VELS

INSTITUTE OF SCIENCE, TECHNOLOGY & ADVANCED STUDIES (VISTAS)
(Deemed to be University Estd. u/s 3 of the UGC Act, 1956)
PALLAVARAM - CHENNAI
NAAC ACCREDITED WITH 'A' GRADE
Marching Beyond 25 Years Successfully

B. E.
Electronics and Communication Engineering

Curriculum and Syllabus

Effective from the Academic year 2018 - 2019

Department of Electronics and Communication Engineering

School of Engineering
VISTAS

VISION OF THE DEPARTMENT

To be a centre of excellence in the field of Electronics and Communication Engineering (ECE) equipped with the state of art technologies to produce highly competent, resourceful and ethical young professionals who create innovative solutions to the needs of the society and excel in the varied professional trends globally.

MISSION OF THE DEPARTMENT

M1: To impart strong theoretical and experimental fundamentals in electronics and communication engineering that enable students to be competent in the growing technical demands and challenges.

M2: To facilitate appropriate technical exposure on the latest and cutting-edge technological trends through academic and collaborative interactions with industry, academia and research organizations.

M3: To foster an environment of excellence in theoretical and applied research evident through product development, patents, projects, publications in SCI and WOS journals, books and conferences.

M4: To participate in the development of the nation through social and ethical commitments by promising innovation, research and entrepreneurship.

ROGRAMME EDUCATIONAL OBJECTIVES (PEOs)

PEO 1: **Implement the required sound technical knowledge in core and specialized subjects of Electronics and Communication Engineering to be creative and innovative in solving engineering problems in the current scenario.**

PEO 2: **Professionally competent with a high degree of employability in national and international industries with the ability to handle any complicated technical issues.**

PEO 3: **Induce critical thinking with the awareness of recent and future technological developments to contribute effectively towards Research and Development.**

PEO 4: **Inculcate life-long learning, collective responsibility, and leadership qualities by adapting to new technologies for societal benefits.**

PEO 5: **Posses managerial capabilities with the acquired soft skills by way of moral and ethical practices to accomplish various roles and responsibilities in the working environment.**

PROGRAMME OUTCOMES (POs)

PO 1: ***Engineering Knowledge:*** **Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.**

PO 2: ***Problem Analysis:*** **Identity, formulate, research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.**

PO 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.**

PO 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**

PO 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.**

PO 6: ***The Engineering 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.**

PO 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.**

PO 8: ***Ethics:*** **Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.**

PO 9: ***Individual and Team Work:*** **Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.**

PO 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.**

PO 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.**

PO 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.**

PROGRAMME SPECIFIC OUTCOMES (PSOs)

PSO 1: **Design and analyze the concepts and applications in the field of Communication, Cognitive Networks, Signal & Image processing, Embedded systems, Data Science and Artificial Intelligence to find solutions to the real-world problems.**

PSO 2: **Demonstrate the acquired professional and competitive skills for successful carrier, demonstrating the practice of Professional Ethics and the concerns for Social and Environmental impact technologies.**

MEMBERS OF BOARD OF STUDIES

S. NO	NAME	AFFILIATION	ROLE
1.	Dr. V. Rajendran	Professor & Head / ECE	Convener
2.	Dr. S. Karthikeyan	Professor, Department of Electronics and Communication Engineering, Sathyabama Institute of Science and Technology Chennai	Academic Expert
3.	Mr. S. O. Dinesh Babu	Director, Samhitha Marine Private Limited, Chennai	Industrial Expert
4.	Ms. T. Aruna Jacintha	Lecturer, Little Flower Polytechnic, Chennai	Alumni
5.	Dr. S. Jerritta	Associate Professor/ECE	Member
6.	Dr. T. Jaya	Assistant Professor/ECE	Member
7.	Dr. G.R. Jothilakshmi	Assistant Professor / ECE	Member
8.	Mrs. Vijayalakshmi. P	Assistant Professor/ECE	Member
9.	Mrs. M. Meena	Assistant Professor/ECE	Member

B.E. – ELECTRONICS AND COMMUNICATION ENGINEERING
COURSES OF STUDY AND SCHEME OF ASSESSMENT
(MINIMUM CREDITS TO BE EARNED: 170)

	SEMESTER I	Hours/Weeks				Maximum Marks		
Category	**Course Title**	**Lecture**	**Tutorial**	**Practical**	**Credits**	**CA**	**SEE**	**Total**
BS	Chemistry	3	1	0	4	40	60	100
BS	Mathematics – I (Calculus and Linear Algebra)	3	1	0	4	40	60	100
ES	Programming for Problem solving	3	0	0	3	40	60	100
BS	Chemistry Laboratory	1	0	3	2	40	60	100
ES	Programming for problem solving Laboratory	1	0	3	2	40	60	100
ES	Workshop/Manufacturing Practices	1	0	4	3	40	60	100
MC	Constitution of India	2	0	0	0	-	-	-
		14	**2**	**10**	**18**			

	SEMESTER II	Hours/Weeks				Maximum Marks		
Category	**Course Title**	**Lecture**	**Tutorial**	**Practical**	**Credits**	**CA**	**SEE**	**Total**
HS	English	2	0	0	2	40	60	100
BS	Physics (Oscillation, Waves and Optics)	3	1	0	4	40	60	100
BS	Mathematics – II(Calculus, Ordinary Differential Equations and Complex Variable)	3	1	0	4	40	60	100
ES	Basic Electrical Engineering	3	1	0	4	40	60	100
ES	Engineering Graphics & Design	1	0	4	3	40	60	100
BS	Physics Laboratory	1	0	3	2	40	60	100
ES	Electrical Engineering Laboratory	0	0	2	1	40	60	100
HS	English Laboratory	0	0	2	1	40	60	100
MC	Environmental Science and Engineering	3	0	0	3	40	60	100
		16	**3**	**11**	**24**			

CA - Continuous Assessment, **SEE -** Semester **End Examination**

	SEMESTER III	Hours/Weeks				Maximum Marks		
Category	**Course Title**	**Lecture**	**Tutorial**	**Practical**	**Credits**	**CA**	**SEE**	**Total**
BS	Mathematics – III (Fourier Series and Transforms)	3	1	0	3	40	60	100
PC	Electronic Devices	3	0	0	3	40	60	100
ES	Material Science	3	0	0	3	40	60	100
PC	Digital System Design	3	0	0	3	40	60	100
PC	Signals and Systems	3	0	0	3	40	60	100
PC	Network Theory	3	0	0	3	40	60	100
PC	Electronic Devices Laboratory	0	0	3	1	40	60	100
PC	Digital System Design Laboratory	0	0	3	1	40	60	100
HS	Personality Development I	2	0	0	2	40	60	100
		20	**1**	**6**	**22**			

	SEMESTER IV	Hours/Weeks				Maximum Marks		
Category	**Course Title**	**Lecture**	**Tutorial**	**Practical**	**Credits**	**CA**	**SEE**	**Total**
BS	Mathematics – IV (Probability and Random Processes)	3	1	0	3	40	60	100
ES	Introduction to MATLAB	3	0	0	3	40	60	100
PC	Analog and Digital Communication	3	0	0	3	40	60	100
PC	Linear Integrated Circuits	3	0	0	3	40	60	100
PC	Analog Circuits	3	1	0	4	40	60	100
MC	Human Rights, Law and Practice	2	0	0	2	40	60	100
HS	Personality Development II	2	0	0	2	40	60	100
PC	Analog and Digital Communication Laboratory	0	0	3	1	40	60	100
PC	Analog Circuits Laboratory	0	0	3	1	40	60	100
BS	Basic Life Skills	0	0	2	1	40	60	100
		19	**2**	**8**	**23**			

CA - Continuous Assessment, **SEE -** Semester **End Examination**

	SEMESTER V	Hours/Weeks				Maximum Marks		
Category	**Course Title**	**Lecture**	**Tutorial**	**Practical**	**Credits**	**CA**	**SEE**	**Total**
BS	Mathematics – V (Statistical and Numerical Methods)	3	1	0	4	40	60	100
PC	Electromagnetic Waves	3	0	0	3	40	60	100
PC	Computer Architecture	3	0	0	3	40	60	100
PC	Digital Signal Processing	3	0	0	3	40	60	100
PE	Professional Elective – I	3	0	0	3	40	60	100
OE	Open Elective – I	3	0	0	3	40	60	100
HS	Personality Development III	2	0	0	2	40	60	100
PC	Electromagnetic Waves Laboratory	0	0	3	1	40	60	100
PC	Digital Signal Processing Laboratory	0	0	3	1	40	60	100
		20	**1**	**6**	**23**			

	SEMESTER VI	Hours/Weeks				Maximum Marks		
Category	**Course Title**	**Lecture**	**Tutorial**	**Practical**	**Credits**	**CA**	**SEE**	**Total**
PC	Control Systems	3	0	0	3	40	60	100
PC	Computer Networks	3	0	0	3	40	60	100
PC	Microcontrollers	3	0	0	3	40	60	100
PE	Professional Elective – II	3	0	0	3	40	60	100
PE	Professional Elective – III	3	0	0	3	40	60	100
OE	Open Elective – II	3	0	0	3	40	60	100
HS	Personality Development IV	2	0	0	2	40	60	100
PC	Computer Networks Laboratory	0	0	3	1	40	60	100
PC	Microcontrollers Laboratory	0	0	3	1	40	60	100
PC	Internship	0	0	3	1	40	60	100
PC	Industrial Visit	0	0	0	0	-	-	-
		20	**0**	**9**	**23**			

CA - Continuous Assessment, **SEE -** Semester **End Examination**

	SEMESTER VII	Hours/Weeks				Maximum Marks		
Category	**Course Title**	**Lecture**	**Tutorial**	**Practical**	**Credits**	**CA**	**SEE**	**Total**
PE	Professional Elective– IV	3	0	0	3	40	60	100
PE	Professional Elective– V	3	0	0	3	40	60	100
PE	Professional Elective – VI	3	0	0	3	40	60	100
OE	Open Elective – III	3	0	0	3	40	60	100
PC	Optical and Microwave Laboratory	0	0	3	1	40	60	100
HS	NSS– I	2	0	1	2	40	60	100
P1	Project Phase I	0	0	10	5	40	60	100
		14	0	14	20			

	SEMESTER VIII	Hours/Week				Maximum Marks		
Category	**Course Title**	**Lecture**	**Tutorial**	**Practical**	**Credits**	**CA**	**SEE**	**Total**
PE	Professional Elective – VII	3	0	0	3	40	60	100
OE	Open Elective– IV	3	0	0	3	40	60	100
OE	Open Elective – V	3	0	0	3	40	60	100
P2	Project Phase II	0	0	16	8	40	60	100
		9	**0**	**16**	**17**			

CA - Continuous Assessment, **SEE -** Semester **End Examination**

LIST OF COURSES

HUMANITIES AND SOCIAL SCIENCES

Code No.	Course Title	Hours / Week			Credits
		Lecture	Tutorial	Practical	
HS – 01	English	2	0	0	2
HS – 02	English Laboratory	0	0	2	1
HS – 03	Personality Development I	2	0	0	2
HS – 04	Personality Development II	2	0	0	2
HS – 05	Personality Development III	2	0	0	2
HS – 06	Personality Development IV	2	0	0	2
HS – 07	NSS – I	2	0	1	2

BASIC SCIENCES

Code No.	Course Title	Hours / Week			Credits
		Lecture	Tutorial	Practical	
BS – 01	Chemistry	3	1	0	4
BS – 02	Chemistry Laboratory	1	0	3	2
BS – 03	Mathematics – I (Calculus and Linear Algebra)	3	1	0	4
BS – 04	Physics (Oscillation, Waves and Optics)	3	1	0	4
BS – 05	Physics Laboratory	1	0	3	2
BS – 06	Mathematics – II (Calculus, Ordinary Differential Equations and Complex Variable)	3	1	0	4
BS – 07	Mathematics – III (Fourier Series and Transforms)	3	1	0	3
BS – 08	Mathematics – IV (Probability and Random Processes)	3	1	0	3
BS – 09	Mathematics – V (Statistical and Numerical Methods)	3	1	0	4
BS – 10	Basic Life Skills	0	0	2	1

ENGINEERING SCIENCES

Code No.	Course Title	Hours / Week			Credits
		Lecture	Tutorial	Practical	
ES – 01	Programming for Problem Solving	3	0	0	3
ES – 02	Programming for Problem Solving Laboratory	1	0	3	2
ES – 03	Workshop/Manufacturing Practices	1	0	4	3
ES – 04	Basic Electrical Engineering	3	1	0	4
ES – 05	Electrical Engineering Laboratory	0	0	2	1
ES – 06	Engineering Graphics and Design	1	0	4	3
ES – 07	Material Science	3	0	0	3
ES – 08	Introduction to MATLAB	3	0	0	3

PROFESSIONAL CORE COURSES

Code No.	Course Title	Hours / Week			Credits
		Lecture	Tutorial	Practical	
PC – 01	Electronic Devices	3	0	0	3
PC – 02	Electronic Devices Laboratory	0	0	3	1
PC – 03	Digital System Design	3	0	0	3
PC – 04	Digital System Design Laboratory	0	0	3	1
PC – 05	Signals and Systems	3	0	0	3
PC – 06	Network Theory	3	0	0	3
PC – 07	Analog and Digital Communication	3	0	0	3
PC – 08	Analog and Digital Communication Laboratory	0	0	3	1
PC – 09	Analog Circuits	3	1	0	4
PC – 10	Analog Circuits Laboratory	0	0	3	1
PC – 11	Linear Integrated Circuits	3	0	0	3
PC – 12	Electromagnetic Waves	3	0	0	3
PC – 13	Electromagnetic Waves Laboratory	0	0	3	1
PC – 14	Computer Architecture	3	0	0	3
PC – 15	Digital Signal Processing	3	0	0	3
PC – 16	Digital Signal Processing Laboratory	0	0	3	1
PC – 17	Control Systems	3	0	0	3
PC – 18	Computer Networks	3	0	0	3
PC – 19	Computer Networks Laboratory	0	0	3	1
PC – 20	Microcontrollers	3	0	0	3
PC – 21	Microcontrollers Laboratory	0	0	3	1
PC – 22	Optical Communication Laboratory	0	0	3	1
PC – 23	Internship	0	0	3	1

PROFESSIONAL ELECTIVES

Code No.	Course Title	Hours / Week			Credits
		Lecture	Tutorial	Practical	
PE – 01	Microwave Theory and Techniques	3	0	0	3
PE – 02	Antennas and Propagation	3	0	0	3
PE – 03	Microstrip Antennas	3	0	0	3
PE – 04	Fiber Optic Communications	3	0	0	3
PE – 05	Mobile Communication and 5G Networks	3	0	0	3
PE – 06	Satellite Communication	3	0	0	3
PE – 07	Wireless Sensor Networks	3	0	0	3
PE – 08	Information Theory and Coding	3	0	0	3
PE – 09	Adaptive Signal Processing	3	0	0	3
PE – 10	Digital Image and Video Processing	3	0	0	3
PE – 11	Wavelets Transforms and Techniques	3	0	0	3
PE – 12	Introduction to MEMS	3	0	0	3
PE – 13	Bio-Medical Electronics	3	0	0	3
PE – 14	CMOS Design	3	0	0	3
PE – 15	High Speed Electronics	3	0	0	3
PE – 16	Embedded Systems	3	0	0	3
PE – 17	Nano Electronics	3	0	0	3
PE – 18	Professional Ethics In Engineering	3	0	0	3
PE – 19	5G and Beyond 5G	3	0	0	3
PE – 20	Advanced Mobile Communication	3	0	0	3

OPEN ELECTIVES

Code No.	Course Title	Hours / Week			Credits
		Lecture	Tutorial	Practical	
OE – 01	Transmission Lines and Waveguides	3	0	0	3
OE – 02	Electromagnetic Interference and Compatibility	3	0	0	3
OE – 03	Radar and Navigational Aids	3	0	0	3
OE – 04	Remote Sensing	3	0	0	3
OE – 05	Wireless Networks	3	0	0	3
OE – 06	Mobile Adhoc Networks	3	0	0	3
OE – 07	Optical Networks	3	0	0	3
OE – 08	Cognitive Radio Networks	3	0	0	3
OE – 09	Cryptography and Network Security	3	0	0	3
OE – 10	5G Based Internet of Things	3	0	0	3
OE – 11	Artificial Intelligence	3	0	0	3
OE – 12	Machine Learning	3	0	0	3
OE – 13	Data Science and Analytics	3	0	0	3
OE – 14	Cloud Computing	3	0	0	3
OE – 15	Medical Signal and Image Processing	3	0	0	3
OE – 16	VHDL and Verilog HDL Programming	3	0	0	3
OE – 17	Introduction to Block Chain	3	0	0	3

PROJECT/DISSERTATION

Code No.	Course Title	Hours / Week			Credits
		Lecture	Tutorial	Practical	
P1	Project Phase - I	0	0	10	5
P2	Project Phase - II	0	0	16	8

MANDATORY COURSES

Code No.	Course Title	Hours / Week			Credits
		Lecture	Tutorial	Practical	
MC – 01	Constitution of India	2	0	0	0
MC – 02	Human Rights, Law and Practice	2	0	0	2
MC – 03	Environmental Science and Engineering	3	0	0	3
MC – 04	Essence of Indian Traditional Knowledge	3	0	0	3

INSTITUTE OF SCIENCE, TECHNOLOGY & ADVANCED STUDIES (VISTAS)
(Deemed to be University Estd. u/s 3 of the UGC Act, 1956)
PALLAVARAM - CHENNAI
NAAC ACCREDITED WITH 'A' GRADE
Marching Beyond 25 Years Successfully

B. E.
Electronics and Communication Engineering

Syllabus

Effective from the Academic year 2018 - 2019

Department of Electronics and Communication Engineering
School of Engineering
VISTAS

SEMESTER I

BS – 01	CHEMISTRY	3 1 0 4

COURSE OBJECTIVES:

1. To learn about the molecular orbitals, ionic interactions and periodic properties.
2. To rationalise periodic properties such as ionization potential, electronegativity, oxidation states and electronegativity.
3. To list major chemical reactions that are used in the synthesis of molecules.

UNIT I ATOMIC AND MOLECULAR STRUCTURE, INTERMOLECULAR FORCES AND POTENTIAL ENERGY SURFACES 12

Molecular orbitals of diatomic molecules and plots of the multicentre orbitals. Equations for atomic and molecular orbitals. Energy level diagrams of diatomics. Pi-molecular orbitals of butadiene and benzene and aromaticity. Crystal field theory and the energy level diagrams for transition metal ions and their magnetic properties. Ionic, dipolar and van Der Waals interactions. Equations of state of real gases and critical phenomena. Potential energy surfaces of H_3, H_2F and HCN.

UNIT II SPECTROSCOPIC TECHNIQUES AND APPLICATIONS 12

Principles of spectroscopy and selection rules. Electronic spectroscopy. Vibrational and rotational spectroscopy of diatomic molecules. Applications. Diffraction and scattering

UNIT III USE OF FREE ENERGY IN CHEMICAL EQUILIBRIA 12

Thermodynamic functions: energy, entropy and free energy. Estimations of entropy and free energies. Free energy and EMF. Cell potentials, the Nernst equation and applications. Acid base, oxidation reduction and solubility equilibria. Water chemistry. Corrosion.

UNIT IV PERIODIC PROPERTIES 12

Variations of s, p, d and f orbital energies of atoms in the periodic table, electronic configurations, atomic and ionic sizes, ionization energies, electron affinity and electronegativity, polarizability, oxidation states, coordination numbers and geometries, hard soft acids and bases, molecular geometries.

UNIT V ORGANIC REACTIONS AND SYNTHESIS OF A DRUG MOLECULE 12

Introduction to reactions involving substitution, addition, elimination, oxidation, reduction, cyclization and ring openings. Synthesis of a commonly used drug molecule.

TOTAL: 60 h

COURSE OUTCOMES:

At the end of this course the students will be able to,

CO1: Explain the relation between the intermolecular forces present within a substance and the temperatures associated with changes in its physical state.

CO2: Apply formalisms based on molecular symmetry to predict spectroscopic properties

CO3: Determine and understand the operation of electrochemical systems for the production of electric energy, i.e. batteries and fuel cells

CO4: Explain general corrosion in terms of electrochemistry

CO5: Explain the arrangement of elements in the periodic table and relate the arrangement to electronic configuration, bonding and properties

TEXT BOOKS:

1. Chemistry: Principles and Applications, by M. J. Sienko and R. A. Plane.
2. Fundamentals of Molecular Spectroscopy, by C. N. Banwell.
3. Engineering Chemistry (NPTEL Web-book), by B. L. Tembe, Kamaluddin and M. S. Krishnan.

REFERENCE BOOKS:

1. Physical Chemistry, by P. W. Atkins.
2. Organic Chemistry: Structure and Function by K. P. C. Volhardt and N. E. Schore, 5thEdition http://bcs.whfreeman.com/vollhardtschore5e/default.asp.
3. University chemistry, by B. H. Mahan.

BS – 03	**MATHEMATICS-I (CALCULUS AND LINEAR ALGEBRA)**	**3 1 0 4**

COURSE OBJECTIVES:

1. To familiarize the prospective engineers with techniques in calculus and linear algebra.
2. To equip the students with standard concepts and tools at an intermediate to advanced level of mathematics that would be useful in their disciplines.

UNIT I CALCULUS 12

Evolutes and involutes - Evaluation of definite and improper integrals- Beta and Gamma functions and their properties

UNIT II CALCULUS 12

Rolle's Theorem-Mean value theorems-Taylor's and Maclaurin theorems with remainders-Indeterminate forms and L'Hospital's rule.

UNIT III SEQUENCES AND SERIES 12

Convergence of sequence and series – tests for convergence – Power series Taylor's series - series for exponential – trigonometric and logarithm functions.

UNIT IV MULTIVARIABLE CALCULUS (DIFFERENTIATION) 12

Limit continuity and partial derivatives – directional derivatives – total derivative – Tangent plane and normal line - Maxima, minima and saddle points – Method of Lagrange multipliers.

UNIT V MATRICES 12

Introduction to matrix and rank of a matrix – System of linear equations – Symmetric, skew - symmetric and orthogonal matrices – Eigen values and Eigen vectors – Diagonalization of matrices –Cayley – Hamilton Theorem, and Orthogonal transformation.

TOTAL: 60 h

COURSE OUTCOMES:

At the end of this course the students will be able to,

CO1: Apply differential and integral calculus to Notions of curvature and to improper integrals.
CO2: Analyze engineering problems using Rolle's Theorem.
CO3: Derive power series for learning advanced Engineering Mathematics.
CO4: Perform partial, directional and total derivatives.
CO5: Compute Eigen values and vectors for matrices.

TEXTBOOKS:

1. G.B.Thomas and R.L.Finney, Calculusand Analytic geometry, 9thEdition,Pearson, Reprint,2002.
2. Ramana B.V., Higher Engineering Mathematics, Tata McGraw Hill New Delhi,11th reprint 2010.

REFERENCE BOOKS:

1. Erwin Reyszig, Advanced Engineering Mathematics, 9th Edition, John Wiley & Sons, 2006.
2. Veerarajan. T., Engineering Mathematics for first year, Tata McGraw-Hill, New Delhi,2008.
3. D. Poole, Linear Algebra: A ModernIntroduction,2nd Edition, Brooks/Cole,2005.
4. N.P. Bali and Manish Goyal, "A text book of Engineering Mathematics", Laxmi Publications, Reprint, 2008.
5. B.S.Grewal, "Higher Engineering Mathematics, Khanna Publishers, 36th Edition2010.

ES – 01	PROGRAMMING FOR PROBLEM SOLVING	3 0 0 3

COURSE OBJECTIVES:

1. To understand the basic concepts of programming – Flow chart, Pseudocode.
2. To learn the fundamentals of C programming - declarations, operators, expressions and control statements.
3. To learn the manipulation of strings, functions, pointers and file operations.
4. To understand the concepts of arrays, basic sorting and searching algorithms.
5. To find the order of time complexity of basic algorithms.

UNIT I INTRODUCTION TO PROGRAMMING 9

Introduction to Programming (Flow chart / pseudo code, compilation etc.), Variables (including data types) -Arithmetic expressions and precedence, Conditional Branching and Loops - Writing and evaluation of conditionals and consequent branching Iteration and loops.

UNIT II ARRAYS AND BASIC ALGORITHMS 9

Arrays (1-D, 2-D), Character arrays and Strings, Searching, Basic Sorting Algorithms, finding roots of equations, Notion of order of time complexity through example programs.

UNIT III FUNCTION AND POINTERS 9

Functions (including using built in libraries), Parameter passing in functions, call by value, Passing arrays to functions: idea of call by reference, Recursion with example programs such as Finding Factorial, Fibonacci series, etc. Pointers - Defining pointers, Use of Pointers in self-referential structures.

UNIT IV STRUCTURES AND UNIONS 9

Structures – Defining structures and Array of Structures, Structures containing Pointers, Unions – Storage classes: auto, static, extern, register – Dynamic memory allocation.

UNIT V STRING FUNCTIONS AND FILES 9

Strings - library string functions, pointers in strings, pointers and function arguments, Files - file Operations, processing a file, Pre-processors directives, use of typedef, Command line arguments, Enumerated data types.

TOTAL: 45 h

COURSE OUTCOMES:

At the end of this course the students will be able to,

- **CO1:** Construct a pictorial representation with a stepwise procedure for solving complex problems.
- **CO2:** Develop a high level programming code using c languages.
- **CO3:** Evaluate the various functional operations for solving problem.
- **CO4:** Make use of various c operations like array, pointer, strings and searching method.
- **CO5:** Develop a C module for a given set of instruction.
- **CO6:** Determine a searching and sorting operations on various modules

TEXT BOOKS:

1. Byron Gottfried, “Schaum's Outline of Programming with C”, McGraw-Hill.
2. E. Balaguruswamy, “Programming in ANSI C”, Tata McGraw-Hill.

REFERENCE BOOKS:

1. Brian W. Kernighan and Dennis M. Ritchie, “The C Programming Language”, Prentice Hall of India.
2. Yashavant Kanetkar, “Let Us C”, BPB Publications.
3. Ashok. N. Kamthane, “Computer Programming”, Pearson Education (India).

BS – 02	CHEMISTRY LABORATORY	1 0 3 2

COURSE OBJECTIVES:

1. To help students estimate rate constants of reactions from concentration of reactants/products as a function of time.
2. To measure molecular/system properties such as surface tension, viscosity, conductance of solutions, redox potentials, chloride content of water, etc.
3. To synthesize a small drug molecule and analyse a salt sample.

LIST OF EXPERIMENTS (Choice of 10-12 experiments from the following)

1. Determination of surface tension and viscosity
2. Thin layer chromatography
3. Ion exchange column for removal of hardness of water
4. Determination of chloride content of water
5. Colligative properties using freezing point depression
6. Determination of the rate constant of a reaction
7. Determination of cell constant and conductance of solutions
8. Potentiometry - determination of redox potentials and EMFs
9. Synthesis of a polymer/drug
10. Saponification/acid value of an oil
11. Chemical analysis of a salt
12. Lattice structures and packing of spheres
13. Models of potential energy surfaces
14. Chemical oscillations- Iodine clock reaction
15. Determination of the partition coefficient of a substance between two immiscible liquids
16. Adsorption of acetic acid by charcoal
17. Use of the capillary viscometers to the demonstrate of the isoelectric point as the pH of minimum viscosity for gelatin sols and/or coagulation of the white part of egg.

COURSE OUTCOMES:

At the end of this course the students will be able to,

CO1: Estimate the rate constants of reactions, freezing point depression and partial coefficient of immiscible liquids

CO2: To develop a small drug molecule and analyse a salt sample

CO3: To find the viscosity and partition coefficient of a substance.

CO4: To determine the saponification value of an oil

CO5: Apply formalisms based on molecular symmetry to predict spectroscopic properties

TEXT BOOKS:

1. S. Sundaram and K. Raghavan, "Practical Chemistry", S. Viswanathan. Co. 3rd edition 2011.
2. Gnanaprakasam, Ramamurthy, "Organic Chemistry Lab Manual" S. Viswanathan Pvt. Ltd. 3rd edition 2011.

REFERENCE BOOKS:

1. Vogel', "TEXTBOOKS of qualitative organic Analysis", Longmann, 12th edition, 2011.
2. J. N. Gurtu and R. Kapoor "Advanced experimental Chemistry", S. Chand and Co. 6th edition, 2010.

ES – 02	PROGRAMMING FOR PROBLEM SOLVING LABORATORY	1 0 3 2

COURSE OBJECTIVE:

1. To design and develop C Programs for various application.

LIST OF EXPERIMENTS

1. Simple computational problems using arithmetic expressions
2. Problems involving if-then-else structures
3. Iterative problems
4. 1D Array manipulation
5. Matrix problems
6. String operations
7. Simple functions
8. Solving Numerical methods problems
9. Recursive functions
10. Pointers and structures
11. File operations

COURSE OUTCOMES:

At the end of this course the students will be able to,

1. At the end of this course the students will be able to,
   - **CO1:** Apply and practice logical ability to solve the problems.
   - **CO2:** Understand C programming development environment, compiling, debugging, linkingand executing a program using the development environment
   - **CO3:** Analyzing the complexity of problems, Modularize the problems into small modules and then convert them into programs
   - **CO4:** Understand and apply the in-built functions and customized functions for solving the problems
   - **CO5:** Understand and apply the pointers, memory allocation techniques and use of files for dealing with variety of problems..

ES – 03	WORKSHOP / MANUFACTURING PRACTICES	1 0 4 3

COURSE OBJECTIVS:

1. To study bench fitting drawings for making male and female fittings as per the given dimensions and Tolerances.
2. To study Arc welding drawings for making common weld joints as per the given dimensions.
3. To study sheet metal development drawings for making common metal parts/components as per the given dimensions.

DETAILED CONTENTS:

1. Manufacturing Methods- casting, forming, machining, joining, advanced manufacturing methods (3 lectures)
2. CNC machining, Additive manufacturing (1 lecture)
3. Fitting operations & power tools (1 lecture)
4. Electrical &Electronics (1 lecture)
5. Carpentry (1 lecture)
6. Plastic moulding, glass cutting (1 lecture)
7. Metal casting (1 lecture)
8. Welding (arc welding & gas welding), brazing (1 lecture)

WORKSHOP PRACTICE:

1. **Machine shop** **10**
   To make Facing and plain turning, step turning, drilling in the lathe

2. **Fitting shop** **8**
   To make square, V joint in bench fitting as per the given dimensionand tolerances

3. **Carpentry** **6**
   To make half lap joint, dovetail, TEE Lap joint

4. **Electrical & Electronics** **8**
   i. To make fluorescent lamp wiring.
   ii. To make stair case wiring.
   iii. To make residential wiring.
   iv. To measure Peak-peak, RMS, period, frequency using CRO.
   v. To solder components devices and circuits by using general purpose PCB.

5. **Welding shop (Arc welding 4 hrs + gas welding 4 hrs)** **8**
   To make single, butt, lap and T fillet joint by arc welding with the back hand and fore hand welding techniques as per the given dimensions.

6. **Plumbing Works**

   Study of pipeline joints, its location and functions: valves, taps, couplings, unions, reducers, elbows in household fittings.

   Basic pipe connections – Mixed pipe material connection – Pipe connections with different joining components.

7. **Sheet Metal Work**

   To make simple Dust pan, Rectangular trays in sheet metal with the jigs as perthe given Dimensions.

COURSE OUTCOMES:

At the end of this course the students will be able to,

- **CO1:** Experiment with facing, Turning and various types of fitting joint
- **CO2:** Develop the half lap joint, TEE Lap joint carpentry and welding.
- **CO3:** Illustrate the basic wiring for fluorescent lamp, Staircase, residential wiring.
- **CO4:** Developments of sheet metal jobs from GI sheets, knowledge of basic concepts of \ soldering
- **CO5:** Make a Basic pipe connections for Mixed pipe material connection and Pipe connections with different joining components

TEXT BOOKS:

1. V.N. Shukla, Constitutional Law of India
2. D.D. Basu, Commentary on the Constitution of India
3. J.N. Pandey, Constitution of India
4. Durga Das Basu, "Introduction to the Constitution of India ", Prentice Hall of India, New Delhi.
5. R.C.Agarwal, (1997) "Indian Political System", S.Chand and Company, New Delhi.
6. Maciver and Page, "Society: An Introduction Analysis ", Mac Milan India Ltd., New Delhi.
7. K.L.Sharma, (1997) "Social Stratification in India: Issues and Themes", Jawaharlal Nehru University, New Delhi.

REFERENCES BOOKS:

1. V.D. Mahajan, Constitutional Law of India
2. H.M. Seervai, Constitution of India
3. Sharma, Brij Kishore, "Introduction to the Constitution of India:, Prentice Hall of India, New Delhi.
4. U.R.Gahai, "Indian Political System ", New Academic Publishing House, Jalaendhar.
5. R.N. Sharma, "Indian Social Problems ", Media Promoters and Publishers Pvt. Ltd.

MC – 01	CONSTITUTION OF INDIA – BASIC PRINCIPLES	2 0 0 0

COURSE OBJECTIVES:

1. The purpose of the course is to acquaint the students with basic principles of the Constitution of India and its working.
2. To help students be familiar with the historical and significant aspects of the constitution of India.
3. To make students aware of their fundamental duties and rights.
4. To know about central and state government functionalities in India.

UNIT I NATURE, OBJECT AND SCOPE OF THE CONSTITUTION 6

Nature, object and scope of Constitutional Law and Constitutionalism – Historical Perspective of the Constitution of India – Salient Features and Characteristics of Constitution of India.

UNIT II FUNDAMENTAL RIGHTS 6

Nature and scope of Fundamental Rights – Scheme of Fundamental Rights – Right to Equality – Right to Freedom of Speech and Expression – Right to Life – Right against Exploitation – Right to Religious Freedom – Minority Rights.

UNIT III DIRECTIVE PRINCIPLES OF STATE POLICY AND FUNDAMENTAL DUTIES 6

Directive Principles of State Policy – Importance and Implementation – Scheme of Fundamental Duties and its Legal Status.

UNIT IV FEDERAL STRUCTURE 6

Federal Structure – Distribution of Legislative and Financial Powers between the Union and the States – Parliamentary Form of Government in India – Constituent Powers and Status of the President of India.

UNIT V AMENDMENT AND EMERGENCY PROVISIONS 6

Amendment of the Constitution – Procedure – Historical Perspective of the Constitutional Amendments in India – Emergency Provisions – National Emergency – President Rule – Financial Emergency – Local Self Government – Constitutional Scheme in India.

TOTAL: 30 h

COURSE OUTCOMES:

At the end of this course the students will be able to,

CO1: Understanding the Evaluation of Constitution of India.

CO2: Determine about the fundamental Rights available to the citizens.

CO3: Explaining about Directive principles of Sate policy and Fundamental Rights.

CO4: Discussing about the federal Structure of the Constitution.

CO5: Interpreting the Emergency Provisions especially in the Backdrop of Fundamental Rights.

