ANNA UNIVERSITY, CHENNAI
AFFILIATED INSTITUTIONS
M.E. ELECTRONICS AND COMMUNICATION ENGINEERING
REGULATIONS – 2017
CHOICE BASED CREDIT SYSTEM

PROGRAM EDUCATIONAL OBJECTIVES (PEOs)

1. To enable graduates to possess skills to develop new innovation in the field of Electronics and Communication Engineering using analytical reasoning and state-of-the-art approaches derived from the Engineering Sciences and Engineering practice.
2. To enable graduates to create useful systems, components, or processes through agile, skillful, and innovative analysis and design, while respecting economic, environmental, cultural, and ethical standards or constraints.
3. To enable graduates to engage in lifelong learning, adapt to evolving Technology, work in multidisciplinary research for designing innovative products & solutions and become Entrepreneurs.
4. To enable graduates to acquire technical and managerial leadership positions in their chosen fields.

PROGRAM OUTCOMES (POs)

Engineering Graduates will be able to:

1. **Engineering knowledge**: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems. [K3-APPLY]

2. **Problem analysis**: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences. [K4-ANALYZE]

3. **Design/development of solutions**: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations. [K5-EVALUATE]

4. **Conduct investigations of complex problems**: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.[K5-EVALUATE]

5. **Modern tool usage**: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations. [K3/K5-APPLY/EVALUATE]

6. **The engineer and society**: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.[A2-RESPOND]

7. **Environment and sustainability**: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.[A3-VALUING]

8. **Ethics**: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice. [A3-VALUING]

9. **Individual and team work**: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.[A3-VALUING]

10. **Communication**: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.[A3-VALUING]

11. **Project management and finance**: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.[A3-VALUING]

12. **Life-long learning**: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change. [A2-RESPOND]

Program Specific Outcomes (PSOs)

1. To apply the core aspects of Electronics and Communication Engineering principles such as Signal Processing, Embedded Systems, Networking and Semiconductor Technology for designing Electronic products.
2. To identify and utilize the strengths of current technologies in the Microelectronics, Signal Processing and Communication System domains in implementing ICT enabled services for societal needs.
3. To identify user needs to provide suitable design solutions for implementing Analog &Digital Circuits or Systems for a given specification and function.

Provide mapping of 1) POs to PEOs and 2) PSOs to PEOs.
Use the following marking:

Contribution 1: Reasonable 2: Significant 3: Strong

MAPPING OF PROGRAMME EDUCATIONAL OBJECTIVES WITH PROGRAMME OUTCOMES

A broad relation between the programme objective and the outcomes is given in the following table

Programme Educational Objectives	Programme Outcomes											
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
1	3	3	3	3	3	2	2	-	-	2	-	-
2	3	3	3	3	3	3	3	3	-	2	**-**	**-**
3	2	2	2	2	2	-	-	-	3	3	3	3
4	2	2	2	2	2	1	-	2	3	3	3	1

MAPPING OF PROGRAM SPECIFIC OBJECTIVES WITH PROGRAMME OUTCOMES

A broad relation between the Program Specific Objectives and the outcomes is given in the following table.

PROGRAMME SPECIFIC OUTCOMES	PROGRAMME OUTCOMES											
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
1	3	3	3	3	3	-	-	-	2	-	2	-
2	3	3	3	3	3	3	3	1	2	1	2	2
3	3	3	3	3	3	-	-	1	2	1	2	3

M.E. ELECTRONICS AND COMMUNICATION ENGINEERING
SEMESTER COURSE WISE PO MAPPING

Year/ Semester		SUBJECTS	Programme Outcomes (POs)												Programme Specific Outcomes (PSOs)		
			PO 1	PO 2	PO 3	PO 4	PO5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PSO1	PSO 2	PSO3
I YEAR	SEMESTER I	Applied Mathematics for Electronics Engineers	3	3	2	1				1	1				-	-	-
		Advanced Digital Signal Processing	3	3	3	2	1	1		1					3	3	3
		Solid State Device Modeling and Simulation	3	3	3	2	2		1						3	2	2
		Advanced Digital Communication Techniques	3	3	3	2	1	1		1					3	3	3
		Optical Networks	3	3	2	2			1						3	2	1
		Professional Elective I															
		Advanced Microprocessors and Microcontrollers	3	3	2	2		1	1						3	2	3
		Soft Computing Techniques	3	2	1	1									2	1	1
		Signal Integrity for High Speed Design	3	3	2	2			1						3	2	2
		Optical Sensors and Applications	3	2	1	1		1	1						3	2	1
		Communication and Signal Processing Laboratory	3	3	3	2	2	1	1	1	2	2	2	2	3	3	3
	SEMESTER II	ASIC and FPGA Design	3	3	3	2		1	1						3	3	3
		RF System Design	3	3	3	2			1						3	3	3
		Wireless Communication and Networking	3	3	2	1		1	1						3	2	1
		Nano Electronics	3	3	3	2		1	1						3	3	3
		Professional Elective II															
		Advanced Digital Image Processing	3	3	3	2			1						3	3	3
		Multimedia Compression Techniques	3	3	2	2		1	1						3	2	1

Year/ Semester		SUBJECTS	Programme Outcomes (POs)												Programme Specific Outcomes (PSOs)		
			PO 1	PO 2	PO 3	PO 4	PO5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PSO1	PSO 2	PSO3
		Advanced Radiation Systems	3	3	2	2	2	2	2	1	2	-	1	2			
		Advanced Embedded Systems	3	3	2	2		1	1						3	2	2
		Professional Elective III															
		Electromagnetic Interference and Compatibility	3	3	2	1			1						3	2	1
		Smart Antennas	3	3	2	1		1	1						3	2	1
		Broadband Access Technologies	3	3	2	1			1						3	2	1
		Wavelet Transforms and its Applications	3	3	2	1			1						3	2	1
		Advanced Electronics System Design Laboratory	3	3	3	2	2	1	1	1	2	2	2	2	3	3	3
		Technical Seminar	3	3	2	2		1	1		2	2	2	2	1	1	1
II YEAR	**SEMESTER III**	Wireless Adhoc and Sensor Networks	3	3	2	2		1	1						3	2	2
		Professional Elective IV															
		VLSI Signal Processing	3	3	3	2			1						3	3	2
		Bio Signal Processing	3	3	2	1		1	1						3	2	1
		Hardware – Software Co-design	1	1	1	1	1	3	2	3	2	3			3	3	2
		MEMS and NEMS	3	3	3	2		1	1						3	3	2
		Professional Elective V															
		Machine Vision	3	3	2	1		1	1						3	2	1
		Robotics	3	2	2	2	1			3	2	3		2			
		Cryptography and Network Security	3	3	2	1		1	1						3	2	1
		Network Routing Algorithms	3	3	2	1		1	1						3	2	1
		Project Work – Phase-I	3	3	3	3	3	2	2	2	3	3	3	3	3	3	3

Year/ Semester		SUBJECTS	Programme Outcomes (POs)												Programme Specific Outcomes (PSOs)		
			PO 1	PO 2	PO 3	PO 4	PO5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PSO1	PSO 2	PSO3
	SEMESTER IV	Project Work Phase – II	3	3	3	3	3	2	2	2	3	3	3	3	3	3	3

ANNA UNIVERSITY, CHENNAI
AFFILIATED INSTITUTIONS
M.E. ELECTRONICS AND COMMUNICATION ENGINEERING
REGULATIONS – 2017
CHOICE BASED CREDIT SYSTEM
CURRICULA AND SYLLABI

SEMESTER I

SI.NO	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
THEORY								
1.	MA5152	Applied Mathematics for Electronics Engineers	FC	4	4	0	0	4
2.	AP5152	Advanced Digital Signal Processing	PC	5	3	2	0	4
3.	AP5092	Solid State Device Modeling and Simulation	PC	3	3	0	0	3
4.	CU5151	Advanced Digital Communication Techniques	PC	3	3	0	0	3
5.	CU5192	Optical Networks	PC	3	3	0	0	3
6.		Professional Elective I	PE	3	3	0	0	3
PRACTICALS								
7.	EL5111	Communication and Signal Processing Laboratory	PC	4	0	0	4	2
			TOTAL	**25**	**19**	**2**	**4**	**22**

SEMESTER II

S.NO	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
THEORY								
1.	AP5252	ASIC and FPGA Design	PC	3	3	0	0	3
2.	AP5073	RF System Design	PC	3	3	0	0	3
3.	EL5201	Wireless Communication and Networking	PC	3	3	0	0	3
4.	AP5071	Nano Electronics	PC	3	3	0	0	3
5.		Professional Elective II	PC	3	3	0	0	3
6.		Professional Elective III	PC	3	3	0	0	3
PRACTICALS								
7.	EL5211	Advanced Electronics System Design Laboratory	PC	4	0	0	4	2
8.	EL5212	Technical Seminar	EEC	2	0	0	2	1
			TOTAL	**24**	**18**	**0**	**6**	**21**

SEMESTER III

Sl.NO	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
THEORY								
1.	CU5097	Wireless Adhoc and Sensor Networks	PC	3	3	0	0	3
2.		Professional Elective IV	PE	3	3	0	0	3
3.		Professional Elective V	PE	3	3	0	0	3
PRACTICALS								
4.	EL5311	Project Work Phase I	EEC	12	0	0	12	6
			TOTAL	**21**	**9**	**0**	**12**	**15**

SEMESTER IV

Sl. NO	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
PRACTICALS								
1.	EL5411	Project Work Phase II	EEC	24	0	0	24	12
				TOTAL	**0**	**0**	**24**	**12**

TOTAL NO. OF CREDITS: 70

FOUNDATION COURSES (FC)

SL. NO	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1.	MA5152	Applied Mathematics for Electronics Engineers	FC	4	4	0	0	4

PROFESSIONAL CORE (PC)

SL. NO	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1.	AP5152	Advanced Digital Signal Processing	PC	5	3	2	0	4
2.	AP5092	Solid State Device Modeling and Simulation	PC	3	3	0	0	3
3.	CU5151	Advanced Digital Communication Techniques	PC	3	3	0	0	3
4.	CU5192	Optical Networks	PC	3	3	0	0	3
5.	EL5111	Communication and Signal Processing Laboratory	PC	4	0	0	4	2
6.	AP5252	ASIC and FPGA Design	PC	3	3	0	0	3
7.	AP5073	RF System Design	PC	3	3	0	0	3
8.	EL5201	Wireless Communication and Networking	PC	3	3	0	0	3
9.	AP5071	Nano Electronics	PC	3	3	0	0	3
10	EL5211	Advanced Electronics System Design Laboratory	PC	4	0	0	4	2
11	CU5097	Wireless Adhoc and Sensor Networks	PC	3	3	0	0	3

EMPLOYABILITY ENHANCEMENT COURSE (EEC)

SL. NO	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1.	CP5281	Technical Seminar	EEC	2	0	0	2	1
2.	EL5311	Project Work Phase I	EEC	12	0	0	12	6
3.	EL5411	Project Work Phase II	EEC	24	0	0	24	12

PROFESSIONAL ELECTIVES (PE)*

SEMESTER I

ELECTIVE I

Sl.No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1.	EL5001	Advanced Microprocessors and Microcontrollers	PE	3	3	0	0	3
2.	MP5092	Soft Computing Techniques	PE	3	3	0	0	3
3.	AP5094	Signal Integrity for High Speed Design	PE	3	3	0	0	3
4.	EL5002	Optical Sensors and Applications	PE	3	3	0	0	3

