Vel Tech Multi Tech Dr.Rangarajan Dr.Sakunthala Engineering College

(An Autonomous Institution, Affiliated to Anna University)

Regulation 2019

Curriculum

B.E – ELECTRONICS AND COMMUNICATION ENGINEERING

VISION OF THE DEPARTMENT

- To emerge as a centre of academic eminence in Electronics and Communication and related spheres through knowledge acquisition and propagation meeting global needs and standards.

MISSION OF THE DEPARTMENT

- To impart quality education by inculcating fundamental knowledge in Electronics and Communication Engineering with due focus on research and industry practices.
- To propagate lifelong learning.
- To impart the right proportion of knowledge, attitudes and ethics in students to enable them take up positions of responsibility in the society and make significant contributions.

PROGRAMME OUTCOMES (PO'S)

PO'S	PROGRAMME OUTCOMES
PO1	Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals and an engineering specialization to the solution of complex engineering problems.
PO2	Problem Analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO3	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.
PO4	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.
PO5	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.
PO6	The engineer and society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
PO7	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.
PO8	Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
PO9	Individual and team work: Function effectively as an individual and as a member or leader in diverse teams, and in multidisciplinary settings.
PO10	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.
PO11	Project management and finance: Demonstrate knowledge and understanding of the engineering 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.
PO12	Life-long learning: Recognize the need for and have the preparation and ability to engage in independent and lifelong learning in the broadest context of technological change.

PROGRAMME SPECIFIC OUTCOMES (PSO'S)

PSO'S	PROGRAMME SPECIFIC OUTCOMES
PSO1	Demonstrate and analysis of Electronic systems through analog and digital circuits.
PSO2	Design and Develop models to progress on latest technological improvement in the fulfillment of electronics, communication and computing knowledge.
PSO3	Identify the environmental requirements and able to provide technological assistance to the society by acquired technical knowledge.

PROGRAMME EDUCATIONAL OBJECTIVES (PEO'S)

PEOS	PROGRAMME EDUCATIONAL OBJECTIVES
PEO1	Graduates will acquire strong foundation in basic science, mathematics and computing knowledge and get benefits in their professional career or higher education and research or technological entrepreneur
PEO2	Graduates will have analyze the trends in need of electronics engineering, design appropriate system to provide solutions that are technically sound, economically feasible and socially acceptable.
PEO3	Graduates will have the ethical attitude, effective communication skills, and team work to adapt recent trends by engaging in lifelong learning

Semester-I

S.No	Course Code	Name of the Course	Category	No of Hours/Week			Credits
THEORY				Lecture	Tutorial	Practical	
1	191MA101	Engineering Mathematics - I	BS	2	2	0	3
2	191PH101	Engineering Physics	BS	3	0	0	3
3	191CH101	Engineering Chemistry	BS	3	0	0	3
4	191HS101	English for Engineering Students	HSS	3	0	0	3
5	191ME111	Basic of Civil and Mechanical Engineering	ES	3	0	0	3
6	191EE111	Basic of Electrical and Electronics Engineering	ES	3	0	0	3
7	191ME112	Engineering Graphics	ES	2	2	0	3
PRACTICAL							
8	191PH10A	Physics Laboratory	BS	0	0	2	1
9	191CH10A	Chemistry Laboratory	BS	0	0	2	1
Total				19	4	4	23

Semester-II

S.No	Course code	Name of the Course	Category	No of Hours/Week			Credits
THEORY				Lecture	Tutorial	Practical	
1	191MA201	Engineering Mathematics - II	BS	2	2	0	3
2	191EE211	Network Analysis and Synthesis	ES	2	2	0	3
3	191EC221	Semiconductor Devices	PC	3	0	0	3
4	191HS201	Environment Science and Engineering	HSS	3	0	0	3
5	191CS211	Problem Solving and Python Programming	ES	3	0	0	3
PRACTICAL							
6	191EC22A	Circuits and Devices Laboratory	PC	0	0	4	2
7	191CS21A	Problem Solving and Python Programming Laboratory	ES	0	0	2	1
8	191ME21A	Engineering Practices Laboratory	ES	0	0	4	2
Total				13	4	10	20

