIPLES OF CRYPTOGRAPHY AND NETWORK SECURITY L T P C

3 0 0 3

OBJECTIVES:

- To learn the fundamentals of cryptography and its application to network security.
- To understand the mathematics behind cryptography.
- To study about network security threats, security services, and counter measures.
- To learn about the principles and protocols that enables its application to wired and wireless networks.
- To develop an understanding of security policies such as authentication, integrity and confidentiality as well as protocols to implement such policies.

UNIT I INTRODUCTION AND NUMBER THEORY 9

Introduction – Goals, Attacks, Security Services and Mechanisms, and Techniques, Classic Cipher Techniques – Mono-alphabetic and Poly-alphabetic Substitution Ciphers - Transposition Ciphers. Number Theory and Finite Arithmetic, Congruence Arithmetic, Fermat's Theorem and Euler's Theorem, Primes, Primality Testing, Factorization, CRT, Exponentiation.

UNIT II SYMMETRIC AND ASYMMETRIC CRYPTOSYSTEMS 9

Modern Symmetric Block Ciphers – DES, 3DES, AES and Mode of operations, Stream Ciphers, Asymmetric Cryptosystem- RSA, ElGamal, ECC, Key Management using Exponential Ciphers - Diffie-Hellman.

UNIT III AUTHENTICATION, DIGITAL SIGNATURES AND CERTIFICATES 9

Message Authentication (Integrity) – MAC – Hash Functions – Birthday Attacks, Digital Signature - Digital Signature Standards (FIPS 186-2), DSA (ANSI X9.30), RSA (ANSI X9.31) – Public key distribution - RSA, PKI Certificates, PKI Life Cycle Management.

UNIT IV TRUSTED IDENTITY 9

Password System: Fixed and One time Passwords (S/Key) RFC 2289 – Callback Systems, Challenge and Response Systems – RADIUS – Kerberos v4 & v5 – Needham Schroeder Protocol – ITU-T X.509 – Wireless Security – Issues, WEP.

UNIT V SECURITY AT LAYERS 9

Network Layer- IPSec, Transport Layer- SSL/TLS, SSH Application Layer –PGP, S/MIME, Firewall - Concepts, Architecture, Packet Filtering, Proxy Services and Bastion Hosts.

TOTAL: 45 PERIODS

OUTCOMES:

- To design cryptographic algorithms and carry out their implementation.
- To be able to do cryptanalysis on cipher.
- To be able to design and implement security protocols.

REFERENCES:

1. Behrouz A.Forouzan, "Cryptography and Network Security", Special Edition, Tata McGraw Hill, 2007.
2. William Stallings "Cryptography and Network Security: Principles and Practice", 3rd Edition, Pearson Education, 2002.
3. William Stallings "Network Security Essentials: Applications and Standards", 2nd Edition, Pearson Education, 2000.
4. Charlie Kaufmann, Radia Perlman, Mike Speciner, "Network Security", Second Edition, Prentice Hall, 2002. .
5. Bruce Scheneier, "Applied Cryptography", John Wiley & Sons, 1994.
6. Douglas R.Stinson, "Cryptography: Theory and Practice", CRC Press Series on Discrete Mathematics and its Applications, 1995.
7. David M. Durton, "Elementary Number Theory", Tata Mcgraw Hill, Sixth Edition, 2009.

NE7012 **RF INTEGRATED CIRCUITS** **L T P C**
3 0 0 3

OBJECTIVES:

- To understand the fundamentals of RF integrated circuits operating at microwave frequencies.
- To learn RFIC design techniques, including system architecture, key building blocks design methodologies in CMOS technology.

UNIT I BASIC RF IC COMPONENTS 9

Skin effect, Resistors, Capacitor, Inductor and Transformers at high frequency, Interconnect options. S-parameters with Smith chart, Impedance matching networks, Transmission lines, finite length effects, MOSFET characteristics, Noise: Two port Noise theory, Noise Figure, THD, IP2, IP3, Sensitivity, SFDR.

UNIT II RECEIVERS ARCHITECTURE AND LOW NOISE AMPLIFIERS 9

Homodyne Receiver, Heterodyne Receiver, Image reject, Low IF Receiver Architectures Direct up conversion Transmitter, Two step up conversion Transmitter, CMOS amplifiers, Single ended and Differential LNAs, Terminated with Resistors and Source Degeneration LNAs, OC Time constants in bandwidth estimation and enhancement, Power match and Noise match.

UNIT III FEEDBACK SYSTEMS AND POWER AMPLIFIERS 9

Stability of feedback systems: Gain and phase margin, Root-locus techniques, Time and Frequency domain considerations , Compensation, General model – Class A, AB, B, C, D, E and F amplifiers, Power amplifier Linearization Techniques, Efficiency boosting techniques.

UNIT IV PLL AND FREQUENCY SYNTHESIZERS 9

Linearised PLL Model, Noise properties, Phase detectors, Loop filters and Charge pumps, PLL Design examples. Integer-N frequency synthesizers, Direct Digital Frequency synthesizers.

UNIT V MIXERS AND OSCILLATORS 9

Mixer characteristics, Non-linear based mixers, Multiplier based mixers, Single balanced and double balanced mixers, sub sampling mixers, Oscillators describing Functions, Resonators, Phase noise, Chip Design Examples: GPS Receiver, WLAN receiver.

TOTAL: 45 PERIODS

OUTCOMES:

- The ability to analyze and design the high frequency effects on basic circuit components.
- To design RF LNAs and receivers.
- To design RF power amplifiers.
- To design PLL and frequency synthesizers.

REFERENCES:

1. Thomas Lee," The Design of Radio Frequency CMOS Integrated Circuits", Cambridge University Press, 2nd Edition, Cambridge, 2004.
2. Matthew M.Radmanesh "RF and Microwave Design Essentials", Author House, Bloomington, 2007.
3. John W.M.Rogers and Calvin Plett, "Radio Frequency Integrated Circuit Design", 2nd Edition, Artech House, Norwood, 2010.
4. Devendra.K. Misra, "Radio Frequency and Microwave Communication Circuits – Analysis and Design", John Wiley and Sons, Newyork, 2004.

NE7014 SPEECH RECOGNITION AND SYNTHESIS LT P C
3 0 0 3

OBJECTIVES:

- To understand the basic characteristics of speech
- To know the details of algorithms, techniques and limitations of state of the art speech systems.
- To investigate speech processing applications like speech synthesis and speech recognition

UNIT I BASIC CONCEPTS 8

Speech fundamentals: Articulatory phonetics- Production and Classification of Speech Sounds; Acoustic Phonetics – acoustics of speech production; Review of Digital Signal Processing concepts; Short-time Fourier transform, Filter Bank and LPC Methods.

UNIT II SPEECH ANALYSIS 10

Features, Feature Extraction and Pattern Comparison Techniques; Spectral distortion measures-mathematical and perceptual – Log Spectral Distance, Cepstral Distances, Weighted Cepstral Distances and Liftering, Likelihood Distortions, Spectral Distortion using a Warped frequency Scale, LPC, PLP and MFCC Coefficients, Time Alignment and Normalization – Dynamic Time Warping, multiple Time – Alignment Paths.

UNIT III SPEECH MODELLING 8

Hidden Markov Models: Markov Processes, HMMs – Evaluation, Optimal State Sequence – Viterbi search, Baum – Welch Parameter Re-estimation, Implementation issues.

UNIT IV SPEECH RECOGNITION 10

Large Vocabulary Continuous Speech Recognition: Architecture of a large vocabulary Continuous Speech Recognition system – acoustics and language models, Sub-word units- models for phonemes, syllables, triphones, Language models, n-grams, context dependent sub-word units.

UNIT V SPEECH SYNTHESIS 9

Text-to-speech synthesis: Concatenative and waveform synthesis methods, sub-word units for TTS, intelligibility and naturalness-role of prosody, Applications.

TOTAL: 45 PERIODS

OUTCOMES:

- To be able to analyse speech signal
- To design speech recognition systems
- To design speech synthesis systems

REFERENCES:

1. Lawrence Rabiner and Biiing – Hwang Juang, “Fundamentals of Speech Recognition”, Pearson Education, 2003.
2. Daniel Jurafsky and James H Martin, “Speech and Language Processing – An introduction to Natural Language Processing, Computational Linguistics, and Speech Recognition”, Pearson Education 2002.
3. Steven W. Smith, “The Scientist and Engineer’s Guide to Digital Signal Processing”, California Technical Publishing, 1997.
4. Thomas F Quatieri, “ Discrete- Time Speech Signal Processing- Principles and Practice”, Pearson Education, 2004.
5. Claudio Becchetti and Lucio Prina Ricotti, “ Speech Recognition”, John Wiley and Sons, 1999.
6. Bengold & Neoban margom “ Speech and Audio Signal Processing: Processing and Perception of Speech and Music”, John Wiley and Sons 2002.
7. Donglos O shanhnessy “Speech Communication: Human and Machine", 2nd Edition. University Press 2001.
8. F. Jebinek, "Statistical Methods for Speech Recognition”, MIT press, 1998.