SEMESTER II

ELECTIVE II

Sl.No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1.	DS5291	Advanced Digital Image Processing	PE	3	3	0	0	3
2.	MU5091	Multimedia Compression Techniques	PE	3	3	0	0	3
3.	CU5191	Advanced Radiation Systems	PE	3	3	0	0	3
4.	EL5003	Advanced Embedded Systems	PE	3	3	0	0	3

SEMESTER II

ELECTIVE III

Sl.No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1.	CU5292	Electromagnetic Interference and Compatibility	PE	3	3	0	0	3
2.	EL5004	Smart Antennas	PE	3	3	0	0	3
3.	EL5071	Broadband Access Technologies	PE	3	3	0	0	3
4.	CU5093	Wavelet Transforms and its Applications	PE	3	3	0	0	3

SEMESTER III
ELECTIVE IV

Sl.No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1.	VL5291	VLSI Signal Processing	PE	3	3	0	0	3
2.	BM5191	Bio Signal Processing	PE	3	3	0	0	3
3.	VL5091	MEMS and NEMS	PE	3	3	0	0	3
4.	AP5291	Hardware – Software Co-design	PE	3	3	0	0	3

SEMESTER III
ELECTIVE V

Sl.No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1.	EL5005	Machine Vision	PE	3	3	0	0	3
2.	AP5093	Robotics	PE	3	3	0	0	3
3.	IF5072	Cryptography and Network Security	PE	3	3	0	0	3
4.	NC5071	Network Routing Algorithms	PE	3	3	0	0	3

MA5152 APPLIED MATHEMATICS FOR ELECTRONICS ENGINEERS L T P C
4 0 0 4

OBJECTIVES :

The main objective of this course is to demonstrate various analytical skills in applied mathematics and extensive experience with the tactics of problem solving and logical thinking applicable in electronics engineering. This course also will help the students to identify, formulate, abstract, and solve problems in electrical engineering using mathematical tools from a variety of mathematical areas, including fuzzy logic, matrix theory, probability, dynamic programming and queuing theory.

UNIT I FUZZY LOGIC 12

Classical logic – Multivalued logics – Fuzzy propositions – Fuzzy quantifiers.

UNIT II MATRIX THEORY 12

Cholesky decomposition - Generalized Eigenvectors - Canonical basis - QR factorization - Least squares method - Singular value decomposition.

UNIT III PROBABILITY AND RANDOM VARIABLES 12

Probability – Axioms of probability – Conditional probability – Baye's theorem - Random variables - Probability function – Moments – Moment generating functions and their properties – Binomial, Poisson, Geometric, Uniform, Exponential, Gamma and Normal distributions – Function of a Random variable.

UNIT IV DYNAMIC PROGRAMMING 12

Dynamic programming – Principle of optimality – Forward and backward recursion – Applications of dynamic programming – Problem of dimensionality.

UNIT V QUEUEING MODELS 12

Poisson Process – Markovian queues – Single and multi server models – Little's formula - Machine interference model – Steady state analysis – Self service queue.

TOTAL: 60 PERIODS

OUTCOMES :

After completing this course, students should demonstrate competency in the following skills:

- Concepts of fuzzy sets, knowledge representation using fuzzy rules, fuzzy logic, fuzzy prepositions and fuzzy quantifiers and applications of fuzzy logic.
- Apply various methods in matrix theory to solve system of linear equations.
- Computation of probability and moments, standard distributions of discrete and continuous random variables and functions of a random variable.
- Conceptualize the principle of optimality and sub-optimization, formulation and computational procedure of dynamic programming
- Exposing the basic characteristic features of a queuing system and acquire skills in analyzing queuing models.
- Using discrete time Markov chains to model computer systems.

REFERENCES :

1. Bronson, R., "Matrix Operations", Schaum's Outline Series, McGraw Hill, 2011.
2. George, J. Klir. and Yuan, B., "Fuzzy sets and Fuzzy logic, Theory and Applications", Prentice Hall of India Pvt. Ltd., 1997.
3. Gross, D., Shortle J. F., Thompson, J.M., and Harris, C. M., "Fundamentals of Queueing Theory", 4th Edition, John Wiley, 2014.
4. Johnson, R.A., Miller, I and Freund J., "Miller and Freund's Probability and Statistics for Engineers", Pearson Education, Asia, 8th Edition, 2015.
5. Taha, H.A., "Operations Research: An Introduction", 9th Edition, Pearson Education, Asia, New Delhi, 2016.

AP5152	ADVANCED DIGITAL SIGNAL PROCESSING	L	T	P	C
		3	2	0	4

OBJECTIVES:

- The student comprehends mathematical description and modelling of discrete time random signals.
- The student is conversant with important theorems and random signal processing algorithms.
- The student learns relevant figures of merit such as power, energy, bias and consistency.
- The student is familiar with estimation, prediction, filtering, multirate concepts and techniques.

UNIT I DISCRETE RANDOM SIGNAL PROCESSING 9+6

Discrete random processes – Ensemble averages – Wide sense stationary process – Properties - Ergodic process – Sample mean & variance - Auto-correlation and Auto-correlation matrices- Properties – White noise process – Weiner Khitchine relation - Power spectral density – Filtering random process – Spectral Factorization Theorem – Special types of Random Processes – AR,MA, ARMA Processes – Yule-Walker equations.

UNIT II SPECTRUM ESTIMATION 9+6

Bias and Consistency of estimators - Non-Parametric methods – Periodogram – Modified Periodogram – Barlett's method – Welch's mehod – Blackman-Tukey method – Parametric methods – AR, MA and ARMA spectrum estimation - Performance analysis of estimators.

UNIT III SIGNAL MODELING AND OPTIMUM FILTERS 9+6

Introduction- Least square method – Pade approximation – Prony's method – Levinson Recursion – Lattice filter - FIR Wiener filter – Filtering – Linear Prediction – Non Causal and Causal IIR Weiner Filter -– Mean square error – Discrete Kalman filter.

UNIT IV ADAPTIVE FILTERS 9+6

FIR Adaptive filters - Newton's steepest descent method – Widrow Hoff LMS Adaptive algorithm – Convergence – Normalized LMS – Applications – Noise cancellation - channel equalization – echo canceller – Adaptive Recursive Filters - RLS adaptive algorithm – Exponentially weighted RLS-sliding window RLS.

UNIT V MULTIRATE SIGNAL PROCESSING 9+6

Decimation - Interpolation – Sampling Rate conversion by a rational factor I/D – Multistage implementation of sampling rate conversion – Polyphase filter structures – Applications of multirate signal processing.

TOTAL45+30: 75 PERIODS

OUTCOMES:

- Formulate time domain and frequency domain description of Wide Sense Stationary process in terms of matrix algebra and relate to linear algebra concepts.
- State W-K theorem, spectral factorization theorem, spectrum estimation, bias and consistency of estimators.
- Wiener filtering, LMS algorithms, Levinson recursion algorithm, applications of adaptive filters
- Decimation, interpolation, Sampling rate conversion, Applications of multirate signal processing

REFERENCES:

1. John G. Proakis, Dimitris G. Manolakis, “Digital Signal Processing”, Prentice Hall of India, New Delhi, 2005.
2. Monson H. Hayes, “Statistical Digital Signal Processing and Modeling”, John Wiley and Sons Inc., New York, 2006.
3. P. P. Vaidyanathan, “Multirate Systems and Filter Banks”, Prentice Hall, 1992.
4. S. Kay,” Modern spectrum Estimation theory and application”, Prentice Hall, Englehood Cliffs, NJ1988.
5. Simon Haykin, “Adaptive Filter Theory”, Prentice Hall, Englehood Cliffs, NJ1986.
6. Sophoncles J. Orfanidis, “Optimum Signal Processing “, McGraw-Hill, 2000.

AP5092 SOLID STATE DEVICE MODELLING AND SIMULATION L T P C
3 0 0 3

OBJECTIVES:

- To understand the concept of device modeling
- To learn multistep method
- To study device simulations

UNIT I MOSFET DEVICE PHYSICS MOSFET 9

capacitor, Basic operation, Basic modeling, Advanced MOSFET modeling, RF modeling of MOS transistors, Equivalent circuit representation of MOS transistor, High frequency behavior of MOS transistor and A.C small signal modeling, model parameter extraction, modeling parasitic BJT, Resistors, Capacitors, Inductors.

UNIT II DEVICE MODELLING 9

Prime importance of circuit and device simulations in VLSI; Nodal, mesh, modified nodal andhybrid analysis equations. Solution of network equations: Sparse matrix techniques, solution of nonlinear networks through Newton-Raphson technique, convergence and stability.

UNIT III MULTISTEP METHODS 9

Solution of stiff systems of equations, adaptation of multistep methods to the solution of electrical networks, general purpose circuit simulators.

UNIT IV MATHEMATICAL TECHNIQUES DEVICE SIMULATIONS 9

Poisson equation, continuity equation, drift-diffusion equation, Schrodinger equation, hydrodynamic equations, trap rate, finite difference solutions to these equations in 1D and 2D space, grid generation.

UNIT V SIMULATION OF DEVICES 9

Computation of characteristics of simple devices like p-n junction, MOS capacitor and MOSFET; Small-signal analysis.

OUTCOMES:

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

- Explain the importance of MOS Capacitor and Small signal modeling
- Apply and determine the drift diffusion equation and stiff system equation.
- Analyze circuits using parasitic BJT parameters and newton raphson method.
- Model the MOS transistor using schrodinger equation and Multistep methods.

REFERENCES:

1. Arora, N., “MOSFET Modeling for VLSI Simulation”, Cadence Design Systems, 2007
2. Chua, L.O. and Lin, P.M., “Computer-Aided Analysis of Electronic Circuits: Algorithms and Computational Techniques”, Prentice-Hall., 1975
3. Fjeldly, T., Yetterdal, T. and Shur, M., “Introduction to Device Modeling and Circuit Simulation”, Wiley-Interscience., 1997
4. Grasser, T., “Advanced Device Modeling and Simulation”, World Scientific Publishing Company., 2003
5. Selberherr, S., “Analysis and Simulation of Semiconductor Devices”, Springer- Verlag.,1984
6. Trond Ytterdal, Yuhua Cheng and Tor A. Fjeldly Wayne Wolf, “Device Modeling for Analog and RF CMOS Circuit Design”, John Wiley & Sons Ltd.

CU5151	ADVANCED DIGITAL COMMUNICATION TECHNIQUES	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To understand the basics of signal-space analysis and digital transmission.
- To understand the coherent and noncoherent receivers and its impact on different channel characteristics.
- To understand the different Equalizers
- To understand the different block coded and convolutional coded digital communication systems..
- To understand the basics of Multicarrier and Multiuser Communications.

UNIT I COHERENT AND NON-COHERENT COMMUNICATION 9

Coherent receivers – Optimum receivers in WGN – IQ modulation & demodulation – Noncoherent receivers in random phase channels; MFSK receivers – Rayleigh and Rician channels – Partially coherent receivers – DPSK; M-PSK; M-DPSK-BER Performance Analysis. Carrier Synchronization- Bit synchronization.

UNIT II EQUALIZATION TECHNIQUES 9

Band Limited Channels- ISI – Nyquist Criterion- Controlled ISI-Partial Response signals- Equalization algorithms – Viterbi Algorithm – Linear equalizer – Decision feedback equalization – Adaptive Equalization algorithms.