Semester-III

S.No	Course Code	Name of the Course	Category	No of Hours/Week			Credits
THEORY				Lecture	Tutorial	Practical	
1	191MA304	Linear Algebra and Partial Differential Equations	BS	2	2	0	3
2	191CS311	Data Structures in C	ES	3	0	0	3
3	191EC321	Digital Logic Circuit Design	PC	3	0	0	3
4	191EC322	Electronic Circuits-I	PC	3	0	0	3
5	191EC323	Signals and Systems	PC	2	2	0	3
6	191HS301	Management Science	HSS	3	0	0	3
PRACTICAL							
7	191CS31A	Data Structures in C Laboratory	ES	0	0	2	1
8	191EC32A	Analog and Digital Electronics Laboratory	PC	0	0	4	2
9	191HS30B	Inter Personal Skills Listening and Speaking	BS	0	0	2	1
Total				16	4	8	22

Semester-IV

S.No	Course Code	Name of the Course	Category	No of Hours/Week			Credits
THEORY				Lecture	Tutorial	Practical	
1	191MA401	Probability and Random Process	BS	2	2	0	3
2	191EC421	Analog Communication	PC	3	0	0	3
3	191EC422	Electronic Circuits-II	PC	3	0	0	3
4	191EC423	Electromagnetic Field	PC	2	2	0	3
5	191EC424	Linear Integrated Circuits	PC	3	0	0	3
6	191EC425	Microprocessors and Microcontrollers	PC	3	0	0	3
PRACTICAL							
7	191EC42A	Integrated Circuits and Simulation Laboratory	PC	0	0	2	1
8	191EC42B	Microprocessor and Microcontrollers Laboratory	PC	0	0	2	1
9	191MC46A	Internship / Training-I	MC	0	0	0	**
Total				16	4	4	20

Semester-V

S.No	Course Code	Name of the Course	Category	No of Hours/Week			Credits
THEORY				Lecture	Tutorial	Practical	
1	191EC521	Digital Communication	PC	3	0	0	3
2	191EC522	Digital Signal Processing	PC	2	2	0	3
3	191EC523	Transmission Lines and RF Systems	PC	3	0	0	3
4	191EE511	Control System Engineering	ES	3	0	0	3
5		Professional Elective I	PE	3	0	0	3
6		Open Elective I	OE	3	0	0	3
PRACTICAL							
7	191EC52A	Communication System Laboratory	PC	0	0	2	1
8	191EC52B	Digital Signal Processing Laboratory	PC	0	0	2	1
9		Technical Seminar	PW	0	0	2	1
Total				17	2	6	21

Semester-VI

S.No	Course Code	Name of the Course	Category	No of Hours/Week			Credits
	THEORY			Lecture	Tutorial	Practical	
1	191EC621	Antennas and Microwave Engineering	PC	3	0	0	3
2	191EC622	Digital VLSI Design	PC	3	0	0	3
3		Professional Elective II	PE	3	0	0	3
4		Professional Elective III	PE	3	0	0	3
5		Open Elective II	OE	3	0	0	3
6		Open Elective III	OE	3	0	0	3
PRACTICAL							
7	191EC62A	Digital VLSI Design Laboratory	PC	0	0	2	1
8	191EC62B	Microwave Engineering Laboratory	PC	0	0	2	1
9	191MC66A	Internship - II	MC	0	0	0	**
Total				18	0	4	20

Semester-VII

S.No	Course Code	Name of the Course	Category	No of Hours/Week			Credits
	THEORY			Lecture	Tutorial	Practical	
1	191EC721	Embedded and Real Time Systems	PC	3	0	0	3
2	191EC722	Optical Communication and Networks	PC	3	0	0	3
3		Professional Elective IV	PE	3	0	0	3
4		Professional Elective V	PE	3	0	0	3
5		Open Elective IV	OE	3	0	0	3
PRACTICAL							
6	191EC72A	Embedded System Laboratory	PC	0	0	2	1
7	191EC72B	Optical Communication Laboratory	PC	0	0	2	1
8		Mini Project	PW	0	0	4	2
Total				15	0	8	19

Semester-VIII

S.No	Course Code	Name of the Course	Category	No of Hours/Week			Credits
	THEORY			Lecture	Tutorial	Practical	
1		Professional Elective VI	PE	3	0	0	3
2		Open Elective V	OE	3	0	0	3
3		Project Work	PW	0	0	20	10
Total				6	0	20	16

TOTAL NO. OF CREDITS: 161

Humanities and Social Sciences (HSS)

S.No	Course Code	Name of the Course	Category	Lecture	Tutorial	Practical	Credits
1	191HS101	English for Engineering Students	HSS	3	0	0	3
2	191HS201	Environment Science and Engineering	HSS	3	0	0	3
3	191HS301	Management Science	HSS	3	0	0	3

Basic Sciences (BS)