NE7016 **VLSI DESIGN AUTOMATION** **L T P C**

3 0 0 3

OBJECTIVES

- To give clear idea about VLSI Design Cycle and Physical Design Cycle.
- Study of different architectures of FPGA from different families.
- To learn the algorithmic concepts and complexity in physical design automation.
- To understand the algorithms used for Partitioning in Physical design.
- To understand the faults in System and causes for occurrence of faults.

UNIT I INTRODUCTION AND LOGICAL DESIGN AUTOMATION 9

CAD for ASIC Design – design entry – Hardware Description Language (HDL) – Schematic / Graphical design entry – Net list extraction – functional simulation – synthesis – Combinational Logic Synthesis - Binary Decision Diagrams - Two Level Logic Synthesis. Data structures and algorithms for electronic design automation (EDA) - Complexity issues and NP-hardness, Basic Algorithms, Basic Data Structures.

UNIT II PHYSICAL DESIGN AUTOMATION 9

VLSI Design Cycle , Physical Design Cycle, New Trends, Design Styles, System Packaging Styles, Historical Perspectives, Existing Design Tools - Fabrication Process **-** Fabrication Materials, Fabrication of VLSI Circuits, Design Rules, Layout of the Basic Design, Scaling Methods, Status of Fabrication Process, Issues Related to Fabrication Process, Future of Fabrication Process, Tools and Process Development - Parasitic extraction, back annotation and simulation - Graph Algorithms for Physical Design.

UNIT III PARTITIONING, FLOORPLANNING, PLACEMENT, ROUTING AND AUTOMATION OF FPGAs AND MCMs 9

Introduction to Partitioning, Problem Formulation, Classification of Partitioning Algorithm, Group Migration Algorithm, Simulated Annealing and Evolution, Other Partitioning Algorithm, Performance Drive Partitioning **-** Floorplanning, Chip Planning, Pin Assignment, Integrated Approach, Placement. Global Routing, Detailed Routing, Clock Routing, Power and Ground Routing, Compaction, Physical Design Automation of the FPGA's and MCM's.

UNIT IV MODELLING, SIMULATION AND VERIFICATION 9

Modelling - Register transfer level (RTL) – Structural - Gate level, switch level and high level modelling - High-level modeling of VLSI Systems - System Verilog and SystemC concepts- Simulation & Verification – Event driven and continuous analog simulation methods - Analog and mixed signal simulation and verification – SPICE – Introduction to assertion-Based-Verification (ABV) and Formal Verification (FV).

UNIT V TESTING & VERIFICATION 9

Design for Testability, Boundary scan test, Fault simulation – ATPG – Application of ASICs – Analog and Mixed signal (AMS) test and DFT – Case Studies.

TOTAL: 45 PERIODS

OUTCOMES:

- To be able to carry out Physical Design Flow.
- To be able to carry out product quality diagnosis.
- To acquire the expertise to meet out the expectation of industries in various processes related to chip development.
- To be able to carry out complete design flow using CAD tools.

REFERENCES:

1. Naveed Sherwani, "Algorithms for VLSI Physical Design Automation", 3rd Edition, Springer International Edition, 2005.
2. M.J.Smith, “Application Specific Integrated Circuits”, Addison Wesley, 1999.
3. S.H.Gerez, “Algorithms for VLSI Design Automation”, Wiley Publication, 1999.
4. Sadiq M. Sait and Habib Youssef , “VLSI Physical Design Automation: Theory and Practice” World Scientific Publishers, Singapore/New-Jersey, USA, 1999.

NE7075 DETECTION AND ESTIMATION THEORY L T P C

3 0 0 3

OBJECTIVES:

- To understand the concepts of detection and estimation.
- To learn the basics of multi-user detection theory
- To understand the theory behind various estimation techniques.
- To understand Wiener filter and Kalman filter in detail.

UNIT I REVEIW OF PROBABILITY AND STOCHASTIC PROCESS 9

Conditional Probability, Bayes' Theorem , Random Variables, Conditional Distributions and Densities, moments and distribution of random variables., Stationary Processes Cyclostationary Processes Averages and Ergodicity Autocorrelation Function Power Spectral Density Discrete-Time Stochastic Processes, Spatial Stochastic Processes Random Signals, Relationship of Power Spectral Density and Autocorrelation Function.

UNIT II SINGLE AND MULTIPLE SAMPLE DETECTION 9

Hypothesis Testing and the MAP Criterion, Bayes Criterion, Minimax Criterion, Neyman-Pearson Criterion, Sequential Detection, The Optimum Digital Detector in Additive Gaussian Noise , Performance of Binary Receivers in AWGN.

UNIT III FUNDAMENTALS OF ESTIMATION THEORY 9

Formulation of the General Parameter Estimation Problem, Relationship between Detection and Estimation Theory, Types of Estimation Problems, Properties of Estimators, Bayes Estimation, Minimax Estimation, Maximum-Likelihood Estimation, Comparison of Estimators of Parameters.

UNIT IV WIENER AND KALMAN FILTERS 9

Orthogonality Principle, Autoregressive Techniques, Discrete Wiener Filter, Continuous Wiener Filter, Generalization of Discrete and Continuous Filter Representations , Linear Least-Squares Methods, Minimum-Variance Weighted Least-Squares Methods, Minimum-Variance, LeastSquares, Kalman Algorithm - Computational Considerations, Signal Estimation, Continuous Kalman Filter, Extended Kalman Filter.

UNIT V APPLICATIONS 9

Detector Structures in Non-Gaussian Noise , Examples of Noise Models, Receiver Structures, and Error-Rate Performance, Estimation of Non-Gaussian Noise Parameters Fading Multipath Channel Models, Receiver Structures with Known Channel Parameters, Receiver Structures without Knowledge of Phase, Receiver Structures without Knowledge of Amplitude or Phase, Receiver Structures and Performance with No Channel Knowledge.

TOTAL: 45 PERIODS

OUTCOMES:

- To be able to apply detection and estimation theory to solve communication problems.
- To apply probability and stochastic process concepts in detection and estimation.
- To design Wiener and Kalman filters to solve linear estimation problems.

REFERENCES:
1. Thomas Schonhoff, "Detection and Estimation Theory", Prentice Hall, NewJersy, 2007.
2. Steven M. Kay, "Fundamentals of Statistical Processing, Volume I: Estimation Theory", Prentice Hall Signal Processing Series, Prentice Hall, PTR, NewJersy, 1993.
3. Harry L. Van Trees, "Detection, Estimation and Modulation Theory", Part I John Wiley and Sons, New York, 2001.

AP7252 DIGITAL IMAGE PROCESSING L T P C
3 0 0 3

OBJECTIVES:
- To provide an introduction to basic concepts and methodologies for digital image processing.
- To develop engineering skills and intuitive understanding of the most important concepts, techniques and algorithms for digital image processing.
- To understand the general processes of image acquisition, storage, enhancement, segmentation, representation and description.
- To implement filtering and enhancement algorithms for monochrome as well as color images.
- To appreciate the challenges and understand the principles and applications of visual pattern recognition.

UNIT I DIGITAL IMAGE FUNDAMENTALS 9
Elements of digital image processing systems, Digital Camera working principles, Elements of visual perception, brightness, contrast, hue, saturation, Mach Band effect, Image sampling, Quantization, Dither, Two dimensional mathematical preliminaries.

UNIT II IMAGE TRANSFORMS 9
1D DFT, 2D transforms - DFT, DCT, Discrete Sine, Walsh, Hadamard, Slant, Haar, KLT, SVD, Wavelet transform.

UNIT III IMAGE ENHANCEMENT AND RESTORATION 9
Spatial domain filtering, intensity transformations, contrast stretching, histogram equalization, smoothing filters, sharpening filters, noise distributions, mean filters, order statistics filters. Image restoration - degradation model, Unconstrained and Constrained restoration, Inverse filtering-removal of blur caused by uniform linear motion, Wiener filtering, Geometric transformations-spatial transformations, Gray-Level interpolation.

UNIT IV IMAGE SEGMENTATION AND MORPHOLOGY 9
Image segmentation - Edge detection, Edge linking and boundary detection, Region growing, Region splitting and Merging, Image Recognition - Patterns and pattern classes, Matching by minimum distance classifier, Matching by correlation, Morphological Image Processing - Basics, SE, Erosion, Dilation, Opening, Closing, Hit-or-Miss Transform, Boundary Detection, Hole filling, Connected components, convex hull, thinning, thickening, skeletons, pruning, Geodesic Dilation, Erosion, Reconstruction by dilation and erosion.

UNIT V IMAGE COMPRESSION 9
Need for data compression, Huffman, Run Length Encoding, Shift codes, Arithmetic coding, Vector Quantization, Block Truncation Coding, Transform coding, JPEG, MPEG.

TOTAL : 45 PERIODS

OUTCOMES:

At the end of the course, the student should be able to:

- Develop an overview of the field of image processing.
- Outline and implement the fundamental algorithms
- Gain experience in applying image processing algorithms to real problems

REFERENCES:

1. Rafael C. Gonzalez, Richard E. Woods, " Digital Image Processing", Pearson Education, Inc., Second Edition, 2004
2. Anil K. Jain, "Fundamentals of Digital Image Processing", Prentice Hall of India, 2002.
3. Rafael C. Gonzalez, Richard E. Woods, Steven Eddins," Digital Image Processing using MATLAB", Pearson Education, Inc., 2004.
4. William K. Pratt, " Digital Image Processing", John Wiley, New York, 2002.
5. S. Sridhar, " Digital Image Processing", Oxford University Press.
6. Milan Sonka et al, "Image Processing, Analysis and Machine Vision", Brookes/Cole, Vikas Publishing House, 2nd edition, 1999;
7. Sid Ahmed, M.A., " Image Processing Theory, Algorithms and Architectures", McGrawHill, 1995.