TEXT BOOKS:

1. V.N. Shukla, Constitutional Law of India
2. D.D. Basu, Commentary on the Constitution of India
3. J.N. Pandey, Constitution of India
4. Durga Das Basu, "Introduction to the Constitution of India ", Prentice Hall of India, New Delhi.
5. R.C.Agarwal, (1997) "Indian Political System", S.Chand and Company, New Delhi.
6. Maciver and Page, "Society: An Introduction Analysis ", Mac Milan India Ltd., New Delhi.
7. K.L.Sharma, (1997) "Social Stratification in India: Issues and Themes", Jawaharlal Nehru University, New Delhi.

REFERENCES BOOKS:

1. V.D. Mahajan, Constitutional Law of India
2. H.M. Seervai, Constitution of India
3. Sharma, Brij Kishore, "Introduction to the Constitution of India:, Prentice Hall of India, New Delhi.
4. U.R.Gahai, "Indian Political System ", New Academic Publishing House, Jalaendhar.
5. R.N. Sharma, "Indian Social Problems ", Media Promoters and Publishers Pvt. Ltd.

SEMESTER II

HS – 01	ENGLISH	2 0 0 2

COURSE OBJECTIVE:

1. To help students acquire basic proficiency in English including reading and listening comprehension, writing and speaking skills.

UNIT I VOCABULARY BUILDING 6

General Vocabulary –Nouns- Compound nouns, Word borrowing & Word making, Foreign machinery in English, Dictionary and Thesaurus usages, Synonyms, Antonyms, Prefixes and Suffixes, Homonyms, Homographs and Homophones, Changing words from one form to another, Acronyms and Abbreviations.

UNIT II BASIC WRITING 6

Sentences structures – Kinds of sentences, Types of sentences, Clauses and Phrases, Punctuations, Word Links and Connectives, Summarizing, Precise writing, Paragraph Writing.

UNIT III IDENTIFYING COMMON ERRORS IN ENGLISH 6

Articles, Prepositions, Subject-verb Agreement, Pronouns - Relative pronouns, Demonstrative pronouns, Misplaced Modifiers, Redundancies, Clichés, Infinitives& Gerund

UNIT IV NATURE AND STYLE OF SENSIBLE WRITING 6

Describing people place and situations, Process description, Definitions, Numerical Expressions, Information Transfer- Flow chart Bar chart and Pie chart, Checklists, Writing introduction and conclusion.

UNIT V WRITING PRACTICES 6

Letter Writing- Formal & Informal Letters, Report Writing- Letter Report, Accident Report, Investigation Report and Survey, Essay writing, Comprehension Passages.

TOTAL: 30 h

COURSE OUTCOMESS:

At the end of this course the students will be able to,

CO1: Distinguish various listening & written contexts for understanding the implied meanings and responding to them accordingly.

CO2: Use appropriate pronunciation and rhythm of spoken language in oral communication

CO3: Draft and interpret the written communication in official contexts like narrative, descriptive, creative, critical and analytical reports

CO4: Infer implied meanings of different genres of texts and critically analyse and evaluate them for ideas, as well as for method of oral presentation.

CO5: Make use of suitable communicative strategies to express their point of views convincingly in any type of discussions, negotiation and conversations.

TEXT BOOKS:

1. Prof. K. R. Lakshmi Narayanan, "English for Scientists, Scitech Publications (India Pvt. Ltd.), 2014.
2. Mindscapes, 'English for Technologists and Engineers', Orient Longman Pvt. Ltd, Chennai, 2012.
3. 'English for Engineers and Technologists' Combined Edition (Volumes 1 and 2), Chennai: Orient Longman Pvt. Ltd., 2006.
4. M.Ashraf Rizvi, "Effective Technical Communication", Tata McGraw-Hill Publishing Company Limited, New Delhi.2009.

REFERENCE BOOKS:

1. Practical English Usage. Michael Swan. OUP. 1995.
2. Remedial English Grammar. F.T. Wood. Macmillan, 2007
3. On Writing Well. William Zinsser. Harper Resource Book, 2001
4. Study Writing. Liz Hamp-Lyons and Ben Heasly. Cambridge University Press, 2006.
5. Communication Skills. Sanjay Kumar and PushpLata. Oxford University Press, 2011.
6. Exercises in Spoken English. Parts. I-III. CIEFL, Hyderabad. Oxford University Press.

BS – 04	PHYSICS (OSCILLATIONS, WAVES AND OPTICS)	3 1 0 4

COURSE OBJECTIVE:

1. To learn the basics of oscillations, wave-optics, lasers and to apply these fundamental principles to solve practical problems related to optical systems used for engineering applications.

UNIT I SIMPLE HARMONIC MOTION, DAMPED AND FORCED SIMPLE HARMONIC OSCILLATOR 9

Harmonic oscillator – Differential equation and solution of simple harmonic oscillator – simple pendulum – damped harmonic oscillator: Equation of motion and its solution, qualitative description of heavy, critical and light damping – energy decay in a damped harmonic oscillator – Q factor – forced mechanical and electrical oscillators – power absorbed by oscillator.

UNIT II NON-DISPERSIVE TRANSVERSE AND LONGITUDINAL WAVES IN ONE DIMENSION AND INTRODUCTION TO DISPERSION 9

Waves, travailing waves example of waves, characteristics of a waves - longitudinal and transverse waves–Examples - Transverse wave on a string, the wave equation on a string- longitudinal waves and the wave equation- acoustics waves and speed of sound- characteristics of musical sound, quality of tone, decibel- noise pollution- acoustics- of buildings - Reverberation - Reverberation time.

UNIT III THE PROPAGATION OF LIGHT AND GEOMETRIC OPTICS 9

Fermat's principle of stationary time- laws of reflection and refraction- Fresnel equations, reflectance and transmittance, Brewster's angle, total internal reflection - Dispersion, Dispersive power of prism- Defect of lenses- spherical aberration- coma-achromatic lenses.

UNIT IV WAVE OPTICS 9

Huygens' Principle, superposition of waves - Young's double slit experiment- Newton's rings-Michelson interferometer, Mach Zehnder interferometer - Fraunhofer diffraction from a single slit and a circular aperture, the Rayleigh criterion for limit of resolution and its application to vision - Dispersion of a diffraction of grating and their resolving power.

UNIT V LASERS 9

Einstein's theory of matter radiation interaction and A and B coefficients- population inversion, different types of lasers: gas lasers (He-Ne, CO_2), solid-state lasers (ruby, Neodymium), dye lasers; Properties of laser beams: mono-chromaticity, coherence, directionality and brightness, laser speckles, applications of lasers in science, engineering and medicine.

TOTAL:45 h

COURSE OUTCOMES:

At the end of this course the students will be able to,

CO1: Understand the basic concepts of simple harmonic oscillator.
CO2: Identify the remedies for acoustic of building.
CO3: Discover the different types of aberration in lens.
CO4: Distinguish between Fresnel and Fraunhofer diffraction
CO5: Classify the different types of lasers and their applications.

TEXT BOOKS:

1. Mechanics, D. S. Mathur and P. S. Hemne, S. Chand & Co. Pvt Ltd., New Delhi
2. A text book of waves and oscillations, Brij Lal and N. Subrahmanyam, Vikas Publishing
3. A text book of optics, M. N. Avadhanulu, Brij Lal and N. Subrahmanyam, S. Chand & Co. Pvt .Ltd. New Delhi

REFERENCE BOOKS:

1. I. G. Main, "Vibrations and waves in physics", Cambridge University Press, 1993.
2. H. J. Pain, The physics of vibrations and waves, Wiley, 2006.
3. E. Hecht, "Optics", Pearson Education, 2008.
4. A. Ghatak, "Optics", McGraw Hill Education, 2012.
5. O. Svelto, "Principles of Lasers", Springer Science & Business Media, 2010.
6. N.K. Bajaj, "The Physics of Waves and Oscillations", Tata McGraw-Hill, 1988
7. K. Uno Ingard, "Fundamentals of Waves & Oscillations", Cambridge University Press, 1988.

BS – 06	MATHEMATICS – II (CALCULUS, ORDINARY DIFFERENTIAL EQUATIONS AND COMPLEX VARIABLE)	3 1 0 4

COURSEOBJECTIVES:

1. To familiarize the prospective engineers with techniques in multivariate integration, ordinary and partial differential equations and complex variables.
2. To equip the students to deal with advanced level of mathematics and applications that would be essential for their disciplines.

UNIT I MULTIVARIABLE CALCULUS (INTEGRATION) 12

Multiple Integration: Double integrals (Cartesian) – change of order of integration in double integrals – Change of variables (Cartesian to polar) – Triple integrals (Cartesian) – orthogonal curvilinear coordinates – Green, Gauss and Stokes theorems (statement only) – Simple problems.

UNIT II FIRST ORDER ORDINARY DIFFERENTIAL EQUATIONS 12

Exact, linear and Bernoulli's equations, Euler's equations, Equations not of first degree: equations solvable for p, equations solvable for y, equations solvable for x and Clairaut's type.

UNIT III ORDINARY DIFFERENTIAL EQUATIONS OF HIGHER ORDERS 12

Second order linear differential equations with variable coefficients, method of variation of parameters, Cauch – Euler equation; Power series solutions; Legendre polynomials.

UNIT IV COMPLEX VARIABLE–DIFFERENTIATION 12

Differentiation, Cauchy – Riemann equations, analytic functions, harmonic functions, finding harmonic conjugate; elementary analytic functions (exponential, trigonometric, logarithm) and their properties; Conformal mappings, Mobius transformations and their properties.

UNIT V COMPLEX VARIABLE–INTEGRATION 12

Contour integrals, Cauchy – Goursat theorem (without proof), Cauchy Integral formula (without proof) – Taylor's series, zeros of analytic functions, singularities, Laurent's series; Residues, Cauchy Residue theorem (without proof), Evaluation of definite integral involving sine and cosine.

TOTAL: 60 h

COURSE OUTCOMES:

At the end of this course the students will be able to,

CO1: Apply integral calculus to improper integrals.
CO2: Discuss the applications of Differential equations in engineering.
CO3: To develop the ordinary differential equation for learning advanced engineering mathematics.
CO4: Demonstrate functions of several variables that is essential in most branches of engineering
CO5: Perform integration of complex variables for various applications in engineering.

TEXT BOOKS:

1. G.B.Thomas and R.L.Finney, Calculus and Analytic geometry,9th Edition, Pearson, Reprint, 2002.
2. S.L. Ross, Differential Equations, 3rd Ed. Wiley India,1984.
3. E.A.Coddington, "An Introduction to Ordinary Differential Equations",PrenticeHallIndia,1995.
4. N.P. Bali and Manish Goyal, A text book of Engineering Mathematics, Laxmi Publications,Reprint,2008.
5. B.S.Grewal, Higher Engineering Mathematics, Khanna Publishers, 36th Edition,2010.

REFERENCEBOOKS:

1. Erwin Kreyszig ,Advanced Engineering Mathematics,9th Edition, John Wiley & Sons, 2006.
2. E.L.Ince, Ordinary Differential Equations, Dover Publications,1958.
3. J.W.Brown and R.V.Churchill, Complex Variables and Applications,7th Ed., Mc-Graw Hill,2004.
4. W.E.Boyce and R.C.DiPrima, Elementary Differential Equations and Boundary Value Problems, 9th Edn.,Wiley, India, 2009.

ES – 04	BASIC ELECTRICAL ENGINEERING	3 1 0 4

COURSEOBJECTIVES:

1. To obtain basic knowledge on electrical quantities such as current, voltage, power and energy.
2. To provide adequate working knowledge on basic DC and AC circuits used in electrical and electronic devices.
3. To understand the working principle, construction, applications of DC machines, AC machines & measuring instruments.
4. To emphasize the importance of transformers in transmission and distribution of electric power.

UNIT I DC CIRCUITS 12

Electrical circuit elements (R, L and C), voltage and current sources, Kirchoff current and voltage laws, Mesh and Nodal analysis, Analysis of simple circuits with dc excitation, Wye↔Delta Transformation, Superposition, Theremin and Norton Theorems.Time-domain analysis of first-order RL and RC circuits.

UNIT II AC CIRCUITS 12

Representation of sinusoidal waveforms, peak and RMS values, phasor representation, real power, reactive power, apparent power, power factor. Analysis of single – phase ac circuits consisting of R, L, C, RL, RC, RLC combinations (series and parallel), resonance. Three phase balanced circuits, voltage and current relations in star and delta connections.

UNIT III TRANSFORMERS 12

Magnetic materials, BH characteristics, ideal and practical transformer, equivalent circuit, losses in transformers, regulation and efficiency. Auto-transformer and three-phase transformer connections.

UNIT IV ELECTRICAL MACHINES & POWER CONVERTERS 12

Generation of rotating magnetic fields, Construction and working of a three-phase induction motor, Significance of torque-slip characteristic. Single phase induction motor. Construction, working, torque-speed characteristic and speed control of separately excited dc motor. DC-DC buck and boost converters, duty ratio control. Single phase Bridge Rectifier, Single Phase voltage source inverters.

UNIT V ELECTRICAL INSTALLATIONS 12

Components of LT Switchgear: Switch Fuse Unit (SFU), MCB, ELCB, MCCB, Types of Wires and Cables, Earthing. Types of Batteries, Important Characteristics for Batteries. Elementary calculations for energy consumption, power factor improvement and battery backup.

TOTAL: 60 h

COURSE OUTCOMES:

At the end of this course the students will be able to,

- **CO1:** Understand and analyse DC circuits
- **CO2:** Understand and analyse AC circuits
- **CO3:** Explain the construction, operation and characteristics of transformer and classify the types of three –phase transformer connections
- **CO4:** Understand and examine the various electrical machines and converter circuits
- **CO5:** Identify the use of low tension switchgears and Classify the various types of wires, cables, batteries and earthing.

TEXT BOOKS:

1. G.B.Thomas and R.L.Finney, Calculus and Analytic geometry,9th Edition, Pearson, Reprint, 2002.
2. S.L. Ross, Differential Equations, 3rd Ed. Wiley India,1984.
3. E.A.Coddington, "An Introduction to Ordinary Differential Equations",PrenticeHallIndia,1995.
4. N.P. Bali and Manish Goyal, A text book of Engineering Mathematics, Laxmi Publications, Reprint,2008.
5. B.S.Grewal, Higher Engineering Mathematics, Khanna Publishers, 36thEdition,2010.

REFERENCEBOOKS:

1. Erwin Kreyszig, Advanced Engineering Mathematics,9th Edition, John Wiley &Sons,2006.
2. E.L.Ince, Ordinary Differential Equations, Dover Publications,1958.
3. J.W.Brown and R.V.Churchill, ComplexVariables and Applications,7th Ed., Mc-Graw Hill, 2004.
4. W.E.Boyce and R.C.DiPrima, Elementary Differential Equations and Boundary Value Problems, 9th Edn.,WileyIndia,2009.

ES – 06	ENGINEERING GRAPHICS AND DESIGN	1 0 4 3

COURSE OBJECTIVES:

1. To develop in students, graphic skills for communication of concepts, ideas and design of engineering products.
2. To expose them to existing national standards related to technical drawings.

CONCEPTS AND CONVENTIONS (Not for Examination)

Importance of graphics in engineering applications – Use of drafting instruments – BIS conventions and specifications – Size, layout and folding of drawing sheets – Lettering and dimensioning.

UNIT I INTRODUCTION TO ENGINEERING DRAWING AND PLANE CURVES **12**

Curves used in engineering practices: Conics – Construction of ellipse, Parabola and hyperbola by eccentricity method – Construction of cycloid, Epicycloid, Hypocycloid – construction of involutes of squad and circle – Drawing of tangents and normal to the above curves. Scales – Plain, Diagonal and Vernier Scales.

UNIT II PROJECTION OF POINTS, LINES AND PLANE SURFACES 12

Projection of points and straight lines located in the first quadrant – Determination of true lengths and true inclinations – Projection of polygonal surface and circular lamina inclined to both reference planes - Auxiliary Planes

UNIT III PROJECTION OF SOLIDS 12

Projection of simple solids like prisms, pyramids, cylinder and cone when the axis is inclined to one reference plane by change of position method - Auxiliary Views

UNIT IV SECTION OF SOLIDS AND DEVELOPMENT OF SURFACES 12

Sectioning of above solids in simple vertical position by cutting planes inclined to one reference plane and perpendicular to the other – Obtaining true shape of section - Auxiliary Views. Development of lateral surfaces of simple and truncated solids – Prisms, pyramids, cylinders and cones – Development of lateral surfaces of solids with cylindrical cutouts, perpendicular to the axis.

UNIT V ORTHOGRAPHIC PROJECTION AND ISOMETRIC PROJECTION 12

Free hand sketching: Representation of Three Dimensional objects – General principles of orthographic projection – Need for importance of multiple views and their placement - layout views – Developing visualization skills through free hand sketching of multiple views from pictorial views of objects. Principles of isometric projection – isometric scale – isometric projections of simple solids, truncated prisms, pyramids, cylinders and cones.

TOTAL: 60 h

COURSE OUTCOMES:

At the end of this course the students will be able to

CO1: Develop special curves and sketch by free hand orthographic views
CO2: Understand and draw the projections of points, straight lines and planes
CO3: Develop the projections of simple solids like prisms, pyramids, cylinder and cone
CO4: Develop lateral surfaces of the uncut and cut solids
CO5: Develop the perspective projection of simple solids, truncated prisms, pyramids, cone and cylinders and sketch the isometric projection

TEXT BOOK:

1. N.D. Bhatt, “Engineering Drawing”, Charotar Publishing House, 46th Edition, (2003).

REFERENCE BOOKS:

1. K. V. Natrajan, “A text book of Engineering Graphics”, Dhanalakshmi Publishers, Chennai (2006).
2. M.S. Kumar, “Engineering Graphics”, D.D. Publications, (2007).
3. K. Venugopal & V. Prabhu Raja, “Engineering Graphics”, New Age International (P) Limited (2008).
4. M.B. Shah and B.C. Rana, “Engineering Drawing”, Pearson Education (2005).
5. K. R. Gopala krishnana, “Engineering Drawing” (Vol.I & II), Subhas Publications (1998).
6. Dhananjay A.Jolhe, “Engineering Drawing with an introduction to AutoCAD” Tata McGraw Hill Publishing Company Limited (2008).
7. Basant Agarwal and Agarwal C.M., “Engineering Drawing”, Tata McGraw Hill Publishing Company Limited, New Delhi, (2008).

BS – 05	PHYSICS LABORATORY	1 0 3 2

COURSE OBJECTIVE:

1. To introduce different experiments to test basic understanding of physics concepts applied in properties of matter, waves, oscillations and optics.

LIST OF EXPERIMENTS (Choice of 8 experiments from the following)

1. Spectrometer –Dispersive Power of prism
2. Spectrometer – Grating
3. Semiconductor Laser – To find Wavelength and particle size.
4. Ultrasonic Interferometer
5. Torsional Pendulum
6. Hooke's Law
7. Compound pendulum–To determine 'g'
8. Newton's Ring
9. Air wedge
10. Bifilar Pendulum

COURSE OUTCOMES:

At the end of this course the students will be able to,

CO1: Calculate the wavelength and particle size of semiconductor diode laser.

CO2: Analyze the band gap of a semiconductor material

CO3: Examine the resistivity and determination of band gap using Four Probe method.

CO4: Measure the velocity of ultrasonic waves and compressibility of the liquid using ultrasonic interferometer.

CO5: Predict the various physical parameters in the areas of optics, fluid mechanics and quantum mechanics

TEXT BOOKS:

1. Dr. P. Mani, Engineering Physics Practical's, VRB Publishers.
2. Prof. Jyoti D. Deshpande, Physics Practical handbook, Target Publications Pvt. Ltd.
3. C.C. Ouseph, U.J. Rao, V. Vijayendran, Practical Physics and Electronics, Viswanathan S, Publishers Pvt. Ltd.

ES – 05	ELECTRICALENGINEERING LABORATORY	0 0 2 1

COURSEOBJECTIVE:

1. To provide comprehensive idea about AC and D C circuit analysis, working principles and applications of basic machines in electrical engineering.

LIST OF EXPERIMENTS:

1. Basic safety precautions. Introduction and use of measuring instruments – voltmeter, ammeter, multi-meter, oscilloscope. Real-life resistors, capacitors and inductors.
2. Sinusoidal steady state response of R-L, and R-C circuits – impedance calculation and verification.

3. Resonance in R-L-C circuits.
4. Loading of a transformer: measurement of primary and secondary voltages and currents, and power
5. Three-phase transformers: Star and Delta connections. Voltage and Current relationships (line-line voltage, phase-to-neutral voltage, line and phase currents).
6. Load Characteristics of a DC Motor
7. Torque - Slip Characteristic of an Induction motor
8. Three phase induction motors – Direction reversal by change of phase-sequence of connections.
9. Demonstration of DC-DC Converter.
10. Demonstration of DC-AC converter.
11. Demonstration of AC-DC converter.

COURSE OUTCOMES:

At the end of this course the students will be able to,

CO1: Illustrate different meters and instruments for measurement of electrical quantities
CO2: Implement power and power factor in ac circuits
CO3: Understand 3 phase balanced and unbalanced, star and delta connected supply with load and to measure power in 3 phase circuits
CO4: Illustrate the Characteristics of DC motor and Induction motor
CO5: Demonstrate various converter circuits and to implement for the particular application

TEXT BOOKS:

1. D. P. Kothari and I. J. Nagrath, "Basic Electrical Engineering", Tata McGraw Hill, 2010.
2. D. C. Kulshreshtha, "Basic Electrical Engineering", McGraw Hill, 2009.
3. L. S. Bobrow, "Fundamentals of Electrical Engineering", Oxford University Press, 2011.
4. E. Hughes, "Electrical and Electronics Technology", Pearson, 2010.
5. V. D. Toro, "Electrical Engineering Fundamentals" prentice hall India 1990.

HS – 02	ENGLISH LABORATORY	0 0 2 1

COURSE OBJECTIVE:

1. The student will attain the ability to possess the Basic English language proficiency in both oral and written communication in real life situation.

LIST OF EXPERIMENTS:

1. Listening comprehensions
2. Pronunciation
3. Phonology
4. Intonation
5. Stress and Rhythm
6. Situational Dialogues
7. Communication in workplace
8. Interviews
9. Seminar
10. Formal Presentations
11. Group Discussions
12. Debates
13. JAM sessions

COURSE OUTCOMES:

At the end of this course the students will be able to,

- **CO1:** Distinguish various listening & written contexts for understanding the implied meanings and responding to them accordingly.
- **CO2:** Use appropriate pronunciation and rhythm of spoken language in oral communication
- **CO3:** Draft and interpret the written communication in official contexts like narrative, descriptive, creative, critical and analytical reports
- **CO4:** Infer implied meanings of different genres of texts and critically analyse and evaluate them for ideas, as well as for method of oral presentation
- **CO5:** Make use of suitable communicative strategies to express their point of views convincingly in any type of discussions, negotiation and conversations.

TEXT BOOKS:

1. Anderson, P.V, Technical Communication, Thomson Wadsworth, Sixth Edition, New Delhi, 2007.
2. Prakash, P, Verbal and Non-Verbal Reasoning, Macmillan India Ltd., Second Edition, New Delhi, 2004.
3. Liz Hamp-Lyons and Ben Heasly, "Study Writing" Cambridge University Press. 2006.
4. Communication Skills. Sanjay Kumar and Pushp Lata. Oxford University Press. 2011.

REFERENCE BOOKS:

1. John Seely, The Oxford Guide to Writing and Speaking, Oxford University Press, New Delhi, 2004.
2. Evans, D, Decision maker, Cambridge University Press, 1997.
3. Thorpe, E, and Thorpe, S, Objective English, Pearson Education, Second Edition, New Delhi, 2007.
4. Exercises in Spoken English. Parts. I-III. CIEFL, Hyderabad. Oxford University Press.

MC – 02	ENVIRONMENTAL SCIENCE AND ENGINEERING	3 0 0 3

COURSE OBJECTIVES:

1. To inculcate the importance of environmental pollution, preservation of nature and environmental management for human welfare.
2. The student is expected to understand what constitutes the environment, what precious resources in the environment are, how to conserve these resources, what is the role of a human being in maintaining a clean environment and useful environment for the future generations and how to maintain ecological balance and preserve bio-diversity.
3. The role of government and non – governmental organization in environmental managements.

UNIT I ENVIRONMENT, ECOSYSTEM AND BIODIVERSITY 9

Definition – Scope and importance – Need for public awareness – Concepts of an Ecosystem – Structure and Function of an Ecosystem –Producers, Consumers and Decomposers – Energy Flow in the Ecosystem – Ecological Succession – Food Chains, Food Webs and Ecological Pyramids – Introduction, Types, Characteristic Features, Structure and Function of the (A) Forest Ecosystem (B) Grassland Ecosystem (C) Desert Ecosystem (D) Aquatic Ecosystems (Ponds, Streams, Lakes, Rivers, Oceans, Estuaries) – Introduction to Biodiversity – Definition: Genetic, Species and Ecosystem Diversity – Bio-geographical

Classification of India – Value of Biodiversity: Consumptive Use, Productive Use, Social, Ethical, Aesthetic and Option Values – Biodiversity at Global, National and Local Levels – India as a Mega-Diversity Nation – Hot-Spots of Biodiversity – Threats to Biodiversity: Habitat Loss, Poaching of Wildlife, Man-Wildlife Conflicts – endangered and Endemic Species of India – Conservation of Biodiversity: In-Situ and Ex-Situ conservation of Biodiversity. Field Study of Common Plants, Insects and Birds. Field study of simple ecosystems - pond, river, hill slopes, etc.

UNIT II ENVIRONMENTAL POLLUTION 9

Definition – Causes, Effects and Control Measures of (A) Air Pollution (B) Water Pollution (C) Soil Pollution (D) Marine Pollution (E) Noise Pollution (F) Thermal Pollution (G) Nuclear Hazards Solid Waste Management: Causes, Effects and Control Measures of municipal solid Wastes – Role of an Individual in Prevention of Pollution – Pollution Case Studies – disaster Management - Floods, Earthquake, Cyclone and Landslides. Field study of local polluted site – Urban / Rural / Industrial / Agricultural.

UNIT III NATURAL RESOURCES 9

Forest resources -Use and over – Exploitation – Deforestation – Case studies – Timber extraction –Mining – Dams and their ground water – Floods – Drought – Conflicts over water –Dams – Benefits and Problems – Mineral Resources- Use and Exploitation, Environmental Effects of Extracting and Using Mineral Resources, Case Studies – Food Resources: World Food Problems, Changes caused by Agriculture and Overgrazing, Effects of Modern Agriculture, Fertilizer- Pesticide Problems, Water Logging, salinity, Case Studies – Energy Resources:- Growing Energy Needs, Renewable and Non Renewable Energy Sources, Use of Alternate Energy Sources, Case Studies – Land Resources - Land as a Resource, Land Degradation, Man Induced Landslides, Soil Erosion and Desertification – Role of an Individual in Conservation of Natural Resources – Equitable use of Resources for Sustainable Lifestyles.Field study of local area to document environmental assets – river / forest / grassland / hill / mountain.

UNIT IV SOCIAL ISSUES AND THE ENVIRONMENT 9

From Unsustainable To Sustainable Development – Urban Problems Related to energy – Water conservation, Rain Water Harvesting, Watershed Management – Resettlement and Rehabilitation of People, its Problems and Concerns, Case Studies Role of non – governmental organization - Environmental Ethics – Issues and Possible Solutions – Climate Change, Global Warming, Acid Rain, Ozone Layer Depletion, Nuclear Accidents and Holocaust, Case Studies –Wasteland Reclamation – Consumerism and Waste Products – Environment Production Act – Air (Prevention and Control of Pollution) Act – Water (Prevention and Control of Pollution) Act – Wildlife Protection Act – Forest Conservation Act –enforcement machinery involved in environmental Legislation – Central and state pollution control boards - Public Awareness.

UNIT V HUMAN POPULATION AND THE ENVIRONMENT 9

Population Growth, Variation among Nations – Population Explosion Family Welfare Programme – environment and Human Health – Human Rights –Value Education – HIV /AIDS – Women and Child Welfare – Role of Information Technology in Environment and Human Health – Case Studies.

TOTAL: 45 h

COURSE OUTCOMES:

At the end of this course the students will be able to,

CO1: Understand the core concepts, methods of ecological and physical sciences, their application in environmental problem-solving.

CO2: Apply system concepts and methodologies to analyse, understand the interactions between social and environmental processes.

CO3: Apply the ethical, cross-cultural, and historical context of environmental issues and the link between human and natural systems.

CO4: Develop the understanding based on the observations and illustration, drawn from the experiences of physical, biological, social and cultural aspects of life, rather than abstractions.

CO5: Reflect critically about their roles and identities as citizens, consumers and environmental actors in a complex, interconnected world.Implement scientific, technological, economic solutions to environmental problems.

TEXT BOOKS:

1. De AK, "Environmental Chemistry", Wiley Eastern Ltd.
2. BharuchaErach, "The Biodiversity of India", Mapin Publishing Pvt. Ltd, India, 2003.
3. Brunner RC,"Hazardous Waste Incineration", McGraw Hill Inc. 480pgs, 1989.
4. Clark RS, "Marine Pollution", Clanderson Press, Oxford (TB).

REFERENCE BOOKS:

1. Agarwal KC, 2001. Environmental Biology, Nidi Publishers Ltd. Bikaner.
2. Gleick HP, "Water in Crisis, Pacific Institute for Studies in Development, Environment and Security", Stockholm Environmental Institute, Oxford University Press, 1993, 473pgs.
3. Heywood V.H, and Watson RT, "Global Biodiversity Assessment" Cambridge University Press, 1995, 1140pgs.
4. Jadhav H and Bhosale VM, "Environmental Protection and Law", Himalaya Publishing House, Delhi 284pgs.
5. Mckinney ML and Schoch RM, "Environmental Science Systems and Solutions" Web enhanced edition, 639pgs.
6. Miller TG, Jr. "Environmental Science", Wadsworth Publishing CO. (TB)

SEMESTER III

BS – 07	MATHEMATICS – III (FOURIER SERIES AND TRANSFORMS)	3 1 0 3

COURSE OBJECTIVES:

1. To understand Fourier series representation of periodic signals.
2. To analyze signals in the frequency domain.

UNIT I FOURIER SERIES 12

Dirichlet's conditions – General Fourier series – Odd and even functions – Half range sine series – Half range cosine series – Parseval's identity – Harmonic Analysis.

UNIT II FOURIER TRANSFORM 12

Fourier integral theorem (without proof) – Fourier transform pair – Fourier Sine and Cosine transforms – Properties – Transforms of simple functions – Convolution theorem – Parseval's identity.

UNIT III PARTIAL DIFFERENTIAL EQUATIONS 12

Formation of partial differential equations - singular integrals- Solutions of standard types of first order partial differential equations – Lagrange's linear equation - Linear partial differential equations of second and higher order with constant coefficients of homogeneous functions.

UNI IVAPPLICATIONS OF PARTIAL DIFFERENTIAL EQUATIONS 12

Classification PDE– Method of separation of variables – One dimensional wave and heat equation – Steady state solution of two-dimensional heat equation (square plate only).

UNIT V Z -TRANSFORM AND DIFFERENCE EQUATIONS 12

Z-transform – Introduction – Properties – Inverse Z-transform (using partial fraction and residues) – Convolution theorem - Formation of difference equations – Solution of difference equations using Z-transform.

TOTAL: 60 h

COURSE OUTCOMES:

At the end of this course the students will be able to,

CO1: Apply differential and integral calculus to Notions of curvature and to improper integrals
CO2: Analyze engineering problems using Rolle's Theorem
CO3: Derive power series for learning advanced Engineering Mathematics
CO4: Perform partial, directional and total derivatives
CO5: Compute Eigen values and vectors for matrices

TEXTBOOKS:

1. Grewal. B.S, "Higher Engineering Mathematics", Khanna Publications, Delhi, 43rd Edition, 2013.
2. Ramana B.V, "Higher Engineering Mathematics", Tata McGraw Hill Publishing Company, New Delhi, 6th reprint,2008.
3. Sivaramakrishna Das.P & Vijayakumari.C, "A Text book of Engineering Mathematics-II"

REFERENCE BOOKS:

1. Bali.N.P. and Manish Goyal 'A TEXTBOOKS of Engineering Mathematics', Laxmi Publications, 9thedition,2011.
2. Erwin Kreyszig, "Advanced Engineering Mathematics", Wiley India, 9thEdition, 2011.
3. Glyn James, "Advanced Modern Engineering Mathematics", Pearson Education,3rd Edition, 2012.
4. A.Singravelu, "Transforms and partial differential equations" , Publisher:Meenakshi Agency.

PC – 01	ELECTRONIC DEVICES	3 0 0 3

COURSE OBJECTIVES:

1. To be exposed to basic electronic devices
2. To be familiar with the theory, construction, and operation of Basic electronic devices.

UNIT I INTRODUCTION TO SEMICONDUCTOR PHYSICS 9

Review of Quantum Mechanics, Energy Quanta, Wave-Particle Duality, the Uncertainty Principle, Schrodinger's Wave Equation. Energy bands in intrinsic and extrinsic silicon; Carrier transport: diffusion current, drift current, mobility and resistivity.

UNIT II SEMICONDUCTOR DIODES 9

Generation and recombination of carriers; Poisson and continuity equation P-N junction characteristics, I-V characteristics, and small signal switching models; Avalanche breakdown, Zener diode, Schottky diode

UNIT III BIPOLAR JUNCTION AND FIELD EFFECT TRANSITORS 9

Bipolar Junction Transistor, Study of CE, CB and CC configurations and comparison of their characteristics – MOSFET, I-V characteristics, Enhancement and depletion types –structure and operation – comparison of BJT with MOSFET, small signal models of MOS transistor.

UNIT IV POWER AND DISPLAY DEVICES 9

UJT, SCR, Diac, Triac, LED, LCD, Photo transistor, Photo diode, Opto Coupler, Solar cell.

UNIT V INTEGRATED CIRCUIT FABRICATION PROCESS 9

Oxidation, diffusion, Ion implantation, Photolithography, Etching, Chemical vapor deposition, Sputtering, Twin-tub CMOS process.

TOTAL: 45 h

COURSE OUTCOMES:

At the end of this course the students will be able to,

CO1: Explain the quantum mechanics and its principles, Energy band, dirft current

CO2: Understand the semiconductor diode and its characteristics, Zener diode and Schottky diode

CO3: Compare Bipolar junction and Field effect transistors.

CO4: Illustrate the working principle of Diac-Triac, LED - LCD and photo transistor photo diode.

CO5: Explain the processes involved in circuit fabrication

TEXT BOOKS:

1. G. Streetman, and S. K. Banerjee, "Solid State Electronic Devices," 7th edition, Pearson,2014.
2. D. Neamen , D. Biswas "Semiconductor Physics and Devices," McGraw-Hill Education
3. S. M. Sze and K. N. Kwok, "Physics of Semiconductor Devices," 3rd edition, John Wiley & Sons, 2006.

REFERENCE BOOKS:

1. C.T. Sah, "Fundamentals of solid state electronics," World Scientific Publishing Co. Inc,1991.
2. Y. Tsividis and M. Colin, "Operation and Modeling of the MOS Transistor," Oxford Univ. Press, 2011.

ES – 07	MATERIAL SCIENCE	3 0 0 3

COURSE OBJECTIVES:

1. To learn the basics of conducting materials, semiconducting materials, magnetic super conducting materials, Dielectric materials and Modern Engineering Materials etc.
2. To apply these fundamental principles to solve practical problems related to materials used for engineering applications.