S.No	Course Code	Name of the Course	Category	Lecture	Tutorial	Practical	Credits
1	191MA101	Engineering Mathematics - I	BS	2	2	0	3
2	191PH101	Engineering Physics	BS	3	0	0	3
3	191CH101	Engineering Chemistry	BS	3	0	0	3
4	191PH10A	Physics Laboratory	BS	0	0	2	1
5	191CH10A	Chemistry Laboratory	BS	0	0	2	1
6	191MA201	Engineering Mathematics - II	BS	2	2	0	3
7	191MA304	Linear Algebra and Partial Differential Equations	BS	2	2	0	3
8	191HS30B	Inter Personal Skills Listening and Speaking	BS	0	0	2	1
9	191MA401	Probability and Random Process	BS	2	2	0	3

Engineering Sciences (ES)

S.No	Course Code	Name of the Course	Category	Lecture	Tutorial	Practical	Credits
1	191ME111	Basic of Civil and Mechanical Engineering	ES	3	0	0	3
2	191EE111	Basic of Electrical and Electronics Engineering	ES	3	0	0	3
3	191ME112	Engineering Graphics	ES	2	2	0	3
4	191EE211	Network Analysis and Synthesis	ES	2	2	0	3
5	191CS211	Problem Solving and Python Programming	ES	3	0	0	3
6	191CS21A	Problem Solving and Python Programming Laboratory	ES	0	0	2	1
7	191ME21A	Engineering Practices Laboratory	ES	0	0	4	2
8	191CS311	Data Structures in C	ES	3	0	0	3
9	191CS31A	Data Structures in C Laboratory	ES	0	0	2	1
10	191EE511	Control System Engineering	ES	3	0	0	3

Professional Core (PC)

S.No	Course Code	Name of the Course	Category	Lecture	Tutorial	Practical	Credits
1	191EC221	Semiconductor Devices	PC	3	0	0	3
2	191EC22A	Circuits and Devices Laboratory	PC	0	0	4	2
3	191EC321	Digital Logic Circuit Design	PC	3	0	0	3
4	191EC322	Electronic Circuits-I	PC	3	0	0	3
5	191EC323	Signals and Systems	PC	2	2	0	3
6	191EC32A	Analog and Digital Electronics Laboratory	PC	0	0	4	2
7	191EC421	Analog Communication	PC	3	0	0	3
8	191EC422	Electronic Circuits-II	PC	3	0	0	3
9	191EC423	Electromagnetic Field	PC	2	2	0	3
10	191EC424	Linear Integrated Circuits	PC	3	0	0	3
11	191EC425	Microprocessors and Microcontrollers	PC	3	0	0	3
12	191EC42A	Integrated Circuits and Simulation Laboratory	PC	0	0	2	1
13	191EC42B	Microprocessor and Microcontrollers Laboratory	PC	0	0	2	1
14	191EC521	Digital Communication	PC	3	0	0	3
15	191EC522	Digital Signal Processing	PC	2	2	0	3
16	191EC523	Transmission Lines and RF Systems	PC	3	0	0	3
17	191EC52A	Communication System Laboratory	PC	0	0	2	1
18	191EC52B	Digital Signal Processing Laboratory	PC	0	0	2	1
19	191EC621	Antennas and Microwave Engineering	PC	3	0	0	3
20	191EC622	Digital VLSI Design	PC	3	0	0	3
21	191EC62A	Digital VLSI Design Laboratory	PC	0	0	2	1
22	191EC62B	Microwave Engineering Laboratory	PC	0	0	2	1
23	191EC721	Embedded and Real Time Systems	PC	3	0	0	3
24	191EC722	Optical Communication and Networks	PC	3	0	0	3
25	191EC72A	Embedded System Laboratory	PC	0	0	2	1
26	191EC72B	Optical Communication Laboratory	PC	0	0	2	1

Mandatory Course (MC)

S.No	Course Code	Name of the Course	Category	Lecture	Tutorial	Practical	Credits
1	191MC46A	Internship / Training-I	MC	0	0	0	**
2	191MC66A	Internship – II	MC	0	0	0	**

Project Work (PW)

S.No	Course Code	Name of the Course	Category	Lecture	Tutorial	Practical	Credits
1	191EC56A	Technical Seminar	PW	0	0	2	1
2	191EC75A	Mini Project	PW	0	0	4	2
3	191EC85A	Project Work	PW	0	0	20	10

Professional Elective - I (Semester - V)