NE7073 BROADBAND ACCESS TECHNOLOGIES L T P C

3 0 0 3

OBJECTIVES:

- To give fundamental concepts related to broad band access technologies.
- To understand the current and emerging wired / wireless access technologies.
- To acquire knowledge about cable modems and fiber access technologies.
- To have an exposure to different system standards for next generation broadband access networks.

UNIT I REVIEW OF ACCESS TECHNOLOGIES 5

Phone-Line modem, cable-access, ISDN, Emerging Broad band Technologies, Cable DSL, Fiber and Wireless.

UNIT II DIGITAL SUBSCRIBER LINES 10

Asymmetric Digital subscriber lines (ADSL) – Rate Adaptive subscriber line (RADSL)-ISDN Digital subscriber line (IDSL) - High bit rate DSL (HDSL)-Single line DSL (SDSL) - very high bit rate DSL (VDSL) - Standards for XDSL & Comparison.

UNIT III CABLE MODEM 10

Cable Modem, DOCSIS – Physical Cabling, Dual Modem Operation, Hub Restriction, Upstream Operation – Downstream operation – Access control – framing Security sub layer – Data link layer – LLC & Higher layers – ATM centric VS IP – centric cable modem.

UNIT IV FIBER ACCESS TECHNOLOGIES 10

Optical Fiber in access networks, Architecture and Technologies- Hybrid fiber – Coax (HFC) system, Switched Digital Video (SDV) – Passive optical networks (PON) – FTTX (FTTH, FTTB, FTTC, FTT cab) comparison.

UNIT V BROAD BAND WIRELESS 10

Fixed Wireless, Direct Broadcast Satellite (DBS), Multi channel multi point distribution services (MMDS), Local multi point distribution services (LMDS), and Wideband integrated Digital Interactive Services (WIDIS), Mobile Wireless 3G – IMT 2000.

TOTAL:45 PERIODS

OUTCOMES:

- To be able to design systems meeting out the requirements of the recent standards.
- To meet out the industry requirements for man power in Next generation networks.
- To be able to contribute towards the enhancement of the existing wireless technologies.

REFERENCES:

1. Niel Ransom and Albert A. Azzam, “Broadband Access Technologies: ADSL, VDSL Cable Modem, Fiber and LMDS", McGraw Hill, 1999.
2. Gilbert Held, “Next Generation Modems: A Professional Guide to DSL and Cable Modems”, John Wiley & Sons, 2000.
3. Walter J Woralski, “ADSL and DSL Technologies”, McGraw Hill Computer Communication Series, Second Edition Oct 2001.
4. William Webb, “Introduction to Wireless Local Loop Broadband and Narrow Band System”, Mobile Communication Series, Artech House Publishers, Second Edition 2000.
5. Martin P. Clarke, “Wireless Access Network: Fixed Wireless Access and WLL Network Design and Operation”, John Wiley & Sons 2000.
6. Dennis J. Rauschmayer, “ADSL/VDSL Principles: A Practical and Precise Study of Asymmetric Digital Subscriber Lines and Very High Speed Digital Subscriber Lines, Macmillan Technology Series, 1998.

NE7002 COMPUTATIONAL ELECTROMAGNETICS L T P C

3 0 0 3

OBJECTIVES:

- To understand the concepts and mathematical methods to analyze the electromagnetic fields and wave phenomena.
- To learn the analytical and numerical techniques to solve the electromagnetic problems.
- To understand the importance of computational techniques to analyze the field propagation in mediums.

UNIT I INTRODUCTION 9

Review of Electromagnetic Theory – Electromagnetic fields – Magnetostatic fields Maxwell’s equations – Electro thermal formulation – Classification of EM problems.

UNIT II ANALYTICAL TECHNIQUES 9

Limitation of the conventional design procedure – Need for field analysis based design – problem definition – Direct Integration Method – Variable Separable Method – Method of Images – Conformal Mapping.

UNIT III NUMERICAL TECHNIQUES 9

Finite Difference Method(FDM) – Finite Element Method(FEM) – Variational Method – Method of Moments – Transmission Line Matrix Method – Finite Difference Time Domain(FDTD).

UNIT IV FIELD COMPUTATION FOR BASIC STRUCTURES 9

Computation of Electric and Megnatic field intensities – Capacitance and Inductance – Semiconductor Structures – Resonant Circuit Method – Frequency Band Gap for surface wave propagation – Soft and Hard surfaces.

UNIT V APPLICATIONS 9

EBG structure analysis – EBG patch antenna – Surface wave antenna – PBG structures – Physical origin of PBG – Modes – PBG application in Waveguide, Cavity, Narrow Band Filter.

TOTAL :45 PERIODS

OUTCOMES:

- To be able to contribute to development of new methods, software for finite difference and finite element differential equation models as well as integral equation models for frequency domain models.
- To be able to use commercial application software with insight into fundamental properties and limitations.
- To be able to apply the concepts for the design of Photonic and electromagnetic band gap structures.

REFERENCES:

1. Nathan Ida, Joao P.A.Bastos, "Electromagnatics & Calculation of Fields", Springer- Verlag, London, 2012.
2. Fanyang & Yahya Rahmat Samii, "Electromagnetic Band Gap Structures in Antenna Engineering", The Cambridge RF & Microwave Engineering Series, 2009.
3. Mathew N.O.Sadiku, "Numerical Techniques in Electromagnetics with MATLAB", CRC Press, Bocaraton, 2009.
4. K.J.Binns, P.J.Lawrenson, C.W.Trowbridge, "The Analytical & Numerical Solution of Electric & Magnetic Fields", John Wiley & Sons, 1995.
5. Joannopoulous.J, Meade R.D. and Winn J.N. "Photonic Crystals: Molding the Flow of Lights", Princeton Univ. Press, 2008.

NE7003 DIGITAL AUDIO AND VIDEO BROADCASTING TECHNOLOGY L T P C

3 0 0 3

OBJECTIVES:

- To understand the basics of audio and video broadcasting technology.
- To learn the principle of audio and video coding methods.
- To understand the technology of digital TV transmission.

UNIT I INTRODUCTION 9

Basic television, analog and digital TV, standards for analog and digital TV,scanning on original black and white picture, synchronization, horizontal and vertical synchronization, adding colour information, transmission methods, distortion and interference, measurements on analog video standards.

UNIT II VIDEO CODING 9

Video compression, MPEG-2 data stream, coding, modulation of moving pictures, DPCM of moving pictures, DCT and quantization, Huffman coding, structure of video elementary system, recent compression methods, MPEG-4 –H.263-advanced video coding. HDTV.

UNIT III AUDIO AND VIDEO COMPRESSION 9

Digital audio signal, MPEG and dolby digital, subband coding, transform coding for MPEG, multi channel sound, Comparison digital video signal, MPEG- 1, MPEG-- 2, VCD, DVD, MPEG 3, MPEG-4, MPEG- 7 and MPEG- 21, measurement of MPEG-2 transport system, picture quality analysis.

UNIT IV DIGITAL AUDIO BROADCASTING 9

Digital audio broadcasting (DAB),comparing DAB and DVB, physical layer of DAB, forward error correction of DAB, modulator and transmitter for DAB, single frequency networks, DAB data broadcasting.

UNIT V DIGITAL TV SIGNAL TRANSMISSION 9

Digital TV signal transmission by satellite, DVB-S/S2, parameters, modulator, signal processing in satellite, receiver, satellite transmission link, DVB-S measurement of CNR, SNR and Eb/No, noise power, broadcast cable transmission, DVB-C, modulator and receiver, DVB-T and DVB-H standards.

TOTAL : 45 PERIODS

OUTCOMES:

- To be able to explain principles of analog and digital TV technologies.
- To be able to design and implement digital compression techniques.
- To be able to design and develop various digital modulation techniques used in audio and video broadcasting.
- To identify issues and provide solutions for digital TV transmission.

REFERENCES:

1. W.Fischer, "Digital Video and Audio Broadcasting Technology, A Practical Engineering Guide", 2nd Edition, Springer, 2010.
2. W.Fischer, "Digital Television, A Practical Engineering Guide", 2nd Edition, Springer,2004.
3. Ken C Pohlmann, “Principles of Digital Audio”, 6th Edition, McGraw Hill, 2010.
4. Herve Benoit, “Digital Television, MPEG-1,MPEG-2 and Principles of DVB Systems”, Focal Press, Elsevier Science Imprint, 2002.

NE7005 FUNDAMENTALS OF CLOUD COMPUTING L T P C

3 0 0 3

OBJECTIVES

- To Introduce the fundamentals of Cloud Computing and virtualization.
- To familiarize various standards related to cloud computing.

UNIT I INTRODUCTION TO CLOUD 9

Cloud Computing – History, Architecture, Storage, Advantages, Disadvantages, Services, Server Virtualization- Parallel Processing, Vector Processing, Symmetric Multiprocessing Systems and Massively Parallel Processing Systems.