UNIT III BLOCK CODED DIGITAL COMMUNICATION 9

Architecture and performance – Binary block codes; Orthogonal; Biorthogonal; Transorthogonal – Shannon's channel coding theorem; Channel capacity; Matched filter; Concepts of Spread spectrum communication – Coded BPSK and DPSK demodulators– Linear block codes; Hammning; Golay; Cyclic; BCH ; Reed – Solomon codes. Space time block codes.

UNIT IV CONVOLUTIONAL CODED DIGITAL COMMUNICATION 9

Representation of codes using Polynomial, State diagram, Tree diagram, and Trellis diagram – Decoding techniques using Maximum likelihood, Viterbi algorithm, Sequential and Threshold methods – Error probability performance for BPSK and Viterbi algorithm, Turbo Coding.

UNIT V MULTICARRIER AND MULTIUSER COMMUNICATIONS 9

Single Vs multicarrier modulation, orthogonal frequency division multiplexing (OFDM), Modulation and demodulation in an OFDM system, An FFT algorithmic implementation of an OFDM system, Bit and power allocation in multicarrier modulation, Peak-to-average ratio in multicarrier modulation. Introduction to CDMA systems, multiuser detection in CDMA systems – optimum multiuser receiver, suboptimum detectors, successive interference cancellation.

TOTAL : 45 PERIODS

OUTCOMES:

Upon Completion of the course, the students will be able to

- Develop the ability to understand the concepts of signal space analysis for coherent and non- coherent receivers.
- Conceptually appreciate different Equalization techniques
- Possess knowledge on different block codes and convolutional codes.
- Comprehend the generation of OFDM signals and the techniques of multiuser detection.

REFERENCES:

1. Bernard Sklar, "Digital Communications", second edition, Pearson Education, 2001.
2. John G. Proakis, "Digital Communication", Fifth Edition, Mc Graw Hill Publication, 2008.
3. M.K.Simon, S.M.Hinedi and W.C.Lindsey, "Digital communication techniques; Signal Design and Detection", Prentice Hall of India, New Delhi, 1995.
4. Richard Van Nee & Ramjee Prasad, "OFDM for Multimedia Communications" Artech House Publication, 2001.
5. Simon Haykin, "Digital communications", John Wiley and sons, 1998.
6. Stephen G. Wilson, "Digital Modulation and Coding", First Indian Reprint, Pearson

Education, 2003.
7. Theodore S.Rappaport, 'Wireless Communications", 2nd edition, Pearson Education, 2002.

CU5192 OPTICAL NETWORKS L T P C
3 0 0 3

OBJECTIVES:

The students should be made to understand:

- Optical system components like optical amplifiers, wavelength converters.
- Up-to-date survey of development in Optical Network Architectures.
- Packet switching.
- Network design perspectives.
- Different Optical Network management techniques and functions.

UNIT I **9**

Introduction to Optical Networks: Telecommunications Networks Architecture, Services, circuit switching and packet switching, Optical Networks: Multiplexing Techniques, Second generation Optical Networks, Optical Packet Switching, Transmission Basics: Wavelength, frequencies, and channel spacing, Wavelength standards, Optical power and loss, Network Evolution, Nonlinear Effects: Self-phase Modulation, Cross-phase Modulation, Four Wave mixing, Solitons. Components: Couplers, Isolators and Circulators, Multiplexers and Filters, Optical Amplifiers, Transmitters, Detectors, Switches, Wavelength Converters.

UNIT II **9**

Transmission System Engineering: System Model, Power Penalty, Transmitter, Receiver, Optical Amplifiers, Crosstalk, Dispersion, Wavelength Stabilization, Overall Design Considerations. Optical Internets: Migration to IP optical networking, IP and Optical backbone, IP Routing table, MPLS and optical cross connect table, Protocol stack Alternatives, Internetworking SS7 and Legacy Transport, Internet transport network protocol stack.

UNIT III **9**

SONET, SDH and Optical Transport Networks (OTNs): SONET and SDH: SONET multiplexing hierarchy, Frame structure, Functional Component, problem detection, concatenation. Architecture of Optical Transport Networks (OTNs): Digital wrapper, in-band and out-ofband control signalling, Importance of Multiplexing and multiplexing hierarchies, SONET multiplexing hierarchies, SDH multiplexing hierarchies, New Optical Transport, OTN layered Model, Generic Framing Procedure (GFP **.**

UNIT IV **9**

WDM, Network topologies, MPLS and Optical Networks: WDM: WDM operation, Dense Wavelength Division Multiplexing (DWDM), Erbium-doped Fiber (EDF), WDM amplifiers, Add-Drop Multiplexers, Wavelength Continuity Property, Higher dispersion for DWDM, Tunable DWDM Lasers.

UNIT V **9**

Network topologies and protection schemes: Robust networks, Line and path protection switching, Types of topology, Point to point topology, bi-directional line-switched ring (BLSR), meshed topology, Passive optical networks, Metro optical networks 28 MPLS and Optical Networks: IS label switching, Forwarding equivalence class (FEC), Types of MPLS nodes, Label distribution

and binding, label swapping and traffic forwarding, MPLS support of Virtual Private Networks (VPN), MPLS traffic engineering, Multi protocol Lambda switching (MPIS).

TOTAL : 45 PERIODS

OUTCOMES:

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

- Design and Analyze Network Components
- Assess and Evaluate optical networks

REFERENCES:

1. Rajiv Ramaswami and Kumar Sivarajan, Optical Networks – Practical Perspective, 3rd Edition, Morgan - Kaufmann Publishers.
2. Optical Networks, Third Generation Transport Systems, Uyless Black, Pearson

EL5111 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.	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 use SDR platform for design of communication systems.

AP5252 ASIC AND FPGA DESIGN L T P C

3 0 0 3

OBJECTIVES:

- To study the design flow of different types of ASIC.
- To familiarize the different types of programming technologies and logic devices.
- To learn the architecture of different types of FPGA.
- To gain knowledge about partitioning, floor planning, placement and routing including circuit extraction of ASIC

UNIT I OVERVIEW OF ASIC AND PLD 9

Types of ASICs - Design flow – CAD tools used in ASIC Design – Programming Technologies: Antifuse – static RAM – EPROM and EEPROM technology, Programmable Logic Devices: ROMs and EPROMs – PLA –PAL. Gate Arrays – CPLDs and FPGAs

UNIT II ASIC PHYSICAL DESIGN 9

System partition -partitioning - partitioning methods – interconnect delay models and measurement of delay - floor planning - placement – Routing: global routing - detailed routing - special routing - circuit extraction - DRC

UNIT III LOGIC SYNTHESIS, SIMULATION AND TESTING 9

Design systems - Logic Synthesis - Half gate ASIC -Schematic entry - Low level design language - PLA tools -EDIF- CFI design representation. Verilog and logic synthesis -VHDL and logic synthesis - types of simulation - boundary scan test - fault simulation - automatic test pattern generation.

UNIT IV FIELD PROGRAMMABLE GATE ARRAYS 9

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

UNIT V SOC DESIGN 9

System-On-Chip Design - SoC Design Flow, Platform-based and IP based SoC Designs, Basic Concepts of Bus-Based Communication Architectures. High performance algorithms for ASICs/ SoCs as case studies: Canonical Signed Digit Arithmetic, Knowledge Crunching Machine, Distributed Arithmetic, High performance digital filters for sigma-delta ADC.

TOTAL : 45 PERIODS

OUTCOMES:

- To analyze the synthesis, Simulation and testing of systems.
- To apply different high performance algorithms in ASICs.
- To discuss the design issues of SOC.

REFERENCES:

1. David A.Hodges, Analysis and Design of Digital Integrated Circuits (3/e), MGH 2004
2. H.Gerez, Algorithms for VLSI Design Automation, John Wiley, 1999
3. Jan.M.Rabaey et al, Digital Integrated Circuit Design Perspective (2/e), PHI 2003
4. J. Old Field, R.Dorf, Field Programmable Gate Arrays, John Wiley& Sons, Newyork.
5. M.J.S. Smith : Application Specific Integrated Circuits, Pearson, 2003
6. P.K.Chan& S. Mourad, Digital Design using Field ProgrammableGate Array, Prentice Hall.
7. Sudeep Pasricha and NikilDutt, On-Chip Communication Architectures System on Chip Interconnect, Elsevier, 2008
8. S.Trimberger, Edr., Field Programmable Gate Array Technology,Kluwer Academic Pub.
9. S.Brown,R.Francis, J.Rose, Z.Vransic, Field Programmable GateArray,Kluwer Pub. 5. Richard FJinder , "Engineering Digital Design,"Academic press

AP5073 RF SYSTEM DESIGN L T P C
3 0 0 3

OBJECTIVES:

- The CMOS RF Front End (RFE) is a very crucial building block and in all of wireless and many high frequency wire-line systems. The RFE has few important building blocks within ii including the Low Noise Amplifiers, Phase Locked Loop Synthesizers, Mixers, Power Amplifiers, and impedance matching circuits.
- The present course will introduce the principles of operation and design principles associated with these important blocks.
- The course will also provide and highlight the appropriate digital communication related design objectives and constraints associated with the RFEs

UNIT I CMOS PHYSICS, TRANSCEIVER SPECIFICATIONS AND ARCHITECTURES 9

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

UNIT II IMPEDANCE MATCHING AND AMPLIFIERS 9

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

UNIT III FEEDBACK SYSTEMS AND POWER AMPLIFIERS 9

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 Linearisation Techniques, Efficiency boosting techniques, ACPR metric, Design considerations

UNIT IV MIXERS AND OSCILLATORS 9

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

UNIT V PLL AND FREQUENCY SYNTHESIZERS 9

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

TOTAL : 45 PERIODS

OUTCOMES:

- The student after completing this course must be able to translate the top level wireless communications system specifications into block level specifications of the RFE.
- The student should be also able to carry out transistor level design of the entire RFE.

REFERENCES:

1. B.Razavi, “RF Microelectronics”, Pearson Education, 1997.
2. B.Razavi, “Design of Analog CMOS Integrated Circuits”, McGraw Hill, 2001
3. T.Lee, “Design of CMOS RF Integrated Circuits”, Cambridge, 2004.
4. Jan Crols, Michiel Steyaert, “CMOS Wireless Transceiver Design”, Kluwer Academic Publishers, 1997.
5. Recorded lectures and notes available at . http://www.ee.iitm.ac.in/~ani/ee6240

EL5201 WIRELESS COMMUNICATION AND NETWORKING

L	T	P	C
3	0	0	3

OBJECTIVES:

- To understand the characteristics of wireless channels and the fundamental limits on the capacity of wireless channels
- Understand various types of local area networks, WiMax and wide area networks.
- Understand various wireless networking standards such as 3G and 4G.
- To interwork between WLAN and WWAN.
- To have a good understanding of emerging wireless networks such as Adhoc, Sensor networks and cooperative wireless networks.

UNIT I THE WIRELESS CHANNEL 9

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 3G EVOLUTIONS 9

IMT-2000 - W-CDMA, CDMA 2000 – radio & network components, network structure, packet-data transport process flow, Channel Allocation, core network, interference-mitigation techniques, UMTS-services, air interface, network architecture of 3GPP, UTRAN – architecture, High Speed Packet Data-HSDPA,HSUPA.

UNIT III 4G AND BEYOND 9

Introduction to LTE-A – Requirements and Challenges, network architectures – EPC, E-UTRAN architecture - mobility management, resource management, services, channel - logical and transport channel mapping, downlink/uplink data transfer, MAC control element, PDU packet formats, scheduling services, random access procedure.