S.No	Course Code	Name of the Course	Category	Lecture	Tutorial	Practical	Credits
1	191EC531	Computer Architecture and Organization	PE	3	0	0	3
2	191EC532	Human Rights	PE	3	0	0	3
3	191EC533	Medical Electronics	PE	3	0	0	3
4	191EC534	Operating Systems	PE	3	0	0	3
5	191EC535	Robotics and Automation	PE	3	0	0	3
6	191HS531	Principle of Management	PE	3	0	0	3

Professional Elective - II (Semester - VI)

S.No	Course Code	Name of the Course	Category	Lecture	Tutorial	Practical	Credits
1	191EC631	CMOS Analog IC Design	PE	3	0	0	3
2	191EC632	Computer Networks	PE	3	0	0	3
3	191EC633	Cryptography and Network Security	PE	3	0	0	3

4	191EC634	Disaster Management	PE	3	0	0	3
5	191EC635	MEMS and NEMS	PE	3	0	0	3
6	191EC636	Speech Signal Processing	PE	3	0	0	3

Professional Elective - III (Semester - VI)

S.No	Course Code	Name of the Course	Category	Lecture	Tutorial	Practical	Credits
1	191EC637	Cognitive Radio	PE	3	0	0	3
2	191EC638	Intellectual Property Rights	PE	3	0	0	3
3	191EC639	Mixed Signal IC Design	PE	3	0	0	3
4	191EC6310	Sensors and Transducers	PE	3	0	0	3
5	191EC6311	Telecommunication Network Management	PE	3	0	0	3
6	191EC6312	Wireless Communication	PE	3	0	0	3

Professional Elective - IV (Semester - VII)

S.No	Course Code	Name of the Course	Category	Lecture	Tutorial	Practical	Credits
1	191EC731	Data Converters	PE	3	0	0	3
2	191EC732	Design Compressive Sensing	PE	3	0	0	3
3	191EC733	Electro Magnetic Interference and Compatibility	PE	3	0	0	3
4	191EC734	Satellite Communication	PE	3	0	0	3
5	191EC735	Video Analytics	PE	3	0	0	3
6	191EC736	Wireless Networks	PE	3	0	0	3

Professional Elective - V (Semester - VII)

S.No	Course Code	Name of the Course	Category	Lecture	Tutorial	Practical	Credits
1	191EC737	Digital Image Processing	PE	3	0	0	3
2	191EC738	DSP Architecture and Programming	PE	3	0	0	3
3	191EC739	Electronics Packaging and Testing	PE	3	0	0	3
4	191EC7310	Fundamentals of Nano Science	PE	3	0	0	3
5	191EC7311	Photonic Networks	PE	3	0	0	3
6	191EC7312	Total Quality Managements	PE	3	0	0	3

Professional Elective - VI (Semester - VIII)

S.No	Course Code	Name of the Course	Category	Lecture	Tutorial	Practical	Credits
1	191EC831	Ad hoc and Wireless Sensor Networks	PE	3	0	0	3
2	191EC832	Foundation Skills in Integrated Product Development	PE	3	0	0	3
3	191EC833	Low power SoC	PE	3	0	0	3
4	191EC834	Multimedia Compression and Communication	PE	3	0	0	3
5	191EC835	Principles of RADAR	PE	3	0	0	3
6	191EC836	Professional Ethics in Engineering	PE	3	0	0	3

Summary

S.NO.	SUBJECT AREA	CREDITS AS PER SEMESTER								CREDITS TOTAL	Percentage
		I	II	III	IV	V	VI	VII	VIII		
1	**HSS**	3	3	3						9	**5.59**
2	**BS**	11	3	4	3					21	**13.04**
3	**ES**	9	9	4		3				25	**15.53**
4	**PC**		5	11	17	11	8	8		60	**37.27**
5	**PE**					3	6	6	3	18	**11.18**
6	**OE**					3	6	3	3	15	**9.32**
7	**PW**					1		2	10	13	**8.07**
	TOTAL	**23**	**20**	**22**	**20**	**21**	**20**	**19**	**16**	**161**	

Credit Distribution

S.No.	Code	Category	AICTE	Credits (Regular)	Credits (Lateral)
1	HSS	Humanities and Social Science	12	9	3
2	BS	Basic Science	25	21	7
3	ES	Engineering Science	24	25	7
4	PC	Program Core	48	60	55
5	PE	Professional Electives	18	18	18
6	OE	Open Electives	18	15	15
7	PW	Project Work	15	13	13
8	MC	Mandatory Course		0	0
Total Credits			160	161	118

Semester	I	L	T	P	C
Course Code/ Title	191MA01 ENGINEERING MATHEMATICS - I	2	2	0	3

Objectives	• To develop greater knowledge and understanding of mathematics and to attain the skills necessary for success in the study of higher mathematics.