UNIT II CLOUD BASED WEB SERVICES 9

Understanding Private and Public cloud environments – Communication as a Service (CaaS)- Infrastructure as a Service (IaaS) – On-demand, Amazon’s Elastic, Amazon EC2, Mosso– Monitoring as a Service (MaaS) –Platform as a Service (PaaS) – On-Premises model, new cloud model – Software as a Service (SaaS) –implementation issues, characteristics, SaaS model.

UNIT III CLOUD COMPUTING FOR EVERYONE 9

Centralizing Email Communications – Collaborating on Schedules – Collaborating on To-Do Lists – Collaborating Contact Lists – Cloud Computing for the Community – Collaborating on Group Projects and Events – Cloud Computing for the Corporation

UNIT IV USING CLOUD SERVICES 9

Collaborating on Calendars, Schedules and Task Management – Exploring Online Scheduling Applications – Exploring Online Planning and Task Management – Collaborating on Event Management – Collaborating on Contact Management – Collaborating on Project Management – Collaborating on Word Processing - Collaborating on Databases – Storing and Sharing Files

UNIT V FUTURE DIRECTIONS TO CLOUD 9

Cloud Security – Software as a Service Security – Standards for application developers –Ajax, XML, JSON, LAMP, LAPP –Standards for Messaging –SMTP, POP, IMAP, HTTP, SIMPLE, XMPP – Standards for Security –SAML oAuth, OpenID, SSL/TLS, Collaborating via Blogs and Wikis – Mobile Platform Virtualization –KVM, VMWare

TOTAL:45 PERIODS

OUTCOMES:

- To be able to build custom made clouds.
- To be able to develop remote access applications, alert generation using cloud.
- To be able to work with commercial cloud packages.

REFERENCES:

1. John W.Rittinghouse and James F.Ransome, “Cloud Computing – Implementation, Management and Security", CRC press, 2012.
2. Michael Miller, “Cloud Computing: Web-Based Applications That Change the Way You Work and Collaborate Online", Pearson, 2008.
3. Barrie Sosinsky, “Cloud Computing –Bible”, Wiley Indian Edition, 2011.

NE7077 GAME THEORY FOR WIRELESS COMMUNICATION AND NETWORKING L T P C 3 0 0 3

OBJECTIVES :

- To give an overview of a broad range of models that is studied in game theory.
- To understand a range of mathematical models of Conflict and cooperation between two or more agents.
- To discuss the main concepts in the game theory and to explain the classes of games.
- To discuss the application of game theory in wireless communication and networking

UNIT I INTRODUCTION 9

Introduction to theory of games- conflict, strategy, utility theory, games in extensive and normal forms, Examples.

UNIT II NON CO-OPERATIVE GAMES 9

Basics of Non-Cooperative games, Non-Cooperative games in strategic form – Matrix games, Nash Equilibrium, Mixed Strategies. Dynamic Non-Cooperative games – Non-Cooperative game in extensive form, repeated games, and stochastic games.

UNIT III COOPERATIVE GAMES 9

Basics of Cooperative games, bargaining theory – Introduction, Nash bargaining solution, Coalition game theory – shape value, Dynamic Coalition formation algorithms.

UNIT IV BAYESIAN GAMES 9

Overview of Bayesian Games, Bayesian Games in extensive form, Cournot duopoly model with incomplete information, Super-Modular games, Learning in games: Fictitious play, and Regret minimization, Vickrey-Clarke-Groves Auction, Optimal Auction .

UNIT V APPLICATIONS TO NETWORKING 9

Cellular & Broadband wireless access networks – Routing & Resource allocation, Power allocation, Network selection in Multi-technology, WLAN – MAC Protocol design, Random Access Control, Rate Selection for VOIP services, throughput efficiency, competition and implication on network performance – Game theoretic solutions for cooperation in ad hoc networks.

TOTAL: 45 PERIODS

OUTCOMES:

- To be able to design game theory based models.
- To be able to apply game theory to solve network related issues.

REFERENCES:

1. Martin J. Osborne, “An Introduction to Game Theory”, Oxford Press 2006.
2. Zhu Han, Dusit Niyato, Walid Saad, Tamer Basar, Are Hjorungnes, “Game Theory in Wireless and Communication Networks: Theory, Models, and Applications”, University Press Cambridge, 1st Edition, 2012.
3. Allan MacKenzie, Luiz DaSilva, "Game Theory for Wireless Engineers, Synthesis Lectures on Communication", Morgan and Claypool Publishers, 2006.
4. Drew Fudenberg and Jean Tirole, "Game Theory", MIT Press, 1991.
5. Vijay Krishna, "Auction Theory", Academic Press, 2010.
6. Prajit K.Dutta, "Strategies and Games: Theory and Practice", MIT Press, 1999.

NE7006 MICROWAVE PHOTONICS L T P C

3 0 0 3

OBJECTIVES:

- To understand the role of optical fiber to transmit RF and microwave signal for wireless communication applications.
- To learn different optoelectronic and all optical techniques for microwave signal generation and microwave signal processing.
- To learn the applications of radio over fiber in the field of mobile communication networks, CATV and RADAR.

UNIT I RADIO OVER FIBER (ROF) LINK 9

Introduction to microwave photonics, Radio over fiber, figure of merit and performance of microwave photonics, gain and frequency response, noise figure, distortion in RF links, directly modulated optical links, RF subcarrier link for local access networks.

UNIT II MODULATION TECHNIQUES FOR MICROWAVE PHOTONICS 9

Laser diode fundamentals, rate equation analysis, small signal analysis, microwave loss, modulation effect on link performance frequency modulation, intensity modulation, External modulation, $LiNbO_3$ modulator, broad band travelling wave modulator, Electro absorption modulator and polymer modulator.

UNIT III OPTO-ELECTRONIC OSCILLAOTR AND MICROWAVE GENERATION 9

Basics of opto-electronic oscillators, signal generation for RF photonic systems, multi loop opto electronic oscillator, photonic link technique for microwave frequency conversion, benefits of frequency converting, optical local oscillator signal generation, microwave frequency converting photonic links.

UNIT IV ROF FOR CELLULAR SYSTEMS 9

Analysis of analog fiber optic link, fiber optic remote antenna feeding links, comparison of fiber optic and co axial remote antenna feeding links, ROF for micro cellular system, fiber optic micro cell repeater, performance evaluation, WCDMA for 3G cellular systems, WCDMA based ROF system performance, ROF for micro cellular communication networks

UNIT IV ROF FOR RADAR AND CATV APPLICATIONS 9

ROF for mobile communications, antenna remoting applications, phased array antennas, wide band photonic phased array antenna, photonic beam steering, ROF for CATV applications, mobile CATV, ROF application for multiservice wireless communication systems, fixed and integrated multi service mobile communication.

TOTAL : 45 PERIODS

OUTCOMES:

- To be able to design microwave photonic systems.
- To be able to carry out power- bandwidth budget calculations.
- To be able to design photonic and microwave systems.
- To be able solve issues related to loss, bandwidth, crosstalk and nonlinearities.

REFERENCES:

1. Stacros Iezekiel, “Microwave Photonics, Devices and Applications”, John Wiley and Sons, 2009.
2. Nathan J. Gomes, Paulo P.Monterio and Atilio Gameiro “Next Generation Wireless Communication using Radio Over Fiber” John Wiley and Sons, 2012.
3. WIliiam S.C.Chang, “RF Photonic Technology in Optical Fiber Links”, Cambridge University Press, 2002.
4. Hamed Al-Rawesshidy and Shozo Komaki, “Radio Over Fiber Technology for Mobile Communication Networks”, Artech House, London, 2002.

NE7007 OPTICAL NETWORKS L T P C

3 0 0 3

OBJECTIVES:

- To gain an understanding of various issues in designing a high speed, high date rate and huge bandwidth optical network.
- To acquire knowledge of architecture and standards of optical networks.
- Thorough understanding of the scientific and engineering principles underlying the photonics technology.

UNIT I OPTICAL SYSTEM COMPONENTS 9

Light propagation in optical fibers-Loss& Bandwidth, System limitations, Non-Linear effect, Solitons, Optical Network \ Components- Couplers, Isolators & Circulators, Multiplexers & Filters Optical Amplifiers, Switches Wavelength Converters.

UNIT II OPTICAL NETWORK ARCHITECTURES 9

Introduction to Optical Networks**;** WDM networks , SONET / SDH, Metropolitan-Area Networks, Layered Architecture; Broadcast and Select Networks- Topologies for Broadcast Networks, Media-Access Control Protocols, Wavelength Routing Architecture. WOBAN and OTDM networks.

UNIT III WAVELENGTH ROUTING NETWORKS 9

The Optical layer, Node Designs, Optical layer cost tradeoff, Routing and Wavelength Assignment algorithms, Virtual Topology design, Architectural variations

UNIT IV PACKET SWITCHING AND ACCESS NETWORKS 9

Photonic Packet Switching – OTDM , Multiplexing and De multiplexing, Synchronization, Broadcast OTDM networks, Switch based networks; Access Networks- Network Architecture overview , Future Access Networks, Optical Access Network Architectures.