UNIT IV ADHOC & SENSOR NETWORKS 9

Introduction to WLAN – IEEE 802.11and HIPERLAN, Bluetooth, WiMAX. Characteristics of MANETs, Table-driven and Source-initiated On Demand routing protocols, Hybrid protocols, Wireless Sensor networks- Classification, MAC and Routing protocols.

UNIT V INTERWORKING CONCEPTS AND COOPERATIVE WIRELESS NETWORKS 9

Interworking objectives and requirements, Schemes to connect WLANs and 3GNetworks, Session Mobility, Interworking Architectures for WLAN and GPRS. Introduction to User cooperation and cognitive systems- Relay channels- A general three node relay channel- Wireless relay channel- User cooperation in wireless networks- Two user cooperative network

TOTAL : 45 PERIODS

OUTCOMES:

On successful completion of this course, student will be able to

- Understand the concepts of wireless LAN, WAN and various wireless standards.
- Work with different wireless networks.
- Familiarize with advanced wireless networks such as Adhoc, Sensor networks and cooperative wireless networks.

REFERENCES:

1. Andrea Goldsmith, “Wireless Communications”, Cambridge University Press, 2005.
2. Andrea Goldsmith, “Wireless Communications”, Cambridge University Press, 2005.
3. Cognitive Radio Communication and Networks- Alexander M. Wyglinski published by Academic Press December 2009.
4. Clint Smith,P.E, Dannel Collins, “3G Wireless Networks” 2nd edition, Tata McGraw-Hill, 2008.
5. Jochen H.Schiller, “Mobile Communications”, 2/e, Pearson, 2014.
6. Kaveh Pahlavan, “Principles of wireless networks”, Prentice-Hall of India, 2008.
7. Sassan Ahmadi, “LTE-Advanced – A practical systems approach to understanding the 3GPP LTE Releases 10 and 11 radio access technologies”, Elsevier, 2014.
8. Sumit Kasera and Nishit Narang, “3G Networks – Architecture, Protocols and Procedures”, Tata McGraw Hill, 2007.
9. Vijay K.Garg, “Wireless Network Evolution- 2G & 3G” Pearson, 2013.

AP5071 **NANOELECTRONICS** **L T P C**
3 0 0 3

OBJECTIVES:

- To understand how transistor as Nano device
- To understand various forms of Nano Devices
- To understand the Nano Sensors

UNIT I SEMICONDUCTOR NANO DEVICES 9

Single-Electron Devices; Nano scale MOSFET – Resonant Tunneling Transistor - Single-Electron Transistors; Nanorobotics and Nanomanipulation; Mechanical Molecular Nanodevices; Nanocomputers: Optical Fibers for Nanodevices; Photochemical Molecular Devices; DNA-Based Nanodevices; Gas-Based Nanodevices.

UNIT II ELECTRONIC AND PHOTONIC MOLECULAR MATERIALS 9

Preparation – Electroluminescent Organic materials - Laser Diodes - Quantum well lasers:- Quantum cascade lasers- Cascade surface-emitting photonic crystal laser- Quantum dot lasers - Quantum wire lasers:- White LEDs - LEDs based on nanowires - LEDs based on nanotubes - LEDs based on nanorods - High Efficiency Materials for OLEDs- High Efficiency Materials for OLEDs - Quantum well infrared photo detectors.

UNIT III THERMAL SENSORS 9

Thermal energy sensors -temperature sensors, heat sensors - Electromagnetic sensors - electrical resistance sensors, electrical current sensors, electrical voltage sensors, electrical power sensors, magnetism sensors - Mechanical sensors - pressure sensors, gas and liquid flow sensors, position sensors - Chemical sensors - Optical and radiation sensors.

UNIT IV GAS SENSOR MATERIALS 9

Criteria for the choice of materials - Experimental aspects – materials, properties, measurement of gas sensing property, sensitivity; Discussion of sensors for various gases, Gas sensors based on semiconductor devices.

UNIT V BIOSENSORS 9

Principles - DNA based biosensors – Protein based biosensors – materials for biosensor applications - fabrication of biosensors - future potential.

TOTAL: 45 PERIODS

OUTCOMES:

- To be able to simulate and design the nano device
- To be able to simulate and design the nano sensors

REFERENCES:

1. K.E. Drexler, “Nano systems”, Wiley, 1992.
2. M.C. Petty, “Introduction to Molecular Electronics”, 1995.
3. W. Ranier, “Nano Electronics and Information Technology”, Wiley, 2003.

EL5211 ADVANCED ELECTRONICS SYSTEM LABORATORY L T P C
0 0 4 2

OBJECTIVES:

- To study of 32 bit ARM7 microcontroller RTOS
- To learn modeling of sequential digital system using Verilog and VHDL
- To study designing of wireless network using embedded systems
- To understand system design using ASIC

1. Study of 32 bit ARM7 microcontroller RTOS and its application
2. Testing RTOS environment and system programming
3. Designing of wireless network using embedded systems
4. Implementation of ARM with FPGA
5. Design and Implementation of ALU in FPGA using VHDL and Verilog
6. Modeling of Sequential Digital system using Verilog and VHDL
7. Flash controller programming - data flash with erase, verify and fusing
8. System design using ASIC

TOTAL: 60 PERIODS

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

- Analyze testing RTOS environment and system programming
- Demonstrate Implementation of ARM with FPGA
- Explain flash controller programming
- Discuss design and implementation of ALU in FPGA using VHDL and Verilog

CU5097 WIRELESS ADHOC AND SENSOR NETWORKS L T P C
3 0 0 3

OBJECTIVES:

- To understand the basics of Ad-hoc & Sensor Networks.
- To learn various fundamental and emerging protocols of all layers.
- To study about the issues pertaining to major obstacles in establishment and efficient management of Ad-hoc and sensor networks.
- To understand the nature and applications of Ad-hoc and sensor networks.
- To understand various security practices and protocols of Ad-hoc and Sensor Networks.

UNIT I MAC & TCP IN AD HOC NETWORKS 9

Fundamentals of WLANs – IEEE 802.11 Architecture - Self configuration and Auto configuration-Issues in Ad-Hoc Wireless Networks – MAC Protocols for Ad-Hoc Wireless Networks – Contention Based Protocols - TCP over Ad-Hoc networks-TCP protocol overview - TCP and MANETs – Solutions for TCP over Ad-Hoc Networks.

UNIT II ROUTING IN AD HOC NETWORKS 9

Routing in Ad-Hoc Networks- Introduction-Topology based versus Position based Approaches-Proactive, Reactive, Hybrid Routing Approach-Principles and issues – Location services - DREAM – Quorums based location service – Grid – Forwarding strategies – Greedy packet forwarding – Restricted directional flooding- Hierarchical Routing- **Issues and Challenges in providing QoS.**

UNIT III MAC, ROUTING & QOS IN WIRELESS SENSOR NETWORKS 9

Introduction – Architecture - Single node architecture – Sensor network design considerations – Energy Efficient Design principles for WSNs – Protocols for WSN – Physical Layer : Transceiver Design considerations – MAC Layer Protocols – IEEE 802.15.4 Zigbee – Link Layer and Error Control issues - Routing Protocols – Mobile Nodes and Mobile Robots - Data Centric & Contention Based Networking – Transport Protocols & QOS – Congestion Control issues – Application Layer support.

UNIT IV SENSOR MANAGEMENT 9

Sensor Management - Topology Control Protocols and Sensing Mode Selection Protocols - Time synchronization - Localization and positioning – Operating systems and Sensor Network programming – Sensor Network Simulators.

UNIT V SECURITY IN AD HOC AND SENSOR NETWORKS 9

Security in Ad-Hoc and Sensor networks – Key Distribution and Management – Software based Anti-tamper techniques – water marking techniques – Defense against routing attacks - Secure Adhoc routing protocols – Broadcast authentication WSN protocols – TESLA – Biba – Sensor Network Security Protocols – SPINS.

TOTAL : 45 PERIODS

OUTCOMES:

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

- Identify different issues in wireless ad hoc and sensor networks.
- To analyze protocols developed for ad hoc and sensor networks.
- To identify and address the security threats in ad hoc and sensor networks.
- Establish a Sensor network environment for different type of applications.

REFERENCES:

1. Adrian Perrig, J. D. Tygar, "Secure Broadcast Communication: In Wired and Wireless Networks", Springer, 2006.
2. Carlos De Morais Cordeiro, Dharma Prakash Agrawal “Ad Hoc and Sensor Networks: Theory and Applications (2nd Edition), World Scientific Publishing, 2011.
3. C.K.Toh, “Ad Hoc Mobile Wireless Networks”, Pearson Education, 2002.
4. C.Siva Ram Murthy and B.S.Manoj, “Ad Hoc Wireless Networks – Architectures and Protocols”, Pearson Education, 2004.
5. Erdal Çayırcı , Chunming Rong, “Security in Wireless Ad Hoc and Sensor Networks”, John Wiley and Sons, 2009.
6. Holger Karl, Andreas willig, Protocols and Architectures for Wireless Sensor Networks, John Wiley & Sons, Inc .2005.
7. Subir Kumar Sarkar, T G Basavaraju, C Puttamadappa, “Ad Hoc Mobile Wireless Networks”, Auerbach Publications, 2008.
8. Waltenegus Dargie, Christian Poellabauer, “Fundamentals of Wireless Sensor Networks Theory and Practice”, John Wiley and Sons, 2010.

EL5001	ADVANCED MICROPROCESSORS AND MICROCONTROLLERS	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To familiarize about the features, specification and features of modern microprocessors.
- To gain knowledge about the architecture of Intel 32 and 64 bit microprocessors and salient features associated with them.
- To familiarize about the features, specification and features of modern microcontrollers.
- To gain knowledge about the 32 bit microcontrollers based on ARM and PIC32 architectures

UNIT I FEATURES OF MODERN MICROPROCESSORS 9

Evolution of microprocessors - Data and Address buses – clock speed – memory interface - multi-core architectures – cache memory hierarchy – operating modes – super scaler execution – dynamic execution – over clocking – integrated graphics processing - performance benchmarks

UNIT I HIGH PERFORMANCE CISC ARCHITECTURES 9

Introduction to IA 32 bit architecture – Intel Pentium Processors family tree – Memory Management – Branch prediction logic - Superscalar architecture – Hyper threading technology – 64 bit extension technology – Intel 64 bit architecture - Intel Core processor family tree – Turbo boost technology – Smart cache - features of Nehalem microarchitecture

UNIT II HIGH PERFORMANCE RISC ARCHITECTURE - ARM 9

RISC architecture merits and demerits – The programmer's model of ARM Architecture – 3-stage pipeline ARM organization - 3-stage pipeline ARM organization – ARM instruction execution – Salient features of ARM instruction set - ARM architecture profiles (A, R and M profiles).

UNIT III FEATURES OF MODERN MICROPROCESSORS 9

Introduction to microcontrollers – microcontroller vs microprocessors – microcontroller architecture - Processor Core – Memory interfaces– Communication interfaces (SPI,I^2C, USB and CAN) – ADC - PWM – Watchdog timers – Interrupts – Debugging interfaces.

UNIT IV HIGH PERFORMANCE MICROCONTROLLER ARCHITECTURES 9

Introduction to the Cortex-M Processor Family - ARM 'Cortex-M3' architecture for microcontrollers – Thumb 2 instruction technology – Internal Registers - Nested Vectored Interrupt controller - Memory map - Interrupts and exception handling – Applications of Cotex-M3 architecture.