Unit-I	MATRICES	12

Characteristic equation–Eigen values and Eigen vectors of a real matrix–Properties of Eigen values–Cayley Hamilton theorem- Orthogonal reduction of a symmetric matrix to diagonal form– Reduction of quadratic form by orthogonal transformation -Applications.

Unit-II	GEOMETRICAL APPLICATIONS OF DIFFERENTIAL CALCULUS	12

Curvature–Cartesian and Polar coordinates – Centre of curvature, Circle of curvature – Evolutes and Envelopes-Applications.

Unit-III	FUNCTIONS OF SEVERAL VARIABLES	12

Function of two variables – Partial derivatives – Total derivative – Change of Variables – Jacobians- Taylor's expansion – Maxima and Minima – Constrained Maxima and Minima by Lagrangian Multiplier method-Applications.

Unit-IV	ORDINARY DIFFERENTIAL EQUATIONS	12

Linear differential equations of second and higher order with constant coefficients – Method of variation of parameters – Equations reducible to linear equations with constant coefficients : Cauchy's homogeneous linear equation and Legendre's linear equation – Simultaneous linear equations with constant coefficients - Applications.

Outcomes	On completion of the course, students will be able to 1. Analyze the characteristics equation of a linear system with Eigen values and vectors for practical application. 2. Determine the bending of family of curves using differential calculus which deals in various disciplines. 3. Apply partial derivatives in various engineering problems. 4. Identify and solve the real time problems using higher order differential equations.

TOTAL PERIODS 60

Text Books

1. Kreyszig.E,"AdvancedEngineeringMathematics",JohnWiley&Sons.Singapore,10thedition,2012.
2. Grewal.B.S,Higher EngineeringMathematics,Khanna Publications,42ndEdition,2012.

References

1. Veerarajan.T,"EngineeringMathematicsI",TataMcGrawHillPublishingCo,NewDelhi,5thedition,2006
2. Kandasamy.Pet.al."Engineering Mathematics" ,Vol.I (4threviseddedition),S.Chand&Co,NewDelhi,2000.

Semester	I	L	T	P	C
Course Code/ Title	191PH101 /ENGINEERING PHYSICS	3	0	0	3

Objectives

- The course aims to equip engineering undergraduates with principles of Physics in a broader sense with a view to lay foundation for the various engineering courses

Unit-I	PROPERTIES OF SOLIDS	9

Elasticity- Hooke's law – stress -strain diagram – Poisson's ratio –Factors affecting elasticity –Bending moment – Depression of a cantilever –Young's modulus by uniform bending- Young's modulus by non-uniform bending (Theory and Experiment) - Torsional stress and twisting couple- Torsional Pendulum ((Theory and Experiment) I-shaped girders

Unit-II	PRINCIPLES OF LASERS:	9

Properties of laser radiation and their significance-wavelength, power, monochromaticity, coherence. Types of lasers working media and their radiation characteristics-Power, wavelength and operational modes of He-Ne, Carbon-dioxide. Physical principles of Laser beam delivery systems. Applications- Industry and Medical. Selection of lasers for various applications

Unit-III	OPTICAL FIBRE SYSTEMS	9

Optical Fibres- Propagation mechanism -Critical Angle- Snell's Law-Total Internal Reflection- Acceptance cone- Numerical aperture- Types of fibers- Attenuation-Active and passive fibre sensors (Temperature and Displacement)- Applications (Industry and Medical) - communication in optical fiber- Endoscope

Unit-IV	WAVE NATURE OF PARTICLES	9

Introduction to Quantum mechanics, Black body radiation- Planck's Hypothesis-Compton Effect (Theory and Experiment) -Wave nature of Particles, Time-dependent and time-independent Schrodinger equation for wavefunction, Schrodinger equation for one dimensional problems– particle in a box-SEM and TEM

Unit-V	SOLID STATE PHYSICS	9

Crystalline and non crystalline materials-Lattice – Unit cell – Bravais lattice – Lattice planes – Miller indices – Expression for inter planar spacing- Bragg's law- Diffraction of X-rays by crystal planes - Co- ordination number. Atomic packing factors (SC, FCC, BCC and HCP structures) – Diamond and graphite structures (qualitative treatment) -Crystal growth techniques (Bridgman and Czochralski)

Outcomes

On completion of the course, students will be able to

1. Demonstrate the proficiency on the properties of matter and its applications
2. Describe the working principles of Laser and its developments in industrial and medical applications
3. Explain the propagation of waves in optical fibres and their applications
4. Apply the theory of wave nature of particles in various microscopic applications
5. Analyze the structure of materials and its crystal growth techniques

TOTAL PERIODS 45

Text Books

1. 'Engineering Physics', R.K. Gaur and S.L. Gupta, Dhanpat Rai Publications (P) Ltd., 8th Edition. New Delhi (2001).
2. Introduction to Solid State Physics, 7th Edition, Charles Kittel, Wiley, Delhi 2007.
3. Halliday, D., Resnick, R. & Walker, J. ―Principles of Physics‖. Wiley, 2015.