UNIT V NETWORK DESIGN AND MANAGEMENT 9

Transmission system Engineering-system model, Power penalty-transmitter, receiver, Optical amplifiers, crosstalk, dispersion, wavelength stabilization; overall design consideration; Control and Management-Network management functions, Configuration management, Performance management, Fault management. Optical safety, Service interface.

TOTAL: 45 PERIODS

OUTCOMES:

- To be able to apply design state-of-the-art optical networks.
- To be able to implement optical network protocols.

REFERENCES:

1. Rajiv Ramaswami and Kumar N.Sivarajan, “Optical Networks: A Practical Perspective”, Harcourt Asia Pvt Ltd., Second Edition 2004.
2. C.Siva Ram Moorthy and Mohan Gurusamy, “WDM Optical Networks: Concept, Design and Algorithms”, PHI, 1st Edition, 2002.
3. P.E.Green, jr., "Fiber Optical Networks", Prentice Hall, New Jersey, 1993.

NE7011 RECONFIGURABLE COMPUTING L T P C

3 0 0 3

OBJECTIVES:

- To study the different architectures of FPGA.
- To understand the concepts of reconfigurable systems and OS support.
- To understand the issues of scheduling and memory in reconfigurable processors.

UNIT I INTRODUCTION 9

Goals and motivations - History, state of the art, future trends - Basic concepts and related fields of study - Performance, power, and other metrics - Algorithm analysis and speedup projections - RC Architectures - Device characteristics - Fine-grained architectures - Coarse-grained architectures.

UNIT II PROGRAMMABLE LOGIC DESIGN 9

PLD / CPLD technology - FPGA Physical Design Tools -Technology mapping - Placement & routing - Register transfer (RT)/Logic Synthesis - Controller/Data path synthesis - Logic minimization.

UNIT III PARALLEL PROCESSING 9

RC Application Design - Parallelism - Systolic arrays -Pipelining - Optimizations - Bottlenecks - High-level Design - High-level synthesis - High-level languages - Design tools.

UNIT IV ARCHITECTURES 9

Hybrid architectures- Communication - HW/SW partitioning - Soft-core microprocessors- System architectures -System design strategies - System services - Small-scale architectures - HPC architectures - HPEC architectures - System synthesis - Architectural design space explorations.

UNIT V CASE STUDY **9**

Case Studies- Signal and image processing - Bioinformatics - Security - Special Topics - Partial Reconfiguration - Numerical Analysis -Performance Analysis/Prediction - Fault Tolerance.

TOTAL: 45 PERIODS

OUTCOMES:

- To be able to design FPGA based architectures.
- To design reconfigurable systems.
- To be able to solve issues related to scheduling and memory in reconfigurable processors.

REFERENCES:

1. C. Maxfield, “The Design Warrior's Guide to FPGAs: Devices, Tools and Flows”, Newnes, 2004.
2. M. Gokhale and P. Graham, “Reconfigurable Computing: Accelerating Computation with Field-Programmable Gate Arrays”, Springer, 2005.
3. C. Bobda, “Introduction to Reconfigurable Computing: Architectures, Algorithms and Applications”, Springer, 2007.
4. P. Lysaght and W. Rosenstiel, “New Algorithms, Architectures and Applications for Reconfigurable Computing”, Springer, 2005.
5. D. Pellerin and S. Thibault, “Practical FPGA Programming in C”, Prentice-Hall, 2005.
6. W. Wolf, “FPGA Based System Design”, Prentice-Hall, 2004.
7. R. Cofer and B. Harding, “Rapid System Prototyping with FPGAs: Accelerating the Design Process”, Newnes, 2005.

NE7013 SATELLITE COMMUNICATIONS AND NAVIGATION SYSTEMS **L T P C 3 0 0 3**

OBJECTIVES:

- To provide an in-depth understanding of satellite communication technologies.
- To know the tools necessary for the calculation of basic parameters in a satellite communication system.
- To have an exposure to orbital mechanics, launching techniques and satellite link design.
- To analyze the different satellite access system.
- To understand GPS technology.

UNIT I BASIC PRINCIPLES **9**

General features- frequency allocation for satellite services- properties of satellite communication systems- Kepler's laws- orbital dynamics- orbital characteristics- satellite spacing and orbital capacity-GSO & LEO Satellites – Launch Vehicle Technology-GSLV.

UNIT II SATELLITE SUBSYSTEMS **9**

Attitude and orbit control system- telemetry, tracking and command- power systems- communication subsystems- antenna subsystem- equipment reliability and space qualification.

UNIT III SATELLITE LINKS **9**

Free space loss-Atmospheric effects-Ionospheric scintillation-link design- Power Budget Calculation - system noise temperature – Modulation for satellite communication.

UNIT IV MULTIPLE ACCESS TECHNOLOGIES 9

Introduction to space segment access methods -TDMA, FDMA, CDMA, SDMA- assignment methods-Internetworking and Computing Over Satellite Networks – MAC protocols for Satellite Communications.

UNIT V GPS 9

Overview of GPS- GPS Signal structure-GPS coordinate frames- Time references- GPS orbits and satellite position determination- GPS Errors & Accuracy- Applications.

TOTAL: 45 PERIODS

OUTCOMES:

- To able to design satellite links- transmitter and receiver design.
- To be able to design various satellite access techniques.
- To be able to design and implement GPS systems.

REFERENCES:

1. Dennis Roddy, "Satellite Communications", Fourth Edition , Tata Mc Graw-Hill,2006.
2. Tri Ha, " Digital Satellite Communication", Tata Mc Graw-Hill, 2004.
3. Zhang, Yongguang , "Internetworking and Computing Over Satellite Networks", kluwer Academic Publishers, 2003.
4. B. Hoffman – Wellenhof, H. Liehtenegger and J. Collins, "GPS – Theory and Practice", Springer – Wien, New York, 2001.

NE7080 SPACE TIME WIRELESS COMMUNICATION L T P C
3 0 0 3

OBJECTIVES:

- To acquire the knowledge on various modulation and coding schemes for space-time wireless communications.
- To understand transmission and decoding techniques associated with wireless communications.
- To understand multiple-antenna systems such as multiple-input multiple-output (MIMO) and space-time codes.

UNIT I MULTIPLE ANTENNA PROPAGATION AND ST CHANNEL CHARACTERIZATION 9

Wireless channel, Scattering model in macrocells, Channel as a ST random field, Scattering functions, Polarization and field diverse channels, Antenna array topology, Degenerate channels, reciprocity and its implications, Channel definitions, Physical scattering model, Extended channel models, Channel measurements, sampled signal model, ST multiuser and ST interference channels, ST channel estimation.

UNIT II CAPACITY OF MULTIPLE ANTENNA CHANNELS 8

Capacity of frequency flat deterministic MIMO channel: Channel unknown to the transmitter, Channel known to the transmitter, capacity of random MIMO channels, Influence of ricean fading, fading correlation, XPD and degeneracy on MIMO capacity, Capacity of frequency selective MIMO channels.

UNIT III SPATIAL DIVERSITY 8

Diversity gain, Receive antenna diversity, Transmit antenna diversity, Diversity order and channel variability, Diversity performance in extended channels, Combined space and path diversity, Indirect transmit diversity, Diversity of a space-time- frequency selective fading channel.

UNIT IV MULTIPLE ANTENNA CODING AND RECEIVERS 10

Coding and interleaving architecture, ST coding for frequency flat channels, ST coding for frequency selective channels, Receivers(SISO,SIMO,MIMO),Iterative MIMO receivers, Exploiting channel knowledge at the transmitter: linear pre-filtering, optimal pre-filtering for maximum rate, optimal pre-filtering for error rate minimization, selection at the transmitter, Exploiting imperfect channel knowledge.

UNIT V ST OFDM, SPREAD SPECTRUM AND MIMO MULTIUSER DETECTION 10

SISO-OFDM modulation, MIMO-OFDM modulation, Signaling and receivers for MIMO-OFDM,SISO-SS modulation, MIMO-SS modulation, Signaling and receivers for MIMO- S.MIMO-MAC,MIMO-BC, Outage performance for MIMO-MU,MIMO-MU with OFDM,CDMA and multiple antennas.

TOTAL : 45 PERIODS

OUTCOMES:

- To be able to design and evaluate receiver and transmitter diversity techniques.
- To be able to design and develop OFDM based MIMO systems.
- To be able to calculate capacity of MIMO systems.

REFERENCES:

1. A. Paulraj, Rohit Nabar, Dhananjay Gore., “Introduction to Space Time Wireless Communication Systems”, Cambridge University Press, 2003
2. Sergio Verdu “ Multi User Detection” Cambridge University Press, 1998
3. Andre Viterbi “ Principles of Spread Spectrum Techniques” Addison Wesley 1995

NE7015 SPREAD SPECTRUM TECHNIQUES L T P C

3 0 0 3

OBJECTIVES:

- To understand the basics of spread spectrum communication systems.
- To understand the performance of spread spectrum in multipath environment.
- To understand the way in which spread spectrum is applied to CDMA and GPS systems.

UNIT I SPREADING CODES 9

Finite-Field Arithmetic- Sequence Generator Fundamentals-State - Machine Representation of Shift-Register Generators-Generation &Properties of m-Sequences Gold Codes - Kasami Sequences (Small Set) - Quaternary Sequences - Complementary Code Keying - Walsh–Hadamard Sequences.