TOTAL : 45 PERIODS

OUTCOMES:

After completion of the course, the students should be able

- To explain the features and important specifications of modern microprocessors
- To explain the salient features CISC microprocessors based on IA-32 bit and IA-64 bit architectures
- To explain the salient features RISC processors based on ARM architecture and different application profiles of ARM core
- To explain the features and important specifications of modern microcontrollers
- To explain about ARM – M3 architecture and its salient features

REFERENCES:

1. Barry. B. Breg," The Intel Microprocessors" , PHI,2008.
2. Gene .H.Miller ." Micro Computer Engineering ," Pearson Education , 2003.
3. Intel Inc, "Intel 64 and IA-32 Architectures Developer's Manual", Volume-I, 2016
4. Joseph Yiu, "The Definitive Guide to the ARM ® Cortex-M3", Newnes, 2010
5. Scott Mueller, "Upgrading and Repairing PCs", 20th edition, Que
6. Steve Furber, '' ARM System –On –Chip architecture "Addision Wesley , 2000.
7. Trevor Martin, "The Designer's Guide to the Cortex-M Processor Family", Newnes, 2013

		L	T	P	C
MP5092	**SOFT COMPUTING TECHNIQUES**	**3**	**0**	**0**	**3**

OBJECTIVES:

- To know the basics of artificial neural networks
- To provide adequate knowledge about feed forward /feedback neural networks
- To apply the concept of fuzzy logic in various systems.
- To have the idea about genetic algorithm
- To provide adequate knowledge about the applications of Soft Computing.

UNIT I ARTIFICIAL NEURAL NETWORK 9

Introduction-Basic concepts of Neural Network-Model of an Artificial Neuron-Characteristics of Neural Network-Learning Methods-Backpropagation Network Architecture-Backpropagation Learning-Counter Propagation Network-Hopfield/Recurrent Network-Adaptive Resonance Theory.

UNIT II FUZZY LOGIC 9

Basic concepts of Fuzzy Logic-Fuzzy Sets and Crisp Sets-Fuzzy Set Theory and Operations-Properties of Fuzzy Sets-Fuzzy and Crisp relations, Fuzzy to Crisp Conversion-Membership Functions-Interference in Fuzzy Logic-Fuzzy if-then Rules, Fuzzy implications and Fuzzy Algorithms, Fuzzification & Defuzzification-Fuzzy Controller.

UNIT III NEURO-FUZZY MODELLING 9

ANFIS Architecture-Classification and Regression Trees-Data Clustering algorithms-Rulebase Structure Identification.

UNIT IV GENETIC ALGORITHMS 9

Basic concepts-Working Principle-Inheritance Operators-Cross Over-Inversion & Deletion-Mutation Operator-Generation Cycle.

UNIT V APPLICATIONS OF SOFTCOMPUTING 9

Genetic Algorithm Application- Bagley and Adaptive Game-Playing Program- Greg Viols Fuzzy Cruise Controller-Air Conditioner Controller-Application of Back Propagation Neural Network.

TOTAL : 45 PERIODS

OUTCOMES:

- Knowledge on concepts of soft computational techniques.
- Able to apply soft computational techniques to solve various problems.
- Motivate to solve research oriented problems.

REFERENCES:

1. George J. Klir and Bo Yuan, 'Fuzzy Sets and Fuzzy Logic Theory and Applications', Printice Ha 2002.
2. J.S.R.Jang,C.T.Sun and E.Mizutani,"Neuro-Fuzzy and Soft Computing",PHI,2004, Pearson Education 2004.
4. Laurene Fausett,"Fundamentals of Neural Networks: Architectures, Algorithms and Applications", Pearson Education India, 2006.
5. S.Rajasekaran and G.A.V.Pai."Neural Networks, Fuzzy Logic and Genetic Algorithms", PHI, 2010.
6. Timothy J Ross, "Fuzzy logic with Engineering Applications", John Wiley and Sons, 2009.
7. Zimmermann H.J."Fuzzy Set Theory and Its Application" Springer International Edition,2011.

AP5094 SIGNAL INTEGRITY FOR HIGH SPEED DESIGN L T P C
3 0 0 3

OBJECTIVES:

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

UNIT I SIGNAL PROPAGATION ON TRANSMISSION LINES 9

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

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

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

UNIT III NON-IDEAL EFFECTS 9

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

UNIT IV POWER CONSIDERATIONS AND SYSTEM DESIGN 9

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

UNIT V CLOCK DISTRIBUTION AND CLOCK OSCILLATORS 9

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

TOTAL : 45 PERIODS

OUTCOMES:

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

REFERENCES:

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

TOOLS REQUIRED

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

EL5002 OPTICAL SENSORS AND APPLICATIONS L T P C
3 0 0 3

OBJECTIVES:

- To understand the basic concept of optics for different parameters measurement
- To learn the principle of optical sensing,
- To know the fundamental of integrated optical sensing elements and accessories

UNIT I INTRODUCTION 9

Optics for differential sensing of temperature, humidity and pressure; detection of bio-molecules, gases and chemicals; measurements of displacement, vibration and thickness of transparent thin-films; inertial navigation – position, velocity, acceleration, and rotational sensing; structural health monitoring; scanning and infrared imaging, etc.

UNIT II PRINCIPLE OF OPTICAL SENSING 9

Fluorescence & Absorption Spectroscopy, Polarization/Amplitude/Intensity Modulation, Cavity Resonances & Sagnac Effect, Distributed Scattering Effects (Bragg, Raman & Brillouin).

UNIT III INTEGRATED OPTICAL SENSING ELEMENTS & ACCESSORIES 9

Dielectric and Plasmonic Waveguides, Microbridge / Suspended Waveguide and Waveguide cantilever, Passive and Active Phase Shifters, Quantum Dot Photodetectors, Dielectric Mirror & Antireflection Coating, Membrane / Diaphragm, Microfluidic Channels, and Micropumps.

UNIT IV INTEGRATED OPTICAL MULTI-FUNCTIONAL SENSOR DEVICES 9

Surface Plasmon Polariton Resonators, Vertical and In-Plane Fabry-Perot Interferometer, Mach-Zehnder Interferometers, Coupled Microring Resonator(s), Lab-on-Chip.

UNIT V APPLICATION SPECIFIC OPTICAL SENSOR SYSTEMS 9

Integrated Fiber Optic Gyro (IFOG), Optical Time Domain Reflectometer (OTDR), Light Detection and Ranging (LIDAR), Optical Scanners, IR Camera and Photodetector Array.

OUTCOMES:

After completing this course the student,

- To utilize integrated optical multifunctional sensor devices
- To discuss different applications of sensor systems

REFERENCES:

1. Fiber Optic Sensors: Fundamentals and Applications, Fourth Edition Author(s): David A. Krohn; Trevor W. MacDougall; Alexis Mendez. Date Published: 7 January 2015 ISBN: 9781628411805 , Volume: PM247
2. Fiber Optic Sensors, Second Edition – Import, 21 Mar 2008 by ShizhuoYin (Editor), Paul B. Ruffin (Editor), Francis T.S. Yu.
3. Francis T.S. Yu, Shizhou Yin, Paul B. Ruffin, “Fiber Optic Sensors”, 2/e, CRC Press, 2008
4. John Dakin and Brain Culshaw, “Optical Fiber Sensors”, Artech House, 1997.
5. K.T.V. Grattan & B.T. Megitt, “Optical Fiber Sensor Technology”,Kluwer Academic Publishers, 1999.
6. Optical Sensors - New Developments and Practical Applications Edited by Mohamad Yasin, Sulaiman Wadi Harun and Hamzah Arof, ISBN 978- 953-51-1233-4, 238 pages, Publisher: In Tech, Chapters published March 19, 2014 under CC BY 3.0 license DOI:10.5772/57077

DS5291 ADVANCED DIGITAL IMAGE PROCESSING L T P C
3 0 0 3

OBJECTIVES:

- To understand the image fundamentals.
- To understand the various image segmentation techniques.
- To extract features for image analysis.
- To introduce the concepts of image registration and image fusion.
- To illustrate 3D image visualization.

UNIT I FUNDAMENTALS OF DIGITAL IMAGE PROCESSING 9

Elements of visual perception, brightness, contrast, hue, saturation, mach band effect, 2D image transforms-DFT, DCT, KLT,SVD. Image enhancement in spatial and frequency domain, Review of Morphological image processing.

UNIT II SEGMENTATION 9

Edge detection, Thresholding, Region growing, Fuzzy clustering, Watershed algorithm, Active contour models, Texture feature based segmentation, Graph based segmentation, Wavelet based Segmentation - Applications of image segmentation.

UNIT III FEATURE EXTRACTION 9

First and second order edge detection operators, Phase congruency, Localized feature extraction - detecting image curvature, shape features, Hough transform, shape skeletonization, Boundary descriptors, Moments, Texture descriptors- Autocorrelation, Co-occurrence features, Runlength features, Fractal model based features, Gabor filter, wavelet features.

UNIT IV REGISTRATION AND IMAGE FUSION 9

Registration - Preprocessing, Feature selection - points, lines, regions and templates Feature correspondence - Point pattern matching, Line matching, Region matching, Template matching. Transformation functions - Similarity transformation and Affine Transformation. Resampling – Nearest Neighbour and Cubic Splines. Image Fusion - Overview of image fusion, pixel fusion, wavelet based fusion -region based fusion.

UNIT V 3D IMAGE VISUALIZATION 9

Sources of 3D Data sets, Slicing the Data set, Arbitrary section planes, The use of color, Volumetric display, Stereo Viewing, Ray tracing, Reflection, Surfaces, Multiple connected surfaces, Image processing in 3D, Measurements on 3D images.

TOTAL: 45 PERIODS

OUTCOMES:

- Upon Completion of the course, the students will be able to
- Explain the fundamentals digital image processing.
- Describe image various segmentation and feature extraction techniques for image analysis.
- Discuss the concepts of image registration and fusion.
- Explain 3D image visualization.

REFERENCES:

1. Anil K. Jain, Fundamentals of Digital Image Processing', Pearson Education,Inc., 2002.
2. Ardeshir Goshtasby, " 2D and 3D Image registration for Medical, Remote Sensing and Industrial Applications",John Wiley and Sons,2005.
3. John C.Russ, "The Image Processing Handbook", CRC Press,2007.
4. Mark Nixon, Alberto Aguado, "Feature Extraction and Image Processing", Academic Press,2008.
5. Rafael C. Gonzalez, Richard E. Woods, Digital Image Processing', Pearson,Education, Inc.,Second Edition, 2004.
6. Rick S.Blum, Zheng Liu, "Multisensor image fusion and its Applications", Taylor& Francis,2006.

MU5091	MULTIMEDIA COMPRESSION TECHNIQUES	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To understand the basic ideas of compression algorithms related to multimedia components – Text, speech, audio, image and Video.
- To understand the principles and standards and their applications with an emphasis on underlying technologies, algorithms, and performance.
- To appreciate the use of compression in multimedia processing applications
- To understand and implement compression standards in detail.

UNIT I FUNDAMENTALS OF COMPRESSION 9

Introduction To multimedia – Graphics, Image and Video representations – Fundamental concepts of video, digital audio – Storage requirements of multimedia applications – Need for compression – Taxonomy of compression Algorithms - Elements of Information Theory – Error Free Compression – Lossy Compression.

UNIT II TEXT COMPRESSION 9

Huffman coding – Adaptive Huffman coding – Arithmetic coding – Shannon-Fano coding – Dictionary techniques – LZW family algorithms.

UNIT III IMAGE COMPRESSION 9

Image Compression: Fundamentals –– Compression Standards – JPEG Standard – Sub-band coding – Wavelet Based compression – Implementation using Filters – EZW, SPIHT coders – JPEG 2000 standards – JBIG and JBIG2 standards.