UNIT I CONDUCTING MATERIALS 9

Conductors – classical free electron theory of metals – Electrical and thermal conductivity – Wiedemann – Franz law – Lorentz number – Drawbacks of classical theory – Quantum theory – Fermi distribution function – Effect of temperature on Fermi function – Density of energy states – carrier concentration in metals.

UNIT II SEMICONDUCTING MATERIALS 9

Intrinsic semiconductor – carrier concentration derivation – Fermi level – Variation of Fermi level with temperature – electrical conductivity – band gap determination – extrinsic semiconductors – carrier concentration derivation in n-type and p-type semiconductor – variation of Fermi level with temperature and impurity concentration – compound semiconductors – Hall effect – Determination of Hall coefficient – Applications.

UNIT III MAGNETIC AND SUPERCONDUCTING MATERIALS 9

Origin of magnetic moment – Bohr magneton value magnetron – Dia and Para magnetism – Ferro magnetism – Domain theory – Hysteresis – soft and hard magnetic materials – antiferromagnetic materials – Ferrites, applications – magnetic recording and readout, storage of magnetic data, tapes, floppy and magnetic disc drives. Superconductivity - properties – Types of superconductors – BCS theory of

superconductivity(Qualitative) – High TC superconductors – Applications of superconductors – SQUID, cryotron, magnetic levitation.

UNIT IV DIELECTRIC MATERIALS 9

Electrical susceptibility – dielectric constant – electronic, ionic, orientational and space charge polarisation – frequency and temperature dependence of polarisation – internal field – Clausius – Mosotti relation (derivation) – dielectric loss – dielectric breakdown – uses of dielectric materials (capacitor and transformer) – Ferro electricity and applications.

UNIT V MODERN ENGINEERING MATERIALS 9

Metallic glasses: preparation, properties and applications. Shape memory alloys (SMA): Characteristics, properties, application, advantages and disadvantages of SMA. Nanomaterials: synthesis – plasma arcing – chemical vapour deposition – sol-gels – electrodeposition – ball milling – properties of nanoparticles and applications, Carbon nanotubes: fabrication.

TOTAL: 45 h

COURSE OUTCOMES:

At the end of this course the students will be able to,

CO1: Understand the classical free electron theory of conducting materials.

CO2: Explain the theoretical aspects of semiconducting materials and illustrate the correct and efficient ways of solving problems.

CO3: Select the types of magnetic and superconducting materials and their applications.

CO4: Utilize the various types of polarization mechanisms in dielectrics and illustrate the applications of dielectric materials.

CO5: Identify new engineering materials such as nanomaterials and biomaterials and develop the various synthesis routes for advanced engineering materials.

TEXT BOOKS:

1. Rajendran, V, and Marikani A, 'Materials Science' Tata McGraw Hill publications, New Delhi 2011.
2. Vijaya, M. and Rangarajan G, 'Materials Science' Tata McGraw Hill publications, New Delhi 2006.

REFERENCE BOOKS:

1. Charles Kittel, "Introduction to Solid State Physics", John Wiley and sons, 7th edition, Singapore 2008.
2. Kasap S.O, "Principles of Electronic Materials", 3rd edition, McGraw Hill Higher Education, 2005.
3. Pradeep T, "A text book of Nanoscience and Nano technology, McGraw Hill Higher Education, 2012.
4. Palanisamy P.K, 'Materials Science', Scitech publications, Chennai, 2007.

PC – 03	DIGITAL SYSTEM DESIGN	3 0 0 3

COURSE OBJECTIVES:

1. To introduce basic postulates of Boolean algebra and shows the correlation between Boolean expressions
2. To introduce the methods for simplifying Boolean expressions
3. To outline the formal procedures for the analysis and design of combinational circuits and sequential circuits
4. To introduce the concept of memories and programmable logic devices.

UNIT I LOGIC GATES, BOOLEAN ALGEBRA AND MINIMIZATION TECHNIQUES 9

Logic Simplification and Combinational Logic Design: Review of Boolean Algebra and De-Morgan's Theorem, Minimum of Boolean Expressions, Minterm, Maxterm, Sum Of Products (SOP) & Product Of Sums (POS) forms, Canonical forms, Karnaugh maps, Quine McCluskey method of minimization

UNIT II COMBINATIONAL LOGIC DESIGN 9

Adders, Subtractors, Serial and Parallel Adders, BCD Adder, Binary codes, Code Converters, Comparator, Multiplexer, Demultiplexer, Encoder, Decoder, Barrel shifter and ALU.

UNIT III SEQUENTIAL LOGIC DESIGN 9

Flip Flop design: S-R, JK and Master-Slave JK , D and T FF, Edge triggered FF, Design of Asynchronous (Ripple) counters, Design of Synchronous counters, Modulo N Counter, Ring counter, Sequence Generators, Shift registers, Universal Shift Register, Finite state machines, Design of synchronous FSM, Algorithmic State Machines charts.

UNIT IV MEMORIES, PROGRAMMABLE LOGIC DEVICESAND LOGIC FAMILIES 9

Memories: ROM, PROM, EPROM, EEPROM, RAM, Static RAM cell, Bipolar RAM cell, MOSFET RAM cell, Dynamic RAM CELL. Programmable logic devices: Programmable Logic Array (PLA), Programmable Array Logic (PAL), Field Programmable Gate Array (FPGA). Logic Families: TTL, ECL, CMOS.

UNIT V VHDL CONCEPTS IN DIGITAL DESIGN 9

Design entry: Different modeling styles in VHDL, Data types and objects, Dataflow, Behavioural and Structural Modeling, VHDL constructs and codes for combinational and sequential circuits.

TOTAL: 45 h

COURSE OUTCOMES:

At the end of this course the students will be able to,

CO1: List the laws of Boolean algebra and Simplify minterms and maxterms using K map and tabulation methods.

CO2: Analyze combinational logic circuits like adders, subtractors, multiplexers and Demultiplexers.

CO3: Distinguish the operations of SR,JK,T and D flip-flops.

CO4: Compare the different types of memories and their designs.

CO5: Make use of VHDL codes to design combinational and sequential circuits.

TEXT BOOKS:

1. R.P. Jain, "Modern digital Electronics", Tata McGraw Hill, 4th edition, 2009.
2. Douglas Perry, "VHDL", Tata McGraw Hill, 4th edition, 2002.
3. M. Morris Mano, Digital Design, 3rd Edition, Prentice Hall of India Pvt. Ltd., 2003 / Pearson Education (Singapore) Pvt. Ltd., New Delhi, 2003.
4. S. Salivahanan and S. Arivazhagan, Digital Circuits and Design, 3rd Edition., Vikas Publishing House Pvt. Ltd, New Delhi, 2006.

REFERENCE BOOKS:

1. W.H. Gothmann, "Digital Electronics- An introduction to theory and practice", PHI, 2nd edition, 2006.
2. D.V. Hall, "Digital Circuits and Systems", Tata McGraw Hill, 1989.
3. Charles Roth, "Digital System Design using VHDL", Tata McGraw Hill 2nd edition2012.
4. Donald D. Givone, Digital Principles and Design, Tata McGraw–Hill Education, 2002.

PC – 05	SIGNALS AND SYSTEMS	3 0 0 3

COURSE OBJECTIVES:

1. To study the properties and representation of discrete and continuous signals.
2. To study the sampling process and analysis of discrete systems using z–transforms.
3. To study the analysis and synthesis of discrete time systems.

UNIT I CLASSIFICATION OF SIGNALS AND SYSTEMS 9

Classification of Signals: Continuous time signals and Discrete time signals – Periodic and Aperiodic signals – Even and odd signals – Energy and power signals – Deterministic and random signals – Complex exponential and Sinusoidal signals. Unit step, Unit ramp, Unit impulse – Representation of signals in terms of unit impulse.

Classification of Systems: Continuous time systems and Discrete time systems – linearity: additivity and homogeneity, shift-invariance, causality, stability, Invertibility.

UNIT II ANALYSIS OF CONTINUOUS TIMESIGNALS 9

Fourier series analysis – Properties of Continuous time Fourier series – Parseval's relation –Fourier spectrum – The Continuous – time Fourier Transform – Representation of Aperiodic Signals, properties of the CTFT – common transform pairs –convolution and multiplication property Laplace Transform – Definition – region of convergence – properties.

UNIT III LINEAR TIME INVARIANT –CONTINUOUS TIME SYSTEMS 9

Differential equation – Block Diagram representation –Impulse response – Frequency response – Convolution – Analysis and characterization of Linear Time Invariant (LTI) system using Fourier transform (FT) and Laplace transform (LT) methods.

UNIT IV ANALYSIS OF DISCRETE TIME SIGNALS 9

Base band Sampling – Discrete time Fourier transform (DTFT) – and its properties Z–transform. Definition – Region of convergence – properties of ROC – Unilateral & Bilateral Z transforms – properties of Z–transform– Inverse Z transform: Power series expansion – Partial fraction.

UNIT V LINEAR TIME INVARIANT – DISCRETE TIME SYSTEMS 9

Difference equations, Block diagram representation, Linear Time Invariant systems (LTI) –Analysis and characterization of DT system using Z transform, State-space analysis and multi–input, multi-output representation, State-transition matrix.

TOTAL: 45 h

COURSE OUTCOMES:

At the end of this course the students will be able to,

- **CO1:** Classify and differentiate different types of signals and systems
- **CO2:** Apply Fourier Transform and Laplace Transform along with their properties and analyze continuous time signals.
- **CO3:** Analyse Z transform and its variants like Unilateral and Bilateral Z transform, inverse Z-transform, their Region of convergence and properties
- **CO4:** Simplify Linear Time Invariant Continuous Time (LTI CT) system in terms of differential equation and understand its impulse and frequency response
- **CO5:** Evaluate discrete time system using state variable equations and matrix representation

TEXT BOOKS:

1. A.V. Oppenheim, A.S. Willsky and I.T. Young, "Signals and Systems", Prentice Hall, 1983.
2. R.F. Ziemer, W.H. Tranter and D.R. Fannin, “Signals and Systems - Continuous and Discrete”, 4thedition, Prentice Hall, 1998.
3. B.P. Lathi, “Signal Processing and Linear Systems”, Oxford University Press, c1998.
4. Douglas K. Lindner, “Introduction to Signals and Systems”, McGraw Hill International Edition: c1999.
5. Simon Haykin, Barry van Veen, “Signals and Systems”, John Wiley and Sons (Asia) Private Limited, c1998.

REFERENCE BOOKS:

1. Robert A. Gabel, Richard A. Roberts, “Signals and Linear Systems”, John Wiley and Sons, 1995.
2. M. J. Roberts, “Signals and Systems - Analysis using Transform methods and MATLAB”, TMH, 2003.
3. J. Nagrath, S. N. Sharan, R. Ranjan, S. Kumar, “Signals and Systems”, TMH New Delhi, 2001.
4. Ashok Ambardar, “Analog and Digital Signal Processing”, 2nd Edition, Brooks/ Cole Publishing Company (An international Thomson Publishing Company), 1999.

PC – 06	NETWORK THEORY	3 0 0 3

COURSE OBJECTIVES:

1. To introduce electric circuits and its analysis
2. To impart knowledge on solving circuits using network theorems
3. To introduce the phenomenon of resonance in coupled circuits.
4. To educate on obtaining the transient response of circuits.

UNIT I BASIC CIRCUITS ANALYSIS 9

Resistive elements, Ohm's Law, Resistors in series and parallel circuits, Kirchoffs laws, Node and Mesh Analysis, matrix approach of network containing voltage and current sources, and reactances.

UNIT II NETWORK REDUCTION AND THEOREMS FOR DC AND AC CIRCUIT 9

Voltage and current division, source transformation, duality, star delta conversion, Thevenin's and Norton Theorems, Superposition Theorem, Maximum power transfer theorem, Tallegen's theorem, Reciprocity Theorem, Millman's theorem.

UNIT III TRIGONOMETRIC AND EXPONENTIAL FOURIER SERIES 9

Discrete spectra and symmetry of waveform, steady state response of a network to non-sinusoidal periodic inputs, power factor, effective values, Fourier transform and continuous spectra, three phase unbalanced circuit and power calculation.

UNIT IV LAPLACE TRANSFORMS AND PROPERTIES 9

Partial fractions, singularity functions, waveform synthesis, analysis of RC, RL, and RLC networks with and without initial conditions with Laplace transforms, evaluation of initial conditions.

UNIT V TRANSIENT RESPONSE ANALYSIS 9

Transient behaviour, concept of complex frequency, Driving points and transfer functions poles and zeros of immittance function, properties, sinusoidal response from pole-zero locations, convolution theorem and Two four port network and interconnections, Behaviours of series and parallel resonant circuits, Introduction to band pass, low pass, high pass and band reject filters.

TOTAL: 45 h

COURSE OUTCOMES:

At the end of this course the students will be able to,

CO1: Apply the knowledge of basic circuital law and simplify the a network using different Voltage & Current law

CO2: Analyze the Network reduction of circuits using different Voltage and Current division theorem

CO3: Evaluate the steady state response of a network by using Fourier transform and continuous spectra

CO4: Analyze RC, RL, and RLC networks with and without initial conditions using Laplace transforms

CO5: Evaluate different network parameters and transient response of networks

TEXT BOOKS:

1. Van, Valkenburg, “Network analysis”, Prentice hall of India, 2000.
2. Sudhakar, A., Shyammohan, S. P.; “Circuits and Network”; Tata McGraw-Hill New Delhi, 1994.

REFERENCE BOOKS:

1. A William Hayt, “Engineering Circuit Analysis” 8th Edition, McGraw-Hill Education
2. S P GhoshandA. K. Chakraborty, “Network Analysis & Synthesis”, McGraw-Hill, 2009.

PC – 02	ELECTRONIC DEVICES LABORATORY	0 0 3 1

COURSE OBJECTIVES:

1. To study experimentally the characteristics of diodes, BJT’s and FET’s.
2. To verify practically the response of various special purpose electron devices.

LIST OF EXPERIMENTS

1. PN Junction Diode Characteristics.
2. Zener Diode Characteristics.
3. Zener Diode as a Voltage Regulator.
4. Half Wave Rectifier with and without filter.
5. Full Wave Rectifier with and without filter
6. Characteristics of CE configuration.
7. Characteristics of CB configuration.
8. Characteristics of Photodiode and Phototransistor.
9. FET Characteristics.
10. MOSFET Characteristics.
11. UJT Characteristics.
12. SCR Characteristics.

COURSE OUTCOMES:

At the end of this course the students will be able to,

CO1: Experiment with various diodes and determine the characteristics
CO2: Evaluate the performance of zener diode as voltage regulator.
CO3: Analye the characteristics of CE, CC and CB transistors
CO4: Compare the characteristics of photodiode and phototransistor
CO5: Explain the characteristics of FET, UJT and SCR

TEXT BOOKS:

1. G. Streetman, and S. K. Banerjee, “Solid State Electronic Devices,” 7thedition,
2. Pearson,2014.
3. D. Neamen, D. Biswas "Semiconductor Physics and Devices,” McGraw-Hill Education
4. S. M. Sze and K. N. Kwok, “Physics of Semiconductor Devices,” 3rd edition, John Wiley & Sons, 2006.

REFERENCE BOOKS:

1. C.T. Sah, "Fundamentals of Solid State electronics," World Scientific Publishing Co. Inc,1991.
2. Y. Tsividis and M. Colin, "Operation and Modeling of the MOS Transistor," Oxford Univ. Press, 2011.

PC – 04	DIGITAL SYSTEM DESIGN LABORATORY	0 0 3 1

COURSE OBJECTIVES:

1. To provide students with an understanding of how to analyze, build, and troubleshoot digital circuits.
2. To understand the relationships between combination logic and Boolean algebra, and between sequential logic and finite state machines;
3. To analyze and design combinational logic circuits at the transistor level
4. To design and implement the synchronous and asynchronous sequential circuits.

LIST OF EXPERIMENTS

1. Study of logic gates
2. Verification of Boolean logic theorems
3. Implementation of Half and Full Adder/Subtractor using logic gates.
4. Design and implementation of 4 bit binary Adder/ Subtractor and BCD adder using IC 7483.
5. Design and implementation of code converters using logic gates
    a. BCD to excess–3 code and vice versa
    b. Binary to gray and vice–versa
6. Design and verification of Magnitude Comparator using logic gates
7. Design of 16 bit odd/even parity checker generator using IC74180.
8. Design and implementation of Multiplexer and De-multiplexer using logic gates and study of IC74150 and IC 74154
9. Design and implementation of encoder and decoder using logic gates and study of IC7445 and IC74147
10. Construction and verification of Mod N Counters
11. Implementation of SISO, SIPO, PISO and PIPO shift registers
12. Simulation of combinational and sequential circuits using VHDL programs

COURSE OUTCOMES:

At the end of this course the students will be able to,

CO1: Explain DeMorgan's law and verify it
CO2: Design combinational logic circuits like adders, subtractors, multiplexers, Demultiplexers etc.
CO3: Analyze various code convertors using logic gates
CO4: Compare the working of various shift registers
CO5: Contrast the operation of various flip-flops
CO6: Design and explain the working of various counters

TEXT BOOKS:

1. R.P. Jain, "Modern digital Electronics", Tata McGraw Hill, 4th edition, 2009.
2. Douglas Perry, "VHDL", Tata McGraw Hill, 4th edition, 2002.
3. M. Morris Mano, Digital Design, 3rd Edition, Prentice Hall of India Pvt. Ltd., 2003 / Pearson Education (Singapore) Pvt. Ltd., New Delhi, 2003.
4. S. Salivahanan and S. Arivazhagan, Digital Circuits and Design, 3rd Edition., Vikas Publishing House Pvt. Ltd, New Delhi, 2006.

REFERENCE BOOKS:

1. W.H. Gothmann, "Digital Electronics- An introduction to theory and practice", PHI, 2nd edition, 2006.
2. D.V. Hall, "Digital Circuits and Systems", Tata McGraw Hill, 1989.
3. Charles Roth, "Digital System Design using VHDL", Tata McGraw Hill 2nd edition, 2012.
4. Donald D. Givone, Digital Principles and Design, Tata McGraw–Hill Education, 2002.

HS – 04	PERSONALITY DEVELOPMENT I	2 0 0 2

COURSE OBJECTIVES:

1. To nurture and develop winning personalities and eventually leading them to become dynamic and socially responsible leaders
2. To avoid negative spiritual experiences it's important to keep the balance between spiritual and physical life.
3. To guide and orient students into becoming effective and exceptional communicators

UNIT I SOFT SKILLS I 6

Introduction to Personality Development – Meaning–Features of personality – Dimensions of Personality Determinants of Personality–Features and Traits– Components of self-concept–Barriers–Self-analysis.

UNIT II SOFT SKILLS II 6

Importance of Soft Skills – First impression–Work Place requirements–Discipline –Cleanliness Hygiene –general Appearance–Building Confidence – Concept of Thinking and Usage –Value of Time–Focus & Commitment.

UNIT III SOFT SKILLS IN ACTION 6

Grooming – Attire – Understanding others– Stability & Maturity Development – Strength s – Weakness – Opportunities–threats – Merits of SWOT Analysis – Components – how to convert weakness into strengths – Goal settings

UNIT IV SELF AWARENESS AND SELF ESTEEM 6

Definitions – Components of Self-awareness – Developing Self-awareness – Self-esteem – meaning – Steps to improve self-esteem.

UNIT V SELF MOTIVATION 6

Motivation – Meaning –Techniques of Self-motivation–Motivation & goal setting – Motivation and emotion – Motivation at work.

TOTAL: 30 h

COURSE OUTCOMES:

At the end of this course the students will be able to,

CO1 : Discuss the features, dimensions and determinants of personality and self analysis.

CO2 : Develop first impression and self discipline in workplace environment.

CO3 : Analysis of strengths, Weakness, Opportunities and Threats.

CO4 : Develop self-awareness and improve self-esteem.

CO5 : Develop Self Motivation and goal setting.

TEXT BOOKS:

1. Personality Development and Soft Skills Barun K Mitra, Oxford Publication
2. Stephen R. covey, "Seven habits of Highly Effective people".

REFERENCE BOOKS:

1. Nathan C. , "Emotion, motivation and Self-regulation", Hall, McGill University, Canada.
2. Thomas Goetz, University of Konstanz, Germany http://www.emeraldgrouppublishing.com.
3. Nathaniel Branden, Nash, "Psychology of Self Estee", (1st edition),Jossey – Bass (32nd anniversary edition.

SEMESTER IV

BS– 08	MATHEMATICS-IV (PROBABILITY AND RANDOM PROCESSES)	3 1 0 3

COURSE OBJECTIVES:

1. To develop the mathematical theory of random variables and random processes for Telecom Engineers.
2. To teach the theoretical concepts and techniques for solving problems that arises in practice.

UNIT I RANDOM VARIABLES 9

Discrete and continuous random variables – Moment generating functions and their properties – Binomial – Poisson – Geometric – Uniform – Exponential and Normal distributions.

UNIT II TWO DIMENSIONAL RANDOM VARIABLES 9

Joint distributions – Marginal and conditional distributions – Covariance – Correlation and regression – Central limit theorem.

UNIT III CLASSIFICATION OF RANDOM PROCESSES 9

Definition and examples – First order – Second order – Strictly stationary – Wide-sense stationary and ergodic process – Markov process – Poisson and Normal process – Sine wave process – Random telegraph process.

UNIT IV CORRELATION AND SPECTRAL DENSITY 9

Auto correlation – Cross correlation – Properties – Power spectral density – Cross spectral density – Properties – Wiener-Khintchine relation – Relationship between cross power spectrum and cross correlation function.

UNIT V LINEAR SYSTEMS WITH RANDOM INPUTS 9

Linear Time Invariant System – System transfer function – Linear systems with random inputs – Auto correlation and cross correlation functions of Input and Output – White Noise.

TOTAL: 60 h

COURSE OUTCOMES:

At the end of this course the students will be able to,

CO1: Obtain the distributions of functions of random variables.

CO2: Generate moments and Characteristic functions.

CO3: Classify random processes and concepts such as strict stationary, wide-sense stationary and ergodicity. Understand Markov chains.

CO4: Explain the concepts of correlation functions and power spectral density

CO5: Apply the concepts of filtering and prediction of a random

TEXT BOOKS:

1. Oliver C. Ibe, “Fundamentals of Applied Probability and Random Processes”, 1st Indian Reprint, Elsevier, 2007.
2. Peebles Jr. P.Z., “Probability Random Variables and Random Signal Principles”, 4th Edition, TMH Publishers, 2002.

REFERENCE BOOKS:

1. Miller, S.L. and Childers, S.L., "Probability and Random Processes with Applications to Signal Processing and Communications", 1st Indian Reprint, Elsevier Inc., 2007.
2. Stark, H. and Woods, J.W., "Probability and Random Processes with Applications to Signal Processing", 3rd Edition, Pearson Education, 2002.
3. Hwei Hsu, "Schaum's Outline of Theory and Problems of Probability, Random Variables and Random Processes", 8th Edition, TMH, 2004.

ES – 08	INTRODUCTION TO MATLAB	3 0 0 3

COURSE OBJECTIVES:

1. To help student be familiar with the environment and tools in MATLAB.
2. To make student write programs to solve scientific and mathematical problems in MATLAB.

UNITI MATLAB BASICS 9

The MATLAB environment - Basic computer programming -Variables and constants, operators and simple calculations -Formulas and functions-MATLAB toolboxes.

UNIT II MATRICES AND VECTORS 9

Matrix and linear algebra review-Vectors and matrices in MATLAB-Matrix operations and functions in MATLAB.

UNIT III SPECIAL ARRAYS AND NUMBER 9

Multidimensional Arrays, Array Functions- Sorting Arrays, Cell Array,Conversion to Various Numeric Data Types,Smallest and Largest Integers.

UNIT IV COMPUTER PROGRAMMING 9

Algorithms and structures-MATLAB scripts and functions (m-files)Simple sequential algorithms - Control structures (if...then, loops).

UNIT V MATLAB PROGRAMMING 9

Reading and writing data, file handling -Personalized functions-Toolbox structure -MATLAB graphic functions.

TOTAL: 45 h

COURSE OUTCOMES:

At the end of this course the students will be able to,

CO1: Explain the various aspects of the MATLAB development environment
CO2: Perform and analyze numerical computations on vectors and matrices in MATLAB.
CO3: Experiment array functions and multidimensional arrays using MATLAB
CO4: Evaluate the various control structures in MATLAB
CO5: Write programs in MATLAB using toolboxes and graphic functions
CO6: .

TEXT BOOKS:

1. David Houcque "Introduction to Matlab for Engineering Students" Northwestern University.
2. https://mypustak.com/product/get.
3. William J.Palm "Introduction to Matlab for Engineers" third edition, University of Rhode Island.

PC – 07	ANALOG AND DIGITAL COMMUNICATION	3 0 0 3

COURSE OBJECTIVES:

1. To analyze various Amplitude, Angle and Pulse modulation systems.
2. To provide some depth analysis in noise performance of various receiver.
3. To study some basic information theory with some channel coding theorem.
4. To study signal space representation of signals and discuss the process of sampling, quantization and coding that are fundamental to the digital transmission of analog signals.
5. To understand baseband and band pass signal transmission and reception techniques.
6. To learn error control coding which encompasses techniques for the encoding and decoding of digital data streams for their reliable transmission over noisy channels.

UNIT I ANALOG COMMUNICATION 9

Introduction to Communication Systems – Modulation – Types – Need for Modulation. Theory of Amplitude Modulation – Evolution and Description of SSB Techniques – Theory of Frequency and Phase Modulation – Comparison of Analog Communication Systems (AM – FM – PM).

UNIT II PULSE AND DATA COMMUNICATION 9

Pulse Communication: Pulse Amplitude Modulation (PAM) – Pulse Time Modulation (PTM) – Pulse code Modulation (PCM) – Comparison of various Pulse Communication System (PAM – PTM – PCM). Data Communication: History of Data Communication – Standards Organizations for Data Communication– Data Communication Circuits – Data Communication Codes – Data communication Hardware – serial and parallel interfaces.

UNIT III DIGITAL COMMUNICATION 9

Amplitude Shift Keying (ASK) – Frequency Shift Keying (FSK)–Phase Shift Keying (PSK) – BPSK – QPSK – Quadrature Amplitude Modulation (QAM) – 8 QAM – 16 QAM – Bandwidth Efficiency– Comparison of various Digital Communication System (ASK – FSK – PSK – QAM).

UNIT IV SOURCE AND ERROR CONTROL CODING 9

Entropy, Source encoding theorem, Shannon fano coding, Huffman coding, mutual information, channel capacity, Error Control Coding, linear block codes, cyclic codes – ARQ Techniques.

UNIT V MULTI-USER RADIO COMMUNICATION 9

Global System for Mobile Communications (GSM) – Code division multiple access (CDMA) – Cellular Concept and Frequency Reuse – Channel Assignment and Handover Techniques – Overview of Multiple Access Schemes – Satellite Communication – Bluetooth.

TOTAL: 45 h

COURSE OUTCOMES:

At the end of this course the students will be able to,

CO1: Analyze and compare different Analog modulation schemes for their efficiency and bandwidth

CO2: compare various pulse modulation techniques and expalin the performance of Data communication system

CO3: Explain and compare various digital modulation schemes

CO4: Evaluate source coding and error control coding techniques

CO5: Analyze the working principle of multi user radio communication Analyze and compare different Analog modulation schemes for their efficiency and bandwidth

TEXT BOOKS:

1. Haykin S., "Communications Systems", John Wiley and Sons, 2001.
2. Proakis J. G. and Salehi M., "Communication Systems Engineering", Pearson Education, 2002.
3. Barry J. R., Lee E. A. and Messerschmitt D. G., "Digital Communication", Kluwer Academic Publishers, 2004.
4. Proakis J.G., "Digital Communications", 4th Edition, McGraw Hill, 2000.

REFERENCE BOOKS:

1. Taub H. and Schilling D.L., "Principles of Communication System", Tata McGraw Hill, 2001.
2. Wozencraft J. M. and Jacobs I. M. "Principles of Communication Engineering", John Wiley, 1965.

PC – 11	LINEAR INTEGRATED CIRCUITS	3 0 0 3

COURSE OBJECTIVES:

1. To study characteristics; realize circuits; design for signal analysis using Op-amp ICs.
2. To study internal functional blocks and the applications of special ICs like Timers, PLLcircuits, regulator Circuits, ADCs.

UNITI IC FABRICATION 9

IC classification, fundamental of monolithic IC technology, epitaxial growth, masking and etching, diffusion of impurities.Realisation of monolithic ICs and packaging.Fabrication of diodes, capacitance, resistance and FETs.

UNIT II APPLICATIONS OF OPAMP 9

Ideal OP-AMP characteristics, DC characteristics, AC characteristics, offset voltage and current: voltage series feedback and shunt feedback amplifiers, differential amplifier; frequency response of OP-AMP; Basic applications of op-amp – summer, differentiator and integrator.

UNIT III CHARACTERISTICS OF OPAMP 9

Instrumentation amplifier, first and second order active filters, V/I & I/V converters, comparators, multivibrators, waveform generators, clippers, clampers, peak detector, S/H circuit, D/A converter (R-2R ladder and weighted resistor types), A/D converter - Dual slope, successive approximation and flash types.

UNIT IV SPECIAL ICs 9

555 Timer circuit – Functional block, characteristics & applications; 566-voltage controlled oscillator circuit; 565 – phase lock loop circuit functioning and applications, Analog multiplier ICs.

UNIT V APPLICATION ICs 9

IC voltage regulators - LM317, 723 regulators, switching regulator, MA 7840, LM 380 power amplifier, ICL 8038 function generator IC, isolation amplifiers, opto coupler, opto electronic ICs.

TOTAL: 45 h

COURSE OUTCOMES:

At the end of this course the students will be able to,

CO1: Focus the basic processes involved in IC fabrication

CO2: Infer the DC , AC characteristics and frequency response of operational amplifiers

CO3: Analyze the input and output signal of clippers, clampers, peak detector, S/H circuit, D/A converter,A/D converter using operational amplifier

CO4: Compare the working priciple of special ICs 555 timer , 566 VCO and 565 Phase Locked Loop and its application

CO5: Illustrate the function of application specific ICs such as Voltage regulators, power amplifier, opto coupler etc

TEXT BOOKS:

1. RamakantA.Gayakward, "Op-amps and Linear Integrated Circuits", IV edition, Pearson Education, 2003 / PHI.(2000)
2. Roy Choudhary, D.andSheilB.Jani, "Linear Integrated Circuits", II Edition, New Age, 2003.

REFERENCE BOOKS:

1. JacobMillman, Christos C.Halkias, "Integrated Electronics - Analog and Digital circuits system", Tata McGraw Hill, 2003.
2. Robert F.Coughlin, Fredrick F.Driscoll, "Op-amp and Linear ICs", Pearson Education, 4th edition, 2002 / PHI.
3. David A.Bell, "Op-amp & Linear ICs", Prentice Hall of India, 2nd edition, 1997

PC – 09	ANALOG CIRCUITS	3 1 0 4

COURSE OBJECTIVES:

1. To help students design and analyze amplifier circuits using small – signal equivalent circuits to determine gain input impedance and output impedance.
2. To be familiar withpower amplifiers, tuned amplifiers, wave shaping circuits, multivibrators, blocking oscillators and time base generators.

UNIT I MIDBAND ANALYSIS OF SMALL SIGNAL AMPLIFIERS 12

CE, CB and CC amplifiers – Method of drawing small–signal equivalent circuit – Mid-band analysis of various types of single stage amplifiers to obtain gain, input impedance and output impedance – Miller's theorem – Comparison of CB, CE and CC amplifiers and their uses. Basic emitter coupled differential amplifier circuit – Bisection theorem. Differential gain – CMRR – Use of constant current circuit to improve MRR Derivation of transfer characteristics.

UNIT II FREQUENCY RESPONSE OF AMPLIFIERS 12

General shape of frequency response of amplifiers – Definition of cut-off frequencies and bandwidth – Low frequency analysis of amplifiers to obtain lower cut-off frequency Hybrid – π equivalent circuit of BJTs – High frequency analysis of BJT amplifiers to obtain upper cut-off frequency – Gain Bandwidth Product – High frequency equivalent circuit of FETs – High frequency analysis of FET amplifiers – Gain–bandwidth product of FETs

UNIT III LARGE SIGNAL AMPLIFIERS 12

Classification of amplifiers, Class A large signal amplifiers, transformer–coupled class A audio power amplifier – efficiency of Class A amplifiers. Class B amplifier – efficiency – push–pull amplifier – complementary–symmetry (Class B) push–pull amplifier, Class AB, Class C, Introduction to Class D amplifier.

UNIT IV FEEDBACK & TUNED AMPLIFIERS 12

Block diagram, Loop gain, Gain with feedback, Effects of negative feedback –Basic concepts of feedback, four types of negative feedback – effect of feedback on input resistance, output resistance, voltage gain and current gain, characteristics of negative feedback amplifier– Small signal tuned amplifiers – Analysis of capacitor coupled single tuned amplifier – double tuned amplifier – Stagger tuned amplifiers – large signal tuned amplifiers – Class C tuned amplifier

UNIT V OSCILLATORS 12

Classification, Barkhausen Criterion – Mechanism for start of oscillation and stabilization of amplitude, General form of an Oscillator, Analysis of LC oscillators – Hartley, Colpitts, Clapp, Franklin, Armstrong, Tuned collector oscillators, RC oscillators – phase shift – Wienbridge – Twin–T Oscillators, Frequency range of RC and LC Oscillators, Quartz Crystal Construction, Electrical equivalent circuit of Crystal, Miller and Pierce Crystal oscillators, frequency stability of oscillators.

TOTAL: 60 h

COURSE OUTCOMES:

At the end of this course the students will be able to,

- **CO1:** Design and analyze CE, CB, CC amplifiers using small signal equivalent circuits and Familiar with Gain, CMRR and transfer characteristics of the amplifiers.
- **CO2:** Perform low and high frequency analysis of BJT to evaluate Gain - bandwidth product of BJT and FET amplifiers.
- **CO3:** Differentiate class A, class B, class AB, class C and class D amplifiers on the basis of their operation and working.
- **CO4:** Explainfour types of negative feedback amplifiers and analysis of various tuned amplifier
- **CO5:** Explain the working of various LC and RC oscillators.

TEXT BOOKS:

1. J. Millman and A. Grabel, Microelectronics, 2nd edition, McGraw Hill, 1988.
2. P. Horowitz and W. Hill, The Art of Electronics, 2nd edition, Cambridge University Press, 1989.
3. A.S. Sedra and K.C. Smith, Microelectronic Circuits, Saunder's College.

REFERENCE BOOKS:

1. Robert L. Boylestad and Louis Nashelsky, Electronic Devices and Circuit Theory, 9th Edition, Pearson Education / PHI, 2007.
2. Salivahanan S., Suresh Kumar. N. and Vallavaraj A., Electronic Devices and Circuits, 2nd Edition, TMH, 2007.