References

1. Laser Fundamentals, William T. Silfvast, 2nd Edition, Cambridge University press, New York, 2004.
2. Fundamentals of Physics, 6th Edition, D. Halliday, R. Resnick and J. Walker, John Wiley and Sons, New York 2001.
3. E. Hecht, Optics, Pearson Endcation, 2008

Semester	I	L	T	P	C
Course Code/ Title	191CH101 /ENGINEERING CHEMISTRY	3	0	0	3
Objectives	• To acquaint the students with the new developments of microscopic chemistry in terms of atomic, molecular, orbital and intermolecular forces and acquires the knowledge of water treatment and instrumentation of advanced materials. The students will be able to analyze the polymer properties and apply the electro-chemical reaction mechanism				

Unit-I	CHEMICAL BONDING	9

Types of chemical bonds - bond polarity- dipole moment – partial ionic character - consequences. Weak Interactions – Hydrogen bonding, van der Waals forces - influence on properties of matter. Metallic bond – free electron theory, MO treatment - band theory-metals, semiconductors and insulators. Non stoichiometric semiconductors, chalgogen semiconductors. Defect structures of crystals – Schottky and Frenkel defects.

Unit-II	WATER CHEMISTRY	9

Hardness - determination (EDTA method). Water softening - zeolite and demineralization processes. Desalination by electro-dialysis and reverse osmosis. Water analysis by fluoride ion, Water quality parameters, Instrumental methods for water analysis- AAS, flame emission spectroscopy, ICP-MS and photocolorimetry.

Unit-III	ELECTROCHEMISTRY	9

Electrode potential – standard and reference electrodes, Nernst equation, emf series – applications. Galvanic and concentration cells. Applications of potential measurements – glass electrode - pH measurement, acid- base titration, redox titration. Conductance measurement – applications – conductometric titrations.

Unit-IV	POLYMERS	9

Classification, degree of polymerization, molecular weight – Mn and Mw. Polymerization reactions. Glass transition temperature – factors affecting Tg - determination by DSC. Polymer processing - compounding, outline of moulding techniques compression, injection, extrusion and blow moulding. Charge transport in conjugated polymers - doped conjugated polymers - glucose biosensor. Polymers for LED and LCD displays.

Unit-V	ADVANCED MATERIALS	9

Carbon nanotubes and carbon fibres, graphene and polymer nano-composites-properties and applications - morphological studies by SEM and TEM. Solid oxide materials and polymer electrolytes - energy storing applications. Polymer blends and alloys, photo and electroluminescence materials, insulating materials, photopolymers and photoresists for electronics, polymer photovoltaics.

Outcomes

On completion of the course, students will be able to

1. Analyse microscopic chemistry in terms of atomic, molecular and Intermolecular forces for real time applications of semiconductors.
2. Investigate the various water treatment and softening methods.
3. Appraise the types and mechanism of electrochemical reaction in batteries and fuel cells.
4. Explain the basic principle, types and mechanism of polymerization process and techniques.
5. Assess the properties, characterization and applications of advanced materials for energy storage.

TOTAL PERIODS 45

Text Books

1. Mary Jane Shultz, -"Engineering Chemistry", Cengage Learning, USA, 2009.
2. Palanna O. G., -"Engineering Chemistry", Tata Mc.Graw Hill Education Pvt. Ltd., New Delhi, 2009.

References
1. GesserH.D., - "Applied Chemistry - A Textbook for Engineers and Technologies", Springer, NewYork, 2008. 2. Gowarikar V. R., Viswanathan N.V. and Jayadev Sreedhar, -"Polymer Science", New Age International (P) Ltd., New Delhi, 2011. 3. Vijayamohanan K. Pillai and Meera Parthasarathy. – "Functional Materials - A Chemist 's Perspective" Universities Press, India, 2012. 4. Shashi Chawla, - "A Text book of Engineering Chemistry", Dhanpat Rai & Co, New Delhi, 2005.