UNIT IV AUDIO COMPRESSION 9

Audio compression Techniques – law, A-Law companding – Frequency domain and filtering – Basic sub-band coding – Application to speech coding – G.722 – MPEG audio – progressive encoding – Silence compression, Speech compression – Formant and CELP vocoders.

UNIT V VIDEO COMPRESSION 9

Video compression techniques and Standards – MPEG video coding: MPEG-1 and MPEG-2 video coding: MPEG-3 and MPEG-4 – Motion estimation and compensation techniques – H.261 Standard – DVI technology – DVI real time compression – Current Trends in Compression standards.

TOTAL : 45 PERIODS

OUTCOMES:

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

- Implement basic compression algorithms with MATLAB and its equivalent open source environments.
- Design and implement some basic compression standards
- Critically analyze different approaches of compression algorithms in multimedia related mini projects.

REFERENCES:

1. David Solomon, “Data Compression – The Complete Reference”, Fourth Edition, Springer Verlog, New York, 2006.
2. Darrel Hankerson, Greg A Harris, Peter D Johnson, ‘Introduction to Information Theory and Data Compression’ Second Edition, Chapman and Hall ,CRC press, 2003
3. Khalid Sayood: Introduction to Data Compression”, Morgan Kauffman Harcourt India, Third Edition, 2010.
4. Mark S. Drew, Ze-Nian Li, “Fundamentals of Multimedia”, PHI, 2009.
5. Peter Symes : Digital Video Compression, McGraw Hill Pub., 2004.

CU5191	ADVANCED RADIATION SYSTEMS	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To understand antenna radiation and its parameters.
- To enhance the student knowledge in the area of various antenna design.
- To design mono pole, dipole and patch antenna and to impart the knowledge about modern antennas.

UNIT I ANTENNA FUNDAMENTALS 9

Wave equations, radiation pattern, HPBW,FNBW, gain and directivity, polarization, equivalent circuit, radiation resistance, Radiation integrals, Radiation from surface and line current distributions – dipole, monopole, loop antenna, Antenna parameters, Image theory; Induction, reciprocity theorem, Balance to unbalance transformer, Introduction to numerical techniques.

UNIT II RADIATION FROM APERTURES 9

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

UNIT III ARRAYS 9

Introduction-General structure of phased array, linear array theory, variation of gain as a function of pointing direction, effects of phase quantization, frequency scanned arrays, analog beamforming matrices-Active modules, digital beam forming, MEMS technology in phased arrays-Retrodirective and self phased arrays.

UNIT IV MICRO STRIP ANTENNA 9

Radiation mechanism from patch; Excitation techniques; Microstrip dipole; Rectangular patch, Circular patch, and Ring antenna – radiation analysis from transmission line model, cavity model; input impedance of rectangular and circular patch antenna; Microstrip array and feed network; Applications of microstrip array antenna.

UNIT V SPECIAL ANTENNAS AND MEASUREMENTS 9

Mobile phone antenna ,base station, hand set antenna, UWB antenna, PIFA, Vivaldi antenna, Antenna for automobiles, Broadband antenna, antenna factor, Gain, impedance and radiation pattern measurements, Test sites and anechoic chamber.

TOTAL : 45 PERIODS

OUTCOMES:

- Ability to understand antenna concepts
- Ability to design antenna for various applications
- Knowledge of modern antenna design

REFERENCES:

1. Balanis.A, “Antenna Theory Analysis and Design”, John Wiley and Sons, New York, 1982.
2. Hubregt.J.Visser “Antenna Theory and Applications” 1st Edition, John Wiley & Sons Ltd,New York,2012.
3. S.Drabowitch et.al., ”Modern Antennas”, 2nd Edition Springer science business Media,Inc.2005.
4. Xavier Begaud, “Ultra Wide Band Antennas” , 1st Edition, ISTE Ltd and John Wiley & Sons Ltd, New York,2013.
5. Zhijun Zhang” Antenna Design for Mobile Devices” 1st Edition, John Wiley & Sons (Asia) Ltd, New York,2011.

EL5003 ADVANCED EMBEDDED SYSTEMS L T P C
3 0 0 3

OBJECTIVES

- To understand concepts of embedded hardware and software
- To learn the fundamentals on design attributes of functional units of a Processor
- To study intra and Inter processor Communications

UNIT I INTRODUCTION TO EMBEDDED HARDWARE AND SOFTWARE 9

Terminology – Gates – Timing diagram – Memory – Microprocessor buses – Direct memory access – Interrupts – Built interrupts – Interrupts basis – Shared data problems – Interrupt latency - Embedded system evolution trends – Interrupt routines in an RTOS environment.

UNIT II EMBEDDED PROCESSORS AND MEMORY 9

ISA Architecture Models, Internal Processor Design, Processor Performance, ROM, RAM, Auxiliary Memory, Memory Management of External Memory, Board Memory and Performance.

UNIT III MEMORY AND INTERFACING 9

Advance RAM interfacing communication basic – Microprocessor interfacing I/O addressing – Interrupts – Direct memory access – Arbitration multilevel bus architecture – Serial protocol – Parallel protocols – Wireless protocols – Digital camera example.

UNIT IV SYSTEM MODELLING WITH HARDWARE/SOFTWARE PARTITIONING 9

Embedded systems, Hardware/Software Co-Design, Co-Design for System Specification and modelling- Single-processor Architectures, Multi-Processor Architectures, comparison of Co Design Approaches, Models of Computation, Requirements for Embedded System Specification, Hardware/Software Partitioning Problem, Hardware/Software Cost Estimation, Generation of Partitioning by Graphical modelling, Formulation of the HW/SW scheduling, Optimization.

UNIT V CONCURRENT PROCESS MODELS AND HARDWARE SOFTWARE CO- DESIGN 9

Modes of operation – Finite state machines – Models – HCFSL and state charts language – state machine models – Concurrent process model – Concurrent process – Communication among process –Synchronization among process – Implementation – Data Flow model. Design technology – Automation synthesis – Hardware software co-simulation – IP cores – Design Process Model.

TOTAL : 45 PERIODS

OUTCOMES:

- To discuss on Hardware software partitioning in system design
- To discuss strategies for processor communications

REFERENCES:

1. David. E. Simon, “An Embedded Software Primer”, Pearson Education, 2001.
2. Frank Vahid and Tony Gwargie, “Embedded System Design”, John Wiley & sons, 2002.
3. JorgenStaunstrup, Wayne Wolf, “Harware/Software Co-Design :Principles and Practice”, Kluwer Academic Pub, 1997.
4. Giovanni De Micheli, Rolf Ernst Morgon, “Reading in Hardware/Software Co-Design” Kaufmann Publishers, 2001
5. Raj Kamal, “Embedded Systems- Architecture, Programming and Design” Tata McGraw Hill, 2006.
6. RalfNiemann, “Hardware/Software Co-Design for Data Flow Dominated Embedded Systems”, Kluwer Academic Pub, 1998.
7. Steve Heath, “Embedded System Design”, Elsevier, Second Edition, 2004.
8. Tammy Noergaard, ”Embedded System Architecture, A comprehensive Guide for Engineers and Programmers”, Elsevier, 2006.

CU5292 ELECTROMAGNETIC INTERFERENCE AND COMPATIBILITY LT P C
3 0 0 3

OBJECTIVES:

At the end of the course the student able to learn the concepts of :

- The basics of EMI.
- EMI sources.
- EMI problems.
- Solution methods in PCB.
- Measurements techniques for emission.
- Measurement techniques for immunity.

UNIT I BASIC THEORY 9

Introduction to EMI and EMC, Intra and inter system EMI, Elements of Interference, Sources and Victims of EMI, Conducted and Radiated EMI emission and susceptibility, Case Histories, Radiation hazards to humans, Various issues of EMC, EMC Testing categories EMC Engineering Application.

UNIT II COUPLING MECHANISM 9

Electromagnetic field sources and Coupling paths, Coupling via the supply network, Common mode coupling, Differential mode coupling, Impedance coupling, Inductive and Capacitive coupling, Radioactive coupling, Ground loop coupling, Cable related emissions and coupling, Transient sources, Automotive transients.

UNIT III EMI MITIGATION TECHNIQUES 9

Working principle of Shielding and Murphy‟s Law, LF Magnetic shielding, Apertures and shielding effectiveness, Choice of Materials for H, E, and free space fields, Gasketting and sealing, PCB Level shielding, Principle of Grounding, Isolated grounds, Grounding strategies for Large systems, Grounding for mixed signal systems, Filter types and operation, Surge protection devices, Transient Protection .

UNIT IV STANDARD AND REGULATION 9

Need for Standards, Generic/General Standards for Residential and Industrial environment, Basic Standards, Product Standards, National and International EMI Standardizing Organizations; IEC, ANSI, FCC, AS/NZS, CISPR, BSI, CENELEC, ACEC. Electro Magnetic Emission and susceptibility standards and specifications, MIL461E Standards.

UNIT V EMI TEST METHODS AND INSTRUMENTATION 9

Fundamental considerations, EMI Shielding effectiveness tests, Open field test, TEM cell for immunity test, Shielded chamber , Shielded anechoic chamber, EMI test receivers, Spectrum analyzer, EMI test wave simulators, EMI coupling networks, Line impedance stabilization networks, Feed through capacitors, Antennas, Current probes, MIL -STD test methods, Civilian STD test methods.

TOTAL : 45 PERIODS

OUTCOMES:

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

- Identify Standards
- Compare EMI test methods
- Discuss EMI mitigation techniques

REFERENCES:

1. Bemhard Keiser, “Principles of Electromagnetic Compatibility”, 3rd Ed, Artech house, Norwood,
   1986.
2. Clayton Paul, “Introduction to Electromagnetic Compatibility”, Wiley Interscience, 2006.
3. Daryl Gerke and William Kimmel, “EDN‟s Designer‟s Guide to Electromagnetic Compatibility”, Elsevier Science & Technology Books, 2002
4. Dr Kenneth L Kaiser, “The Electromagnetic Compatibility Handbook”, CRC Press 2005.
5. Electromagnetic Compatibility by Norman Violette ,Published by Springer, 2013
6. Electromagnetic Interference and Compatibility: Electrical noise and EMI specifications Volume 1 of A Handbook Series on Electromagnetic Interference and Compatibility, Donald R. J. White Publisher-Don white consultants Original from the University of Michigan Digitized 6
   Dec 2007
7. Henry W. Ott, “Electromagnetic Compatibility Engineering”, John Wiley & Sons Inc, Newyork, 2009
8. V Prasad Kodali, “Engineering Electromagnetic Compatibility”, IEEE Press, Newyork, 2001.
9. W Scott Bennett, “Control and Measurement of Unintentional Electromagnetic Radiation”, John Wiley & Sons Inc., (Wiley Inter science Series) 1997.

EL5004 **SMART ANTENNAS** **L T P C**
3 0 0 3

OBJECTIVES:

- To understand smart antenna environments
- To learn channel models
- To learn algorithms for Multi target decision

UNIT I **9**

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

UNIT II **9**

Coherent and non-coherent CDMA spatial processors. Dynamic re-sectoring. Range and capacity extension – multi-cell systems.

UNIT III **9**

Spatio – temporal channel models. Environment and signal parameters. Geometrically based single bounce elliptical model.

UNIT IV **9**

Optimal spatial filtering – adaptive algorithms for CDMA. Multi target decision – directed algorithm.