HS – 05	PERSONALITY DEVELOPMENT II	2 0 0 2

COURSE OBJECTIVES:

1. To help students be socially responsible and ethical citizens.
2. To inculcate the need to lead a healthy lifestyle and manage stress
3. To improve leadership quality
4. To improve physical aspects of personality/posture & Good team spirit

UNIT I SOFT SKILLS- III 6

Basic Etiquette – Email etiquette – Business etiquette – Telephone etiquette – Meeting etiquette – Adjustment of Role & Leadership – Team Management & Development

UNIT II QUANTITATIVE APTITUDE - I 6

Percentage – Profit Loss –Discount – Ratio Proportion – Time & Work – Time, Speed & Distance. Problems relating to ages– Permutation & Combination–Probability

UNIT III QUANTITATIVE APTITUDE - II 6

Mensuration – Clocks and Calendars – Boats – Simple Interest – Compound Interest – Fractions and Decimals – Square roots – Functions.

UNIT IV ANALYTICAL PROBLEMS 6

Introduction – Linear Sequencing – Seating Arrangements – Distribution/Double Line Up – Selection – Ordering and Sequencing – Binary Logic – Venn Diagrams –Directions.

UNIT V LOGICAL PROBLEMS 6

Introduction to Logical problems – Cause and Effect – Course of Action – Statement and Assumption – Letter and Symbol series – Analogies.

TOTAL: 30 h

COURSE OUTCOMES

At the end of this course the students will be able to,

CO1: Discover basic Etiquette and develop confidence and skills to interact in meetings
CO2: Solve problems related to age, time, speed and distance
CO3: Develop quantitative aptitude skills and Determine problems with fraction and decimals
CO4: Explore the importance of logical thinking and develop skills to interpret analogies
CO5: Percieve critical thinking skills and abilities to lead others toward common goals

TEXT BOOKS/ REFERENCE BOOKS:

1. K. R. Dhanalakshmi and N. S. Raghunathan, “Personality Enrichment” Margham Publications.

2. Dr. V. M. Selvaraj, “Personality Development”, Bhavani Publications.
3. R. S. Agarwal, “Quantitative Aptitude”, S. Chand Publishers, 2015.
4. A.K Gupta, “Logical and Analytical Reasoning (English)”, 30th Edition.

PC – 08	ANALOG AND DIGITAL COMMUNICATION LABORATORY	0 0 3 1

COURSE OBJECTIVES:

1. To visualize the effects of sampling and TDM,
2. To Implement AM & FM modulation and demodulation
3. To implement PCM & DM
4. To implement FSK, PSK and DPSK schemes
5. To implement Equalization algorithms
6. To implement Error control coding schemes

LIST OF EXPERIMENTS:

1. Amplitude modulation and Demodulation techniques.
2. Frequency Modulation and Demodulation techniques.
3. Pulse Modulation – PAM / PWM / PPM.
4. Pulse Code Modulation.
5. Delta Modulation, Adaptive Delta Modulation.
6. Digital Modulation & Demodulation – ASK, PSK, QPSK, FSK (Hardware & MATLAB)
7. Designing, Assembling and Testing of Pre–Emphasis / De–emphasis Circuits.
8. Line Coding/ Error Control Coding (Hardware & MATLAB)
9. Sampling & Time Division Multiplexing
10. Frequency Division Multiplexing.

COURSE OUTCOMES:

At the end of this course the students will be able to,

CO1: Examine various modulation and demodulation techniques with experiment
CO2: Distinguish and explore the working of various pulse modulation techniques
CO3: Analyze and distinguish working of Pre–Emphasis / De–emphasis Circuits.
CO4: Evaluate various Error control coding schemes
CO5: Analyze and explore the working of TDM and FDM

TEXT BOOKS:

1. Haykin S., “Communications Systems”, John Wiley and Sons, 2001.
2. Proakis J. G. and Salehi M., “Communication Systems Engineering", Pearson Education, 2002.
3. Barry J. R., Lee E. A. and Messerschmitt D. G,“Digital Communication”, Kluwer Academic Publishers, 2004.
4. Proakis J.G, “Digital Communications", 4th Edition, McGraw Hill, 2000.

REFERENCE BOOKS:

1. Taub H. and Schilling D.L., “Principles of Communication Systems”, Tata McGraw Hill, 2001.
2. Wozencraft J. M. and Jacobs I. M., “Principles of Communication Engineering”, John Wiley, 1965.

PC – 10	ANALOG CIRCUITS LABORATORY	0 0 3 1

COURSE OBJECTIVES:

1. To study the characteristic of CE,CB and CC Amplifier.
2. To learn the frequency response of CS Amplifiers.
3. To be familiar with the transfer characteristics of differential amplifier.
4. To obtain the bandwidth of single stage and multistage amplifiers.

LIST OF EXPERIMENTS:

I. Design of Following Circuits

1. BJT Common Emitter Amplifier using voltage divider bias (self–bias).
2. BJT Common Collector Amplifier using voltage divider bias (self–bias).
3. Differential amplifier using BJT.
4. Class A Power Amplifier.
5. Class B complementary–symmetry Amplifier.
6. Current Series feedback amplifiers: Frequency response, Input and output impedance calculation.
7. Voltage Shunt feedback amplifiers: Frequency response, Input and output impedance calculation.
8. RC Phase shift oscillator, Wien Bridge Oscillator using BJT.
9. Hartley Oscillator, ColpittsOscillator using BJT.

II. Design and testing of the following experiments using op–amp

10. Inverting, non- inverting and differential amplifiers.
11. Integrator and Differentiator.
12. Schmitt Trigger.

COURSE OUTCOMES:

At the end of this course the students will be able to,

CO1: Analyse the frequency response of CB, CE and CC amplifiers and determine its gain and bandwidth.

CO2: Design and analyze large signal amplifiers and plot its frequency response.

CO3: Analyse and estimate the midband gain of feedback amplifiers.

CO4: Construct and evaluate the frequency of LC and RC Oscillators

CO5: Test amplifiers, integrator, differentiators, schmitt trigger using op-amp.

TEXT BOOKS:

1. J. Millman and A. Grabel, Microelectronics, 2nd edition, McGraw Hill, 1988.
2. P. Horowitz and W. Hill, The Art of Electronics, 2nd edition, Cambridge University Press, 1989.
3. A.S. Sedra and K.C. Smith, Microelectronic Circuits, Saunder's College.

REFERENCE BOOKS:

1. Robert L. Boylestad and Louis Nashelsky, Electronic Devices and Circuit Theory, 9thEdition, Pearson Education / PHI, 2007.
2. Salivahanan S., Suresh Kumar. N. and Vallavaraj A., Electronic Devices and Circuits, 2nd Edition, TMH, 2007.

MC – 03	HUMAN RIGHTS LAW & PRACTICE	2 0 0 2

COURSE OBJECTIVES:

1. To give students grounding in the basics of Human Rights Law.
2. To equip students in a rudimentary fashion with basic knowledge and tools for human rights lawyering.
3. To expose students to the working of human rights in practice by structured classroom discussions with human rights lawyers and activists;
4. To bring research in human rights into classroom discussions by involving the research centres in a modest manner to begin with.

UNIT I INTRODUCTION 6

Jurisprudence of Human Rights - Nature and Definition of Human Rights – Origin and Theories of Human Rights.

UNIT II UNIVERSAL PROTECTION OF HUMAN RIGHTS 6

United Nations and Human Rights – Universal Declaration of Human Rights, 1948– International Covenant on Civil and Political Rights, 1966 - International Covenant on Economic,Social and Cultural Rights, 1966.

UNIT III REGIONAL PROTECTION OF HUMAN RIGHTS 6

European System – European Court of Human Right- Inter American System – African System.

UNIT IV HUMAN RIGHTS LEGISLATIONS IN INDIA 6

Protection of Human Rights at National Level – Human Rights and the Constitution – The Protection of Human Rights Act, 1993.

UNIT V HUMAN RIGHTS AND VULNERABLE GROUPS 6

Rights of Women, Children, Disabled, Tribals, Aged and Minorities – National andInternational Legal Developments.

TOTAL: 45 h

COURSE OUTCOMES:

At the end of this course the students will be able to,

CO1: Applying the nature and theories relating to Human rights
CO2: Explaining the International perspective relating to Human rights.
CO3: Comparing the protection of Human rights in different nations
CO4: Analyzing the legislations in India pertaining to Human Rights
CO5: Categorizing the Vulnerable groups in the society

TEXT BOOKS:

1. Thomas Buergenthal, International Human Rights in a Nutshell, West Publisher Company, 4th edn., 2009.
2. S. K. Kapoor, International Law and Human Rights, Central Law Agency, 2014.

REFERENCE BOOKS:

1. M. K. Sinha, Implementation of Basic Human Rights, Lexis Nexis, 2013
2. D.D. Basu, Human Rights in Constitutional Law, Lexis Nexis, 3rd edn, 2008.
3. Upendra Baxi, The Future of Human Rights, Oxford University Press, 3rd edn, 2012.

BS – 10	BASIC LIFE SKILLS	0 0 2 1

COURSE OBJECTIVE:

1. To provide value education to improve the students' character, understanding of principled life, physical health, maintaining youthfulness, measures and methods in five aspects of life.

UNIT I PHYSICALHEALTH 6

Manavalakalai (SKY) Yoga: Introduction - Education as a means for youth empowerment - Greatness of Education - Yoga for youth Empowerment.Simplified Physical Exercises: Hand, Leg, Breathing, Eye exercises - Kapalabathi, Makarasana Part I, Makarasana Part II, Body Massage, Acu pressure, Relaxation exercises - Benefits.Yogasanas: Pranamasana – HasthaUttanasana - PadaHasthasana – AswaSanjalana Asana – ThuvipathaasvaSanjalana asana – AstangaNamaskara - Bhujangasana–AthaMukthaSavasana – AswaSanjalana Asana - PadaHasthasana–HasthaUttanasana - Pranamasana.Pranayama: Naddisuddi - Clearance Practice - Benefits.

UNIT II LIFE FORCE 6

Reasons for Diseases - Natural reasons (Genetic / imprints, Planetary Position, Natural calamities and climatic changes) - Unnatural reasons (Food habits, Thoughts, Deeds).Philosophy of Kaya kalpa - Physical body - Sexual vital fluid - Life force -Bio-Magnetism - Mind. Maintaining youthfulness. Postponing old age - Transformation of food into seven components - Importance of sexual vital fluid Measure and method in five aspects of life - Controlling undue Passion.Kayakalpa practice - Aswini Mudra - Ojas breath - Benefits of Kaya Kalpa.

UNIT III MENTAL HEALTH 6

Mental Frequencies - Beta, Apha, Theta and Delta wave - Agna Meditation explanation - benefits.
Shanthi Meditation explanation – Benefits - Thuriya Meditation explanation – Benefit.Benefits of Blessing - Self blessing (Auto suggestion) - Family blessing - Blessing the others - World blessing - Divine protection

UNIT IV VALUES 6

Human Values Self-control - Self-confidence - Honesty Contentment - Humility – ModestyTolerance - Adjustment - Sacrifice – ForgivenessPurity (Body, Dress, Environment) - Physical purity - Mental purity - Spiritual puritySocial Values:Non-violence– ServicePatriotism – EqualityRespect for parents and elders - care and protection - Respect for teacher Punctuality - Time Management.

UNIT V MORALITY (VIRTUES) 6

Importance of Introspection - I - Mine (Ego, Possessiveness).Six Evil Temperaments - Greed - Anger - Miserliness - Immoral sexual passion - Inferiority and superiority Complex – Vengeance.Maneuvering of Six Temperaments - Contentment - Tolerance - Charity - Chastity - Equality - Pardon

(Forgiveness).Five essential Qualities acquired through Meditation: Perspicacity - Magnanimity - Receptivity - Adaptability – Creativity. Improved Memory Power - Success in the Examination.
TOTAL: 30 h

COURSE OUTCOMES:

At the end of this course the students will be able to,

CO1: Understand the basic concepts of yoga nad Simplified Physical Exercises
CO2: Apply the principles of Yoga to live healthy and active life style
CO3: Analyse and promote the importance of yoga in mental health
CO4: Apply the techniques of yoga in improving the human values
CO5: Percieve the Moral Values through Yoga Utilize skills developed through participation in Manavalakalai (SKY) Yoga to help maintain lifelong health and fitness.

TEXT BOOKS/ REFERENCE BOOKS:

1. Vethathiri Maharishi, 16th Edi.2013, Yoga for Modern Age, Vethathiri Publications, Erode.
2. Vethathiri Maharishi, 2014, Simplified Physical Exercises, Vethathiri Publications, Erode.
3. Vethathiri Maharishi, 3rd Edi.2014, Kayakalpam, Vethathiri Publications, Erode.
4. Rev.Dr.G.U. Pope, 2016, Thirukkural, Giri Trading Agency,
5. Vethathiri Maharishi, 1994, Mind, Vethathiri Publications, Erode.
6. Chandrasekaran.K, 1999, Sound Health through yoga, Sedapati, Tamilnadu, Premkalyan Publications.
7. Iyengar, B.K.S. 2008, Light on Yoga, Noida, UP India, Harber Collins Publishing India Ltd.,
8. K. R. Dhanalakshmi and N. S. Raghunathan, " Personality Enrichment, Margham Publications
9. D.r V. M. Selvaraj, "Personality Development" Bhavani Publications
10. R. S. Agarwal, "Quantitative Aptitude".
11. A.K Gupta, "Logical and Analytical Reasoning (English)", 30th Edition.

SEMESTER V

BS – 09	MATHEMATICS-V (STATISTICAL AND NUMERICAL METHODS)	3 1 0 4

COURSE OBJECTIVE:

1. To provide the necessary basic concepts of a few statistical and numerical methods and be familiar with the procedures for solving numerically different kinds of problems occurring in engineering.

UNIT I TESTING OF HYPOTHESIS 12

Sampling distributions –Large samples-Tests for single mean, Proportion, Difference of means Small samples – Tests for single mean, two mean and paired t-test-F-test – chi-square test for goodness of fit – Independence of attributes – Design of Experiments-Completely randomized design – Randomized block design – Latin square design**.**

UNIT II CORRELATION AND REGRESSION ANALYSIS 12

Introduction to Correlation Analysis– Karl Pearson's Coefficient of Correlation – Rank Correlation – Regression Analysis – Curve fitting-Introduction – method of least squares.

UNIT III SOLUTION OF EQUATIONS 12

Introduction – Bisection method – Newton–Raphson's method – Regulafalsi method – Gauss Elimination method – Gauss – Jordan methods – Matrix Inversion by Gauss – Jordan method.

UNIT IV INTERPOLATION, NUMERICAL DIFFERENTIATION ANDNUMERICAL INTEGRATION 12

Introduction–Newton's forward and backward interpolation–Lagrange's Interpolation formula-Derivatives using Newton's forward and backward difference formula – Numerical integration using Trapezoidal,Simpson's 1/3 rules and Simpson's 3/8 rules.

UNITV NUMERICAL SOLUTION OF ORDINARY DIFFERENTIAL EQUATIONS 12

Introduction – Taylor's series method – Euler's method – Modified Euler's method –Second and Fourth order Runge –Kutta method for solving first order equations – Milne's Predictor corrector method and Adams – Bashforth method (Simple problems).

TOTAL: 60 h

COURSE OUTCOMES:

At the end of this course the students will be able to,

CO1: Acquire the skill on testing of hypothesis.

CO2: Familiar with the design of experiments.

CO3: Attain the knowledge on solution of equations and Eigen value problems.

CO4: Describe the applications of interpolation, numerical differentiation and numerical integration.

CO5: Attain the knowledge on numerical solution of ordinary differential equation.

TEXT BOOKS:

1. Grewal, B.S. and Grewal,J.S., "Numerical methods in Engineering and Science", 9thEdition, Khanna Publishers, New Delhi, 2012.(For units 3, 4 and 5).
2. Johnson R.A. and Gupta C.B, "Miller and Freund's Probability and Statistics for Engineers", Pearson Education, Asia, 7th edition, 2007 (For units 1 and 2).

REFERENCE BOOKS:

1. Chapra, S. C and Canale, R. P. "Numerical Methods for Engineers", Tata McGraw-Hill, New Delhi, 7thEdition,2014.
2. Walpole R.E, Myers R.H, Myers S.L, and Ye. K, "Probability and Statistics for Engineersand Scientists", Pearson Education, Asia, 9th edition, 2011.
3. Dr. Kandasamy.P, Dr. Thilagavathi, Dr. Gunavathi.K, Statistics and numerical methods", S.Chand and company,first edition, 2010.

PC – 12	ELECTROMAGNETIC WAVES	3 0 0 3

COURSE OBJECTIVES:

1. To provide the necessary basic concepts of a electromagnetic fields
2. To provide the necessary basic concepts of a electromagnetic wave radiation from antennas
3. To provide the necessary basic concepts of a electromagnetic wave propagation through transmission lines and waveguides

UNIT I INTRODUCTION TO ELECTROMAGNETICS 9

Basics of Vectors, Vector calculus, Coulombs Law, Gauss Law and its applications, Biot-Savart Law, Amperes Circuital law and its applications, Faradays Law-Maxwell's Equations, Electric Boundary conditions at Media Interface.

UNIT II ELECTROMAGNETIC WAVES 9

Uniform Plane Wave- Uniform plane wave, Propagation of wave, Wave polarization, Wave propagation in conducting medium, phase and group velocity, Power flow and Poynting vector, Surface current and power loss in a conductor- wave polarization at media interface.

UNIT III TRANSMISSION LINES 9

Transmission Lines- Equations of Voltage and Current on TX line, Propagation constant and characteristic impedance, and reflection coefficient and VSWR, Impedance Transformation on Loss-less and Low loss Transmission line, Power transfer on TX line, Smith Chart, Admittance Smith Chart, Applications of transmission lines: Impedance Matching, use transmission line sections as circuit elements.

UNIT IV WAVEGUIDES 9

Wave propagation in parallel plane waveguide, Analysis of waveguide general approach, Surface currents on the waveguide walls, Field visualization, Attenuation in waveguide.

UNIT V ANTENNAS 9

Radiation: Solution for potential function, Radiation from the Hertz dipole, Power radiated by hertz dipole, Radiation Parameters of antenna, receiving antenna, Monopole and Dipole antenna – Microstrip antenna.

TOTAL: 45 h

COURSE OUTCOMES:

At the end of this course the students will be able to,

CO1: Discuss the characteristics of wave propagation on high frequency transmission lines.

CO2: Elaborate the characteristics and propagation of EM waves

CO3: Discuss the basics of transmission lines and problem solving using smith chart..
CO4: Analyze wave propagation on metallic waveguides in modal form.
CO5: Explain the principle of radiation and radiation characteristics of an antenna.

TEXT BOOKS:

1. R.K. Shevgaonkar, Electromagnetic Waves, Tata McGraw Hill India, 2005.
2. E.C. Jordan & K.G. Balmain, Electromagnetic waves & Radiating Systems, Prentice, Hall, India.

REFERENCE BOOKS:

1. Narayana Rao, N: Engineering Electromagnetics, 3rd ed., Prentice Hall, 1997.
2. David Cheng, Electromagnetics, Prentice Hall.

PC – 14	COMPUTER ARCHITECTURE	3 0 0 3

COURSE OBJECTIVES:

1. To make students understand the basic structure and operation of digital computer.
2. To understand the hardware–software interface.
3. To familiarize the students with hierarchical memory system including cache memories and virtual memory.
4. To expose the students with different ways of communicating with I/O devices and standard I/O interfaces.

UNIT I BASIC STRUCTURE OF COMPUTERS 9

Basic Structure of Computers, Functional units, software, and performance issues software, machine instructions and programs, Types of instructions, Instruction sets: Instruction formats, Assembly language, Stacks, Ques, Subroutines.

UNIT II ARITHMETIC OPERATIONS 9

Processor organization, Information representation, number formats. Multiplication & division, ALU design, Floating Point arithmetic, IEEE 754 floating point formats.

UNIT III BASIC PROCESSING AND CONTROL UNIT 9

Control Design, Instruction sequencing, Interpretation, Hard wired control – Design methods, and CPU control unit. Microprogrammed Control – Basic concepts, minimizing microinstruction size, multiplier control unit. Microprogrammed computers - CPU control unit.

UNIT IV MEMORY SYSTEM 9

Memory organizations, device characteristics, RAM, ROM, Memory management, Concept of Cache & associative memories, Virtual memory.

UNIT V I/O ORGANIZATION 9

System organization, Input - Output systems, Interrupt, DMA, Standard I/O interfaces Concept of parallel processing, Pipelining, Forms of parallel processing, interconnect network.

TOTAL: 45 h

COURSE OUTCOMES:

At the end of this course the students will be able to,

CO1: Analyse the different basic structure of computers and make use of different instructions in the instruction set architecture for programming.

CO2: Explain the fundamental concepts of a processor and its bus configurations.

CO3: Explain the concept of pipelining and classify the pipeline hazards based on its performance.

CO4: Compare the different secondary storage devices available and to analyze the cache performance.

CO5: List the functions of interrupt mechanism and classify the bus based on serial and parallel port structure..

TEXTBOOKS:

1. V.CarlHammacher, "Computer Organisation", Fifth Edition.
2. A.S.Tanenbum, "Structured Computer Organisation", PHI, Third edition
3. Y.Chu, "Computer Organization and Microprogramming", II, Englewood Chiffs, N.J., Prentice Hall Edition
4. M.M.Mano, "Computer System Architecture", Edition

REFERENCE BOOKS:

1. C.W.Gear, "Computer Organization and Programming", McGraw Hill, N.V. Edition
2. Hayes J.P, "Computer Architecture and Organization", PHI, Second edition

PC – 15	DIGITAL SIGNAL PROCESSING	3 0 0 3

COURSE OBJECTIVES:

1. To be familiar with sampling and the various types of analysis performed on digital signals
2. To design filters in accordance to the application.

UNIT I DISCRETE TIME SIGNALS AND SYSTEMS 9

Discrete time signals: Sequences; representation of signals on orthogonal basis; Sampling and reconstruction of signals; Discrete systems attributes, Z-Transform, Analysis of LTI systems, frequency Analysis, Inverse Systems.

UNIT II ANALYSIS OF SIGNALS USING DFT – FFT ALGORITHMS 9

Discrete Fourier Transform (DFT)- DFT – properties – Frequency analysis of signals using DFT – FFT algorithms –Advantages over discrete computation of DFT – Radix 2 algorithms – DIT and DIF algorithms – Computation of IDFT using FFT– overlap add and save methods.

UNITIII INFINITE IMPULSE RESPONSE FILTER DESIGN 9

Design of Infinite Impulse Response Filter from Analog Butterworth and Chebyshev filters – Impulse invariance and bilinear methods of IIR digital filter design – realization using direct, cascade, and parallel and ladder forms.

UNIT IV FINITE IMPULSE RESPONSE FILTER DESIGN 9

Design of FIR filters using windowing technique–Rectangular – Hamming – Blackman windows. Realization of FIR filters – Transversal, linear phase and polyphase realization structures.

UNIT V SPECTRUM ESTIMATION AND MULTIRATE SIGNAL PROCESSING 9

Effect of finite register length in FIR filter design.Parametric and non-parametric spectral estimation. Introduction to multiratesignal processing – Decimation and Interpolation by integer factors – sub band coding of speech signals – QMF filters, Application of DSP.

TOTAL: 45 h

COURSE OUTCOMES:

At the end of this course the students will be able to,

CO1: Represent signals mathematically in continuous and discrete time and frequency domain
CO2: Analyse the response of signals using DFT and FFT algorithms
CO3: Design IIR filters for various applications using Butterworth and Chebyshev approximations
CO4: Estimate the performance of FIR filters using various windowing techniques.
CO5: Illustrate spectral estimation and multirate signal processing.Represent signals mathematically in continuous and discrete time and frequency domain

TEXTBOOKS:

1. Sanjit K. Mitra, "Digital Signal Processing – A Computer Based Approach", Tata McGraw Hill, 2007.
2. A.V.Oppenheim, R.W. Schafer and J.R. Buck, "Discrete-Time Signal Processing", 8th Indian Reprint, Pearson, 2004.
3. John G. Proakis and D.G. Manolakis, Digital Signal Processing: Principles, Algorithms and Applications, Prentice Hall, 1997.
4. L.R. Rabiner and B. Gold, Theory and Application of Digital Signal Processing, Prentice Hall, 1992.

REFERENCE BOOKS:

1. J.R. Johnson, Introduction to Digital Signal Processing, Prentice Hall, 1992.
2. D.J.DeFatta, J. G. Lucas andW.S.Hodgkiss, Digital Signal Processing, John Wiley& Sons, 1988.
3. Emmanuel C..Ifeachor & Barrie.W.Jervis, "Digital Signal Processing", Second Edition, Pearson Education / Prentice Hall, 2002.
4. Andreas Antoniou, "Digital Signal Processing", Tata McGraw Hill, 2006

HS – 06	PERSONALITY DEVELOPMENT III	2 0 0 2

COURSE OBJECTIVES:

1. To improve the verbal and written communication skills.
2. To enhance the interpersonal and group skills.

UNIT I VERBAL APPTITUDE - I 6

Phonetics / Neutral Accent / Pronunciation – Speech Mechanism / Mouth & Face Exercise – Vowels & Consonants – Sounds – Syllable and Syllable Stress/ Word Stress – Sentence Stress & Intonation Articulation Exercise – Rate of Speech / Flow of Speech / Idiomatic Phrases.

UNIT II VERBAL APTITUDE - II 6

Singular/plural – present tense / past tense – genders Prepositions – conjunctions – Choice of words – simple sentences – compound sentences – summarizing phrases Synonyms – Antonyms – Analogies – Similar Words.

UNIT III SOFT SKILLS- IV 6

Attitude – Meaning–Features of attitude – Formation – Personality Factors –Types of attitude – change in attitude – developing Positive attitude.

UNIT IV TIME MANAGEMENT 6

Definition – Meaning–Importance, Value of time as an important resource – comparison of Time and Money – Circle of influence and circle of control – Definition of URGENT and IMPORTANT – Time Wasters and how to reduce – Procrastination – meaning and impact – 4 Quadrants.

UNIT V TEAM BUILDING 6

Meaning – Aspects of team building – Process of team building – Types of Teams – Team Ethics and Understanding – Team trust and commitment.

TOTAL: 30 h

COURSE OUTCOMES:

At the end of this course the students will be able to,

CO1: Articulate ideas by varying the rate and flow of speech
CO2: Appropriately choose words and phrases in any verbal communication
CO3: Distinguish the positive and negative attitudes in handling any situation
CO4: Categorize their tasks and prioritize them using the four quadrant method
CO5: Practice team ethics and understanding when working with teams.Articulate by understanding the rate and flow of speech.

TEXT/REFERENCE BOOKS:

1. B N Ghosh, “Managing Soft Skills and Personality”, McGraw Hill Publications.
2. Shejwalkar and Ghanekar, “Principles and Practices of Management” McGraw Hill Latest.
3. Roberta Roesch, “Time management for Busy people,” Tata McGraw–Hill Edition.
4. Dr. V. M. Selvaraj, Personality Development , Bhavani Publications.

PC – 13	ELECTROMAGNETIC WAVES LABORATORY	0 0 3 1

COURSE OBJECTIVES:

1. To illustrate the basic concepts of a electromagnetic fields
2. To illustrate the necessary basic concepts of an electromagnetic wave radiation from antennas
3. To illustrate the necessary basic concepts of an electromagnetic wave propagation through transmission lines and waveguides

LIST OF EXPERIMENTS

1. Analysis of Hertz Dipole.
2. Analysis of Monopole antenna on a finite ground plane.
3. Determination of RADAR Cross Section (RCS) of thin dielectric sheet.
4. Design and Analysis of Waveguide Power Divider.
5. Study of Maxwell's Equation based solvers MOM and MLFMM.
6. Calculation of surface current, poynting vector in a conducting surface.
7. Determination of power flow in a coaxial cable.
8. Wave propagation on a conductor and dielectric.
9. Analysis of an Isotropic radiator.
10. Determination of H-field around a conductor.
11. Coupling between a monopole antenna and a loaded transmission line.

COURSE OUTCOMES:

At the end of this course the students will be able to,

CO1: Illustrate the Maxwell's Equation based computational electromagnetics solvers.

CO2: Illustrate the characteristics of wave propagation on transmission lines.

CO3: Determine the RCS, surface current, poynting vector power flow, E-field and H-field of materials.

CO4: Illustrate wave propagation on metallic waveguides in modal form.

CO5: Evaluate the principle of radiation and radiation characteristics of an antennaIllustrate the Maxwell's Equation based computational electromagnetics solvers.

TEXT BOOKS:

1. R.K. Shevgaonkar, Electromagnetic Waves, Tata McGraw Hill India, 2005.
2. E.C. Jordan & K.G. Balmain, Electromagnetic waves & Radiating Systems, Prentice, Hall, India.

REFERENCE BOOKS:

1. Narayana Rao, N: Engineering Electromagnetics, 3rd ed., Prentice Hall, 1997.
2. David Cheng, Electromagnetics,2nd Ed. ,Prentice Hall,

PC – 16	DIGITAL SIGNAL PROCESSING LABORATORY	0 0 3 1

COURSE OBJECTIVES:

1. To implement Linear and Circular Convolution
2. To implement FIR and IIR filters
3. To study the architecture of DSP processor
4. To demonstrate Finite word length effect

LIST OF EXPERIMENTS:

- **USING TMS320C5X/TMS320C 67XX/ADSP 218X/219X/BS531/532/561**

1. Study of various addressing modes of DSP using simple programming examples
2. Implementation of Linear and Circular Convolution
3. Sampling of input signal and display
4. Waveform generation
5. Implementation of FIR filters Using windowing techniques**.**

- **USING MATLAB**

1. Generation of Signals
2. Linear and circular convolution of two sequences
3. Sampling and effect of aliasing
4. Design of FIR filters using rectangular, hamming, Hanning, Blackman windows
5. Design of IIR filters using Analog Butterworth and Chebyshev filters

COURSE OUTCOMES:

At the end of this course the students will be able to,

CO1: Evaluate the concepts of digital signal processing using DSP kits.

CO2: Sample Analog signals and generate the different waveforms.

CO3: Differentiate the various types of signals using MATLAB programs

CO4: Analyze, observe and compare the performance of FIR filters using the different windows like rectangular, hamming, Hanning and Blackman.

CO5: Evaluate the magnitude and phase characteristics (Frequency response Characteristics) of digital IIR-Butterworth, Chebyshev filters.Perform linear and circular convolution using DSP kits.

TEXT BOOKS:

1. S.K.Mitra, Digital Signal Processing: A computer based approach.TMH
2. A.V. Oppenheim and Schafer, Discrete Time Signal Processing, Prentice Hall, 1989.
3. John G. Proakis and D.G. Manolakis, Digital Signal Processing: Principles, Algorithms and Applications, Prentice Hall, 1997.
4. L.R. Rabiner and B. Gold, Theory and Application of Digital Signal Processing, Prentice Hall, 1992.

REFERENCE BOOKS:

1. J.R. Johnson, Introduction to Digital Signal Processing, Prentice Hall, 1992.
2. D.J.DeFatta, J. G. Lucas andW.S.Hodgkiss, Digital Signal Processing, John Wiley& Sons, 1988.

SEMESTER VI

PC – 17	CONTROL SYSTEMS	3 0 0 3

COURSE OBJECTIVES:

1. To introduce the elements of control system and their modelling using various Techniques.
2. To introduce methods for analyzing the time response, the frequency response and the stability of systems.
3. To introduce the state variable analysis method.

UNIT I INTRODUCTION TO CONTROL SYSTEM MODELING 9

Basic building blocks of Control System – Open loop and Closed loop systems – Differential equation – Transfer function, Modeling of Electric systems, Translational and rotational mechanical systems – Block diagram reduction Techniques – Signal flow graph

UNIT II TIME RESPONSE ANALYSIS 9

Time response analysis – First Order Systems – Impulse Response analysis of second order systems – step response system of second order system, Steady state errors – P, PI, PD and PID Compensation Analysis using MATLAB

UNIT III FREQUENCY RESPONSE ANALYSIS 9

Frequency Response – Bode Plot, Polar Plot, Nyquist Plot – Frequency Domain specifications from the plots – Constant M and N Circles – Nichol's Chart – Use of Nichol's Chart in Control System Analysis. Series, Parallel, series–parallel Compensators – Lead, Lag, and Lead Lag Compensators.

UNIT IV STABILITY ANALYSIS 9

Stability, Routh–Hurwitz Criterion – Root Locus Technique, Construction of Root Locus, Stability, Dominant Poles, Application of Root Locus Diagram – Nyquist Stability Criterion – Relative Stability. Analysis using MATLAB.

UNIT V STATE VARIABLE ANALYSIS & DIGITAL CONTROL SYSTEMS 9

State space representation of Continuous Time systems – State equations – Transfer function from State Variable Representation – Solutions of the state equations – Concepts of Controllability and Observability – State space representation for Discrete time systems. Sampled Data control systems – Sampling Theorem – Sample & Hold – Open loop & Closed loop sampled data systems. Optimal control problem

TOTAL: 45 h

COURSE OUTCOMES:

At the end of this course the students will be able to,

CO1: Analyze the fundamentals of control systems and different transational and rotational mechanical system

CO2: Analyze the methods of time domain response in first order and second order systems

CO3: Analyse the time and frequency-domain response of first and second-order systems using plots and charts

CO4: Analyse the Performance stability analysis using various methods

CO5: Analyze different sampling theorems and state variable analysis of continuous and discrete time systemsCharacterize a system and find its study state behavior.

TEXT BOOKS:

1. J.Nagrath and M.Gopal,"Control System Engineering", New Age International Publishers, 5th Edition, 2007.
2. K. Ogata, 'Modern Control Engineering', 4th edition, Pearson Education, New Delhi, 2003 / PHI.

REFERENCE BOOKS:

1. Benjamin.C.Kuo, "Automatic control systems", Prentice Hall of India, 7th Edition, 1995.
2. M. Gopal, Digital Control and State Variable Methods, 2nd Edition, TMH, 2007.
3. Schaum's Outline Series, "Feedback and Control Systems' Tata Mc-Graw Hill, 2007.
4. John J. D'azzo& Constantine H. Houpis, "Linear control system analysis and design", Tata Mc-GrowHill, Inc., 1995.
5. Richard C. Dorf& Robert H. Bishop, "Modern Control Systems", Addison – Wesley, 1999.

PC – 18	COMPUTER NETWORKS	3 0 0 3

COURSE OBJECTIVES:

1. To understand the division of network functionalities into layers.
2. Be familiar with the components required to build different types of networks.
3. Be exposed to the required functionality at each layer.
4. To learn the flow control and congestion control algorithms.

UNIT I DATA COMMUNICATIONS 9

Components – Direction of Data flow – networks – Components and Categories – types of Connections – Topologies –Protocols and Standards – ISO / OSI model – Transmission Media – Coaxial Cable – Fiber Optics – Line Coding – Modems – RS232 Interfacing sequences.

UNIT II DATA LINK LAYER 9

Error – detection and correction – Parity – LRC – CRC – Hamming code – low Control and Error control – stop and wait – go back–N ARQ – selective repeat ARQ– sliding window – HDLC. – LAN – Ethernet IEEE 802.3 – IEEE 802.4 – IEEE 802.5 – IEEE 802.11 – FDDI – SONET – Bridges, Switches.