Semester	I	L	T	P	C
Course Code/ Title	191HS101 / ENGLISH FOR ENGINEERING STUDENTS	3	0	0	3

Objectives

- Equip students with the English language skills required for the successful undertaking of academic studies.
- Improve general and academic listening skills
- Provide guidance and practice in basic geranial and classroom conversation and to engage in specific academic speaking activities
- Strengthen the reading and writing skills of students of engineering

Unit-I	VOCABULARY BUILDING	9

Word formation - Prefixes and Suffixes – Root words from foreign languages – Synonyms – Antonyms– Compound Nouns – Standard Abbreviations

Unit-II	GRAMMATICAL COMPETENCY	9

Noun, Verb, Adjective – Subject-Verb Agreement – Articles – Prepositions – Purpose expressions – Model Verbs

Unit-III	BASIC WRITING SKILLS	9

Sentence structure – Phrases – Clauses – Coherence – Cohesion (using linking words) – Paragraph Writing (Descriptive and Narrative)

Unit-IV	READING SKILLS	9

Reading Strategies – Skimming and Scanning – Reading Comprehension exercises with multiple choice and open ended questions – Transforming Information in the form of charts – Note Making

Unit-V	ORAL COMMUNICATION	9

(This unit involves interactive practice sessions in Language Lab)

- Listing Comprehension
- Pronunciation, Syllable and Stress, Rhythm and Intonation
- General conversations and dialogues, common in everyday situations
- Short Speech

Outcomes

On completion of the course, students will be able to

1. Listen, understand and respond to other in different situations
2. Speak correctly and fluently in various situations using appropriate communication strategies
3. Read and comprehend a variety of texts adopting different reading strategies
4. Write with clarity in simple, apt and flawless language with coherence and cohesion
5. Use their communicative competency with precision and clarity in social contexts

TOTAL PERIODS 45

Text Books

1. Department of English, Anna University, Mindscapes: English for Technologists and Engineers, Orient Blackswan, Chennai – 2012.
2. Dhanavel, S. P. English and Communication Skills for Students of Science and Engineering, Orient Blackswan, Chennai – 2011.
3. Communication Skills. Sanjay Kumar and Pushp Lata. Oxford University Press. 2011..

References

1. Practical English Usage. Michael Swan. OUP. 1995.
2. Remedial English Grammar. F.T. Wood. Macmillan.2007.
3. Study Writing. Liz Hamp-Lyons and Ben Heasly. Cambridge University Press. 2006.
4. Exercises in Spoken English. Parts. I-III. CIEFL, Hyderabad. Oxford University Press.
5. Practical English Usage. Michael Swan. OUP. 1995.

Semester	I	L	T	P	C
Course Code/ Title	191ME101 / BASIC CIVIL AND MECHANICAL ENGINEERING	3	0	0	3

Objectives

- To create awareness on fundamental knowledge on various domains of civil engineering
- To introduce the sources of water and treatment of water, sewage treatment and transportation modes
- To introduce the fundamentals of Power Plant Engineering
- To introduce the fundamentals of IC engines
- To introduce the fundamentals of Energy resources and refrigeration cycles

A.BASICS OF CIVIL ENGINEERING

Unit-I	SCOPE OF CIVIL ENGINEERING	9

Introduction – Functions and role of Civil Engineer- Branches of Civil Engineering. Materials – Properties, classification and characteristics of building stones, bricks, timber, cement and cement concrete, reinforcing steel- Components of residential building. Foundation – Types and necessity.

Unit-II	WATER RESOURCES & ENVIRONMENTAL ENGINEERING	9

Sources of water – Hydrologic cycle – Rain water harvesting – importance – methods of rain water harvesting. - Water demand estimation – Sources of water – Quality of water – Treatment of water- Water distribution. Sewerage – collection, treatment and disposal of sewage – Septic tanks.

B.BASICS OF MECHANICAL ENGINEERING

Unit-III	POWER PLANTS, PUMPS AND TURBINES	9

Introduction to Power Plant, Classification of Power Plants – Working principle of steam, Gas, Diesel, Hydro-electric, Geo-thermal and Nuclear Power plants – Merits and Demerits. Pumps and turbines – working principle of single acting and double acting Reciprocating pumps – Centrifugal Pump.

Unit-IV	IC ENGINES	9

Introduction to Internal combustion engines – Working principle of Petrol and Diesel Engines – Four stroke and two stroke cycles – Comparison of four stroke and two stroke engines.