UNIT V **9**

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

TOTAL :45 PERIODS

OUTCOMES:

- To compare algorithms for target decision
- To explain DOA estimation techniques

REFERENCES:

1. M.J. Bronzel, Smart Antennas, John Wiley, 2004. Recent literature in Smart Antennas.
2. R.Janaswamy, Radio Wave Propagation and Smart Antennas for Wireless Communication, Kluwer, 2001.
3. T.S.Rappaport&J.C.Liberti, Smart Antennas for Wireless Communication, Prentice Hall (PTR) , 1999.

EL5071 **BROADBAND ACCESS TECHNOLOGIES** **L T P C**
3 0 0 3

OBJECTIVES:

- To give fundamental concepts related to broadband access technologies.
- To understand the current and emerging wired and wireless access technologies.
- To acquire knowledge about cable modems and fiber access technologies.
- To have an exposure to different systems 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, Standards for access network.

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, **Broadband PON , Gigabit-Capable PON**.

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, **Introduction to LTE-A.**

TOTAL : 45 PERIODS

OUTCOMES:

- To 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. 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.
2. Gilbert Held, “Next Generation Modems: A Professional Guide to DSL and Cable Modems”, John Wiley & Sons, 2000.
3. Leonid G. Kazovsky, Ning Cheng, Wei-Tao Shaw, David Gutierrez, Shing-Wa Wong, “Broadband Optical Access Networks”, John Wiley and Sons, New Jersey, 2011.
4. Martin P. Clarke, “Wireless Access Network: Fixed Wireless Access and WLL Network Design and Operation”, John Wiley & Sons 2000.
5. Niel Ransom and Albert A. Azzam, “Broadband Access Technologies: ADSL, VDSL Cable Modem, Fiber and LMDS", McGraw Hill, 1999.
6. Sassan Ahmadi, “LTE-Advanced – A practical systems approach to understanding the 3GPP LTE Releases 10 and 11 radio access technologies”, Elsevier, 2014.
7. Walter J Woralski, “ADSL and DSL Technologies”, McGraw Hill Computer Communication Series, Second Edition Oct 2001.
8. William Webb, “Introduction to Wireless Local Loop Broadband and Narrow Band System”, Mobile Communication Series, Artech House Publishers, Second Edition

2000.

CU5093 WAVELET TRANSFORMS AND ITS APPLICATIONS L T P C
3 0 0 3

OBJECTIVES:

- To introduce the fundamentals concepts of wavelet transforms.
- To study system design using Wavelets
- To learn the different wavelet families & their applications.

UNIT I INTRODUCTION TO WAVELETS 9

Introduction to Multirate signal processing- Decimation and Interpolation, Quadrature Mirror Filters, Subband coding, Limitations of Fourier transform, Short time Fourier transform and its drawbacks, Continuous Wavelet transform, Time frequency representation, Wavelet System and its characteristics, Orthogonal and Orthonormal functions and function space

UNIT II MULTIRESOLUTION CONCEPT AND DISCRETE WAVELET TRANSFORM 9

Multiresolution formulation of wavelet systems- signal spaces, scaling function, wavelet function and its properties, Multiresolution analysis, Haar scaling and wavelet function, Filter banks- Analysis and Synthesis, 1D and 2D Discrete wavelet transform, Wavelet Packets, Tree structured filter bank, Multichannel filter bank, Undecimated wavelet transform.

UNIT III WAVELET SYSTEM DESIGN 9

Refinement relation for orthogonal wavelet systems, Restrictions on filter coefficients, Design of Daubechies orthogonal wavelet system coefficients, Design of Coiflet and Symlet wavelets.

UNIT IV WAVELET FAMILIES 9

Continuous Wavelets- Properties of Mexican hat wavelet, Morlet, Gaussian and Meyer wavelets. Orthogonal wavelets- Properties of Haar wavelets, Daubechies wavelets, Symlets, Coiflets and Discrete Meyer wavelets. Properties of Biorthogonal wavelets, Applications of wavelet families.

UNIT V WAVELET APPLICATIONS 9

Denoising of Signals and Images, Image enhancement, Edge detection, Image Fusion, Image compression, Wavelet based feature extraction, Analysis of phonocardiogram signals, Analysis of EEG signals, Speech enhancement for hearing aids

TOTAL: 45 PERIODS

OUTCOMES:

The students will be able to apprehend the detailed knowledge about the Wavelet transforms & its applications.

REFERENCES:

1. C.Sidney Burrus, Ramesh Gopinath & Haito Guo, ‗Introduction to wavelets and wavelet transform', Prentice Hall, 1998.
2. G.Strang and T.Nguyen, ‗Wavelet and filter banks', Wesley and Cambridge Press.
3. M.Vetterli and J. Kovacevic, ‗Wavelets and sub band coding', Prentice Hall, 1995.
4. Metin Akay, ‗Time frequency and wavelets in biomedical signal processing', Wiley-IEEE Press, October 1997.
5. P.P.Vaidyanathan, ‗Multi rate systems and filter banks', Prentice Hall 1993

4. Raguveer m Rao & Ajith S. Bopardikar, ‗Wavelet transforms – Introduction to theory and applications', Addison Wesley, 1998

5. S.Mallet, _A Wavelet tour of signal processing‘, Academic Press 1998

VL5291 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 PIPELINING AND PARALLEL PROCESSING OF DIGITAL 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 ALGORITHMIC STRENGTH REDUCTION TECHNIQUE I 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 ALGORITHIMIC STRENGTH REDUCTION - II 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 powerof-2 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, 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.

BM5191	BIO SIGNAL PROCESSING	L	T	P	C
		3	0	0	3

OBJECTIVES

- It provides a solid foundation in advanced biomedical signaling and imaging systems including up-to-date coverage of commercially relevant topics.
- It focuses on biomedical signals, processing the signals, and validate the methods and results for optimization of clinical applications
- To introduce techniques for automated classification and decision making to aid diagnosis

UNIT I SIGNAL, SYSTEM AND SPECTRUM 9

Characteristics of some dynamic biomedical signals, Noises- random, structured and physiological noises. Filters- IIR and FIR filters. Spectrum – power spectral density function, cross-spectral density and coherence function, cepstrum and homomorphic filtering. Estimation of mean of finite time signals.

UNIT II TIME SERIES ANALYSIS AND SPECTRAL ESTIMATION 9

Time series analysis – linear prediction models, process order estimation, non stationary process, fixed segmentation, adaptive segmentation, application in EEG, PCG and HRV signals, model based ECG simulator. Spectral estimation – Blackman Tukey method, periodogram, and model based estimation. Application in Heart rate variability, PCG signals.

UNIT III ADAPTIVE FILTERING AND WAVELET DETECTION 9

Filtering – LMS adaptive filter, adaptive noise cancelling in ECG, improved adaptive filtering in FECG, EEG and other applications in Bio signals, Wavelet detection in ECG – structural features, matched filtering, adaptive wavelet detection, detection of overlapping wavelets.

UNIT IV BIOSIGNAL CLASSIFICATION AND RECOGNITION 9

Signal classification and recognition – Statistical signal classification, linear discriminant function, direct feature selection and ordering, Back propagation neural network based classification. Application in Normal versus Ectopic ECG beats and other biomedical applications

UNIT V TIME FREQUENCY AND MULTIVARIATE ANALYSIS 9

Time frequency representation, spectrogram, Time-scale representation, scalogram, wavelet analysis – Data reduction techniques, ECG data compression, ECG characterization, Feature extraction- Wavelet packets, Multivariate component analysis-PCA, ICA

TOTAL: 45 PERIODS

OUTCOMES:

At the end of this course, the students should be able to:

- Carry out multivariate component analysis.
- Explain biosignal classification

REFERENCES:

1. Arnon Cohen, Bio-Medical Signal Processing Vol I and Vol II, CRC Press Inc., Boca Rato, Florida 1999.
2. Emmanuel C. Ifeachor, Barrie W.Jervis, second edition „Digital Signal processing- A Practical Approach" Pearson education Ltd., 2002
3. P.Ramesh Babu, “Digital Signal Processing”, Sixth Edition, Scitech publications, Chennai, 2014.

4. Rangaraj M. Rangayyan, 2nd edition „Biomedical Signal Analysis-A case study approach", Wiley- Interscience/IEEE Press, 2015.
5. Raghuveer M. Rao and AjithS.Bopardikar, Wavelets transform – Introduction to theory and its applications, Pearson Education, India 2000
6. Willis J. Tompkins, Biomedical Digital Signal Processing, Prentice Hall of India, New Delhi, 2003.

VL5091 MEMS AND NEMS L T P C
3 0 0 3

OBJECTIVES:

- To introduce the concepts of microelectromechanical devices.
- To know the fabrication process of Microsystems.
- To know the design concepts of micro sensors and micro actuators.
- To familiarize concepts of quantum mechanics and nano systems.

UNIT I OVERVIEW 9

New trends in Engineering and Science: Micro and Nanoscale systems, Introduction to Design of MEMS and NEMS, MEMS and NEMS – Applications, Devices and structures. Materials for MEMS: Silicon, silicon compounds, polymers, metals.

UNIT II MEMS FABRICATION TECHNOLOGIES 9

Microsystem fabrication processes: Photolithography, Ion Implantation, Diffusion, Oxidation. Thin film depositions: LPCVD, Sputtering, Evaporation, Electroplating; Etching techniques: Dry and wet etching, electrochemical etching; Micromachining: Bulk Micromachining, Surface Micromachining, High Aspect- Ratio (LIGA and LIGA-like) Technology; Packaging: Microsystems packaging, Essential packaging technologies, Selection of packaging materials

UNIT III MICRO SENSORS 9

MEMS Sensors: Design of Acoustic wave sensors, resonant sensor, Vibratory gyroscope, Capacitive and Piezo Resistive Pressure sensors- engineering mechanics behind these Microsensors. Case study: Piezo-resistive pressure sensor.

UNIT IV MICRO ACTUATORS 9

Design of Actuators: Actuation using thermal forces, Actuation using shape memory Alloys, Actuation using piezoelectric crystals, Actuation using Electrostatic forces (Parallel plate, Torsion bar, Comb drive actuators), Micromechanical Motors and pumps. Case study: Comb drive actuators.

UNIT V NANOSYSTEMS AND QUANTUM MECHANICS 9

Atomic Structures and Quantum Mechanics, Molecular and Nanostructure Dynamics: Schrodinger Equation and Wavefunction Theory, Density Functional Theory, Nanostructures and Molecular Dynamics, Electromagnetic Fields and their quantization, Molecular Wires and Molecular Circuits.

TOTAL: 45 PERIODS

OUTCOMES:

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

- Discuss micro sensors
- Explain micro actuators
- Outline nanosystems and Quantum mechanics

REFERENCES:

1. Chang Liu, “Foundations of MEMS”, Pearson education India limited, 2006.
2. Marc Madou, “Fundamentals of Microfabrication”, CRC press 1997.
3. Sergey Edward Lyshevski, “MEMS and NEMS: Systems, Devices, and Structures” CRC Press, 2002.
4. Stephen D. Senturia,” Micro system Design”, Kluwer Academic Publishers,2001
5. Tai Ran Hsu ,”MEMS and Microsystems Design and Manufacture” ,Tata Mcraw Hill, 2002.

AP5291 HARDWARE - SOFTWARE CO-DESIGN L T P C
3 0 0 3

OBJECTIVES:

- To acquire the knowledge about system specification and modelling.
- To learn the formulation of partitioning
- To study the different technical aspects about prototyping and emulation.