UNIT III NETWORK LAYER 9

Internetworks – circuit switching – space division switches – time division switches, switch fabrics-Crossbar switch. Packet Switching and Datagram approach – IP addressing methods – Subnetting – Routing – Distance Vector Routing – Link State Routing, Open shortest path first (OSPF). Border Gateway protocol (BGP),EGP – Routers.

UNIT IV TRANSPORT LAYER 9

Duties of transport layer – Multiplexing – Demultiplexing – Sockets – User Datagram Protocol (UDP) – Transmission Control Protocol (TCP) – Congestion Control – Quality of services (QOS) – Integrated Services– Differentiated services.

UNIT V APPLICATION LAYER 9

Domain Name Space (DNS) – SMTP –File Transfer protocol (FTP)– HTTP – WWW – Security – Cryptography – Symmetric key and Public Key algorithms –Conventional encryption techniques, Electronic mail,Digital Signature.

TOTAL: 45 h

COURSE OUTCOMES:

At the end of this course the students will be able to,

CO1: Understand the concepts of networking thoroughly computer networks and layered architecture of computer networks.

CO2: Evaluate data communication link considering elementary concepts of data link layer protocols for error detection and correction and Distinguish various IEEE Ethernet standards.

CO3: Analyze various network layer techniques for designing subnets and supernets and analyse packet flow on basis of routing protocols

CO4: Explain different UDP and TCP protocols.

CO5: illustrate application layer protocols and internet applications such as network security, Email and digital signature.

TEXT BOOKS:

1. Behrouz A. Forouzan, "Data communication and Networking", Tata McGraw–Hill, 2004.
2. Andrew S. Tanenbaum, "Computer Networks", PHI, Fourth Edition, 2003.

REFERENCE BOOKS:

1. James F. Kurose and Keith W. Ross, "Computer Networking: A Top–Down Approach Featuring the Internet", Pearson Education, 2003.
2. Larry L. Peterson and Peter S. Davie, "Computer Networks", Harcourt Asia Pvt. Ltd., Second Edition.
3. William Stallings, "Data and Computer Communication", Sixth Edition, Pearson Education, 2000.

PC – 20	MICROCONTROLLERS	3 0 0 3

COURSE OBJECTIVES:

1. To implement the assembly language programming of 8085,8086 and 8051.
2. To experiment the interface concepts of various peripheral device with the processor.

UNIT I 8085 AND 8086 MICROPROCESSORS HARDWARE ARCHITECTURE 9

Overview of microcomputer systems and their building blocks, memoryinterfacing, concepts of interrupts and Direct Memory Access, instruction sets of microprocessors (with examples of 8085 and 8086)

UNIT II MICROPROCESSOR PERIPHERAL INTERFACING AND MEMORY 9

Interfacing with peripherals – timer, serial I/O, parallel I/O, A/D and D/Aconverters;Arithmetic Coprocessors; System level interfacing design; Concepts of virtual memory, Cache memory, Advanced coprocessorArchitectures- 286, 486, Pentium.

UNIT III 8051 MICROCONTROLLER 9

Microcontrollers vs Microprocessors– 8051 Micro Controller Hardware – I/O Pins, Ports and Circuits – External Memory –Counters and Timers – Serial Data I/O – Interrupts–Interfacing to External Memory and 8255.

UNIT IV 8051 PROGRAMMING AND APPLICATIONS 9

8051 Instruction Set – Addressing Modes – Assembly Language Programming – I/O Port Programming – Timer and Counter Programming – Serial Communication – Interrupt Programming– 8051 Interfacing – LCD – ADC – Sensors – Stepper Motors – Keyboard and DAC.

UNIT V INTRODUCTION TO EMBEDDED SYSTEMS 9

Introduction to Embedded Systems and Fundamental – Software for Embedded Systems, Intel 8051 / Atmel 89c51 / Arduino, PIC Microcontroller, Architecture & Programming of ARM processor,Introduction to RISC processors; ARM microcontrollers interface designs.

TOTAL: 60 h

COURSE OUTCOME

At the end of this course the students will be able to,

CO1: Illustrate the applications of 8085 and 8086 microprocessors
CO2: Explain the various Interfacing methods with 8085 microprocessor.
CO3: Distinguish Microprocessors and Microcontrollers..
CO4: Program the interfacing of 8051 Microcontroller
CO5: Testing the program of PIC microcontrollers, ARM processors, Arduino, PIC Microcontroller.

TEXT BOOKS:

1. R. S. Gaonkar, "Microprocessor Architecture: Programming and Applications with the 8085/8080A", Penram International Publishing, 1996
2. D A Patterson and J H Hennessy, "Computer Organization and Design The hardware and software interface", Morgan Kaufman Publishers.
3. Douglas Hall, "Microprocessors Interfacing", Tata McGraw Hill, 1991.
4. Kenneth J. Ayala, "The 8051 Microcontroller", Penram International Publishing, 1996.

REFERENCE BOOK:

1. David. E.Simon, "An Embedded Software Primer", Pearson Education, 2001.

HS – 07	PERSONALITY DEVELOPMENT IV	2 0 0 2

COURSE OBJECTIVES:

1. To develop awareness of different job search techniques, including how to employ practical networking techniques
2. To begin to recognize the skills developed during research and analyse how to present these effectively in written applications
3. To critique the strengths and weaknesses of their own and colleagues' current CVs
4. To understand interview processes and practice being interviewed in a supportive environment.

UNIT I SOFT SKILLS V 6

Assertiveness – Meaning – Importance of assertiveness – Characteristics of Assertive communication – Merits – forms of assertion – Causes of misunderstanding

UNIT II COMMUNICATION SKILLS 6

Meaning – Elements of Communication – Functions of Communication – Principles of Communication Formal and Informal Communication – Barriers in Communication – Characteristics of good – communication – Feedback – Communication systems.

UNIT III PRESENTATION SKILLS - I 6

Meaning – Importance of Presentation – Concept of 5 W's and one H – understanding the audience – Types of presentations – How to make effective presentation.

UNIT IV PRESENTATION SKILLS - II 6

Use of slide, PPT's and visuals – Rules for slide presentation – precautions – seminars and conferences – Steps to eliminate Stage fear.

UNIT V CHANGE MANAGEMENT 6

Definition – Necessity – Resistance towards Change – 10 Principles of Change Management – Leaders approach – Effective Change management.

TOTAL:30 h

COURSE OUTCOME

At the end of this course the students will be able to,

CO1: Develop and Communicate assertively by knowing the causes of misunderstanding
CO2: Analyze and overcome the barriers in formal and informal communication
CO3: Prepare and present messages with a specific intent.
CO4: Select powerful presentations that deliver effective messages.
CO5: Manage the various principles of change

TEXT/REFERENCE BOOKS:

1. Helping employees embrace change – LaClair, J. and Rao, R. Helping Employees Embrace Change, McKinsey Quarterly, 2002, Number 4.
2. Who Moved My Cheese by Spencer Johnson published by vermilion first edition.
3. Effective Communication. Adair, John. London: Pan Macmillan Ltd., 2003.
4. Business Communication Today: Bovee, Courtland L, John V. Thill& Barbara E. Schatzman. Tenth Edition. New Jersey: Prentice Hall, 2010.

PC –19	COMPUTER NETWORKS LABORATORY	0 0 3 1

COURSE OBJECTIVES:

1. To learn to communicate between two desktop computers by implementing the different protocols
2. Be familiar with socket programming and the various routing algorithms
3. Be familiar with simulation tools. To understand the division of network functionalities into layers.
4. Be familiar with the components required to build different types of networks
5. Be exposed to the required functionality at each layer

LIST OF EXPERIMENTS:

1. Implementation of Error Detecting Codes (CRC)
2. Ethernet LAN protocol
3. To create scenario and study the performance of CSMA/CD protocol simulation
4. Token bus and token ring protocols: To create scenario and study the performance of token bus and token ring protocols through simulation.

5. Wireless LAN protocols: To create scenario and study the performance of network with CSMA/ CA protocol and compare with CSMA/CD protocols.
6. Implementation and study of stop and wait protocol.
7. Implementation and study of Go–back–N and selective reject protocols.
8. Implementation of distance vector routing algorithm.
9. Implementation of Link state routing algorithm.
10. Implementation of Data encryption and decryption.

COURSE OUTCOMES:

At the end of this course the students will be able to,

CO1: Explain the role of parity, LRC, CRC and Hamming code in error detection and control and practically simulate the same.

CO2: Classify the different protocols like CSMA-Cd, token bus and token ring and analyse the performance of them.

CO3: Examine the implementation of stop n wait and Go back-N protocols with its performance evaluation

CO4: Explain the implementation of distance vector routing and link state routing algorithm with its performance evaluation.

CO5: Examine the implementation fo Data Encryption and Decryption with a proper simulation.

TEXT BOOKS:

1. BehrouzA. Forouzan, "Data communication and Networking", Tata McGraw–Hill, 2004.
2. Andrew S. Tanenbaum, "Computer Networks", PHI, Fourth Edition, 2003.

REFERENCE BOOKS:

1. James F. Kurose and Keith W. Ross, "Computer Networking: A Top–Down Approach Featuring the Internet", Pearson Education, 2003.
2. Larry L. Peterson and Peter S. Davie, "Computer Networks", Harcourt Asia Pvt. Ltd., Second Edition.
3. William Stallings, "Data and Computer Communication", Sixth Edition, Pearson Education, 2000.

PC – 21	MICROCONTROLLERSLABORATORY	0 0 3 1

COURSE OBJECTIVES:

1. To introduce ALP concepts and features
2. To write ALP for arithmetic and logical operations in 8086 and 8051
3. To differentiate Serial and Parallel Interface
4. To interface different I/Os with Microprocessors
5. To be familiar with MASM

LIST OF EXPERIMENTS:

1. Programs for 8– bit and 16 –bit Arithmetic operations (Using 8085 & 8086).
2. Programs for Sorting and Searching (Using 8085 & 8086).
3. Programs for Code conversions (Using 8085 & 8086).
4. Programs for String manipulation operations (Using 8086).

5. Programs for Digital clock and Stop watch (Using 8086).
6. Interfacing and Programming 8279, 8259, and 8253.
7. Serial and Parallel Communication between two MP Kits.
8. Interfacing and Programming of Stepper Motor and DC Motor Speed control/ Interfacing ADC and DAC.
9. Programming using Arithmetic, Logical and Bit Manipulation instructions of 8051microcontroller.
10. Communication between 8051 Microcontroller kit and PC.
11. Design Entry and simulation of combinational logic circuits (8 bit adders, 4 bit multipliers, address decoders, multiplexers).
12. Design Entry and simulation of sequential logic circuits for counters

COURSE OUTCOMES:

At the end of this course the students will be able to,

CO1: Write a program of two 8-bit addition using 8085 microprocessor.
CO2: Write a program in assembly language for 8086 Microprocessor.
CO3: Expremenring the various Interface priniciples of peripheral devices.
CO4: Measuring the value of addition and subtraction using 8051 Microcontroller.
CO5: Write assembly language programming of 8051 Microcontroller with various interfacing devices for diverse application**s**

TEXT BOOKS:

1. R. S. Gaonkar, Microprocessor Architecture: Programming and Applications with the 8085/8080A, Penram International Publishing, 1996
2. D A Patterson and J H Hennessy, "Computer Organization and Design The hardware and software interface. Morgan Kaufman Publishers.
3. Douglas Hall, Microprocessors Interfacing, Tata McGraw Hill, 1991.

REFERENCE BOOKS:

1. David. E.Simon, “An Embedded Software Primer”, Pearson Education, 2001.
2. Kenneth J. Ayala, The 8051 Microcontroller, Penram International Publishing, 1996.

SEMESTER VII

PC – 22	OPTICAL AND MICROWAVE LABORATORY	0 0 3 1

COURSE OBJECTIVES:

The student should be made to:

1. Develop understanding of simple optical communication link and to Learn about the characteristics and measurements in optical fiber
2. To Understand the working principle of microwave components and their characteristics

LIST OF EXPERIMENTS:

Optical Experiments

1. Attenuation Measurement and Measurement of Connector and Bending Losses.
2. Fiber Optic Analog and Digital Link
3. Numerical Aperture Determination for Fibers.

Microwave Experiments

1. Reflex Klystron – Mode characteristics/ Gunn Diode – Characteristics
2. VSWR, Frequency and Wave Length Measurement
3. Directional Coupler – Directivity and Coupling Coefficient – S – parameter measurement
4. Isolator and Circulator – S – parameter measurement
5. Attenuation, Power and Antenna Gain Measurement.
6. S – matrix Characterization of E–Plane T, H–Plane T and Magic T.
7. Radiation Pattern of Antennas.

COURSE OUTCOMES:

At the end of this course the students will be able to,

CO1: Examine the performance of fiber optic analog and link and estimate numerical aperture
CO2: Determine the bending losso of optical fiber
CO3: Determine the voltage and current characteristics of Gunn diode
CO4: Estimate the Gain Measurement,. Radiation Pattern of horn Antennas
CO5: Determine the frequency and wavelength of rectangular waveguide

TEXT BOOKS:

1. John M. Senior," Optical Fiber Communication", Pearson Education, Second Edition. 2007.
2. Gerd Keiser, "Optical Fiber Communication" ,McGraw Hill, Third Edition. 2000.
3. Samuel Y Liao, "Microwave Devices & Circuits", Prentice Hall of India, 2006.
4. Reinhold. Ludwig and PavelBretshko "RF Circuit Design", Pearson Education, Inc., 2006.

REFERENCE BOOKS:

1. J.Gower, "Optical Communication System", Prentice Hall of India, 2001.
2. Rajiv Ramaswami, "Optical Networks", Second Edition, Elsevier , 2004.

3.Robert. E.Collin, "Foundation of MicrowaveEngg", McGraw Hill.

4.Annapurna Das and Sisir K Das, "Microwave Engineering", Tata McGraw Hill Inc., 2004.

HS – 07	NSS – I	2 0 1 2

COURSE OBJECTIVES:

1. To understand the community in which they work.
2. To understand themselves in relation to their community.
3. To identify the needs and problems of the community and involve them in problem solving process.

UNIT I INTRODUCTION AND BASIC CONCEPTS OF NSS 3

NSS: History, philosophy, aims –Emblem: flag, motto, song, badge – NSS functionaries: Organizational structure, roles and responsibilities.

UNIT II NSS PROGRAMS AND ACTIVITIES 9

Concept of regular activities– special camping–day camps–Basis of adoption of village/slums, Methodology of conducting survey–Financial pattern of the scheme– other youth program/schemes of GOI– Coordination with different agencies– Maintenance of the dairy

UNIT III UNDERSTANDING YOUTH 4

Youth: Definition, profile of youth, categories – youth: Issues, challenges and opportunities – Youth as an agent of social change.

UNIT IV COMMUNITY MOBILIZATION 8

Mapping of community stakeholders–Designing the message in the context of the problem and the culture of the community–Identifying methods of mobilization–Youth adult partnership

UNIT V VOLUNTEERISM AND SHRAMDAN 6

Indian Tradition of volunteerism–Needs& Importance of Volunteerism – Motivation and constraints of volunteerism – Shramdan as a part of volunteerism.

TOTAL: 30 h

COURSE OUTCOMES:

At the end of this course the students will be able to,

CO1: Identify and analyse the qualities of a good leader to develop among themselves a sense of social and civic responsibility

CO2: Develop the competence required for group-living , sharing of responsibilities and motivate national integration and social harmony

CO3: Utilize the knowledge in finding practical solutions and take part and support in mobilizing community participation

CO4: Understand and appraise the role of youth in building peace, solving conflicts, and develop capacity to meet emergencies and natural disasters

CO5: Be familiar with the national youth policy, development programmes and assess the conduct surveys, and prepare reports for social actions.

REFERENCE BOOKS:

1. National Service Scheme Manual, Govt. of India.
2. Training Programme on National Programme scheme, TISS.
3. Ram Ahuja, “Social Problems in India”, second edition, Rawat Publication, New Delhi, 1992.

PROFESSIONAL ELECTIVE COURSES

PE – 01	MICROWAVE THEORY AND TECHNIQUES	3 0 0 3

PREREQUISITE: ELECTROMAGNETIC WAVES

COURSE OBJECTIVES:

1. To inculcate understanding of the basics required for circuit representation of RF networks.
2. To deal with the issues in the design of microwave amplifier.
3. To in still knowledge on the properties of various microwave components.
4. To deal with the microwave generation and microwave measurement techniques

UNIT I TWO PORT NETWORK THEORY 9

Review of Low frequency parameters: Impedance, Admittance, Hybrid and ABCD parameters, Different types of interconnection of Two port networks, High Frequency parameters, Formulation of S parameters, Properties of S parameters, Reciprocal and lossless Network, Transmission matrix, RF behaviour of Resistors, Capacitors and Inductors.

UNIT II RF AMPLIFIERS AND MATCHING NETWORKS 9

Characteristics of Amplifiers, Amplifier power relations, Stability considerations, Stabilization Methods, Noise Figure, Constant VSWR, Broadband, High power and Multistage Amplifiers, Impedance matching using discrete components, Two component matching Networks, Frequency response and quality factor, T and Pi Matching Networks, Microstrip Line Matching Networks.

UNIT III PASSIVE AND ACTIVE MICROWAVE DEVICES 9

Terminations, Attenuators, Phase shifters, Directional couplers, Hybrid Junctions, Power dividers, Circulator, Isolator, Impedance matching devices: Tuning screw, Stub and quarter wave transformers. Crystal and Schottkey diode detector and mixers, PIN diode switch, Gunn diode oscillator, IMPATT diode oscillator and amplifier, Varactor diode, Introduction to MIC.

UNIT IV MICROWAVE GENERATION 9

Review of conventional vacuum Triodes, Tetrodes and Pentodes, High frequency effects in vacuum Tubes, Theory and application of Two cavity Klystron Amplifier, Reflex Klystron oscillator, Traveling wave tube amplifier, Magnetron oscillator using Cylindrical, Linear, Coaxial Voltage tunable Magnetrons, Backward wave Crossed field amplifier and oscillator.

UNIT V MICROWAVE MEASUREMENTS 9

Measuring Instruments : Principle of operation and application of VSWR meter, Power meter, Spectrum analyzer, Network analyzer, Measurement of Impedance, Frequency, Power, VSWR, Q-factor, Dielectric constant, Scattering coefficients, Attenuation, S-parameters.

TOTAL: 45 h

COURSE OUTCOMES:

At the end of this course the students will be able to,

CO1: Analyse the scattering matrix for two port networks and its properties.,

CO2: Determine the characteristics of RF Amplifiers and matching network

CO3: Explaiin the fabrication techniques of Microwave Monolithic Integrated Circuit (MMIC) and .study the characteristics of various diodes

CO4: Compare the principles of operation of Multicavity Klystron and Reflex Klystron.

CO5: Measure power, wavelength, impedance, SWR, attenuation, Q and Phase shift in the microwave region

TEXT BOOKS:

1. Samuel Y Liao, "Microwave Devices & Circuits", Prentice Hall of India, 2006.
2. Reinhold. Ludwig and PavelBretshko "RF Circuit Design", Pearson Education, Inc., 2006.

REFERENCEBOOKS:

1. Robert. E.Collin, "Foundation of MicrowaveEngg", McGraw Hill.
2. Annapurna Das and Sisir K Das, "Microwave Engineering", Tata McGraw Hill Inc., 2004.
3. M.M.Radmanesh, "RF & Microwave Electronics Illustrated", Pearson Education, 2007.
4. Robert E.Colin, Foundations for Microwave Engineering", McGraw Hill, 2001 2ed.
5. D.M.Pozar, "Microwave Engineering", John Wiley & son.

PE – 02	ANTENNAS AND PROPAGATION	3 0 0 3

PREREQUISITE: ELECTROMAGNETIC WAVES, MICROWAVE THEORY AND TECHNIQUES

COURSE OBJECTIVES:

1. To give insight of the radiation phenomena.
2. To give a thorough understanding of the radiation characteristics of different types of antennas
3. To create awareness about the different types of propagation of radio waves at different frequencies

UNITI RADIATION PRINCIPLES & INTRODUCTION TO ANTENNAS 9

Fundamental Concepts- Physical concept of radiation, Radiation pattern, near-and far-field regions, reciprocity, directivity and gain, effective aperture, polarization, input impedance, efficiency, Friis transmission equation, radiation integrals and auxiliary potential functions .Radiation from Wires and Loops- Infinitesimal dipole, finite – Length dipole, linear elements near conductors, dipoles for mobile communication, small circular loop.

UNITII APERTURE ANTENNAS 9

Aperture and Reflector Antennas – Huygens' principle, radiation from rectangular and circular apertures, design considerations, Babinet's principle, Radiation from sectoral and pyramidal horns, design concepts, prime – focus parabolic reflector and cassegrain antennas. Broadband Antennas – Log-periodic and Yagi–Uda antennas, frequency independent antennas, broadcast antennas.

UNIT III MCROSTRIP ANTENNAS 9

Micro strip Antennas – Basic characteristics of micro strip antennas, feeding methods, methods of analysis, design of rectangular and circular patch antennas.

UNIT IV ANTENNA ARRAYS 9

Antenna Arrays- Analysis of uniformly spaced arrays with uniform and non-uniform excitation amplitudes, extension to planar arrays and synthesis of antenna arrays using Schelkunoff polynomial method, Woodward-Lawson method.

UNIT V ANTENNAS 9

Basic Concepts of Smart Antennas- Concept and benefits of smart antennas, fixedweight beam forming basics, Adaptive beam forming.Different modes of Radio Wave propagation used in current practice.

TOTAL: 45 h

COURSE OUTCOMES:

At the end of this course the students will be able to,

- **CO1:** Explain the principles of electromagnetics to explain antenna characteristics such as radiation pattern and directivity...
- **CO2:** Determie the various design considerations of aperture
- **CO3:** Analyse the various feeding methods in micro strip aantenna
- **CO4:** Analysis of uniformly spaced arrays with uniform and non-uniform excitation amplitude
- **CO5:** Explain the Concepts of Smart Antennas.

TEXT BOOKS:

1. J.D. Kraus, "Antenna's", McGraw Hill, 1988.
2. C.A. Balanis, "Antenna Theory - Analysis and Design", John Wiley, 1982.
3. R.E. Collin, "Antennas and Radio Wave Propagation", McGraw Hill, 1985.

REFERENCEBOOKS:

1. R.C. Johnson and H. Jasik, "Antenna Engineering Handbook", McGraw Hill, 1984.
2. I.J. Bahl and P. Bhartia, "Micro Strip Antennas", Artech House, 1980.
3. R.K. Shevgaonkar, "Electromagnetic Waves", Tata McGraw Hill, 2005
4. R.E. Crompton, "Adaptive Antennas", John Wiley Publication.

PE – 03	MICROSTRIP ANTENNAS	3 0 0 3

PREREQUISITE: ELECTROMAGNETIC WAVES, ANTENNAS AND WAVE PROPAGATION

COURSE OBJECTIVES:

1. To give insight of the radiation phenomena from micro-strip antennas.
2. To give a thorough understanding of the radiation characteristics of micro-strip antennas.
3. To create awareness about the different types of micro-strip antenna, its arrays and design.

UNIT I MICRO-STRIP LINES 9

Introduction of Planar Transmission Structures, Micro-strip Field Configuration, Micro-strip measurement, Design Considerations, Suspended and Inverted Micro-strip Lines, Multi-layered Dielectric Micro-strip, Thin Film Micro-strip (TFM), Valley Micro-strip Lines, Micro-strip Applications.

UNIT II SLOT-LINE 9

Introduction of Slot-lines, Slot-line Analysis, Design Considerations, Slot-line Discontinuities, Slot-line Transitions, Slot -- line Applications. Coplanar Lines and Wave Guides: Introduction of Coplanar Waveguide and Coplanar Strips.

UNIT III COUPLED MICRO-STRIP LINES 9

Introduction of Coupled Micro-strip Lines, General Analysis of Coupled Lines, Characteristics of Coupled Micro-strip Lines, Measurements on Coupled Micro-strip Lines, Design Considerations for Coupled Micro-strip Lines, Coupled Multi conductor Micro-strip Lines, Discontinuities in Coupled Micro-strip Lines.

UNIT IV MICRO-STRIP CIRCUIT DESIGN 9

Excitation techniques; Micro-strip dipole; Rectangular patch, Circular patch, Micro-stripYagi antenna, Micro-strip array, Gain improvement techniques in micro-strip antenna, Impedance transformers, filters, isolators and phase shifters.

UNIT V MICRO-STRIP ANTENNA ARRAYS 9

Array theory, Array calculations and analysis, array architectures, corporate array design, Resonant series fed array design, Series fed traveling wave array design. Planar Waveguide Analysis, Discontinuity Measurements.

TOTAL: 45 h

COURSE OUTCOMES:

At the end of this course students will be able to,

CO1: Apply the principles of electromagnetics to explain the various micro-strip line structures and characteristics

CO2: Illustrate micro-strip lines and its types..

CO3: Illustrate the various slot lines.

CO4: Evaluate the effects due to coupling the micro-strip lines.

CO5: Design of various micro-strip antennas with various excitation techniques

TEXT BOOKS:

1. Gupta, K.C. and Garg, Ramesh, “Micro-strip lines and slot lines”, Artech house (1996).
2. Sainiti, Robert A., “CAD of Micro-strip Antenna for Wireless Applications”, Artech House(1996).

REFERENCE BOOKS:

1. Lu, Wong Kim, Planar antennas for Wireless applications, John Wiley and Sons (2003).
2. Simons, Rainee N., Coplanar Waveguide Circuits, Components, and Systems, John Wiley and Sons (2001).
3. Balanis.A, “Antenna Theory Analysis and Design”, John Wiley and Sons, New York,1982.
4. Hubregt.J.Visser, “Antenna Theory and Applications” 1st Edition, John Wiley & Sons Ltd,NewYork,2012.
5. John D Krauss, Ronald J Marhefka and Ahmad S. Khan, “Antennas and Wave Propagation”, Fourth Edition, Tata McGraw-Hill, 2006.
6. Zhijun Zhang, “Antenna Design for Mobile Devices” 1st Edition, John Wiley & Sons (Asia) Ltd, Newyork, 2011.

PE – 04	FIBER OPTIC COMMUNICATIONS	3 0 0 3

PREREQUISITE:PHYSICS (OSCILLATION, WAVES AND OPTICS), MICROWAVE THEORY AND TECHNIQUES

COURSE OBJECTIVES:

1. To facilitate the knowledge about optical fiber sources and transmission techniques and explore the trends of optical fiber measurement systems.
2. To be familiar with the various optical fiber modes, configuration and transmission characteristics of optical fibers
3. To learn about the various optical sources, detectors and transmission techniques
4. To enrich the knowledge on optical fiber measurements, coupling techniques, optical communication systems and networks

UNIT I INTRODUCTION TO OPTICAL FIBER 9

Introduction-general optical fiber communication system-basic optical laws and definitions-optical modes and configurations -mode analysis for optical propagation through fibers-modes in planar wave guide-modes in cylindrical optical fiber-transverse electric and transverse magnetic modes-fiber materials-fiber fabrication techniques-fiber optic cables-classification of optical fiber-single mode fiber-graded index fiber.

UNIT II TRANSMISSION CHARACTERISTIC OF OPTICAL FIBER 9

Attenuation – absorption – scattering losses-bending losses-core and cladding losses – signal dispersion –inter symbol interference and bandwidth – intra model dispersion – material dispersion – waveguide dispersion – polarization mode dispersion – intermodal dispersion– dispersion optimization of single mode fiber – characteristics of single mode fiber – R-I Profile– cut-off wave length– dispersion calculation – mode field diameter.

UNIT III OPTICAL SOURCES AND DETECTORS 9

Sources: Intrinsic and extrinsic material– direct and indirect band gaps – LED- LED structures – surface emitting LED – Edge emitting LED – quantum efficiency and LED power – light source materials-modulation of LED– LASER diodes – modes and threshold conditions – Rate equations – external quantum efficiency– resonant frequencies – structures and radiation patterns – single mode laser-external modulation– temperature effort. Detectors: PIN photo detector – Avalanche photo diodes-Photo detector noise – noise sources – SNR – detector response time– Avalanche multiplication noise-temperature effects– comparisons of photo detectors.

UNIT IV OPTICAL RECEIVER, MEASUREMENTS AND COUPLING 9

Fundamental receiver operation – preamplifiers– digital signal transmission– error sources– Front end amplifiers – digital receiver performance– probability of error-receiver sensitivity– quantum limit.Optical power measurement–attenuation measurement–dispersion measurement-Fiber Numerical Aperture Measurements–Fiber cut-off Wave length Measurements–Fiber diameter measurements-Source to Fiber Power Launching –Lensing Schemes for Coupling Management-Fiber to Fiber Joints–LED Coupling to Single Mode Fibers–Fiber Splicing-Optical Fiber connectors.

UNIT V OPTICAL COMMUNICATION SYSTEMS AND NETWORKS 9

System design consideration Point –to –Point link design –Link power budget –rise time budget, WDM –Passive DWDM Components – Elements of optical networks – SONET/SDH– Optical Interfaces – SONET/SDH Rings and Networks-High speed light wave Links – OADM configuration–Optical ETHERNET – Soliton.

TOTAL: 45 h

COURSE OUTCOMES:

At the end of this course the students will be able to,

CO1: Explain the importance of optical fiber transmission link, fiber modes configurations and structures.

CO2: Analyze the different kind of losses, signal distortion and other signal degradation factors in optical wave guides.

CO3: Evaluate the performance of various optical sources and detectors

CO4: EstimateProbability of error in optical receiver and explain various measurements ofoptical fiber

CO5: Analyze the functions of fiber optic netwok components, variety of networking aspects, FDDI,SONET/SDH, and operating principles of WDM

TEXT BOOKS:

1. John M. Senior,"Optical Fiber Communication", Pearson Education, Second Edition. 2007.
2. Gerd Keiser, "OpticalFiber Communication", McGraw Hill, Third Edition. 2000.

REFERENCE BOOKS:

1. J.Gower, "Optical Communication System", Prentice Hall of India, 2001.
2. Rajiv Ramaswami, "Optical Networks", Second Edition, Elsevier, 2004.
3. Govind P. Agrawal, "Fiber–optic communication Systems", third edition, John Wiley & sons, 2004.
4. Khare .R.P, "Fiber Optics and Optoelectronics", Oxford University Press, 2007.

PE – 05	MOBILE COMMUNICATION AND NETWORKS	3 0 0 3

PREREQUISITE: WIRELESS NETWORKS

COURSE OBJECTIVES:

1. To understand the working principles of the mobile communication systems.
2. To understand the relation between the user features and underlying technology.
3. To analyze mobile communication systems for improved performance

UNIT I CELLULAR ARCHITECTURE 9

Cellular concepts-Cell structure, frequency reuse, cell splitting, channel assignment, handoff, interference, capacity, power control; Wireless Standards: Overview of 2G, 3G, LTE and 5G cellular standards.

UNIT II WIRELESS PROPAGATION CHANNELS 9

Signal propagation – Propagation mechanism – reflection, refraction, diffraction and scattering, large scale signal propagation. Fading channels – Multipath and small scale fading – Doppler shift, narrowband and wideband fading models, power delay profile, average and RMS delay spread, coherence bandwidth and coherence time, flat and frequency selective fading, slow and fast fading, average fade duration and level crossing rate.

UNIT III DIGITAL SIGNALING AND EQUALIZATION TECHNIQUES 9

Modulation schemes – BPSK, QPSK and variants, QAM, MSK and GMSK, multicarrier modulation, OFDM, Receiver structure – Diversity receivers- selection and MRC receivers, RAKE receiver, equalization: linear – ZFE and adaptive, Decision Feedback Equalizer (DFE).

UNIT IV SPREAD SPECTRUM TECHNIQUES FOR WIRELESS STANDARDS 9

Multiple access schemes – FDMA, TDMA, CDMA and SDMA,MIMO and space time signal processing, spatial multiplexing. Performance measures – average SNR, Average Symbol/Bit Error Rate. System examples – GSM, EDGE, GPRS, IS-95, CDMA 2000 and WCDMA.

UNIT V DEVICE-TO-DEVICE (D2D) COMMUNICATIONS 9

LTE architecture and its components, D2D: from 4G to 5G, D2D standardization: 4G LTE D2D, D2D in 5G: research challenges, Radio resource management for mobile broadband D2D, RRM techniques for mobile broadband D2D, RRM and system design for D2D, 5G D2D RRM concept: an example, Multi-hop D2D communications for proximity and emergency, services, National security and public safety requirements in 3GPP and METIS, Device discovery without and with network assistance.

TOTAL: 45 h

COURSE OUTCOMES:

At the end of this course the students will be able to,

CO1: Explain the principles of frequency reuse, cell splitting, channel assignment and handoff.
CO2: Analyze the various propagation mechanisms and its effects
CO3: Evaluate the various modulation schemes and reception of mobile signals
CO4: Evaluate the performance of mobile communication techniques using the various parameters
CO5: Compare the effects of the various antennas used in mobile terminals

TEXT BOOKS:

1. WCY Lee, Mobile Cellular Telecommunications Systems, McGraw Hill, 1990.
2. WCY Lee, Mobile Communications Design Fundamentals, Prentice Hall, 1993.
3. Raymond Steele, Mobile Radio Communications, IEEE Press, New York, 1992.
4. AJ Viterbi, CDMA: Principles of Spread Spectrum Communications, Addison Wesley, 1995.

REFERENCE BOOKS:

1. VK Garg & JE Wilkes, Wireless & Personal Communication Systems, Prentice Hall, 1996.
2. 5G Mobile and Wireless Communications Technology, Afif Osseiran, Jose F. Monserrat, Patrick Marsch Cambridge University Press, Second Edition 2011
3. 5G NR: The Next Generation Wireless Access Technology,Erik Dahlman, Stefan Parkvall, Johan Sko¨ld Elsevier ,First Edition 2016
4. Fundamentals of 5G Mobile Networks Jonathan Rodriguez Wiley First Edition 2010

WEBLINKS:

1. NPTEL :https://nptel.ac.in/courses/108/105/108105134/ M1, M2, M3, M4, M5
2. Udemy:https://www.udemy.com/course/5g-mobile-networks-modern-wireless-communication-technology

PE – 06	SATELLITE COMMUNICATION	3 0 0 3

PREREQUISITE: MICROWAVE THEORY AND TECHNIQUES

COURSE OBJECTIVES:

1. To visualize the architecture of satellite systems as a means of high speed, high range communication system.
2. To state various aspects related to satellite systems such as orbital equations, sub-systems in a satellite, link budget, modulation and multiple access schemes.
3. To solve numerical problems related to orbital motion and design of link budget for the given parameters and conditions.

UNIT I INTRODUCTION TO SATELLITE COMMUNICATION 9

Principles and architecture of satellite Communication, Brief history of Satellite systems, advantages, disadvantages, geo stationary and non Geo–stationary orbits, applications and frequency bands used for satellite communication.

UNIT II ORBITAL MECHANICS 9

Orbital equations, Kepler's laws, Newton's law, orbital parameters, orbital perturbations, Apogee and Perigee for an elliptical orbit, evaluation of velocity, orbital period, angular velocity etc. of a satellite, concepts of Solar day and Sidereal day.