UNIT II SPREAD SPECTRUM SYSTEMS 9

Direct Sequence Spread Spectrum (DSSS)- Processing Gain- Frequency Hop Spread Spectrum (FHSS)- Coherent & Noncoherent Slow FHSS – Coherent & Noncoherent Fast FHSS- Hybrid DS/FH Spread Spectrum.

UNIT III SYNCHRONIZATION IN SPREAD SPECTRUM 9

Baseband Recovery - Carrier Synchronization - Code Synchronization – Code Acquisition & Tracking.

UNIT IV SPREAD SPECTRUM IN MULTIPATH ENVIRONMENT 9

Performance in Jamming Environment – Low Probability of Detection –Mitigation of Multipath Effects using spread spectrum-RAKE Receiver-CDMA

UNIT V GLOBAL POSITIONING SYSTEM 9

GPS Principles-NAVSTAR constellation- Gold codes-Synchronization-Differential GPS

TOTAL: 45 PERIODS

OUTCOMES:

- To be able to arrive at detailed specifications of the spread spectrum systems.
- To design systems based on spread spectrum to mitigate the jamming and multipath effect.
- To design the spread spectrum based systems for CDMA and GPS.

REFERENCES:

1. Rodger E. Ziemer, "Fundamentals of Spread Spectrum Modulation", Morgan & Claypool, Publishers series, 2007.
2. Bernard Sklar & Pabitra Kumar Ray, "Digital Communications Fundamentals and Applications", Second Edition, Pearson Education, Inc, 2001.
3. Robert C.Dixon, "Spread Spectrum Systems with Commercial Applications", 3rd Edition, John Wiley & Sons, Ins, 1994.
4. R. L. Peterson, R. E. Ziemer, and D. E. Borth, "Introduction to Spread Spectrum Communications", Upper Saddle River, NJ: Prentice Hall, 1995.
5. M.K. Simon, J.K. Omura, R.A. Scholtz, and B.K. Levitt, "Spread Spectrum Communications Handbook", Electronic Edition, McGraw-Hill, 2002.
6. Don Torrieri, "Principles of Spread-Spectrum Communication Systems", Springer Science, Business Media, Inc Boston, 2005.

NE7017 WIRELESS SENSOR NETWORK DESIGN L T P C

3 0 0 3

OBJECTIVES:

- To develop an understanding of sensor network architectures from a design and performance perspective.
- To understand the layered approach in sensor networks starting from physical layer to application layer.
- To study the WSN protocols.
- To study TinyOS and Contiki.
- To get adequate exposure to emerging technologies and their potential impact.

UNIT I INTRODUCTION 9

Introduction to wireless sensor networks- Challenges, Comparison with ad hoc network, Node architecture and Network architecture, design principles, Service interfaces, Gateway, Short range radio communication standards-IEEE 802.15.4, Zigbee and Bluetooth. Physical layer and transceiver design considerations.

UNIT II DATA LINK LAYER 9

MAC protocols – fundamentals, low duty cycle protocols and wakeup concepts, contention-based protocols, Schedule-based protocols - SMAC, BMAC,TRAMA, Link Layer protocols – fundamentals task and requirements, error control, framing, link management, Naming and addressing – address assignment, unique, Content-based and geographical addressing.

UNIT III NETWORK LAYER 9

Routing protocols – Requirements, Taxonomy - Data-centric routing – SPIN, Directed Diffusion, Energy aware routing, Gradient-based routing – COUGAR, ACQUIRE, Hierarchical Routing – LEACH, PEGASIS, Location Based Routing – GAF, GEAR, Data aggregation – Various aggregation techniques, Localization and positioning – Properties, Approaches, Mathematical basics for single hop and multi-hop environment.

UNIT IV TRANSPORT LAYER 9

Transport Protocol, Coverage and deployments - Sensing models, Coverage measures, Random deployments: Poisson model, Boolean sensing model, general sensing model, Coverage determination, grid deployment, Reliable data transport, Single packet delivery, Block delivery, Congestion control and rate control, Time synchronization – Issues and protocol – Sender/Receiver, Security – protocols and Key Distribution Techniques.

UNIT V TOOLS FOR WSN 9

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

TOTA L: 45 PERIODS

OUTCOMES:

- To be able to design energy efficient WSNs.
- To design and implement protocols in TinyOS and Contiki.
- To design application dependent WSNs.

REFERENCES:

1. Holger Karl , Andreas willig, “Protocol and Architecture for Wireless Sensor Networks”, John Wiley Publication, 2006.
2. C.S.Raghavendra Krishna, M.Sivalingam and Tarib znati, “Wireless Sensor Networks”, Springer Publication, 2004.
3. Anna Hac, “Wireless Sensor Network Design”, John Wiley & Sons, 2003.
4. Feng Zhao, Leonidas Guibas, “Wireless Sensor Networks: An Information Processing Approach”, Elsevier, 2004.
5. Paolo Santi, “Topology Control in Wireless Adhoc and Sensor Networks”, John Wiley & Sons, 2005.
6. Kazem Sohraby, Daniel Minoli and Taieb Znati, “Wireless Sensor Networks Technology-Protocols and Applications”, John Wiley & Sons, 2007.
   Philip Levis, “TinyOS Programming”, 2006 – www.tinyos.net.
7. The Contiki Operating System. http://www.sics.se/contiki.

NE7009 PATTERN RECOGNITION AND MACHINE LEARNING L T P C
3 0 0 3

OBJECTIVES :

- To create an appropriate knowledge base to machine learning and statistical pattern recognition.
- To provide basic ideas and techniques underlying the design of different artificial intelligence models.
- To provide an overview of the state-of-art algorithms used in machine learning.
- To study different optimization based methods and use the same for wide range of applications.

UNIT I INTRODUCTION 9

Definition of learning systems- Goals and applications of machine learning- Aspects of developing a learning system- training data- concept representation- Function approximation.

UNIT II ARTIFICIAL NEURAL NETWORKS 9

Neurons and biological motivation- Linear threshold units - Perceptrons- representational limitation and gradient descent training - Multilayer networks and back propagation - Hidden layers and constructing intermediate - distributed representations.

UNIT III ARTIFICIAL INTELLIGENCE MODELS 9

Linear models: polynomial regression- over-fitting- model selection- logistic regression- Naive Bayes-Non-linear models: decision trees- instance-based learning- neural networks- Support Vector Machines: Maximum margin linear separators- Quadratic programming solution - maximum margin separators- Kernels for learning non-linear functions.

UNIT IV GAME THEORY 9

Fundamentals-Conflict- Strategy and Games- Game theory- The Prisoner's Dilemma- Games in normal and extensive forms – Representation- Examination- Examples.

UNIT V OPTIMIZATION METHODS 9

Heuristic and Meta - heuristic search techniques - stochastic search methods-social algorithms: ant colony, artificial bee colony, particle swarm optimization-applications.

TOTAL: 45 PERIODS

OUTCOMES:

- To be able to design feature recognition systems tailored to specific applications.
- To design and develop classifiers**.**
- To design and develop machine learning systems.

REFERENCES:

1. Christopher Bishop, "Pattern Recognition and Machine Learning", Springer, 2006.
2. Richard Duda, Peter Hart and David Stork, "Pattern Classification", 2nd Edition, Wiley, 2001.
3. Tom Mitchell, "Machine Learning", McGraw-Hill, 1997.
4. Russel, S.J. and Norvig, P., "Artificial Intelligence a Modern Approach", 2nd Edition, New Jersey, Prentice Hall, 2002
5. Rich, E. and Knight, K. "Artificial Intelligence", 2nd Edition, New York: McGraw-Hill, 1991.
6. E. N. Barron, "Game Theory: An Introduction", Wiley India Pvt Ltd., 2009.
7. Rajiv J. Kapadia, "Optimisation in Signal and Image Processing", John Wiley & Sons, 2010.

NE7079 MICROWAVES AND RADAR L T P C
3 0 0 3

OBJECTIVES:

- To study the principles, types of radar and its signal processing.
- To understand the theoretical principles underlying microwave sources for RADAR.
- To learn about RADAR tracking.

UNIT I MICROWAVE SOURCES FOR RADAR 10

Passive waveguide components, Microstrip line structure and components, Simple theory and operating characteristics of Reflex klystrons, Two cavity Klystrons, Magnetrons, and TWTS - solid state source - TEDS, IMPATTS, TRAPATT, GaAs FETs and Tunnel diode.

UNIT II RADAR PRINCIPLES 9

Introduction to Radar – Radar range equation – Receiver noise and signal to noise ratio- Radar cross section (RCS) – Radar system – Radar Antennas

UNIT III TYPES OF RADARS 9

CW and FMCW radars-Tracking radars-MTI radar -Principles of coherent MTI radars - Digital MTI, Synthetic Aperture radar, Principles of Pulsed Doppler Radar, Low-, High-, and medium-PRF Mode, Phased array radar.

UNIT IV RADAR SIGNAL PROCESSING 9

Radar requirements –Matched filters- The radar ambiguity function – Optimum waveforms for detection in clutter – Classes of waveforms – Digital representation of signals -Pulse compression.