UNIT I SYSTEM SPECIFICATION AND MODELLING 9

Embedded Systems, Hardware/Software Co-Design, Co-Design for System Specification and Modeling , Co-Design for Heterogeneous Implementation - Single-Processor Architectures with one ASIC and many ASICs, Multi-Processor Architectures, Comparison of Co- Design Approaches, Models of Computation, Requirements for Embedded System Specification.

UNIT II HARDWARE / SOFTWARE PARTITIONING 9

The Hardware/Software Partitioning Problem, Hardware-Software Cost Estimation, Generation of the Partitioning Graph , Formulation of the HW/SW Partitioning Problem , Optimization , HW/SW Partitioning based on Heuristic Scheduling, HW/SW Partitioning based on Genetic Algorithms .

UNIT III HARDWARE / SOFTWARE CO-SYNTHESIS 9

The Co-Synthesis Problem, State-Transition Graph, Refinement and Controller Generation, Co-Synthesis Algorithm for Distributed System- Case Studies with any one application

UNIT IV PROTOTYPING AND EMULATION 9

Introduction, Prototyping and Emulation Techniques , Prototyping and Emulation Environments,Future Developments in Emulation and Prototyping ,Target Architecture-ArchitectureSpecialization Techniques ,System Communication Infrastructure, Target Architectures andApplication System Classes, Architectures for Control-Dominated Systems, Architectures forData-Dominated Systems ,Mixed Systems and Less Specialized Systems

UNIT V DESIGN SPECIFICATION AND VERIFICATION 9

Concurrency, Coordinating Concurrent Computations, Interfacing Components, Verification ,Languages for System-Level Specification and Design System-Level Specification ,Design Representation for System Level Synthesis, System Level Specification Languages, Heterogeneous Specification and Multi-Language Co- simulation.

TOTAL: 45 PERIODS

OUTCOMES:

- To assess prototyping and emulation techniques
- To compare hardware / software co-synthesis.
- To formulate the design specification and validate its functionality by simulation

REFERENCES:

1. Giovanni De Micheli , Rolf Ernst Morgon," Reading in Hardware/Software Co-Design "Kaufmann Publishers,2001.
2. Jorgen Staunstrup, Wayne Wolf ,"Hardware/Software Co-Design: Principles and Practice" , Kluwer Academic Pub,1997.
3. Ralf Niemann , "Hardware/Software Co-Design for Data Flow Dominated Embedded Systems", Kluwer Academic Pub, 1998.

EL5005 MACHINE VISION L T P C

3 0 0 3

OBJECTIVES:

- To learn fundamentals of digital image processing
- To understand different types of Image transforms and Models

UNIT I DIGITAL IMAGE PROCESSING FUNDAMENTALS 9

Elements of visual perception – brightness adaption and discrimination, light and electromagnetic spectrum, Image sensing and acquisition, sampling and quantization, some basic relationships between pixels, connectivity, adjacency, distance measures, different types of image sensors, different types of file formats, , fundamental steps in image processing- Examples of the fields that use digital image processing.

UNIT II IMAGE PROCESSING & RESTORATION 9

Image enhancement and image restoration-histogram modification techniques-–image smoothening–image sharpening–algebraic approach to restoration-–constrained and unconstrained restoration–image encoding.

UNIT III IMAGE SEGMENTATION 9

Edge detection, surface orientation ,Thresholding , Region growing, Fuzzy clustering, Watershed algorithm, Active contour methods, Texture feature based segmentation, Model based segmentation, Atlas based segmentation, Wavelet based Segmentation methods.

UNIT IV IMAGE REPRESENTATION 9

Texture– texture as pattern recognition problem–two and three dimensional geometric structures–boundary representation-regions representation–shape properties–knowledge representation and use.

UNIT V

matching – inference – computer reasoning–production systems – active knowledge – goal achievement.

TOTAL: 45 PERIODS

OUTCOMES:

Students will be able to

- Explain Image smoothening, sharpening and encoding
- CompareImage segmentation methods
- Discuss boundary representation

REFERENCES:

1. Ballard B and Brown B, “Computer Vision”, Prentice Hall of India, 2002
2. Forsyth and Ponce, Computer Vision, A modern Approach Pearson Education, 2003.
3. Gonzalez.R and Wintz.P, Digital Image Processing, Addison Wesley Publishing Co. USA, 2007
4. Mallot, Computational Vision: Information Processing in Perception and Visual Behavior. Cambridge, MA: MIT Press, 2000.
5. Rosenfeld A and Kak A.C., “Digital Picture Processing”, Academic Press, 2002

AP5093	ROBOTICS	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To understand robot locomotion and mobile robot kinematics
- To understand perception in robotics
- To understand mobile robot localization
- To understand mobile robot mapping
- To understand simultaneous localization and mapping (SLAM)
- To understand robot planning and navigation

UNIT I LOCOMOTION AND KINEMATICS 9

Introduction to Robotics – key issues in robot locomotion – legged robots – wheeled mobile robots – aerial mobile robots – introduction to kinematics – kinematics models and constraints – robot maneuverability

UNIT II ROBOT PERCEPTION 9

Sensors for mobile robots – vision for robotics – cameras – image formation – structure from stereo – structure from motion – optical flow – color tracking – place recognition – range data

UNIT III MOBILE ROBOT LOCALIZATION 9

Introduction to localization – challenges in localization – localization and navigation – belief representation – map representation – probabilistic map-based localization – Markov localization – EKF localization – UKF localization – Grid localization – Monte Carlo localization – localization in dynamic environments

UNIT IV MOBILE ROBOT MAPPING 9

Autonomous map building – occupancy grip mapping – MAP occupancy mapping – SLAM – extended Kalman Filter SLAM – graph-based SLAM – particle filter SLAM – sparse extended information filter – fastSLAM algorithm

UNIT V PLANNING AND NAVIGATION 9

Introduction to planning and navigation – planning and reacting – path planning – obstacle avoidance techniques – navigation architectures – basic exploration algorithms

TOTAL :45 PERIODS

OUTCOMES:

Upon Completion of the course, the students will be able to

- Explain robot locomotion
- Apply kinematics models and constraints
- Implement vision algorithms for robotics
- Implement robot localization techniques
- Implement robot mapping techniques
- Implement SLAM algorithms
- Explain planning and navigation in robotics

REFERENCES:

1. Gregory DudekandMichael Jenkin, “Computational Principles of Mobile Robotics”, Second Edition, Cambridge University Press, 2010.
2. Howie Choset et al., “Principles of Robot Motion: Theory, Algorithms, and Implementations”, A Bradford Book, 2005.
3. Maja J. Mataric, “The Robotics Primer”, MIT Press, 2007.
4. Roland Seigwart, Illah Reza Nourbakhsh, and Davide Scaramuzza, “Introduction to autonomous mobile robots”, Second Edition, MIT Press, 2011.
5. Sebastian Thrun, Wolfram Burgard, and Dieter Fox, “Probabilistic Robotics”, MIT Press, 2005.

IF5072 CRYPTOGRAPHY AND NETWORK SECURITY L T P C
3 0 0 3

OBJECTIVES:

The student should be able to

- To understand the mathematics behind Cryptography.
- To understand the standard algorithms used to provide confidentiality, integrity and authenticity.
- To get the knowledge of various security practices applied in the field of information technology

UNIT I FUNDAMENTALS AND MATHEMATICS OF CRYPTOGRAPHY 9

Overview - Classical Crypto Systems – Substitution Ciphers –Transposition Ciphers - Stream and Block Ciphers – Introduction to Number Theory – Congruences – Chinese Remainder theorem – Modular Arithmetic - Modular Exponentiation – Fermats and Eulers Theorem - Finite Fields –

GF(2n) Fields.

UNIT II ENCRYPTION TECHNIQUES 9

Data Encryption Standard – Advanced Encryption Standard – Confidentiality using Symmetric Encryption - Public-Key Cryptography and RSA – Key Management - Diffie-Hellman Key Exchange – Elliptic Curve Cryptography – Symmetric Key Distribution – Kerberos - X.509 Authentication Service.

UNIT III HASH FUNCTIONS AND SIGNATURES 9

Message Authentication and Hash Functions – Description of MD Hash Family – Secure Hash Algorithms – SHA-512 - Digital Signatures and Authentication Protocols – Digital Signature Standard – Process - Services - Attacks on Digital Signature - Digital Signature Schemes.

UNIT IV NETWORK SECURITY 9

Security at the application layer - E-Mail - Pretty Good Privacy – S/MIME – Security at the transport layer - SSL Architecture – Protocols – Message Formats - TLS – Security at the Network Layer - IPSec – Two modes - Authentication Header (AH) – Encapsulating Security Payload (ESP) – Security Policy – Security Association – Internet Key Exchange.

UNIT V SYSTEM SECURITY 9

Intruders – Intrusion Detection – Password Management – Malwares and Related Threats – DOS Attacks - Distributed Denial of Service Attacks - Firewalls – Firewall Types-Configuration and Implementation - Demilitarized Zone - Firewall Forensics -Services and Limitations - Intrusion Prevention System.

TOTAL : 45 PERIODS

OUTCOMES :

Upon completion of this course, the student will:

- Analyze the basic security algorithms required by any computing system.
- Predict the vulnerabilities across any computing system.
- Design a security solution for any computing system.

REFERENCES :

1. Atul Kahate, “Cryptography and Network Security”, Tata McGraw Hill, 2003
2. Behrouz A. Forouzan, Debdeep Mukhopadhyay, “Cryptography and Network Security”, Second Edition Tata Mc Graw Hill, 2010
3. Charles B. Pfleeger, Shari Lawrence Pfleeger, “Security in Computing”, Fourth Edition, Pearson Education, 2007
4. Joseph Migga Kizza, “A Guide to Computer Network Security”, Springer International Edition 2010
5. William Stallings, “Cryptography And Network Security – Principles and Practices”, Sixth Edition, Pearson Education, 2013

NC5071 NETWORK ROUTING ALGORITHMS L T P C
3 0 0 3

OBJECTIVES:

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

UNITI INTRODUCTION 7

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

UNIT II INTERNET ROUTING 10

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

UNIT III ROUTING IN OPTICAL WDM NETWORKS 10

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

UNIT IV MOBILE - IP NETWORKS 9

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

UNIT V MOBILE AD –HOC NETWORKS 9

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

TOTAL :45 PERIODS

OUTCOMES:

Upon Completion of the course, the students will be able to

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

REFERENCES:

1. A.T Campbell et al., — Comparison of IP Micromobility Protocols, IEEE Wireless Communications Feb.2002, pp 72-82.
2. C.E Perkins, “Ad Hoc Networking”, Addison – Wesley, 2001.
3. C.Siva Rama Murthy and Mohan Gurusamy, “WDM Optical Networks – Concepts, Design and Algorithms”, Prentice Hall of India Pvt. Ltd, New Delhi –2002.
4. Ian F. Akyildiz, Jiang Xie and Shantidev Mohanty, “A Survey of mobility Management in Next generation All IP- Based Wireless Systems”, IEEE Wireless Communications Aug.2004, pp 16-27.
5. M. Steen Strub, “Routing in Communication network”, Prentice Hall International, Newyork,1995.
6. S. Keshav, “An engineering approach to computer networking”, Addison Wesley 1999.
7. William Stallings, “High speed Networks TCP/IP and ATM Design Principles”, Prentice Hall, New York, 1995.
8. William Stallings, “High speed networks and Internets Performance and Quality of Service”, II Edition, Pearson Education Asia. Reprint India 2002