UNIT III SATELLITE SUB-SYSTEMS 9

Study of Architecture and Roles of various sub-systems of a satellite system such as Telemetry, tracking, command and monitoring (TTC & M), uplink and downlink Analysis and Design, link budget, E/N calculation– performance impairments–system noise, inter modulation and interference, Communication sub-system, power sub-systems etc.

UNIT IV SOLAR ECLIPSE AND SATELLITE LINK DESIGN 9

Solar Eclipse on satellite, its effects, remedies for Eclipse, Look Angle Determination– Limits of visibility–eclipse–Sub satellite point –Sun transit outage–Doppler frequency shift phenomena and expression for Doppler shift. Flux density and received signal power equations, Satellite link budget, Satellite uplink and downlink Analysis and Design, link budgetE/N calculation– performance impairments–system noise, inter modulation and interference, noise power calculation.

UNIT V SATELLITE ACCESS 9

Modulation and Multiple Access Schemes: Modulation and Multiplexing: Voice, Data, Video, Analog – digital transmission system, Digital video Broadcast, Multiple access schemes based on time, frequency, and code sharing namely TDMA, FDMA and CDMA.

TOTAL: 45 h

COURSE OUTCOMES:

At the end of this course the students will be able to,

CO1: Apply the basic principle architecture of satellite systems and analyse its advantages and disadvantages

CO2: Explain the various orbits and frequency bands used for satellite communication.

CO3: Model an uplink and downlink frequency of the satellite system.

CO4: Evaluate the various interferences and its effect on the performance of the system.

CO5: Distinguish the various multiple access schemes such as TDMA, FDMA and CDMA.

TEXT BOOK:

1. Timothy Pratt Charles W. Bostian, Jeremy E. Allnutt, "Satellite Communications", Wiley India. 2nd edition 2002.

REFERENCE BOOKS:

1. Tri T. Ha: Digital "Satellite Communications", Tata McGraw Hill, 2009.
2. Dennis Roddy, "Satellite Communication:", 4th Edition, McGraw Hill,2009.

PE – 07	WIRELESS SENSOR NETWORKS	3 0 0 3

PREREQUISITE: WIRELESS NETWORKS

COURSE OBJECTIVES:

1. To understand the design issues in wireless sensor networks.
2. To learn the different types of MAC protocols.
3. To be familiar with different types of routing protocols.
4. To learn the architecture and protocols of wireless sensor networks.

UNIT I OVERVIEW OF WIRELESS SENSOR NETWORKS 9

Introduction to Sensor Networks, Unique constraints and challenges, Advantage of Sensor Networks, Applications of Sensor Networks, Types of wireless sensor networks, Mobile Ad-hocNetworks (MANETs) and Wireless Sensor Networks, Challenges for WSN, Enabling Technologies for Wireless Sensor Networks.

UNIT II ARCHITECTURES 9

Single – Node Architecture – Hardware Components, Energy Consumption of Sensor Nodes, Network Architecture – Sensor Network Scenarios, Optimization Goals and Figures of Merit, Gateway Concepts: Need for gateway, WSN to Internet Communication, Internet to WSN Communication.

UNIT III NETWORKING SENSORS 9

MAC Protocols for Wireless Sensor Networks, Classification of MAC Protocols: S-MAC, The Mediation Device Protocol, Wakeup Radio Concepts, Routing Protocols– Random walks, Energy–Efficient Routing, Geographic Routing, IEEE 802.15.4 MAC protocol.

UNIT IV DATA DISSEMINATION 9

Data Dissemination: Flooding, Gossipping, Rumour Routing, Data gathering, Data aggregation; Quality of a sensor network, Real –time traffic support, Security protocols.

UNIT V SENSOR NETWORK PLATFORMS AND TOOLS 9

Berkeley Motes, Programming Challenges, Node level software platforms, Operating systems and execution environments: Introduction to TinyOS and nesC, Node– level Simulators, State –centric programming.

TOTAL: 45 h

COURSE OUTCOMES:

At the end of this course the students will be able to,

CO1: Differentiate Wireless Sensor Networks and ADHOC Networks.
CO2: Elaborate the sensor network architecture and apply gateway concepts for wsn to internet communication.
CO3: Classify various MAC protocols and routing protocols used in Wireless Sensor Networks.
CO4: Analyze the various data dissemination methods of Wireless Sensor Networks.
CO5: Program sensor nodes for the various Wireless Sensor Network tools

TEXT BOOKS:

1. Holger Karl& Andreas Willig, "Protocols And Architectures for Wireless Sensor Networks", John Wiley, 2005.
2. Feng Zhao & Leonidas J. Guibas, "Wireless Sensor Networks -An Information Processing Approach", Elsevier, 2007.

REFERENCE BOOKS:

1. WaltenegusDargie, Christian Poellabauer, "Fundamentals Of Wireless Sensor Networks Theory And Practice", By John Wiley & Sons Publications ,2011.
2. SabrieSoloman, "Sensors Handbook" by McGraw Hill publication. 2009.
3. KazemSohrby, Daniel Minoli, "Wireless Sensor Networks": Technology, Protocols and Applications, Wiley-Inter science.
4. Philip Levis, And David Gay, "TinyOS Programming" Cambridge University Press 2009.
5. Feng Zhao, Leonidas Guibas, "Wireless Sensor Networks", Elsevier Publications,2004
6. Holger Karl, Andreas Willig, "Protocols and Architecture for Wireless Sensor Networks", John Wiley & Sons, Ltd.

PE – 08	INFORMATION THEORY AND CODING	3 0 0 3

PREREQUISITE: ANALOG AND DIGITAL COMMUNICATION

COURSE OBJECTIVES:

1. To understand the various concepts in Information Theory and Coding.
2. To be familiar with the methods for the generation of these codes and their decoding techniques.
3. To be aware of the concepts of multimedia communication.

UNIT I INFORMATION ENTROPY FUNDAMENTALS 9

Uncertainty, Information and Entropy – Source coding Theorem – Huffman coding –Shannon Fano coding – Discrete Memory less channels – channel capacity – channel coding Theorem – Channel capacity Theorem.

UNIT II DATA AND VOICE CODING 9

Differential Pulse code Modulation – Adaptive Differential Pulse Code Modulation – Adaptive subband coding – Delta Modulation – Adaptive Delta Modulation – Coding of speech signal at low bit rates (Vocoders, LPC).

UNIT III ERROR CONTROL CODING 9

Linear Block codes – Syndrome Decoding – Minimum distance consideration – cyclic codes – Generator Polynomial – Parity check polynomial – Encoder for cyclic codes – calculation of syndrome – Convolutional codes.

UNIT IV COMPRESSION TECHNIQUES 9

Principles – Text compression – Static Huffman Coding – Dynamic Huffman coding – Arithmetic coding – Image Compression – Graphics Interchange format – Tagged Image File Format – Digitized documents – Introduction to JPEG standards.

UNIT V AUDIO AND VIDEO CODING 9

Linear Predictive coding – code excited LPC – Perceptual coding, MPEG audio coders – Dolby audio coders – Video compression – Principles – Introduction to H.261 & MPEG Video standards.

TOTAL: 45 h

COURSE OUTCOMES:

At the end of this course the students will be able to,

CO1: Analyze the Entropy, Information rate of channels using different coding techniques Shannon – Fano coding, Huffman coding, Extended Huffman coding etc.

CO2: Explain the types of Image and Video Formats and explain JPEG, MPEG standards and audio layer.

CO3: Measure the syndrome using cyclic codes and estimate the errors during encoding and decoding of different codes.

CO4: Examine error control coding, Forward Error Correction (FEC) and error correcting codes.

CO5: Construct a code tree, trellis and state diagram of convolutional codes and apply the encoding and decoding techniques.

TEXT BOOKS:

1. N. Abramson, Information and Coding, McGraw Hill, 1963.
2. M. Mansurpur, Introduction to Information Theory, Mc-Graw Hill, 1987.
3. R.B. Ash, Information Theory, Prentice Hall, 1970.
4. Shu Lin and D.J. Costello Jr., Error Control Coding, Prentice Hall, 1983.Simon Haykin, "Communication Systems", 4thEdition, John Wiley and Sons, 2001.
5. Fred Halsall, "Multimedia Communications, Applications Networks Protocols and Standards", Pearson Education, Asia 2002; Chapters: 3,4,5.

REFERENCE BOOKS:

1. Mark Nelson, "Data Compression Book", BPB Publication 1992.
2. Watkinson J, "Compression in Video and Audio", Focal Press, London, 1995.
3. Ranjan Bose, "Information Theory, Coding and Cryptography, Tata McGraw-Hill Education, 2008.

PE – 09	ADAPTIVE SIGNAL PROCESSING	3 00 3

PREREQUISITE: SIGNALS AND SYSTEMS

COURSE OBJECTIVES:

1. To provide the mathematical framework for the understanding of adaptive statistical signal processing.
2. To know the basic tools of vector spaces and discrete–time stochastic process.
3. To understand the various issues involved in adaptive filtering and be familiar with the various types of adaptive filters will be introduced and their properties will be studied, specifically convergence, tracking, robustness and computational complexity.
4. To apply adaptive filter theory using prescribed case studies.

UNIT I DISCRETE RANDOM SIGNAL PROCESSING 9

General concept of adaptive filtering, Stationary processes, Bias and Estimation, applications and motivation, Review of probability, Power Spectral Density, Spectral factorization, Filtering Random Processes, Special types of Random Processes – ARMA, AR, MA – Yule–Walker equations. Random variables and stationary random processes, Correlation structures, propertiesof correlation matrices.

UNIT II LINEAR ESTIMATION AND PREDICTION 9

Linear prediction – Forward and Backward prediction, Solution of Prony's normal equations, Least mean–squared error criterion, Wiener filter for filtering and prediction, FIR and IIR Wiener filters, Method of steepest descent, extension to complex valued The LMS algorithm (real, complex), convergence analysis, weight error correlation matrix.

UNIT III ADAPTIVE FILTERS 9

Variants of the LMS algorithm: the sign LMS family, FIR adaptive filters – adaptive filter based on steepest descent method– Widrow–Hopf LMS algorithm, Normalized LMS algorithm, Adaptive channel equalization.

UNIT IV SIGNAL SPACE CONCEPTS AND ORTHOGONALITY 9

Signal space concepts – introduction to finite dimensional vector space theory, subspace inner product space, orthogonality, Gram – Schmidt orthogonalization, concepts of orthogonal projection, Vector space of random variables, correlation as inner product, forward and backward projections.

UNIT V RLS ADAPTIVE FILTERS AND ITS ESTIMATION 9

Introduction to recursive least squares (RLS), vector space formulation of RLS estimation, pseudo-inverse of a matrix, time updating of inner products, development of RLS lattice filters, RLS transversal adaptive filters, RLS adaptive algorithm.

TOTAL: 45 h

COURSE OUTCOMES:

At the end of this course the students will be able to,

CO1: Evaluate the performance of adaptive filtering and random process.
CO2: Estimate and predict the least mean–squared error of FIR and IIR Wiener filter using methods like Prony's normal equations
CO3: Analyze the error probability of adaptive filters using LMS and normalized LMS algorithms.
CO4: Differentiate the various types of projections
CO5: Evaluate the mean square error Vector Space using RLS algorithm

TEXT BOOKS:

1. S. Haykin, Adaptive filter theory, Prentice Hall, 1986.
2. C.Widrow and S.D. Stearns, Adaptive signal processing, Pearson Education; 1 edition (2002).

PE – 10	DIGITAL IMAGE AND VIDEO PROCESSING	3 0 0 3

PREREQUISITE: SIGNALS AND SYSTEMS

COURSE OBJECTIVES:

1. To be familiar with the fundamentals of digital images and videos.
2. To perform simple image processing techniques such as image compression and segmentation.
3. To represent image in form of features.

UNIT I FUNDAMENTALS OF IMAGE PROCESSING AND IMAGE TRANSFORMS 9

Basic steps of Image processing – System sampling and quantization of an Image – Basic relationship between pixelsImage Transforms: 2 – D Discrete Fourier Transform, Discrete Cosine Transform (DCT), Discrete Wavelet transforms.

UNITII IMAGE PROCESSING TECHNIQUES 9

Image Enhancement Techniques: Spatial Domain methods: Histogram Processing, Fundamentals of Spatial Filtering, Smoothing Spatial filters, Sharpening Spatial filters Frequency Domain methods: Basics of filtering in frequency domain, image smoothing, image sharpening, selective filtering.

Image Segmentation: Segmentation concepts, point, line and Edge detection, Thresholding, region based segmentation.

UNIT III IMAGE COMPRESSION 9

Image compression fundamentals – coding Redundancy, spatial and temporal redundancy. Compression models: Lossy and Lossless, Huffman coding, Arithmetic coding, LZW coding, run length coding, Bit Plane coding, transform coding, predictive coding , wavelet coding, JPEG standards

UNIT IV FUNDAMENTAL OF VIDEO PROCESSING & VIDEO CODING 9

Basic steps of Video Processing - Analog video, Digital Video, Time varying Image Formation models – 3D motion models, Geometric Image formation, Photometric Image formation, sampling of video signals, filtering operations. Waveform based coding, Block based transform coding, predictive coding-Temporal prediction and transform coding Application of motion estimation in video coding.

UNIT V 2– D MOTION ESTIMATION & ERROR CONTROL TECHNIQUES 9

Optical flow, general methodologies, pixel based motion estimation, Block matching algorithm, Mesh based motion Estimation, global Motion Estimation, Region based motion estimation, multi resolution motion estimation. Transport level error control Error resilient encoding Decoder error concealment Encoder - decoder interactive error control Error resilience Tools in H.263 and MPEG-4.

TOTAL 45 h

COURSE OUTCOMES:

At the end of this course the students will be able to,

CO1: Apply 2D transforms and analyse a digital image in frequency domain.

CO2: Analyze images using histogram based and segmentation techniques.

CO3: Differentiate lossy and lossless compression techniques.

CO4: Analyze various techniques in the processing and coding of analog and digital videos.

CO5: Implement motion estimation and various error control techniques.

TEXT BOOKS:

1. Gonzalez and Woods,"Digital Image Processing", 3rd edition, Pearson.
2. Al Bovic, "Handbook of Image and Video Processing",Elsevier, 2005.
3. Yao wang, JoemOstarmann and Yaquin Zhang, "Video processing and communication 1st edition.
4. M. Tekalp, "Digital video Processing", Prentice Hall Signal Processing 2nd edition.
5. Anil K. Jain, "Fundamentals of Digital Image Processing", Pearson 2002.

REFERENCE BOOKS:

1. Relf, Christopher G, "Image acquisition and processing with LabVIEW", CRC press
2. Anerozdemi R, "Inverse Synthetic Aperture Radar Imaging with MATLAB Algorithms", John Wiley & Sons.
3. Chris Solomon, Toby Breckon "Fundamentals of Digital Image Processing A Practical Approach with Examples in Matlab", John Wiley & Sons.
4. K.R. Rao and J. J. Hwang, "Techniques and Standards for Image, Video and Audio Coding," Prentice Hall, Upper Saddle River, New Jersey.

WEBSITES:

1. Professor Bernd Girod's course page on Image Communication about video compression: http://www.stanford.edu/class/ee398b/.
2. Professor Edward J. Delp of Purdue University class home page gives lot of information related to video processing http://cobweb.ecn.purdue.edu/~ace/courses/ee695-vid/.
3. Professor Yao's Video processing course page http://eeweb.poly.edu/~yao/EL6123.
4. Moving Picture Expert group home page: www.mpeg.org.
5. Advanced System Television committee home page: www.atsc.org
6. Digital Video Broadcasting home page: www.dvb.org.

PE – 11	WAVELET TRANSFORMS AND TECHNIQUES	3 0 0 3

PREREQUISITE: SIGNALS AND SYSTEMS

COURSE OBJECTIVES:

1. To study the basics of Fourier transforms and short time Fourier transforms.
2. To study the wavelet transform in both continuous and discrete domain.
3. To understand Multi Resolution Analysis and Wavelet concepts.
4. To understand the applications of Wavelet transform.

UNIT I INTRODUCTION 9

Fundamentals of Fourier Series and coefficients, Theorems of Fourier transform Introduction to Time-Frequency Analysis, Problems of time localisation, short time Fourier transform and concepts, Wigner-Ville transform.

UNIT II CONTINUOUS WAVELET TRANSFORMS 9

Wavelet Transform – definition and properties – concept of scale and its relation with frequency – Continuous Wavelet Transform (CWT) – Scaling function and wavelet functions: Daubechies, Coiflet, Mexican Hat, Sinc, Gaussian, Bi-Orthogonal.

UNIT III DISCRETE WAVELET TRANSFORMS 9

Filter Bank and sub band coding principle – Wavelet Filters - Inverse DWT computation by Filter banks – Basic Properties of Filter coefficients – Choice of wavelet function coefficients - Derivations of Daubechies Wavelets - Multi-band Wavelet transforms.

UNIT IV MULTI RESOLUTION ANALYSIS 9

Definition of Multi Resolution Analysis (MRA) – Haar basis – Construction of general orthonormal MRA Wavelet basis– Continuous time MRA – Discrete time MRA–QMF filter banks.

UNIT V CASE STUDY 9

Signal processing: Time Frequency analysis, Image and video Compression techniques, Image denoising techniques, Biomedical Application, Underwater Application.

TOTAL: 45 h

COURSE OUTCOMES:

At the end of this course the students will be able to,

CO1: Explain the significance and issues in Time frequency analysis
CO2: Evaluate Continuous Wavelet Transform using the different wavelet functions
CO3: Compute DWT and IDWT using filter banks and sub-band coding principles.
CO4: Explain Multi Resolution Analysis (MRA) using Haar and Wavelet basis.
CO5: Apply DWT and CWT for diverse applications and understand time-frequency analysis.

TEXT BOOKS:

1. Mallat S., "Wavelet tour of Signal Processing", Academic Press, 1996.
2. I. Daubechies, Ten Lectures on Wavelets, Society for Industrial and Applied Mathematics, Philadelphia, PA, 1992.
3. C. K. Chui, An Introduction to Wavelets, Academic Press Inc., New York, 1992.
4. Y.T. Chan, Wavelet Basics, Kluwer Publishers, Boston, 1993.
5. Gerald Kaiser, A Friendly Guide to Wavelets, Birkhauser, New York, 1995.
6. P. P. Vaidyanathan, Multirate Systems and Filter Banks, Prentice Hall, New Jersey, 1993.

REFERENCE BOOKS:

1. B. Boashash, Time-Frequency signal analysis, In S. Haykin, (editor), Advanced Spectral Analysis, pages 418--517. Prentice Hall, New Jersey, 1991.
2. A.N. Akansu and R.A. Haddad, Multiresolutionsignal Decomposition: Transforms, Subbands and Wavelets, Academic Press, Oranld, Florida, 1992.

PE – 12	INTRODUCTION TO MEMS	3 0 0 3

PREREQUISITE: MATERIAL SCIENCE, ELECTRON DEVICES

COURSE OBJECTIVES:

1. To study the design methodology of MEMS for various mechanics.
2. To study about actuators in MEMS.
3. To analyze about MEMS based systems.
4. To Design and model MEM devices.

UNIT I INTRODUCTION TO MEMS 9

overview of MEMS - Intrinsic Characteristics of MEMS –Definitions-Transducers– Sensors and Actuators –Introduction to Micro fabrication – Silicon based MEMS processes – New Materials – Review of Electrical and Mechanical concepts in MEMS – Semiconductor devices – Stress and strain analysis– Flexural beam bending.

UNIT II MEMS FABRICATION SENSORS AND ACTUATORS 9

Electrostatic sensors – Parallel plate capacitors – Applications- Flow sensor, Pressure sensor – Interdigitated Finger capacitor –Comb drive devices – Thermal Sensing and Actuation – Thermal expansion – Thermal couples –Thermal resistors – Applications – flow sensor – Magnetic Actuators – Micromagnetic components.

UNIT III MEMS FABRICATION ELECTROSTATIC SENSORS AND ACTUATOR 9

Piezoresistive sensors – Piezoresistive sensor materials – Stress analysis of mechanical elements – Applications to Inertia, Pressure and Flow sensors – Piezoelectric sensors and actuators –piezoelectric effects – piezoelectric materials – Applications to Inertia , Acoustic, and Flow sensors.

UNIT IV MICROMACHINING 9

Silicon Anisotropic Etching – Anisotropic Wet Etching – Dry Etching of Silicon – Plasma Etching –Deep Reaction Ion Etching (DRIE) – Isotropic Wet Etching – Gas Phase Etchants – Basic surface micromachining processes – Structural and Sacrificial Materials – Assembly of 3D MEMS – Foundry process.

UNIT V ANALYSIS OF MEMS AND NEMS 9

Mechanics of solids in MEMS/NEMS: Stresses, Strain, Hooke's law, Poisson effect, Linear Thermal Expansion, Bending; Energy methods, Overview of Finite Element Method, Modeling of Coupled Electromechanical Systems.

TOTAL: 45 h

COURSE OUTCOMES:

At the end of this course the students will be able to,

CO1: Develop Transducers, Sensors and Actuators and understand Electrical and Mechanical concepts in Silicon based MEMS

CO2: Analyze various applications using sensors and actuators

CO3: Analyze effects of piezoelectric and piezoresistive sensors and actuators

CO4: Analyze different etching methods and Basic surface micromachining processes

CO5: To explain Mechanics of solids in MEMS/NEMS by Hooke's law, Poisson effect and different energy methods

TEXT BOOKS:

1. Chang Liu, 'Foundations of MEMS', Pearson Education Inc., 2006.
2. G. K. Ananthasuresh, K. J. Vinoy, S. Gopalakrishnan, K. N. Bhat, V. K. Aatre, Micro and Smart Systems, Wiley India, 2012.

REFERENCE BOOKS:

1. S. E.Lyshevski, Nano-and Micro-Electromechanical systems: Fundamentals of Nano-and Micro-engineering (Vol. 8). CRC press, (2005).
2. S. D. Senturia, Microsystem Design, Kluwer Academic Publishers, 2001.
3. M. Madou, Fundamentals of Micro-fabrication, CRC Press, 1997.
4. G. Kovacs, Micro-machined Transducers Sourcebook, McGraw-Hill, Boston, 1998.
5. M.H. Bao, Micromechanical Transducers: Pressure sensors, accelerometers, and Gyroscopes, Elsevier, New York, 2000.

PE – 13	BIO-MEDICAL ELECTRONICS	3 0 0 3

PREREQUISITE: NIL

COURSE OBJECTIVES:

1. To gain knowledge about the various physiological parameters both electrical and non-electrical and the methods of recording and also the method of transmitting these parameters.
2. To study about the various assist devices used in the hospitals.
3. To gain knowledge about equipment used for physical medicine and the various recently developed diagnostic and therapeutic techniques.

UNIT I ELECTRO-PHYSIOLOGY AND BIO-POTENTIAL RECORDING 9

The origin of Bio–potentials; Bio-potential electrodes, biological amplifiers, Electro Cardiogram (ECG), Electroencephalogram(EEG), Electromyogram (EMG), PCG, EOG, lead systems and recording methods, typical waveforms and signal Characteristics.

UNIT II BIO-CHEMICAL AND NON ELECTRICAL PARAMETER MEASUREMENT 9

Introduction to biochemical process PH, PO2, PCO2, PHCO3(Bio gas analyzers), Electrophoresis, colorimeter, photometer, Auto analyzer, Blood flow meter, Cardiac output, respiratory measurement, Blood pressure, temperature, pulse, Blood cell counters.

UNIT III ASSIST DEVICES 9

Cardiac pacemakers (Need, Pacing Modes and Pulse generators, Power Sources and Electromagnetic Interference), DC Defibrillator, Dialyser, Ventilators, Magnetic Resonance Imaging Systems, Ultrasonic Imaging Systems.

UNIT IV RADIOLOGICAL EQUIPMENTS AND BIO-TELEMETRY 9

Introduction to radiological equipments Ionizing radiation, Diagnostic X–ray equipments (X ray Machines– Exposure control), Radiation Therapy. Diathermy – Shortwave, ultrasonic and microwave type and their applications, Surgical Diathermy, Telemetry principles– Biotelemetry, Implantable Units – Applications

UNIT V RECENT TRENDS IN MEDICAL INSTRUMENTATION 9

Laser in medicine, Tele-stimulation - Insulin Pumps, Radio pill, Endomicroscopy- Thermograph, endoscopy unit – Brain machine interface, Lab on a chip – Electrical safety in medical equipment (Physiological effects of electrical current, Shock hazards (Gross shock, Micro current shock) from electrical equipment).

TOTAL: 45 h

COURSE OUTCOMES:

At the end of this course the students will be able to,

CO1: Classify the bio-potentials, amplifiers, recording system of various bio signals and analysis of biomedical signals

CO2: Measure the various biochemical processes that take place in the human body.

CO3: Interpret the various assist devices used in the hospitals viz. pacemakers, defibrillators,dialyzers and ventilators

CO4: Apply the principles of radiology for various equipments used in radiology.

CO5: Discuss the various electrical hazards and safety issues in handling medical equipments and applications of Lasers, thermograph,Diathermy etc in medical Application.

TEXT BOOKS:

1. Leislie Cromwell, “Biomedical instrumentation and measurement”, Prentice Hall of India, New Delhi, 2007.
2. Khandpur, R.S., “Handbook of Biomedical Instrumentation”, TATA McGraw-Hill, New Delhi, 2003.

REFERENCES BOOKS:

1. Joseph J.Carr and John M.Brown, “Introduction to Biomedical equipment Technology”, John Wiley and Sons, New York, 2004.
2. John .G. Websster, ed., Medical Instrumentation, Houghton Mifflin, 2007.
3. W.F. Ganong, Review of Medical Physiology, 8th Asian Ed, Medical Publishers, 1977.
4. A.M. Cook and J.G. Webster, eds., Therapeutic Medical Devices, Prentice-Hall, 1982.

PE – 14	CMOS DESIGN	3 0 0 3

PREREQUISITE: ELECTRONIC DEVICES

COURSE OBJECTIVES:

1. To gain knowledge about the various physiological parameters both electrical and non-electrical and the methods of recording and also the method of transmitting these parameters.
2. To study about the various assist devices used in the hospitals.
3. To gain knowledge about equipment used for physical medicine and the various recently developed diagnostic and therapeutic techniques.

UNIT I INTRODUCTION TO CMOS TECHNOLOGY 9

A brief History–MOS transistor, Ideal I–V characteristics, C–V characteristics, Non ideal IV effects, DC transfer characteristics – Basic CMOS technologies – n-well, p-well, twin tub, SOI process, Layout design Rules, CMOS process enhancements, Technology related CAD issues, Manufacturing issues, Physical design of logic gates– Inverter, NAND NOR.

UNIT II CIRCUIT CHARACTERIZATION AND SIMULATION 9

Delay estimation, Logical effort and Transistor sizing, Power dissipation, Interconnect, Design margin, Reliability, Scaling– SPICE tutorial, Device models, Device characterization, Circuit characterization, Interconnect simulation

UNIT III COMBINATIONAL AND SEQUENTIAL CIRCUIT DESIGN 9

Circuit families –Low power logic design – comparison of circuit families – Sequencing static circuits, circuit design of latches and flip flops, Static sequencing element methodology– sequencing dynamic circuits – synchronizers

UNIT IV CMOS TESTING 9

Need for testing– Testers Fault models, Stuck line (single and multiple), Bridging, Stuck open, Text fixtures and test programs– Logic verification– Silicon debug principles– Manufacturing test – Design for testability – Boundary scan– chip level and system level test techniques.

UNIT V VERILOG HDL & IMPLEMENTATION STRATEGIES 9

Basic concepts– identifiers– gate primitives, gate delays, operators, timing controls, procedural assignments conditional statements, Data flow, structural, behavioural modelling– Test benches– Structural gate level description of decoder, equality detector, comparator, priority encoder, half adder, full adder, Ripple carry adder, D latch and D flip flop. Overview – features FPGA, FPGA building blocks– Xilinx Programmable Gate array, Algotronix, Concurrent Logic.

TOTAL : 45 h

COURSE OUTCOMES:

At the end of this course the students will be able to,

CO1: Construct different CMOS circuits using various logic families along with their circuit layout.

CO2: Evaluate the characteristics and basics of CMOS technology, physical design process and develop logic gates.

CO3: Analyze the circuit characteristics like delay estimation, transistor sizing, power dissipation, interconnect, etc. and build models and characterize devices using SPICE.

CO4: Compare the different circuit families, analyze Low power logic designs, and examine the design of combinational and sequential circuits.

CO5: Analyze the various chip level and system level testing techniques and Use tools for VLSI IC design.

TEXTBOOKS:

1. Weste and Harris "CMOS VLSI DESIGN" (Third edition) Pearson Education, 2005.
2. Uyemura J.P "Introduction to VLSI circuits and systems", Wiley 2002.

REFERENCE BOOKS:

1. D. A. Pucknell& K. Eshraghian, "Basic VLSI Design", Third edition, PHI, 2003.
2. Wayne Wolf, "Modern VLSI design", Pearson Education, 2003.
3. M.J.S.Smith, "Application specific integrated circuits", Pearson Education, 1997.
4. J. Bhasker, "Verilog HDL primer", BS publication, 2001.
5. Ciletti, "Advanced Digital Design with the Verilog HDL", Prentice Hall of India, 2003.

PE – 15	HIGH SPEED ELECTRONICS	3 0 0 3

PREREQUISITE: ELECTRONIC DEVICES

COURSE OBJECTIVES:

1. To understand significance and the areas of application of high-speed electronics circuits.
2. To understand the properties of various components used in high speed electronics
3. To design High-speed electronic system using appropriate components.

UNIT I SEMICONDUCTOR MATERIALS CHARACTERISTICS 9

Semiconducting Materials – (Si, GaAs, InP) – electrons in periodic lattices - energy band diagram – carrier concentration and carrier transport phenomenon – electrical – optical – thermal and high field properties of semiconductors.

UNIT II HOMOJUNCTION DEVICES 9

Homojunction Devices (BJT and FET): Structure - band diagram – operation – I-V and C-V characteristics (analytical expressions) - small signal switching models.

UNIT III MOS DEVICES 9

MOS Diode: Structure – band diagram – operation – C–V characteristics – effects of oxide charges – avalanche injection – high field effects and breakdown; Heterojunction Based MOSFET: Band diagram - structure - operation I–V and C–V characteristics (analytical expressions) – MOSFET breakdown and punch through – subthreshold current – scaling down; Alternate High k-dielectric Materials: HF–MOSFETs - SOI MOSFET – buried channel MOSFET –charge coupled devices.

UNIT IV ADVANCED DEVICES 9

HBT and HEMT Devices: AlGaAs/ GaAs, InP and SiGe based HBT and HEMT structure - band diagram - operation - I–V and C–V characteristics (analytical expressions) - small signal switching models - benefits of heterojunction transistor for high speed applications.

UNIT V FABRICATION AND CHARACTERIZATION 9

Crystal Growth and Wafer Preparation: Epitaxy – diffusion – ion implantation – dielectric film deposition and oxidization techniques – masking and lithography techniques (optical, e-beam and other advanced lithography techniques) – metallization – bipolar and MOS integration techniques – interface passivation techniques; Characterization Techniques: Four probe and hall effect measurement – I-V and C-V for dopant profile characterization and DLTS.

TOTAL: 45 h

COURSE OUTCOMES:

At the end of this course the students will be able to,

- **CO1:** Analyze the characteristics of semiconductor materials such as the energy band diagram, carrier concentration and carrier transport phenomenon
- **CO2:** Compare the working of BJT and FET suing small signal switching models
- **CO3:** Distinguish the working and characteristics of various MOS devices.
- **CO4:** Explain the operation of heterojunction transistors for high speed applications
- **CO5:** Recommend various components and methods for fabrication and characterization

TEXT BOOKS:

1. Stephen H. Hall, Garrett W. Hall, James A. McCall “High-Speed Digital System Design: AHandbook of Interconnect Theory and Design Practices”, August 2000, Wiley-IEEE Press.
2. Thomas H. Lee, “The Design of CMOS Radio-Frequency Integrated Circuits”, Cambridge University Press, 2004, ISBN 0521835399.
3. Nandita Das Gupta and Amitava Das Gupta, “Semiconductor Devices: Modeling and Technology”, Prentice Hall of India, 2004.
4. M. S. Tyagi, “Introduction to Semiconductor Materials and Devices”, John Wiley and Sons, 2008.

REFERENCE BOOKS:

1. S. M. Sze, “Physics of Semiconductor Devices”, 3rd edition, John Wiley and Sons, 2007
2. J. Singh, “Semiconductor Devices: Basic Principles”, John Wiley and Sons, 2007.
3. BehzadRazavi, “RF Microelectronics”, Prentice-Hall 1998, ISBN 0-13-887571-5.
4. Guillermo Gonzalez, “Microwave Transistor Amplifiers”, 2nd Edition, Prentice Hall.
5. Kai Chang, “RF and Microwave Wireless systems”, John Wiley & Sons, Inc. New York, 2000.
6. R.G. Kaduskar and V.B.Baru, Electronic Product design, Wiley India, 2011.

WEBSITES:

1. http://nptel.iitm.ac.in/courses/Webcoursecontents/IITDelhi/Semiconductor%20Devices/index.html
2. http://nptel.iitm.ac.in/video.php/subjectId/117106093
3. http://nptel.iitk.ac.in/courses/Webcourse-contents/IITKANPUR/HighSpeed_Semiconductor Devices/ ui/Course_home-

PE – 16	EMBEDDED SYSTEMS	3 0 0 3

PREREQUISITE: NIL

COURSE OBJECTIVES:

1. To Understand the concepts of embedded system design and analysis
2. To learn the architecture and programming of ARM processor
3. To know the basic concepts of embedded programming and real time operating systems

UNIT I INTRODUCTION TO EMBEDDED SYSTEM DESIGN 9

Complex systems and microprocessors–Embedded system design process –Design example: Model train controller– Design methodologies-Design flows – Requirement Analysis –Specifications– System analysis and architecture design –Quality Assurance techniques – Designing with computing platforms – consumer electronics architecture –platform-level performance analysis.

UNIT II ARM PROCESSOR AND PERIPHERALS 9

ARM Architecture Versions – ARM Architecture –Instruction Set –Stacks and Subroutines –Features of the LPC 214X Family – Peripherals –The Timer Unit –Pulse Width Modulation Unit –UART –Block Diagram of ARM9 and ARM Cortex M3 MCU.

UNIT III EMBEDDED PROGRAMMING 9

Components for embedded programs-Models of programs – Assembly, linking and loading –compilation techniques – Program level performance analysis – Software performance optimization –Program level energy and power analysis and optimization – Analysis and optimization of program size –Program validation and testing.

UNIT IV REAL TIME SYSTEMS 9

Structure of a Real Time System – Estimating program run times –Task Assignment and Scheduling – Fault Tolerance Techniques – Reliability, Evaluation –Clock Synchronization.

UNIT V PROCESSES AND OPERATING SYSTEMS 9

Introduction –Multiple tasks and multiple processes – Multirate system – Preemptive real-time operating systems – Priority based scheduling – Inter process communication mechanisms –Evaluating operating system performance – power optimization strategies for processes –Example Real time operating system – POSIX-Windows CE. Distributed embedded systems –MPSoCs and shared memory multiprocessors. Design Example –Audio player, Engine control unit –Video accelerator.