UNIT V TRACKING RADAR 8

Tracking with radar – Monopulse Tracking – conical scan and sequential lobing –limitations to tracking Accuracy- Alpha – Beta Tracker, Kalman Tracker.

TOTAL: 45 PERIODS

OUTCOMES:

- To be able to design a radar system.
- To be able to design and implement radar tracking algorithms.

REFERENCES:

1. Fred E.Nathanson, “Radar Design Principles Signal Processing and The Environment", 2nd Edition, Prentice Hall, 2007.
2. J.C.Toomay and Paul .J.Hannen, "Principles of Radar”, 3rd Edition, PHI, NewDelhi, 2010.
3. M.I. Skolnik, "Introduction to Radar System", Third Edition, McGraw Hill, 2003.
4. Filipo Neri, "Introduction to Electronic Defense Systems",2nd Edition, Scitech, 2006.
5. Michael.O. Kolawole, "Radar Systems, Peak Detection and Tracking", Elsevier, Burlington, 2006.

NE7251 REAL TIME EMBEDDED SYSTEM L T P C
3 0 0 3

OBJECTIVES:

- To understand the basics of embedded system, architecture of PIC microcontroller and ARM processor.
- To understand the RTOS concepts like scheduling and memory management related to the embedded system.
- To learn the protocols of embedded wireless application.
- To understand concepts involved in the design of hardware and software components for an embedded system.

UNIT I INTRODUCTION 12

Real Time System – Embedded Systems – Architecture of Embedded System - Simple Programming for Embedded System – Process of Embedded System Development - Pervasive Computing – Information Access Devices – Smart Cards – Microcontrollers – ARM Processor - Real time Microcontrollers – Low power embedded systems, microcontrollers & RF.

UNIT II EMBEDDED/REAL TIME OPERATING SYSTEM 9

Operating System Concepts: Processes, Threads, Interrupts, Events - Real Time SchedulingAlgorithms - Memory Management – Overview of Operating Systems for Embedded, Real Time,Handheld Devices – Target Image Creation – Programming in Linux, RTLinux, VxWorks, uC/Os overview.

UNIT III CONNECTIVITY 9

Wireless Connectivity - Bluetooth – Other short Range Protocols – Wireless Application Environment – Service Discovery – Middleware.

UNIT IV REAL TIME UML 6

Requirements Analysis – Object Identification Strategies – Object Behaviour – Real Time Design Patterns.

UNIT V SOFTWARE DEVELOPMENT AND CASE STUDY 9

Concurrency – Exceptions – Tools – Debugging Techniques – Optimization – Case Studies - Interfacing Digital Camera with USB port and Data Compressor.

TOTAL: 45 PERIODS

OUTCOMES:

- To be able to make a choice a suitable embedded processor for a given application.
- To be able to design the hardware and software for the embedded system.
- To be able to design and develop the real time kernel/operating system functions, task control block structure and analyze different task states.
- To be able to implement different types of inter task communication and synchronization techniques.

REFERENCES:

1. R.J.A.Buhr, D.L.Bailey, “An Introduction to Real-Time Systems”, Prentice-Hall International, 1999.
2. David E-Simon, “An Embedded Software Primer”, Pearson Education, 2007.
3. C.M.Krishna, Kang G.Shin, “Real Time Systems”, Mc-Graw Hill, 1997.
4. B.P.Douglass, “Real Time UML", 2nd Edition, Addison-Wesley 2000.
5. Dr.K.V.K.K.Prasad, “Embedded/Real Time Systems: Concepts, Design and Programming”, DreamTech Press, Black Book, 2005.
6. R.Barnett, L.O.Cull, S.Cox, “Embedded C Programming and the Microchip PIC”, Thomason Learning, 2004.
7. Wayne Wolf, “Computers as Components - Principles of Embedded Computer System Design”, Mergen Kaufmann Publisher, 2006.
8. Sriram V Iyer, Pankaj Gupta, “Embedded Real Time Systems Programming”, Tata Mc-Graw Hill, 2004.

VL7073 **VLSI SIGNAL PROCESSING** **L T P C**
3 0 0 3

OBJECTIVES:

- To introduce techniques for altering the existing DSP structures to suit VLSI implementations.
- To introduce efficient design of DSP architectures suitable for VLSI

UNIT I INTRODUCTION TO DSP SYSTEMS, PIPELINING AND PARALLEL PROCESSING OF FIR FILTERS **9**

Introduction to DSP systems – Typical DSP algorithms, Data flow and Dependence graphs - critical path, Loop bound, iteration bound, Longest path matrix algorithm,Pipelining and Parallel processing of FIR filters, Pipelining and Parallel processing for low power.

UNIT II RETIMING, ALGORITHMIC STRENGTH REDUCTION **9**

Retiming – definitions and properties, Unfolding – an algorithm for unfolding, properties of unfolding, sample period reduction and parallel processing application, Algorithmic strength reduction in filters and transforms – 2-parallel FIR filter, 2-parallel fast FIR filter, DCT architecture, rank-order filters, Odd-Even merge-sort architecture, parallel rank-order filters.

UNIT III FAST CONVOLUTION, PIPELINING AND PARALLEL PROCESSING OF IIR FILTERS **9**

Fast convolution – Cook-Toom algorithm, modified Cook-Toom algorithm, Pipelined and parallel recursive filters – Look-Ahead pipelining in first-order IIR filters, Look-Ahead pipelining with power-of-ing2 decomposition, Clustered look-ahead pipelining, Parallel processing of IIR filters, combined pipelining and parallel processing of IIR filters.

UNIT IV BIT-LEVEL ARITHMETIC ARCHITECTURES **9**

Bit-level arithmetic architectures – parallel multipliers with sign extension, parallel carry-ripple and carry-save multipliers, Design of Lyon's bit-serial multipliers using Horner's rule, bit-serial FIR filter, CSD representation, CSD multiplication using Horner's rule for precision improvement, Distributed Arithmetic fundamentals and FIR filters

UNIT V NUMERICAL STRENGTH REDUCTION, SYNCHRONOUS, WAVE AND ASYNCHRONOUS PIPELINING **9**

Numerical strength reduction – subexpression elimination, multiple constant multiplication, iterative matching, synchronous pipelining and clocking styles, clock skew in edge-triggered single phase clocking, two-phase clocking, wave pipelining. Asynchronous pipelining bundled data versus dual rail protocol.

TOTAL: 45 PERIODS

OUTCOME:

- Ability to modify the existing or new DSP architectures suitable for VLSI

REFERENCES:

1. Keshab K. Parhi, " VLSI Digital Signal Processing Systems, Design and implementation ", Wiley, Interscience, 2007.
2. U. Meyer – Baese, " Digital Signal Processing with Field Programmable Gate Arrays", Springer, Second Edition, 2004

IF7251 ADVANCED OPERATING SYSTEMS L T P C
3 0 0 3

OBJECTIVES:

- To learn the fundamentals of Operating system.
- To gain knowledge on Distributed operating system concepts that includes architecture, Mutual exclusion algorithms, Deadlock detection algorithms and agreement protocols.
- To gain insight on to the distributed resource management components viz. the algorithms for implementation of distributed shared memory, recovery and commit protocols.
- To know the components and management aspects of Real time, Mobile operating systems.

UNIT I OPERATING SYSTEM BASICS 9

Overview – Synchronization Mechanisms – Process and Threads- Process Scheduling – Deadlocks: Detection – Prevention- Recovery – Models of Resources – Memory Management.

UNIT II DISTRIBUTED OPERATING SYSTEM 9

Issues in Distributed Operating System – Architecture – Communication Primitives – Lamport's Logical clocks – Causal Ordering of Messages – Distributed Mutual Exclusion Algorithms – Centralized and Distributed Deadlock Detection Algorithms – Agreement Protocols.

UNIT III DISTRIBUTED RESOURCE MANAGEMENT 9

Distributed File System – Design Issues - Distributed Shared Memory – Algorithms for Implementing Distributed Shared memory–Issues in Load Distributing – Scheduling Algorithms – Synchronous and Asynchronous Check Pointing and Recovery – Fault Tolerance – Two-Phase Commit Protocol – Nonblocking Commit Protocol – Security and Protection.

UNIT IV REAL TIME & MOBILE OPERATING SYSTEMS 9

Basic Model of Real Time Systems - Characteristics- Applications of Real Time Systems – Real Time Task Scheduling - Handling Resource Sharing - Mobile Operating Systems –Micro Kernel Design - Client Server Resource Access – Processes and Threads - Memory Management - File system.

UNIT V CASE STUDIES 9

Linux System: Design Principles - Kernel Modules - Process Management Scheduling - Memory Management - Input-Output Management - File System - Interprocess Communication. Windows XP: Design Principles - System Components - Process and Thread Management - Memory Management - File System. iphone iOS4: Architecture and SDK Framework - Media Layer - Services Layer - Core OS Layer - File System.