TOTAL: 45 h

COURSE OUTCOMES:

At the end of this course the students will be able to,

CO1: Identify different design methodologies and design flows used in microprcoessors

CO2: Analyze ARM architectures, peripheral units and Block Diagram of ARM9 and ARM Cortex M3 MCU

CO3: Develop different Embedded programming and models of programing and Program level energy and power optimization

CO4: Evaluate the real time systems by Clock Synchronization
CO5: Evaluate different Multiple tasks and multiple processes operating system performance

TEXT BOOKS:

1. Wayne Wolf, "Computers as Components – Principles of Embedded Computer System Design", Morgan Kaufmann Publisher, 2006.
2. J.W. Valvano, "Embedded Microcomputer System: Real Time Interfacing", Brooks/Cole, 2000.
3. Jack Ganssle, "The Art of Designing Embedded System", Newness, 1999.
4. V.K. Madisetti , "VLSI Digital Signal Processing", IEEE Press (NY, USA), 1995.
5. K.J. Ayala, "The 8051 Microcontroller: Architecture, Programming, and Applications", Penram Intl, 1996.

REFERENCE BOOKS:

1. David ESimon, "An Embedded Software Primer", Pearson Education, 2007.
2. K. V. K. K. Prasad, "Embedded Real – Time Systems: Concepts, Design & Programming", dream tech press, 2005.
3. Tim Wilmshurst, "An Introduction to the Design of Small Scale Embedded Systems", Pal grave Publisher, 2004.
4. Sriram V Iyer, Pankaj Gupta, "Embedded Real Time Systems Programming", Tata Mc–Graw Hill, 2004.
5. Tammy Noergaard, "Embedded Systems Architecture", Elsevier, 2006.

PE – 17	NANO ELECTRONICS	3 0 0 3

PREREQUISITE: ELECTRONIC DEVICES

COURSE OBJECTIVES:

1. To understand various aspects of nano-technology and the processes involved in making nano components and material.
2. To leverage advantages of the nano-materials and appropriate use in solving practical problems.

UNIT I INTRODUCTION TO NANOTECHNOLOGY 9

Introduction to nanotechnology, Types of nanotechnology and nano machines – periodic table – atomic structure – molecules and phases – energy – molecular and atomic size – surface and dimensional space, meso structures.

UNIT II BASICS OF QUANTUM MECHANICS 9

Basics of Quantum Mechanics: Schrodinger equation, Density of States. Particle in a box Concepts, Degeneracy. Band Theory of Solids.Kronig– Penny Model.Brillouin Zones.

UNIT III SHRINK-DOWN APPROACHES 9

Shrink-down approaches: Introduction, CMOS Scaling, Thenano scale MOSFET, Finfets-Fin-FET Structure, Double Gate Structure Vertical MOSFETs, limits to scaling, system integration limits (interconnect issues etc.).

UNIT IV CARBON NANOTUBES 9

Carbon Nanotube: Fullerenes – types of nanotubes – formation of nanotubes – assemblies – purification of carbon nanotubes – electronic properties – synthesis of carbon nanotubes – carbon nanotube interconnects – carbon nanotubes FETs – Nanotubes for memory applications.

UNIT V SEMICONDUCTORS AND ELECTRONIC DEVICES 9

Resonant Tunnelling Diode, Coulomb dots, Quantum blockade, Single electron transistors, Band structure and transport, devices, applications, 2D semiconductors and electronic devices, Graphene, atomistic simulation.

TOTAL: 45 h

COURSE OUTCOMES:

At the end of this course the students will be able to,

CO1: Summarize the atomic and molecular structure and size of nano particles.
CO2: Understand Basics of Quantum Mechanics,Band Theory of Solids and apply knowledge to model electronic devices
CO3: Compare the performance of Fin-FET Structure and double Gate Structure Vertical MOSFETs
CO4: Analyze the electronic properties and synthesis of carbonnanotubes , carbon nanotubes FETs
CO5: Analyze the input and output characteristics of Resonant Tunnelling Diode, Coulomb dots, Quantum blockade,2D semiconductors

TEXT BOOKS:

1. G.W. Hanson, Fundamentals of Nanoelectronics, Pearson, 2009.
2. W. Ranier, Nanoelectronics and Information Technology (Advanced Electronic Materialand Novel Devices), Wiley-VCH, 2003.
3. K.E. Drexler, Nanosystems, Wiley, 1992.
4. C.P. Poole, F. J. Owens, Introduction to Nanotechnology, Wiley, 2003
5. J.H. Davies, The Physics of Low-Dimensional Semiconductors, Cambridge University Press, 1998.

PE – 18	PROFESSIONAL ETHICS IN ENGINEERING	3 0 0 3

COURSE OBJECTIVES:

1. To understand engineering ethics, professionalism, its ideals and virtues.
2. To help engineers be responsible experimenters.
3. To study the different safety issues and help engineers be responsible in installing safety measures.
4. To know the responsibilities and rights of engineers as employees and employers.
5. To obtain insight on the different global issues.

UNIT I ENGINEERING ETHICS 9

Introduction – Senses of 'Engineering Ethics' – Variety of moral issues – Types of inquiry – Moral dilemmas – Moral Autonomy – Kohlberg's theory – Gilligan's theory – Consensus and Controversy – Professions and Professionalism – Professional Ideals and Virtues – Uses of Ethical Theories.

UNIT II ENGINEERING AS SOCIAL EXPERIMENTATION 9

Decomposing the system – Overview of System Design – System Design Concepts – System Design Activities – Managing System Design. Engineering as Experimentation – Engineers as responsible

Experimenters – Research Ethics – Codes of Ethics – Industrial Standards – A Balanced Outlook on Law – The Challenger Case Study**.**

UNIT III ENGINEER'S RESPONSIBILITY FOR SAFETY 9

Safety and Risk – Assessment of Safety and Risk – Risk Benefit Analysis – Reducing Risk – The Government Regulator's Approach to Risk – the Three Mile Island – Chernobyl Case Studies and Bhopal – Gas tragedy.

UNIT IV RESPONSIBILITIES AND RIGHTS 9

Collegiality and Loyalty – Respect for Authority – Collective Bargaining – Confidentiality – Conflicts of Interest – Occupational Crime – Professional Rights – Employee Rights – Intellectual Property Rights (IPR) – Discrimination.

UNIT V GLOBAL ISSUES 9

Multinational Corporations – Business Ethics – Environmental Ethics – Computer Ethics – Role in Technological Development – Weapons Development – Engineers as Managers – Consulting Engineers – Engineers as Expert Witnesses and Advisors – Honesty – Moral Leadership – Sample Code of Conduct.

TOTAL: 45 h

COURSE OUTCOMES:

At the end of this course the students will be able to

CO1: Analyze the basic perception of profession, industrial standards, code of ethics and role of professional ethics in engineering fields to solve various moral & social issues.

CO2: Appraise the awareness of professional rights and responsibilities of a Engineer, safety and risk benefit analysis of a Engineer

CO3: Acquire knowledge in various roles of engineers and able to apply ethical principles to resolve situations that arise in their professional lives and support in variety of global issues.

CO4: Identify the core values that shape the ethical behaviour of an engineer and Assess awareness on professional ethics and human values.

CO5: Explain the importance of engineering principles to improve and maintain the technical skills and excelling in competitive and challenging environment.

TEXT BOOKS:

1. Mike Martin and Roland Schinzinger, "Ethics in Engineering", McGraw Hill, New York, 2005.
2. Charles E Harris, Michael S Pritchard and Michael J Rabins, "Engineering Ethics –
3. Concepts and Cases", Thompson Learning, 2000.

REFERENCES BOOKS:

1. Charles D Fleddermann, "Engineering Ethics", Prentice Hall, New Mexico, 1999.
2. John R Boatright, "Ethics and the Conduct of Business", Pearson Education, 2003.
3. Edmund G Seebauer and Robert L Barry, "Fundamentals of Ethics for Scientists and Engineers", Oxford University Press, 2001.
4. Prof. (Col) P S Bajaj and Dr. Raj Agrawal, "Business Ethics – An Indian Perspective", Biztantra, New Delhi, 2004.
5. David Ermann and Michele S Shauf, "Computers, Ethics and Society", Oxford University Press, (2003).

PE – 19	5G AND BEYOND 5G	3 0 0 3

COURSE OBJECTIVES:

- To be familiar with basics of 5G.
- To understand 5G channel access methods & 5G architecture.
- To analyze Radio access Networks & different channel models for 5G.

UNIT-I INTRODUCTION TO 5G 9

3G and 4G(LTE) overview- Introduction to 5G – Use Cases - Evolving LTE to 5G Capability- 5G NR and 5G core network (5GCN) - 5G Standardization - 3GPP and IMT2020 - Spectrum for 5G – 5G deployment – E-Node and G-Node - Options, Challenges and Applications

UNIT-II 5G CHANNEL ACCESS METHODS 9

OFDM and OFDMA – MIMO OFDM – Generalized Frequency Division Multiplexing (GFDM) – Non-Orthogonal Multiple Access (NOMA) - Universal Filtered OFDM -Filter bank multicarrier (FBMC)- Sparse Code Multiple Access (SCMA) –Comparison of multiple access methods

UNIT III THE 5G ARCHITECTURE 9

Introduction, NFV and SDN, Basics about RAN architecture, High-level requirements for the 5G architecture, Functional architecture and 5G flexibility, Functional split criteria, Functional split alternatives, Functional optimization for specific applications, Integration of LTE and new air interface to fulfill 5G Requirements, Enhanced Multi-RAT coordination features, Physical architecture and 5G deployment.

UNIT-IV RADIO ACCESS NETWORK FOR 5G NR 9

5G NR requirements - 5G Core Network Architecture - Radio-Access Network (RAN)- Radio Protocol Architecture -User Plane Protocols-Radio Link Control - Medium-Access Control – Physical Layer functions -Control Plane Protocols - Network Slicing- RAN virtualization-Spectrum Management in 5G

UNIT-V CHANNEL MODELS FOR 5G NR & 5G APPLICATIONS 9

Channel Hierarchy in 5G NR – Logical Channels and Transport Channels in 5G NR - Physical Layer Data Channels in 5G NR - Downlink Physical Channel and Uplink Physical Channels - Propagation Channel models for 5G, Applications-Enhanced Mobile Broadband, Massive Machine Type Communication and Ultra-Reliable Low Latency Communication.

TOTAL: 45 hours

COURSE OUTCOMES:

CO1: Understand basics of 5G.
CO2: Analyze use of MIMO in 5G and its techniques.
CO3: Draw and explain 5G architecture, its components and functional criteria.
CO4: Develop the in-depth functioning of 5G radio access technologies.
CO5: Understand various channel models for 5G.

TEXT BOOKS:

1. Afif Osseiran, Jose F. Monserrat, Patrick Marsch,"5G Mobile and Wireless Communications Technology", Cambridge University Press ,Second Edition , 2011.

2. Erik Dahlman, Stefan Parkvall, Johan Sko ̈ld ,"5G NR: The Next Generation Wireless Access Technology", Elsevier ,First Edition ,2016.

REFERENCE BOOKS:

1. Jonathan Rodriguez," Fundamentals of 5G Mobile Networks", Wiley, First Edition, 2010.
2. Devaki Chandramouli, Rainer Liebhart, and Juho Pirskanen, "5G for the connected World", Wiley, 2019.

WEBLINKS:

1. https://nptel.ac.in/courses/108/105/108105134/
2. https://www.udemy.com/course/5g-mobile-networksmodern-wireless-communication-technology/

PE-20	ADVANCED MOBILE COMMUNICATION	3 0 0 3

COURSE OBJECTIVES:

1. To be familiar with the concepts of 5G
2. To understand the configuration of smart antenna

UNIT I INTRODUCTION TO 5G 9

5G Objectives and Usage Scenarios, 5G Activities, Channel Access Method/Air Interface, 5G Policy, 5G Timelines, 4G/5G Radio Access Network, 5G system concept, LTE-Advanced, LTE-Advanced Pro, 5G NR, The 5G architecture, Spectrum Analysis and Regulations for 5G.

UNIT II INFORMATION THEORETIC ASPECTS OF MIMO 9

Review of SISO fading communication channels, MIMO Channel models, Classical. and extended channels, Frequency selective and correlated channels models, Capacity of MIMO channels, Erogodic and outage capacity, capacity bounds and influence of channel properties on the capacity.

UNIT III SMART ANTENNA CONFIGURATION 9

Fixed Sidelobe Canceling, Retrodirective Arrays, Beamforming, Adaptive Arrays, Butler Matrix, Spatial Filtering with Beamformers, Switched Beam Systems, Multiple Fixed Beam System. Uplink Processing, Diversity Techniques, Angle Diversity, Maximum Ratio Combining, Adaptive Beamforming, Fixed Multiple Beams versus Adaptive Beamforming, Downlink Processing.

UNIT IV MASSIVE MIMO SYSTEM 9

Introduction - MIMO for LTE, capacity of massive MIMO, Pilot Design for massive MIMO, Resource allocation and transceivers design, Base band and RF implementation, Channel Models.

UNIT V MILLIMETER WAVE COMMUNICATION 9

Spectrum regulation, Channel propagation, Hardware technology for mmW systems, architecture and mobility, Beam forming techniques, Beam finding, Physical layer techniques - Duplex scheme and Transmission Schemes.

TOTAL: 45 h

COURSE OUTCOMES:

CO1: Demonstrate knowledge on cellular 5G concepts and its architecture.
CO2: Analyze the MIMO channel capacity models
CO3: Evaluate the configuration of smart antenna.
CO4: Analyze he Resource allocation for Massive MIMO
CO5: Analyze Beam forming techniques for millimeter wave communication

TEXT BOOKS:

1. David Tse and Pramod Viswanath, "Fundamentals of Wireless Communication", Cambridge University Press 2005.
2. Hamid Jafarkhani, "Space - Time Coding: Theory and Practices", Cambridge University Press 2005.

REFERENCE BOOKS:

1. Mischa Dohler, Jose F. Monserrat AfifOsseiran " 5G Mobile and Wireless Communication Technology", Cambridge University Press 2016Narayana Rao, N: Engineering Electromagnetics, 3rd ed., Prentice Hall, 1997.
2. Shahid Mumtaz, Jonathan Rodriguez, Linglong Dai mmWave Massive MIMO: A Paradigm for 5G.

WEBLINKS:
1.https://onlinecourses.nptel.ac.in/noc22_ee56/preview

MAPPING OF COURSE OUTCOMES TO PROGRAM OUTCOMES

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	2	2	-	-	-	-	-	-	-	-	2	-
CO2	3	2	1	2	-	-	-	-	-	-	-	-	2	-
CO3	2	2	2	1	-	-	-	-	-	-	-	-	3	-
CO4	2	2	1	1	-	-	-	-	-	-	-	-	3	-
CO5	2	2	1	2	-	-	-	-	-	-	-	-	2	-
Avg	**2.4**	**2.2**	**1.4**	**1.6**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**2.4**	**-**

OPEN ELECTIVE COURSES

OE – 01	TRANSMISSION LINES AND WAVEGUIDES	3 0 0 3

PREREQUISITE: ELECTROMAGNETIC WAVES

COURSE OBJECTIVES:

1. To acquire the basics of transmission line theory and to get enriched knowledge in design of symmetric network filters. Understand signal propagation at Radio frequencies
2. Understand radio propagation in guided systems
3. To enhance knowledge in high frequency transmission lines.
4. To study the characteristics of EM waves & its propagation between parallel planes & thro' waveguides.

UNIT I TRANSMISSION LINE THEORY 9

General theory of Transmission lines – Characteristic impedance – Propagation Constant –The Two Standard Forms for Voltage and Current of a Line Terminated by an Impedance –The infinite line – Wavelength, velocity of propagation – Waveform distortion – the distortion less line – Loading and different methods of loading – Line not terminated in Z0 – Reflection coefficient – calculation of current , voltage, power delivered and efficiency of transmission – Input and transfer impedance – Open and short circuited lines – reflection factor and reflection loss. – T and Π Section Equivalent to Lines.

UNIT II NETWORK FILTERS 9

Classification of filters– Characteristic impedance of Symmetrical Networks – Current and voltage ratios – Propagation constant, – Properties of Symmetrical Networks – characteristic impedance in the pass and stop band, constant K filters – m–derived filters – BPF and BSF– Filter circuit design – Filter performance – Crystal Filters.

UNIT III HIGH FREQUENCYTRANSMISSION LINES 9

Transmission line equations at radio frequencies – Line constants of Zero dissipation – Voltage and current on the dissipation less line, Standing Waves, Nodes, Standing Wave Ratio – Input impedance of the dissipation less line – Open and short circuited lines – Power and impedance measurement on lines – λ / 4 line, Impedance matching – single and double–stub matching circle diagram, smith chart and its applications – Problem solving using Smith chart. Reflection losses – Measurement of VSWR and wavelength.

UNIT IV GUIDED WAVES BETWEEN PARALLEL PLANES 9

Application of the restrictions to Maxwell's equations – transmission of TM waves between Parallel plans – Transmission of TE waves between Parallel planes. Transmission of TEM waves between Parallel planes – Manner of wave travel. Velocities of the waves – characteristic impedance – Attenuators– Velocities of Propagation – Component Uniform Plane Waves Between Parallel Planes – Attenuation of TE and TM Waves in Parallel Plane Guides –Wave Impedances– Excitation methods for various modes.

UNIT V WAVEGUIDES 9

Application of Maxwell's equations to the rectangular waveguide. TM waves in Rectangular guide. TE waves in Rectangular waveguide – Cylindrical waveguides. The TEM wave in coaxial lines. Excitation of wave guides. Guide termination and resonant cavities.

TOTAL: 45 h

COURSE OUTCOMES:

At the end of this course the students will be able to,

CO1: Analyze voltage, current, power, impedance, efficiency and reflection coefficient on a transmission line..

CO2: Explain the concepts, design techniques and applications of constant K and m-dereived filters

CO3: Estimate voltage , current and input impedance of radio frequency line and solve design problems using Smith chart

CO4: Apply Maxwell's equations to find the field components of TE, TM and TEM.

CO5: Evaluate the field components of TE and TM waves through rectangular and cylindrical wave guides.

TEXT BOOKS:

1. E.C.Jordan, K.G. Balmain: "E.M.Waves& Radiating Systems", Pearson Education, 2006.
2. John. D. Ryder, "Network lines and fields", PHI Learning, Second Edition, 2005.

REFERENCE BOOKS:

1. Umesh Sinha, "Transmission lines and Networks", Sathya Prakasham Publishers, 1997.
2. Joseph Edminister, Schaum's Series, "Electromagnetics", TMH, 2007.
3. G.S.N Raju, "Electromagnetic Field Theory and Transmission Lines", Pearson Education, 2006.

OE – 02	ELECTROMAGNETIC INTERFERENCE AND COMPATIBILITY	3 0 0 3

PREREQUISITE: ELECTROMAGNETIC WAVES

COURSE OBJECTIVES:

1. To understand EMI Sources, EMI problems and their solution methods in PCB level, Subsystem and system level design.
2. To measure the emission. Immunity level from different systems to couple with the prescribed EMC standards.

UNIT I BASIC CONCEPTS 9

Definition of EMI and EMC with examples, Classification of EMI/EMC – CE, RE, CS, RS, Units of Parameters, Sources of EMI, EMI coupling modes – CM and DM, ESD Phenomena and effects, Transient phenomena and suppression.

UNIT II EMI MEASUREMENTS 9

Introduction to Electro Magnetic Interference(EMI) measuring instruments–Antennas, LISN, Feed through capacitor, current probe, EMC analyzer and detection technique open area site, shielded anechoic chamber, TEM cell, GTEM Cell.

UNIT III EMC STANDARD AND REGULATIONS 9

National and International standardizing organizations– FCC, CISPR, ANSI, DOD, IEC, CENEEC, FCC CE and RE standards, CISPR, CE and RE Standards, IEC/EN, CS standards, Frequency assignment – spectrum conversation.

UNIT IV EMI CONTROL METHODS AND FIXES 9

Basics of Electro Magnetic Interference(EMI) control methods and fixes, Eradication methods including Shielding, Grounding, Bonding, Filtering, Electro Magnetic Interference gasket, Isolation transformer, Opto isolator.

UNIT V EMC DESIGN AND INTERCONNECTION TECHNIQUES 9

Introduction to EMC Design And Interconnection Techniques Control Cable routing and connection, Component selection and mounting, PCB design– Trace routing, Impedance control, decoupling, Zoning and grounding.

TOTAL: 45 h

COURSE OUTCOMES:

At the end of this course the students will be able to,

CO1: To understand the basic concepts of EMI and EMC Sources

CO2: Analyze the measuring instruments of Electro Magnetic Interference(EMI)

CO3: Analyze different EMC standards & regulations like FCC, CISPR, ANSI, DOD and spectrum conversion

CO4: Analyze the concepts of different EMI control methods and fixes and eradication methods

CO5: To Design EMC and to learn interconnection techniques

TEXT BOOKS:

1. Prasad Kodali, "Engineering Electromagnetic Compatibility Principles, Measurements, and Technologies", IEEEpress.
2. Henry W. Ott, "Noise Reduction Techniques in Electronic Systems"– 2nd Edition John Wiley & Sons.

REFERENCE BOOKS:

1. BernharoQ'Keiser, 'Principles of Electromagnetic Compatibility', Artech House, 3rd edition, 1986

OE – 03	RADAR AND NAVIGATIONAL AIDS	3 0 0 3

PREREQUISITE: MICROWAVE THEORY AND TECHNIQUES, ANTENNAS AND PROPAGATION

COURSE OBJECTIVES:

1. To be familiar with the fundamental concepts of Radars and Navigational Aids.
2. To understand the various Radar signal detection and signal navigation techniques.

UNIT I INTRODUCTION TO RADAR 9

Basic Radar – The simple form of the Radar Equation– Radar Block Diagram– Radar Frequencies – Applications of Radar – The Origins of Radar–The Radar Equation– Introduction– Detection of Signals in Noise– Receiver Noise and the Signal–to–Noise Ratio–Probability Density Functions– Probabilities of Detection and False Alarm–Integration of Radar Pulses– Radar Cross Section of Targets– Radar cross Section Fluctuations– Transmitter Power–Pulse Repetition Frequency – Antenna Parameters–System losses – Other Radar Equation Considerations

UNIT II MTI AND PULSE DOPPLER RADAR 9

Introduction to Doppler and MTI Radar– Delay –Line Cancelers– Staggered Pulse Repetition Frequencies – Doppler Filter Banks – Digital MTI Processing – Moving Target Detector – Limitations to MTI. Performance – MTI from a Moving Platform (AMIT) – Pulse Doppler Radar – Other Doppler Radar Topics– Tracking with Radar –Monopulse Tracking –Conical Scan and Sequential Lobing – Limitations to Tracking Accuracy – Low–Angle Tracking – Tracking in Range – Other Tracking Radar Topics – Comparison of Trackers – Automatic Tracking with Surveillance Radars (ADT).

UNIT III DETECTION OF SIGNALS IN NOISE 9

Introduction – Matched – Filter Receiver –Detection Criteria – Detectors – Automatic Detector – Integrators – Constant–False–Alarm Rate Receivers – The Radar operator – Signal Management – Propagation Radar Waves – Atmospheric Refraction – Standard propagation – Nonstandard Propagation – The Radar Antenna – Reflector Antennas – Electronically Steered Phased Array Antennas – Phase Shifters – Frequency–Scan Arrays.Radar Transmitters – Power Tubes – Solid State RF Power Sources – Magnetron – Crossed Field Amplifiers – RF Power Sources – Radar Receivers –The Radar Receiver – Receiver noise Figure – Super–heterodyne Receiver – Duplexers and Receiver Protectors – Radar Displays.

UNIT IV RADIO DIRECTION AND RANGES 9

Introduction – Four methods of Navigation**,** Radio Direction Finding –The Loop Antenna – Loop Input Circuits – An Aural Null Direction Finder – The Goniometer – Errors in Direction Finding – Adcock Direction Finders – Direction Finding at Very High Frequencies – Automatic Direction Finders – The Commutated Aerial Direction Finder – Range and Accuracy of Direction Finders Radio Ranges– The LF/MF Four course Radio Range – VHF Omni Directional Range (VOR) – VOR Receiving Equipment – Range and Accuracy of VOR – Hyperbolic Systems of Navigation (Loran and Decca)–Loran – A – Loran – A Equipment – Range and precision of Standard Loran – Loran – C – The Decca Navigation System – Decca Receivers – Range and Accuracy of Decca – The Omega System.

UNIT V SATELLITE NAVIGATION SYSTEM 9

Distance Measuring Equipment – Operation of DME – TACAN – TACAN Equipment –**Aids to Approach and Landing –** Instrument Landing System – Ground Controlled Approach System – Microwave Landing System (MLS).

Doppler Navigation – The Doppler Effect – Beam Configurations –Doppler Frequency Equations – Track Stabilization – Doppler Spectrum – Components of the Doppler Navigation System – Doppler range Equation – Accuracy of Doppler Navigation Systems.

Inertial Navigation – Principles of Operation – Navigation Over the Earth – Components of an Inertial Navigation System – Earth Coordinate Mechanization – Strapped–Down Systems – Accuracy of Inertial Navigation Systems.

Satellite Navigation System – The Transit System – Navstar Global Positioning System (GPS)

TOTAL: 45 h

COURSE OUTCOMES:

- **CO1:** At the end of this course the students will be able to,
- **CO2:** Determine and discuss the Range equation and the nature of detection.
- **CO3:** Apply Doppler principle to radars and hence detect moving targets, cluster, also to understand tracking radars.
- **CO4:** Analyze and explore different methods for detection methods of signals in noise
- **CO5:** Determine the principles of navigation, in addition to approach and landing aids as related to navigation

CO6: Analyze the various types of satellitte navigation system

TEXTBOOKS:

1. Merrill I. Skolnik," Introduction to Radar Systems", Tata McGraw–Hill (3rdEdition) 2003.
2. N. S. Nagaraja, Elements of Electronic Navigation Systems, 2nd Edition, TMH, 2000.

REFERENCES BOOKS:

1. Peyton Z. Peebles:, "Radar Principles", Johnwiley, 2004
2. J.C Toomay, “Principles of Radar", 2nd Edition, PHI, 2004.

OE – 04	REMOTE SENSING	3 0 0 3

PREREQUISITE: SATELLITE COMMUNICATION

COURSE OBJECTIVES:

1. To introduce the students to the basic concepts and principles of various components of remote sensing.
2. To teach the concept of EMR interaction with atmosphere and earth materials.
3. To introduce the students to the basic concepts of optical and microwave remote sensing.
4. To teach the concept of geographic information system and application.

UNIT I REMOTE SENSING 9

Definition – Components of Remote Sensing – Energy, Sensor, Interacting Body – Active and Passive Remote Sensing – Platforms – Aerial and Space Platforms – Balloons, Helicopters, Aircraft and Satellites – Synoptivity and Repetivity – Electro Magnetic Radiation (EMR) – EMR spectrum – Visible, Infrared (IR), Near IR, Middle IR, Thermal IR and Microwave – Black Body Radiation – Planck’s law – Stefan–Boltzman law.

UNIT II EMR INTERACTION WITH ATMOSPHERE AND EARTH MATERIALS 9

Atmospheric characteristics – Scattering of EMR – Raleigh, Mie, Non–selective and Raman Scattering – EMR Interaction with Water vapour and ozone – Atmospheric Windows – Significance of Atmospheric windows – EMR interaction with Earth Surface Materials – Radiance, Irradiance, Incident, Reflected, Absorbed and Transmitted Energy – Reflectance – Specular and Diffuse Reflection Surfaces– SpectralSignature – Spectral Signature curves – EMR interaction with water, soil and Earth Surface Imaging spectrometry and spectral characteristics.

UNIT III OPTICAL AND MICROWAVE REMOTE SENSING 9

Satellites – Classification – Based on Orbits and Purpose – Satellite Sensors – Resolution – Description of Multi Spectral Scanning – Along and Across Track Scanners – Description of Sensors in Landsat, SPOT, IRS series – Current Satellites – Radar – Speckle – Back Scattering – Side Looking Airborne Radar – Synthetic Aperture Radar – Radiometer – Geometrical characteristics –Sonar remote sensing systems.

UNIT IV GEOGRAPHIC INFORMATION SYSTEM 9

GIS – Components of GIS – Hardware, Software and Organizational Context – Data – Spatial and Non–Spatial – Maps – Types of Maps – Projection – Types of Projection – Data Input – Digitizer, Scanner – Editing – Raster and Vector data structures – Comparison of Raster and Vector data structure – Analysis

using Raster and Vector data – Retrieval, Reclassification, Overlaying, Buffering – Data Output – Printers and Plotters.

UNIT V MISCELLANEOUS TOPICS 9

Visual Interpretation of Satellite Images – Elements of Interpretation – Interpretation Keys Characteristics of Digital Satellite Image – Image enhancement – Filtering – Classification – Integration of GIS and Remote Sensing – Application of Remote Sensing and GIS – Urban Applications– Water resources – Urban Analysis – Watershed Management – Resources Information Systems Introduction – Global positioning system.

TOTAL: 45 h

COURSE OUTCOMES:

At the end of this course the students will be able to,

CO1: Explain the components of Remote Sensing, Electromagnetic Spectrum and its influence in Remote Sensing.

CO2: Compare the Electromagnetic Radiation interaction with atmosphere and earth materials.

CO3: Discuss the importance of various types of Satellites and Sensors used in Optical and Microwave Remote Sensing..

CO4: Analyze and interpret various types of data in Geographic Information System (GIS).

CO5: Analyze various applications of Remote Sensing using Geographic Information System (GIS).

TEXT BOOKS:

1. M.G. Srinivas (Edited by), Remote Sensing Applications, Narosa Publishing House, 2001. (Units 1 & 2).
2. Anji Reddy, Remote Sensing and Geographical Information Systems, BS Publications 2001 (Units 3, 4 & 5).

REFERENCE BOOKS:

1. Jensen, J.R., Remote sensing of the environment, Prentice Hall, 2000.
2. Kang Tsung Chang, "Introduction to Geographic Information Systems", TMH, 2002.

OE – 05	WIRELESS NETWORKS	3 0 0 3

PREREQUSITE: NIL

COURSE OBJECTIVES:

1. To understand physical as wireless MAC layer alternatives techniques.
2. To learn planning and operation of wireless networks.
3. To study various wireless LAN and WAN concepts.
4. To understand WPAN and geo–location systems.

UNIT I MULTIPLE RADIO ACCESS 9

Medium Access Alternatives*:* Fixed– Assignment for Voice Oriented Networks, Random Access for Data Oriented Networks, Handoff and Roaming Support, Types of handoff. Security and Privacy in wireless network. Radio propagation mechanism.

UNIT II WIRELESS WANS 9

First Generation Analog, Second Generation TDMA – GSM, Short Messaging Service in GSM, Second Generation CDMA – IS–95,Comparison of TDMA,FDMA and CDMA .GPRS – Third Generation Systems (WCDMA/CDMA 2000)

UNIT III WIRELESS LANS 9

Introduction to wireless LANs – various IEEE Standards IEEE 802.11 WLAN – Architecture and Services, Physical Layer– MAC sub layer– MAC Management Sub layer, Other IEEE 802.11 standards, HIPERLAN, WiMax standard.

UNIT IV ADHOC AND SENSOR NETWORKS 9

Characteristics of MANETs, Merits and demerits of MANET, Table–driven and Source–initiated On Demand routing protocols, Hybrid protocols, Application of ADHOC network Wireless Sensor networks – Classification, MAC and Routing protocols.

UNIT V WIRELESS MANS AND PANS 9

Wireless MANs – Physical and MAC layer details and architecture, Wireless PANs – Architecture of Bluetooth Systems, Physical and MAC layer details, various Standards. for MAN and PAN merits and demerits of MAN and PAN.

TOTAL: 45 h

COURSE OUTCOMES:

At the end of this course students will be able to**,**

CO1: Illustrate the various radio access and propagation mechanisms

CO2: Distinguish the working and performance of TDMA, FDMA and CDMA

CO3: Summarize the various IEEE standards used in wireless LANs.

CO4: write the characteristics and application of ADHOC and wireless sensor networks

CO5: Compare the architecture, layers and standards of wireless MANs and PANs

TEXT BOOKS:

1. William Stallings, “Wireless Communications and Networks", Pearson / Prentice Hall of India, 2nd Ed., 2007.
2. Dharma Prakash Agrawal &QingAnZeng, “Introduction to Wireless and Mobile Systems”, Thomson India Edition, 2nd Ed., 2007.

REFERENCE BOOKS:

1. Vijay. K. Garg, “Wireless Communication and Networking”, Morgan Kaufmann Publishers, 2007.
2. KavethPahlavan, Prashant Krishnamurthy, “Principles of Wireless Networks”, Pearson Education Asia, 2002.
3. Gary. S. Rogers & John Edwards, “An Introduction to Wireless Technology”, Pearson Education, 2007.
4. Clint Smith, P.E. & Daniel Collins, “3G Wireless Networks”, Tata McGraw Hill, 2nd Ed,. 2007.

OE – 06	MOBILE ADHOC NETWORKS	3 0 0 3

PREREQUISITE: WIRELESS NETWORKS

COURSE OBJECTIVES:

1. To understand the design issues in ad hoc networks.
2. To learn the different types of MAC protocols.
3. To be familiar with different types of ad hoc routing protocols.
4. To be exposing to the TCP issues in ad hoc networks.
5. To learn the architecture of ad hoc networks.

UNIT I INTRODUCTION 9

Introduction to Adhoc networks – definition, characteristics advantages and disadvantages, features, applications. Characteristics of Wireless channel, nodes, power saving mechanism, Adhoc Mobility Models – Indoor and outdoor models.

UNIT II MEDIUM ACCESS PROTOCOLS 9

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

UNIT III NETWORK PROTOCOLS 9

Routing Protocols: Design issues, goals and classification.ProactiveVs reactive routing, Unicast routing algorithms, Multicast routing algorithms, hybrid routing algorithm, Energy aware routing algorithm, Hierarchical Routing, QoS aware routing.

UNIT IV END TO END DELIVERY AND SECURITY 9

Transport layer: Issues in designing – Transport layer classification, Adhoc transport protocols. Security issues in Adhoc networks: issues and challenges, types of network security attacks, various, Types of secure routing protocols.

UNIT V CROSS LAYER DESIGN AND INTEGRATION OF ADHOC FOR 4G 9

Introduction to Cross layer Design: Need for cross layer design, cross layer optimization, parameter optimization techniques, Cross layer cautionary perspective. Integration of Adhoc with Mobile IP networks.

TOTAL: 45 h

COURSE OUTCOMES:

At the end of this course the students will be able to,

CO1: Explain the importance of Mobile Adhoc networks applications and its features

CO2: Classify Medium Access Protocols (MAC) protocols used in Adhoc networks and be familiar with the IEEE standards of MAC.

CO3: Discuss the design issues, goals and classification of routing protocols.

CO4: Implement secure routing protocols for the various types of security attacks in Adhoc networks.

CO5: Discuss cross layer design and optimization techniques of Adhoc for 4G

TEXTBOOKS:

1. C. Siva Ram Murthy and B. S. Manoj, Ad hoc Wireless Networks Architectures and protocols, 2nd edition, Pearson Education, 2007.
2. Charles E. Perkins, Ad hoc Networking, Addison – Wesley, 2000.