TOTAL:45 PERIODS

OUTCOMES:

Upon Completion of the course, the students should be able to:

- Get a complete overview of process management & memory management of Operating system.
- Demonstrate the Mutual exclusion, Deadlock detection and agreement protocols of Distributed operating system

REFERENCES:

1. Mukesh Singhal, Niranjan G Shivaratri, "Advanced Concepts in Operating Systems – Distributed, Database, and Multiprocessor Operating Systems", Tata McGraw-Hill, 2001.
2. Abraham Silberschatz; Peter Baer Galvin; Greg Gagne, "Operating System Concepts", Seventh Edition, John Wiley & Sons, 2004.
3. Andrew S.Tanenbaum, "Modern Operating System", Third Edition, Prentice Hall Inc., 2008.
4. Rajib Mall, "Real-Time Systems: Theory and Practice", Pearson Education India, 2006.
5. H M Deital, P J Deital and D R Choffnes, "Operating Systems", Pearson Education, 2004.
6. Neil Smyth, "iPhone iOS 4 Development Essentials – Xcode", Fourth Edition, Payload media, 2011.

NE7081 **VLSI DESIGN TECHIQUES** **L T P C**
3 0 0 3

OBJECTIVE:

- To learn the fundamentals of VLSI design
- To understand the IC Manufacturing Process
- To familiarize with VLSI combinational logic circuits design
- To familiarize with VLSI sequential logic circuits design
- To learn the various arithmetic circuits and testing methodologies
- To familiarize with the different FPGA architectures

UNIT I MOS TRANSISTOR PRINCIPLES 9

MOS Technology and VLSI, Pass transistors, NMOS, CMOS Fabrication process and Electrical properties of CMOS circuits and Device modelling. Characteristics of CMOS inverter, Scaling principles and fundamental limits. Propagation Delays, CMOS inverter scaling, Stick diagram, Layout diagrams, Elmore's constant, Logical Effort.

UNIT II COMBINATIONAL LOGIC CIRCUITS 9

Static CMOS logic Design, Design techniques to improve the speed, power dissipation of CMOS logic, low power circuit techniques, Ratioed logic .Pass transistor Logic, Transmission CPL, DCVSL, Dynamic CMOS logic, Domino logic, Dual Rail logic, NP CMOS logic and NOR array logic.

UNIT III SEQUENTIAL LOGIC CIRCUITS 9

Static and Dynamic Latches and Registers, Timing Issues, Pipelines, Clocking strategies, Memory Architectures, and Memory control circuits

UNIT IV DESIGNING ARITHMETIC BUILDING BLOCKS & TESTING 9

Datapath circuits, Architectures for Adders, Accumulators, Multipliers, Barrel Shifters, Need for testing- Testers, Text fixtures and test programs- Logic verification- - Manufacturing test – Design for testability – Boundary scan.

UNIT V IMPLEMENTATION STRATEGIES 9

Full Custom and Semicustom Design, Standard Cell design and cell libraries, FPGA building block architectures, FPGA interconnect routing procedures.

TOTAL:45 PERIODS

OUTCOMES:

- At the end of the course students will be in a position to understand the basics of VLSI design, testing and different FPGA architectures.

REFERENCES:

1 Jan Rabaey, Anantha Chandrakasan, B.Nikolic, "Digital Integrated circuits: A design perspective". Second Edition, Prentice Hall of India, 2003.s

2 N.Weste, K.Eshraghian, "Principles of CMOS VLSI DESIGN", A system Perspective, second edition,Addision Wesley 1993

3 A.Pucknell, Kamran Eshraghian, "BASIC VLSI DESIGN", Third edition, Prentice Hall of India, 2007.

4. M.J. Smith, "Application specific integrated circuits", Addisson Wesley, 1997

5 R.Jacob Baker, Harry W.LI., David E.Boyee, "CMOS Circuit Design, Layout and Simulation", 2005 Prentice Hall of India.

NE7072 **ASIC DESIGN** **L T P C**
3 0 0 3

OBJECTIVES:

- To learn the fundamentals of the ASIC design
- To understand the various fusing technology
- To familiarize with different ASIC architectures
- To learn the various simulation and testing methodologies
- To familiarize with the ASIC interconnects

UNIT I INTRODUCTION TO ASICS, CMOS LOGIC AND ASIC LIBRARY DESIGN **9**

Types of ASICs - Design flow - CMOS transistors CMOS Design rules - Combinational Logic Cell – Sequential logic cell - Data path logic cell - Transistors as Resistors – Transistor Parasitic Capacitance- Logical effort –Library cell design - Library architecture.

UNIT II PROGRAMMABLE ASICS, PROGRAMMABLE ASIC LOGIC CELLS AND PROGRAMMABLE ASIC I/O CELLS **9**

Anti fuse - static RAM - EPROM and EEPROM technology - Actel ACT - Xilinx LCA –Altera FLEX - Altera MAX DC & AC inputs and outputs - Clock & Power inputs - Xilinx I/O blocks.

UNIT III PROGRAMMABLE ASIC INTERCONNECT, PROGRAMMABLE ASIC DESIGN SOFTWARE AND LOW LEVEL DESIGN ENTRY **9**

Actel ACT -Xilinx LCA - Xilinx EPLD - Altera MAX 5000 and 7000 - Altera MAX 9000 - Altera FLEX –Design systems - Logic Synthesis - Half gate ASIC -Schematic entry - Low level design language - PLA tools -EDIF- CFI design representation.

UNIT IV LOGIC SYNTHESIS, SIMULATION AND TESTING **9**

Verilog and logic synthesis -VHDL and logic synthesis - types of simulation -boundary scan test - fault simulation - automatic test pattern generation.

UNIT V ASIC CONSTRUCTION, FLOOR PLANNING, PLACEMENT AND ROUTING **9**

System partitioning - partitioning methods - floor planning - placement - physical design flow – Routing - global routing - detailed routing - special routing - circuit extraction -DRC.

TOTAL:45 PERIODS

OUTCOMES:

At the end of the course students will be familiarized with different ASIC architectures, Fuses, Interconnects and Placement and Routing

REFERENCES:

1.M.J.S .Smith, "Application Specific Integrated Circuits, Addison -Wesley Longman Inc., 1997.
2. Farzad Nekoogar and Faranak Nekoogar, From ASICs to SOCs: A Practical Approach, Prentice Hall PTR, 2003.
3.Wayne Wolf, FPGA-Based System Design, Prentice Hall PTR, 2004.
4. R. Rajsuman, System-on-a-Chip Design and Test. Santa Clara, CA: Artech House Publishers, 2000.
5.F. Nekoogar. Timing Verification of Application-Specific Integrated Circuits (ASICs).Prentice Hall PTR, 1999.

NE7074 COMPUTATIONAL INTELLIGENCE L T P C
3 0 0 3

OBJECTIVES:

- To provide the basic concepts in computional intelligence.
- To give an exposure to neural network learning techniques and architectures.
- To provide a good understanding of fuzzy concepts and models.
- To provide an exposure to different optimization techniques.

UNIT I INTRODUCTION TO COMPUTATIONAL INTELLIGENCE 9

Evolution of Computing - Constituents - From Conventional AI to Computational Intelligence - Machine Learning Basics

UNIT II NEURAL NETWORKS 9

Biological Neurons Networks – Artificial Neural Networks - Supervised -.unsupervised learning - Reinforcement Learning – Activation functions - Perceptrons - Back Propagation networks – Radial Basis Function Networks - Adaptive Resonance architectures - Advances in Neural networks -SVM

UNIT III FUZZY LOGIC 9

Fuzzy Sets – Operations on Fuzzy Sets – Fuzzy Relations – Membership Functions -Fuzzy Rules and Fuzzy Reasoning – Fuzzy Inference Systems – Fuzzy Expert Systems – Fuzzy Decision Making- Introduction to Fuzzy models

UNIT IV NEURO-FUZZY MODELING 9

Adaptive Neuro-Fuzzy Inference Systems – Coactive Neuro-Fuzzy Modeling - Classification and Regression Trees – Data Clustering Algorithms – Neuro-Fuzzy Control - Hybrid learning algorithms - Applications of Neuro-fuzzy concepts

UNIT V OPTIMIZATION ALGORITHMS 9

Heuristic search and optimization techniques – Random search- Introduction to Genetic Algorithms (GA) -Applications of GA – Social Algorithms

TOTAL:45 PERIODS

OUTCOMES:

- To be able to design systems based on neural network architectures.
- To implement fuzzy models and work on fuzzy tool box.
- To design a suitable optimization algorithm for a given application.

REFERENCES:

1. Jyh-Shing Roger Jang, Chuen-Tsai Sun, Eiji Mizutani, “Neuro-Fuzzy and Soft Computing”, Prentice-Hall of India, 2003.
2. George J. Klir and Bo Yuan, “Fuzzy Sets and Fuzzy Logic-Theory and Applications”, Prentice Hall, 1995.
3. James A. Freeman and David M. Skapura, “Neural Networks Algorithms, Applications, and Programming Techniques”, Pearson Edn., 2003.
4. Mitchell Melanie, “An Introduction to Genetic Algorithm”, Prentice Hall, 1998.
5. David E. Goldberg, “Genetic Algorithms in Search, Optimization and Machine Learning”, Addison Wesley, 1997.
6. S. N. Sivanandam, S. Sumathi and S. N. Deepa, “Introduction to Fuzzy Logic using MATLAB”, Springer, 2007.
7. S.N.Sivanandam · S.N.Deepa, “ Introduction to Genetic Algorithms”, Springer, 2007.
8. Jacek M. Zurada, “Introduction to Artificial Neural Systems”, PWS Publishers, 1992.