REFERENCE BOOKS:

1. Stefano Basagni, Marco Conti, Silvia Giordano and Ivan Stojmenovic, Mobile Adhoc networking, Wiley– IEEE press, 2004.
2. Mohammad Ilyas, The handbook of Adhoc wireless networks, CRC press, 2002.
3. T. Camp, J. Boleng, and V. Davies "A Survey of Mobility Models for Ad Hoc Network Research," Wireless Commn. and Mobile Comp., Special Issue on Mobile Ad Hoc Networking Research, Trends and Applications, vol. 2, no. 5, 2002, pp. 483–502.
4. A survey of integrating IP mobility protocols and Mobile Ad hoc networks, Fekri M. Abduljalil and Shrikant K. Bodhe, IEEE communication Survey and tutorials, Vol. 9. no.1 2007.
5. V.T. Raisinhani and S.Iyer "Cross layer design optimization in wireless protocol stacks", Comp. Communication, Vol. 27, no. 8, 2004.

OE – 07	OPTICAL NETWORKS	3 0 0 3

PREREQUISITE: PHYSICS (OSCILLATION, WAVES AND OPTICS), MICROWAVE THEORY AND TECHNIQUES

COURSE OBJECTIVES:

1. To facilitate the knowledge about optical fiber sources and transmission techniques.
2. To enrich the idea of optical fiber networks algorithm such as SONET/SDH and optical CDMA.
3. To explore the trends of optical fiber measurement systems.

UNIT I OPTICAL SYSTEM COMPONENTS 9

Light propagation in optical fibers – Loss & bandwidth, System limitations, Non–Linear effects; Solutions; Optical Network Components – Couplers, Isolators & Circulators, Multiplexers & Filters, Optical Amplifiers, Switches, Wavelength Converters.

UNIT II OPTICAL NETWORK ARCHITECTURES 9

Introduction to Optical Networks; SONET / SDH, Metropolitan – Area Networks, Layered Architecture; Broadcast and Select Networks – Topologies for Broadcast Networks, Media – Access Control Protocols, Wavelength Routing Architecture, Single hop & Multi hop network.

UNIT III WAVELENGTH ROUTING NETWORKS 9

The optical layer, Node Designs, Optical layer cost tradeoff, Routing and wavelength assignment, Various Routing algorithm, Virtual topology design, Wavelength Routing Test beds, Architectural variations in wavelength routing network..

UNIT IV PACKET SWITCHING AND ACCESS NETWORKS 9

Photonic Packet Switching – OTDM, Multiplexing and Demultiplexing, Synchronizations, Broadcast OTDM networks, Switch–based networks; Access Networks – Network Architecture overview, Future Access Networks, Optical Access Network Architectures; and OTDM networks.

UNIT V NETWORK DESIGN AND MANAGEMENT 9

Transmission System Engineering – System model, Power penalty – transmitter, receiver, Optical amplifiers, crosstalk, dispersion; Wavelength stabilization ; Overall design considerations; Control and Management – Network management functions, Configuration management, Performance management, Fault management, Optical safety, Service interface.

TOTAL: 45 h

COURSE OUTCOMES:

At the end of this course the students will be able to,

CO1: Determine the various losses, signal distortion and other signal degradation factors in optical wave guides.

CO2: Explain the principle of broadcast and select networks.

CO3: Determine the node design and cost tradeoff's in the optical layer and the various routing algorithms.

CO4: Compare the various multiplexing, demultiplexing, synchronization and broadcast techniques of OTDM networks

CO5: Analyze the issues in the management and control of optical networks.

TEXT BOOKS:

1. Rajiv Ramaswami and Kumar N. Sivarajan, "Optical Networks: A Practical Perspective", Harcourt Asia Pte Ltd., Second Edition 2004.
2. Optical Switching Networks: Mayer & Martin, Cambridge University Press, 2008.

REFERENCE BOOKS:

1. C. Siva Ram Moorthy and Mohan Gurusamy, "WDM Optical Networks: Concept, Design and Algorithms", Prentice Hall of India, IstEdition, 2002.
2. P.E. Green, Jr., "Fiber Optic Networks", Prentice Hall, NJ, 1993.

OE – 08	COGNITIVE RADIO NETWORKS	3 00 3

PREREQUISITE: INTRODUCTION TO MATLAB, WIRELESS NETWORKS, INTERNET OF THINGS

COURSE OBJECTIVES:

1. To introduce the students to the basic concepts and principles of multiplexing techniques.
2. To teach the concept of Digital switching and digital switching in analog environment.
3. To introduce the students to the basic concepts of network synchronization control and management.

UNIT I INTRODUCTION TO SOFTWARE DEFINED RADIO 9

Definitions and potential benefits, software radio architecture evolution, technology tradeoffs and architecture implications.

UNIT II SDR ARCHITECTURE 9

Essential functions of the software radio, basic SDR, hardware architecture, Computational processing resources, software architecture, top level component interfaces, interface topologies among plug and play modules.

UNIT III INTRODUCTION TO COGNITIVE RADIOS 9

Marking radio self-aware, cognitive techniques – position awareness, environment awareness in cognitive radios, optimization of radio resources, Artificial Intelligence Techniques.

UNIT IV COGNITIVE RADIO ARCHITECTURE 9

Cognitive Radio – functions, components and design rules, Cognition cycle – orient, plan, decide and act phases, Inference Hierarchy, Architecture maps, Building the Cognitive Radio Architecture on Software defined Radio Architecture.

UNIT V NEXT GENERATION WIRELESS NETWORKS 9

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

TOTAL: 45 h

COURSE OUTCOMES:

At the end of this course the students will be able to,

CO1: Discover the need for software defined radio

CO2: Analyze the hardware and software architecture of software defined radio.

CO3: Interpret a cognitive radio architecture from a software defined radio architecture.

CO4: Compare the function of cognition cycle and its phases.

CO5: Interpret the concepts of next generation networks and its architecture.

TEXT BOOKS:

1. Joseph MitolaIII, "Software Radio Architecture: Object-Oriented Approaches to Wireless System Engineering", John Wiley & Sons Ltd. 2000.
2. Thomas W.Rondeau, Charles W. Bostain, "Artificial Intelligence in Wireless communication", ARTECH HOUSE, 2009.
3. Simon Haykin, "Cognitive Radio: Brain –Empowered Wireless Communications", IEEE Journal on selected areas in communications, Feb 2005.

REFERENCE BOOKS:

1. Ian F. Akyildiz, Won – Yeol Lee, Mehmet C. Vuran, ShantidevMohanty, "Next generation / dynamic spectrum access / cognitive radio wireless networks: A Survey" Elsevier Computer Networks, May 2006.
2. HasariCelebi, HuseyinArslan, "Enabling Location and Environment Awareness in Cognitive Radios", Elsevier Computer Communications, Jan 2008.
3. Markus Dillinger, KambizMadani, Nancy Alonistioti, "Software Defined Radio", John Wiley, 2003.
4. HuseyinArslan, "Cognitive Radio, SDR and Adaptive System", Springer, 2007.
5. Alexander M. Wyglinski, Maziarnekovee, Y. Thomas Hu, "Cognitive Radio Communication and Networks", Elsevier, 2010.

OE – 09	CRYPTOGRAPHY AND NETWORK SECURITY	3 0 0 3

PREREQUISITE: MATHEMATICS IV (PROBABIITY AND RANDOM PROCESSES)

COURSE OBJECTIVES:

1. To understand OSI security architecture and classical encryption techniques.
2. To acquire fundamental knowledge on the concepts of finite fields and number theory.
3. To understand various block cipher and stream cipher models.
4. To describe the principles of public key cryptosystems, hash functions and digital signature.
5. To understand the concepts of public key encryption and number theory.
6. To understand authentication and Hash functions & to know the network security tools and applications.
7. To understand the system level security used

UNIT I INTRODUCTION 9

Services, Mechanisms and attacks–the OSI security architecture–Network security model–Classical Encryption techniques (Symmetric cipher model, substitution techniques, transposition techniques, steganography).Elliptic Curve Architecture and Cryptography – Introduction to Number Theory.

UNIT II PUBLIC KEY CRYPTOGRAPHY 9

Data Encryption Standard–Block cipher principles–block cipher modes of operation–Advanced Encryption Standard (AES)–Triple DES. Public key cryptography: Principles of public key cryptosystems–The RSA algorithm–Key management – Diffie Hellman Key exchange.

UNIT III AUTHENTICATION AND HASH FUNCTION 9

Authentication requirements – Authentication functions – Message Authentication Codes – Hash Functions – Security of Hash Functions and MACs – MD5 message Digest algorithm – Secure Hash Algorithm – RIPEMD – HMAC Digital Signatures – Authentication Protocols – Digital Signature Standard.

UNIT IV NETWORK SECURITY 9

Authentication Applications: Kerberos – X.509 Authentication Service – Electronic Mail Security – PGP – S/MIME– RFC 822, Multipurpose Internet Mail Extensions, Functionality, Messages and Certificate Processing – IP Security – Web Security.

UNIT V SYSTEM LEVEL SECURITY 9

Intrusion detection – password management – Viruses and related Threats – Virus Counter measures – Firewall Design Principles – Characteristics, Types and Configuration – Trusted Systems – Data Access Control, Concept and Trojan Horse Defense.

TOTAL: 45 h

COURSE OUTCOMES:

At the end of this course the students will be able to, Understand OSI security architecture and connect with various security models

CO1: Classify various block ciphers and block cipher modes of operation.

CO2: Able to correlate hash functions and authentication protocols.

CO3: Recommend the suitable security applications such as electronic mail security and IP security in modern electronic world.

CO4: Evaluate the various system threats and analyze protection using virus counter measures, firewall, Trojan etc.,

TEXT BOOKS:

1. William Stallings, "Cryptography And Network Security – Principles and Practices", Pearson Education, Third Edition, 2003.
2. Behrouz A. Foruzan, "Cryptography and Network Security", Tata McGraw–Hill, 2007.

REFERENCES BOOKS:

1. Bruce Schneier, "Applied Cryptography", John Wiley & Sons Inc, 2001.
2. Charles B. Pfleeger, Shari Lawrence Pfleeger, "Security in Computing", Third Edition, Pearson Education, 2003.
3. Wade Trappe and Lawrence C. Washington, "Introduction to Cryptography with coding theory", Pearson Education, 2007.
4. WenboMao, "Modern Cryptography Theory and Practice" , Pearson Education, 2007.
5. Thomas Calabrese, "Information Security Intelligence: Cryptographic Principles and Applications", Thomson Delmar Learning, 2006.
6. AtulKahate, "Cryptography and Network Security", Tata McGraw–Hill, 2003.

OE – 10	5G BASED INTERNET OF THINGS	3 0 0 3

COURSE OBJECTIVES:

- To understandIoT Architectures, protocols and Smart Objects
- To build simple IoT Systems using Embedded system boards.
- To understand different enabling wireless technologies and networks for IoT
- To develop IoT infrastructure for smart real time applications

UNIT I FUNDAMENTALS OF IoT 9

Evolution of Internet of Things - Enabling Technologies – IoT system building blocks - IoT Architectures: one M2M, IoT World Forum (IoTWF) and Alternative IoT models – Simplified IoT Architecture and Core IoT Functional Stack -– Fog, Edge and Cloud in IoT – Functional blocks of an IoT ecosystem – Sensors, Actuators, Smart Objects and Connecting Smart Objects

UNIT II IoT PROTOCOLS 9

IoT Protocols: Physical and MAC layers, topology and Security of IEEE 802.15.4, 802.15.4g, IEEE 802.11 and LoRaWAN- Network Layer: IP versions, Constrained Nodes and Constrained Networks – Optimizing IP for IoT: From 6LoWPAN to 6Lo – Application Layer Protocols: CoAP and MQTT.

UNIT III WIRELESS TECHNOLOGY FOR IOT 9

Wireless Technologies: NFC, RFID, Zigbee, LoRa, Z wave, SPI- Wired vs. Wireless communication, GSM, CDMA, LTE, GPRS, WiFi (IEEE 802.11), Bluetooth/Bluetooth Smart, ZigBee/ZigBee Smart.

UNIT-IV ENABLING WIRELESS NETWORKS FOR IOT 9

Wireless Networks for IOT-overview; Introduction to 5G for IOT–features, Characteristics, Architecture, Impact of 5G on IOT,Applications,5G IoT ecosystem,Device-to-Device (D2D) Communication - 5G for Massive Machine Type Communication and Massive IoT- V2X Communication; Software Defined Networks– features, Characteristics, Architecture and applications.

UNIT V IOT APPLICATIONS- DESIGN AND DEVELOPMENT 9

Design Methodology - Embedded computing logic, Arduino - Board details, IDE programming – Temperature monitoring using Cloud Platform. Raspberry Pi - Interfaces and Raspberry Pi with Python Programming: Temperature monitoring using Cloud.5G based IOT applications- Smart Traffic system, Smart Agriculture

TOTAL: 45 h

COURSE OUTCOMES:

At the end of this course the students will be able to,

CO1: Identify appropriate IoT Architecture and protocol, sensor and actuator for application development.

CO2: Explain role of cloud and smart objects in IoT.

CO3: Recommend appropriate hardware and IOT technology for smart system development.

CO4: Illustrate different protocols and wireless technologies for various layers of Architecture.

CO5: Design and develop5G based IOT applications with suitable cloud platform.

TEXTBOOKS:

1. Simone Cirani, Gianluigi Ferrari, Marco Picone, Luca Veltri, “Internet of Things-Architectures, Protocols, and Standards”, Wiley 2018.
2. David Hanes, Gonzalo Salgueiro, Patrick Grossetete, Rob Barton and Jerome Henry, “IoT Fundamentals: Networking Technologies, Protocols and Use Cases for Internet of Things”, Cisco Press, 2017.
3. Viswanatha Reddy Allugunti,“Introduction to 5G Networks and Applications”,2021

REFERENCE BOOKS:

1. ArshdeepBahga, Vijay Madisetti, “Internet of Things – A hands-on approach‖”, Universities Press, 2015
2. Olivier Hersent, David Boswarthick, Omar Elloumi, “The Internet of Things – Key applications and Protocols‖”, Wiley, 2012 (for Unit 2).
3. Jan Ho¨ ller, VlasiosTsiatsis, Catherine Mulligan, Stamatis, Karnouskos, Stefan Avesand. David Boyle, "From Machine-to-Machine to the Internet of Things - Introduction to a New Age of Intelligence", Elsevier, 2014.
4. Dieter Uckelmann, Mark Harrison, Michahelles, Florian (Eds), “Architecting the Internet of Things‖”, Springer, 2011.
5. Michael Margolis, Arduino Cookbook, Recipes to Begin, Expand, and Enhance Your Projects, 2nd Edition, O'Reilly Media, 2011.

WEBLINKS:

W1: https://archive.nptel.ac.in/courses/106/105/106105166/

W2: https://www.arduino.cc/ https://www.ibm.com/ smarterplanet/us/en /?ca =v_ smarterplanet

W3: https://www.ee.iitb.ac.in/~karandi/assets/attachment/5GMobileEdgeKarandikar.pdf

OE – 11	ARTIFICIAL INTELLIGENCE	3 0 0 3

PREREQUISITE: INTRODUCTION TO MATLAB.

COURSE OBJECTIVES:

1. Study the concepts of Artificial Intelligence.
2. Learn the methods of solving problems using Artificial Intelligence.
3. Introduce the concepts of Expert Systems and machine learning.

UNIT I INTRODUCTION TO Al AND PRODUCTION SYSTEMS 9

Introduction to AI-Problem formulation, Problem Definition -Production systems, Control strategies, Search strategies. Problem characteristics, Production system characteristics -Specialized production system- Problem solving methods – Problem graphs, Matching, Indexing and Heuristic functions -Hill Climbing-Depth first and Breath first.

UNIT II REPRESENTATION OF KNOWLEDGE 9

Game playing – Knowledge representation, Knowledge representation using Predicate logic, Introduction to predicate calculus, Resolution, Use of predicate calculus, Knowledge representation using other logic-Structured representation of knowledge.

UNIT III KNOWLEDGE INFERENCE 9

Knowledge representation – Production based system, Frame based system. Inference – Backward chaining, Forward chaining, Rule value approach, Fuzzy reasoning – Certainty factors, Bayesian Theory-Bayesian Network – Dempster – Shafer theory.

UNIT IV PLANNING AND MACHINE LEARNING 9

Basic plan generation systems – Strips -Advanced plan generation systems – K strips -Strategic explanations – Why, Why not and how explanations. Learning - Machine learning, adaptive Learning.

UNIT V EXPERT SYSTEMS 9

Expert systems – Architecture of expert systems, Roles of expert systems – Knowledge Acquisition – Meta knowledge, Heuristics. Typical expert systems – backward chaining expert -MYCIN, Dynamic Analysis and Replanning Tool (DART), XOON.

TOTAL: 45 h

COURSE OUTCOMES:

At the end of this course the students will be able to,

CO1: Demonstrate fundamental understanding and compare various searching techniques, constraint satisfaction problem and game playing.

CO2: Apply basic principles of AI in solutions that require problem solving, inference, perception, knowledge representation, and learning.

CO3: Explain the role of agents and how it is related to environment and the way of evaluating it and how agents can act by establishing goals.

CO4: Perceive and analyze a real world problem for implementation of different machine learning techniques to design AI machine and enveloping applications.

CO5: Criticize on the current scope and limitations, societal implications to develop applications in an 'AI language', expert system shell, or data mining tool.

TEXT BOOKS:

1. Kevin Night and Elaine Rich, Nair B., "Artificial Intelligence (SIE)", McGraw Hill- 2008.
2. Dan W. Patterson, "Introduction to AI and ES", Pearson Education, 2007.

REFERENCE BOOKS:

1. Peter Jackson, "Introduction to Expert Systems", 3rdEdition, Pearson Education, 2007.
2. Stuart Russel and Peter Norvig "AI – A Modern Approach", 2ndEdition, Pearson Education 2007.
3. Deepak Khemani "Artificial Intelligence", Tata McGraw Hill Education 2013.
4. http://nptel.ac.in

OE – 12	MACHINE LEARNING	3 0 0 3

PREREQUISITE: NIL

COURSE OBJECTIVES:

1. To learn the basic concepts of Machine Learning
2. To become familiar with various techniques like neural networks, genetic algorithms and fuzzy systems.
3. To apply soft computing techniques to solve problems.

UNIT I INTRODUCTION TO FUZZY SET THEORY 9

Introduction to Neuro – Fuzzy and Soft Computing – Classical Sets and Fuzzy Sets – Basic Definition and Terminology – Set-theoretic Operations – Classical Relations and Fuzzy Relations –Member Function Formulation and Parameterization – Fuzzy Rules and Fuzzy Reasoning – Extension Principle and Fuzzy Relations – Fuzzy If–Then Rules – Fuzzy Reasoning.

UNIT II FUZZY SYSTEMS 9

Introduction to Fuzzy systems, Fuzzy Inference Systems – Mamdani Fuzzy Models – Sugeno Fuzzy Models – Tsukamoto Fuzzy Models. Membership Functions – Defuzzification – Fuzzy Arithmetic and Fuzzy Measures – Fuzzy Rule Base and Approximate Reasoning – Introduction to Fuzzy Decision Making.

UNIT III SOFT COMPUTING 9

Introduction–Artificial Intelligence–Artificial Neural Networks – Fuzzy Systems– Genetic Algorithm and Evolutionary Programming– Swarm Intelligent Systems – Classification of ANNs –McCulloch and Pitts Neuron Model-Learning Rules: Hebbian and Delta- Perceptron Network –Adaline Network – Madaline Network.

UNIT IV ARTIFICIAL NEURAL NETWORKS 9

Back propagation Neural Networks – Kohonen Neural Network -Learning Vector Quantization – Hamming Neural Network – Hopfield Neural Network– Bi-directional Associative Memory – Adaptive Resonance Theory Neural Networks – Support Vector Machines – Spike Neuron Models.

UNIT V GENETIC ALGORITHMS 9

Basic Concepts – Working Principles – Encoding – Fitness Function – Reproduction – Inheritance Operators – Cross Over – Inversion and Deletion – Mutation Operator – Bit-wise Operators – Convergence of Genetic Algorithm.

TOTAL: 45 h

COURSE OUTCOMES:

At the end of this course the students will be able to,

CO1: Explain the details of Fuzzy set Theory, Member function formulations

CO2: Differentiate the various of fuzzy systems and models

CO3: Explain the use of soft computing techniques

CO4: Determine the suitable soft computing techniques for different application or problem.

CO5: Explainthe analysis of various soft computing techniques for complex problems.

TEXT BOOKS:

1. J.S. R. Jang, C.T. Sun and E. Mizutani, "Neuro–Fuzzy and Soft Computing", PHI, 2004, Pearson Education 2004. 2. N. P. Padhy, "Artificial Intelligence and Intelligent Systems", Oxford University Press, 2006.
2. S.N. Sivanandam , S.N.Deepa, "Principles of Soft Computing", Wiley India Pvt. Ltd., 2nd Edition, 2011.
3. S. Rajasekaran, G.A.Vijayalakshmi Pai, "Neural Networks, Fuzzy Logic and Genetic Algorithm, Synthesis and Applications ", PHI Learning Pvt. Ltd., 2017.
4. P. Padhy, S.P.Simon, "Soft Computing with MATLAB Programming", Oxford University Press, 2015.

REFERENCE BOOKS:

1. N. P.Padhy, "Artificial Intelligence and Intelligent Systems", Oxford University Press, 2006.
2. Jyh-Shing Roger Jang, Chuen-Tsai Sun, EijiMizutani,"Neuro-Fuzzy and Soft Computing", Prentice-Hall of India, 2002.
3. KwangH.Lee, "First course on Fuzzy Theory and Applications, Springer, 2005.
4. George J. Klir and Bo Yuan, "Fuzzy Sets and Fuzzy Logic-Theory and Applications", Prentice Hall, 1996.
5. James A. Freeman and David M. Skapura, ―Neural Networks Algorithms, Applications, and Programming Techniques, Addison Wesley, 2003.

OE – 13	DATA SCIENCE AND ANALYTICS	3 0 0 3

PREREQUISITE: MACHINE LEARNING, MATHEMATICS IV

COURSE OBJECTIVES:

1. To make the students aware on the trend setting topics and advancements in data science.
2. To enable the students to be familiar with the basics of statistical methods to solve and characterize specific applications.

UNIT I DATA SCIENCE 9

Fundamentals of data science - Probability - Random process - Study of Mean, mode and median, case studies.

UNIT II DATA MINING 9

Study of different data mining techniques- Methodology of DM techniques - Planning, conducting and reporting of 3 phase data techniques - Search strategy - Study selection - Quality assessment and synthesis of extracted data.

UNIT III BEHAVIOURAL CHARACTERISATION OF DATA 9

Study of different clusters - Cluster linking to data matrix - Finding the mean mode median - Fixing of the matrix link behavioural pattern

UNIT IV DATA MINING USING MACHINE LEARNING LANGUAGE 9

Study of different classifier technique for the data training - Logarithmic normalisation - Decision tree classifier - Gradient boosting classifier - K nearest neighbour classifier

UNIT V DATA TESTING 9

Study of aggressive and error analysis - Case study bases technique using a specific application - conclusive remarks of the Study report

TOTAL: 45 h

COURSE OUTCOMES:

At the end of this course the students will be able to,

CO1: Estimate the statistical metrics of various random processes.
CO2: Distinguish the various data mining techniques
CO3: Characterize data using the different clustering methods
CO4: Develop appropriate machine learning techniques based on the application
CO5: Determine the errors in the various data mining techniques.

TEXT/REFERENCE BOOKS:

1. James, G., Witten, D., Hastie, T., Tibshirani, R. An introduction to statistical learning with applications in R. Springer, 2013.
2. Han, J., Kamber, M., Pei, J. Data mining concepts and techniques. Morgan Kaufmann, 2011.
3. Hastie, T., Tibshirani, R., Friedman, J. The Elements of Statistical Learning, 2nd edition. Springer, 2009.
4. 4. Murphy, K. Machine Learning: A Probabilistic Perspective. - MIT Press, 2012.

OE – 14	CLOUD COMPUTING	3 0 0 3

PREREQUISITE: WIRELESS NETWORKS, INTERNET OF THINGS

COURSE OBJECTIVES:

1. To understand the concept of cloud and utility computing.
2. To understand the various issues in cloud computing.
3. To familiarize with the types of virtualization and the lead players in cloud.

UNIT I UNDERSTANDING CLOUD COMPUTING 9

Cloud Computing – History of Cloud Computing – Cloud Architecture – Cloud Storage – Why Cloud Computing Matters – Advantages of Cloud Computing – Disadvantages of Cloud Computing – Companies in the Cloud Today – Cloud Services.

UNIT II DEVELOPING CLOUD SERVICES 9

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

UNIT III CLOUD COMPUTING FOR EVERYONE 9

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

UNIT IV USING CLOUD SERVICES 9

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

UNIT V OTHER WAYS TO COLLABORATE ONLINE 9

Collaborating via Web–Based Communication Tools – Evaluating Web Mail Services – Evaluating Web Conference Tools – Collaborating via Social Networks and Groupware – Collaborating via Blogs and Wikis.

TOTAL: 45 h

COURSE OUTCOMES:

At the end of this course the students will be able to,

CO1: Examine the architecture, model and storage in cloud.

CO2: Compare the types of services on cloud such as SaaS, PaaS, IaaS, public cloud, private cloud, hybrid cloud, etc.

CO3: Analyze some important cloud computing driven commercial systems such as Google Apps, Microsoft Azure and Amazon Web Services and other businesses cloud applications.

CO4: Summarize the uses of cloud based services

CO5: Evaluate cloud based applications using popular cloud platforms.

TEXT BOOKS:

1. Anthony T. Velte “Cloud computing”,TataMcGrawHill, 2009.
2. Ricardo Puttini, ZaighamMahmood,“Cloud Computing Concepts, Technology & Architecture” 2009.

REFERENCE BOOKS:

1. Michael Miller, Cloud Computing: Web–Based Applications That Change the Way You Work and Collaborate Online, Que Publishing, August 2008.
2. Haley Beard, Cloud Computing Best Practices for Managing and Measuring Processes for On–demand Computing, Applications and Data Centers in the Cloud with SLAs, Emereo Pty Limited, July 2008.

OE – 15	MEDICAL SIGNAL &IMAGE PROCESSING	3 00 3

PREREQUISITE: SIGNALS AND SYSTEMS, DIGITAL SIGNAL PROCESSING, DIGITAL IMAGE AND VIDEO PROCESSING

COURSE OBJECTIVES:

1. To understand the fundamentals of medical image processing techniques.
2. To develop computational methods and algorithms to analyze and quantify biomedical data

UNIT I BIOMEDICAL SIGNALS AND IMAGES 9

Origin of Bio-potential electrodes, Bio signals – Electro Cardiogram (ECG), Electroencephalogram(EEG), Electromyogram (EMG), PCG, EOG, lead systems and recording methods, typical waveforms and signal Characteristics clinical applications.

Imaging Modalities**:** Survey of major modalities for medical imaging: ultrasound, X-ray, CT, MRI, PET, and SPECT. MRI: Physics and signal processing for magnetic resonance imaging. Surgical Applications: A survey of surgical applications of medical image processing.

UNIT II FUNDAMENTALS OF DETERMINISTIC SIGNAL 9

Data Acquisition: Sampling in time, aliasing, interpolation, and quantization. Digital Filtering: Difference equations, FIR and IIR filters, basic properties of discrete-time systems, convolution. DTFT: The discrete-time Fourier transform and its properties. FIR filter design using windows.DFT: The discrete Fourier transform and its properties, the fast Fourier transform (FFT), the overlap-save algorithm, digital filtering of continuous-time signals. Sampling Revisited: Sampling and aliasing in time and frequency, spectral analysis

UNIT III BIO MEDICAL IMAGE PROCESSING 9

Review of Image processing - Medical image enhancement. Filtering - Extension of filtering and Fourier methods to 2-D signals and systems. Interpolation, noise reduction methods, edge detection, homomorphic filtering

UNIT IV PROBABILITY AND RANDOM SIGNALS 9

PDFs: Introduction to random variables and probability density functions (PDFs). Classification: Bayes' rule, detection, statistical classification. Estimating PDFs - Practical techniques for estimating PDFs from real data.

Random signals: Time averages, ensemble averages, autocorrelation functions, cross correlation functions. Linear systems, power spectra, cross spectra, Wiener filters. Blind source separation: Use of principal component analysis (PCA) and independent component analysis (ICA) for filtering.

UNIT V IMAGE SEGMENTATION AND REGISTRATION 9

Image Segmentation: statistical classification, morphological operators, connected components. Image Registration: Rigid and non-rigid transformations, objective functions - Joint entropy, optimization methods. Nuclear Imaging: PET and SPECT Ultrasound Imaging

TOTAL: 45 h

COURSE OUTCOMES:

At the end of this course the students will be able to,

CO1: Apply the concepts for acquiring bio signals and images using different modalities

CO2: Analyze sampling, quantization of signals and digital filter design using windows and spectral analysis

CO3: Explain and compare the different techniques for image enhancement, filtering, restoration and edge detection

CO4: Select and discuss the methodologies to analyze probabilistic and random signals

CO5: Conclude the various methods for image segmentation and registration

TEXT BOOKS:

1. KayvanNajarian& Robert Splinter , "Biomedical Signal and Image Processing", 1st Edition Biomedical Signal and Image Processing, 2005.
2. Amit Kumar, FahimuddinShaik, B Abdul Rahim,D.Sravan Kumar , "Signal and Image Processing in Medical Applications (Springer Briefs in Applied Sciences and Technology, 2016.
3. Theis. "Biomedical Signal Analysis: Contemporary Methods and Applications , Prentice Hall India Learning Private Limited (2011)
4. Wolfgang Birkfellner "Applied Medical Image Processing: A Basic Course, Second Edition, 2014.

REFERENCE BOOKS:

1. Ervin Sejdic, Tiago H. Falk , 'Signal Processing and Machine Learning for Biomedical Big Data" 1st Edition, 2018.
2. Karen M. Mudry, RobertPlonsey, Joseph D. Bronzino, "Biomedical Imaging", 1st Edition.

OE – 16	VHDL AND VERILOG HDL PROGRAMMING	3 0 0 3

PREREQUISITE: DIGITAL SYSTEM DESIGN

COURSE OBJECTIVES:

1. To enable students understand the basics of hardware description languages..
2. To help students develop their own sequential logic devices using VHDL and Verilog HDL coding.

UNIT I INTRODUCTION 9

Synchronous and Asynchronous circuit design, Programming logic device families – Designing a synchronous sequential circuit usingPLA/PAL – Realization of finite state machine using PLD – FPGA – Xilinx FPGA – Xilinx4000.

UNIT II VHDL 9

VHDL operators – Arrays – concurrent and sequential statements – packages- Data flow– Behavioural – structural modeling – compilation and simulation of VHDL code –Test bench.

UNIT III HARDWARE MODELLING WITH VHDL 9

Realization of combinational and sequential circuits using VHDL – Registers – counters – sequential machine – serial adder – Multiplier- Divider – Design of simple microprocessor.

UNIT IV VERILOG HDL 9

Logic System, Data Types and Operators For Modelling inVerilog HDL - Behavioural Descriptions in Verilog HDL – HDL Based Synthesis – Synthesis of Finite State Machines– structural modeling – compilation and simulation of Verilog code –Test bench.

UNIT V HARDWARE MODELLING WITH VERILOG HDL 9

Realization of combinational and sequential circuits using Verilog – Registers – counters – sequential machine – serial adder – Multiplier- Divider – Design of simple microprocessor.

TOTAL: 45 h

;

COURSE OUTCOMES:

At the end of this course the students will be able to,

CO1: Analyze and differentiate the use of various PLDs.
CO2: Interpret and simulate VHDL Codes.
CO3: Test for combinational and sequential circuits using VHDL.
CO4: Test for combinational and sequential circuits using Verilog HDL.
CO5: Evaluate the registers and counters using Verilog HDL.

TEXT BOOKS:

1. ParagK.Lala "Digital system Design using PLD" B S Publications, 2003.
2. Charles H Roth Jr."Digital System Design using VHDL" Thomson learning, 2004.
3. Douglas L. Perry, "VHDL programming by Example" Tata McGraw Hill, 2006.
4. Samir Palnitkar, "Verilog HDL", Pearson Education, 2nd Edition, 2004.
5. J.Bhasker, "A Verilog HDL Primer", B.S.Publications, 2nd Edition, 2001.

REFERENCE BOOKS:

1. Charles H.RothJr , "Fundamentals of Logic Design" Thomson Learning, 2004
2. Nripendra N Biswas,"Logic Design Theory" Prentice Hall of India,2001.

OE – 17	INTRODUCTION TO BLOCK CHAIN	3 0 0 3

PREREQUISITE: NIL

COURSE OBJECTIVES:

1. To help students be familiar with the basics and recently developments in block chain technology.

UNIT I INTRODUCTION 9

The consensus problem - Asynchronous Byzantine Agreement - AAP protocol and its analysis - Nakamoto Consensus on permission-less, nameless, peer-to-peer network - Abstract Models for BLOCKCHAIN - GARAY model - RLA Model - Proof of Work (PoW) as random oracle - formal treatment of consistency, liveness and fairness - Proof of Stake (PoS) based Chains - Hybrid models (PoW + PoS)

UNIT II CRYPTOCURENCY 9

Cryptographic basics for cryptocurrency - a short overview of Hashing, signature schemes, encryption schemes and elliptic curve cryptography.

UNIT III MINING 9

Bitcoin - Wallet - Blocks - Merkley Tree - hardness of mining - transaction verifiability - anonymity - forks - double spending - mathematical analysis of properties of Bitcoin.

UNIT IV ETHEREUM PLATFORM 9

Ethereum - Ethereum Virtual Machine (EVM) - Wallets for Ethereum - Solidity - Smart Contracts - some attacks on smart contracts.

UNIT V CURRENT TRENDS 9

Zero Knowledge proofs and protocols in Blockchain - Succinct non interactive argument for Knowledge (SNARK) - pairing on Elliptic curves - Zcash.

TOTAL: 45 h

COURSE OUTCOMES:

At the end of this course the students will be able to,

CO1: Differentiate the various models of block chain.
CO2: Explain the basics and encryption methods of cryptocurrency.
CO3: Verify Bitcoins using Merkle Tree algorithm.
CO4: Explain the concepts of Ethereum Virtual Machine.
CO5: Analyze the protocols in Blockchain.

TEXT BOOKS:

1. Arvind Narayanan, Joseph Bonneau, Edward Felten, Andrew Miller, and Steven Goldfeder. Bitcoin and cryptocurrency technologies: a comprehensive introduction. Princeton University Press, 2016.

REFERENCE BOOKS:

1. Joseph Bonneau et al, SoK: Research perspectives and challenges for Bitcoin and crypto currency, IEEE Symposium on security and Privacy, 2015
2. J.A.Garay et al, The bitcoin backbone protocol-analysis and applications EUROCRYPT 2015, LNCS VOl 9057, (VOLII), pp 281-310.
3. R.Pass et al, Analysis of Blockchain protocol in Asynchronous networks, EUROCRYPT 2017.