Unit-V	RENEWABLE ENERGY AND REFRIGIRATION	9

Introduction to renewable energy sources - Non renewable energy sources-Comparison of Electrical Energy Storage Technologies. Vapour compression Refrigeration system, Vapour absorption refrigeration system.

Outcomes

On completion of the course, students will be able to

1. Explain the usage of construction material and proper selection of construction materials
2. Explain about water resources, sewage treatment and transportation systems
3. Explain about the components use in power plants
4. Describe the internal combustion engines
5. Explain about the renewable energy sources and refrigeration cycles

TOTAL PERIODS 45

Text Books

1. Shanmugam G and Palanichamy M S, “Basic Civil and Mechanical Engineering”, Tata McGraw Hill Publishing Co., New Delhi, 1996.

References

1. T. Jha and S.K. Sinha, “Construction and Foundation Engineering”, Khanna publishers, Delhi, 2003
2. S.K. Garg, “Water Supply Engineering”, Khanna publishers, Delhi, 2005
3. Ramamrutham S., “Basic Civil Engineering”, Dhanpat Rai Publishing Co. (P) Ltd. 1999.
4. Seetharaman S., “Basic Civil Engineering”, Anuradha Agencies, 2005.
5. Venugopal K. and Prahu Raja V., “Basic Mechanical Engineering”, Anuradha Publishers, Kumbakonam, 2000.

Semester	I	L	T	P	C
Course Code/ Title	191EE101 / BASIC ELECTRICAL AND ELECTRONICS ENGINEERING	3	0	0	3
Objectives	• To understand the structure of Electric Power Systems • To execute safety precautions • To study about Electric laws • To know about construction of meters • To understand about Electronics and Communication systems				

A. ELECTRICAL ENGINEERING

Unit-I	INDIAN ELECTRICITY SCENARIO	9

Electric Power-Generation resources, Transmission types & Distribution system (levels of voltage, power ratings and statistics)- Regulatory Authorities governing Indian Electricity

Protection & Safety-Hazards of electricity-shock, effects of electricity on the human body. Electrical safety practices, Protection devices.

Unit-II	BASICS OF ELECTRICAL COMPONENTS	9

Evolution of Electricity and Electrical inventions-Charge, Electric potential, voltage, current, power, energy, DC ,AC, time period, frequency, phase, flux, flux density, RMS, Average, Peak, Phasor & Vector diagram.

Unit-III	BASIC LAWS OF ELECTRIC SYSTEMS& MEASUREMENTS	9

Electric Circuits-Passive components(RLC),Ohm's law, KCL, KVL, Faraday's law, Lenz's law - Illustrative examples- Analog Moving Iron, Moving Coil and Digital meters–Types and usage.

B. ELECTRONICS ENGINEERING

Unit-IV	BASICS ELECTRONICS	9

Electrical Vs Electronics, Electronic products and systems, Electronic Devices (Diode–Forward bias, reverse bias, Transistor (CE, CB, CC), Electronic components, Electronic Circuits-Rectifier, Regulator &IC-Basic Amplifiers and Oscillators- Communication system Block diagram (Transmitter and Receiver)

Unit-V	BASICS OF COMMUNICATION ENGINEERING	9

Amplitude Modulation–AM, DSBSC, SSBSC, VSB–PSD, modulators and demodulators–Angle modulation–PM and FM–PSD.

Outcomes	On completion of the course, students will be able to 1. Summarizes about different structures of Power system and safety measures. 2. Explain about the basics of Electricity 3. Discuss on various electric circuits and use of measuring instruments 4. Clarify the working of basic electronic devices such as diode, transistor and operational amplifiers **5.** Infer about Digital Electronics and Communication System

TOTAL PERIODS 45

Text Books

1. S Salivahanan Rangarajan,Basic Electrical Electronics & Measurement Engineering , Tata McGraw Hill Publishing Co Ltd
2. Basic Electric Engineering, DP Kothari &Nagrath, Tata McGraw Hill
3. C.L.Wadhwa, ―Generation, Distribution and Utilisation of Electrical Energy‖, New Age international pvt.ltd.,2003.

References

1. AlbertPaulMalvino, “ElectronicPrinciples”,TataMcgrawHill,2002
2. SimonHaykin,“CommunicationSystems”,WileyEastern,ThirdEdition,1996
3. M.S. Sukhija and T.K. Nagsarkar, Basic Electrical and Electronic Engineering, Oxford, 2016.
4. M.Morris Mano, Digital Design, Third Edition, Pearson Publication.

Semester	I	L	T	P	C
Course Code/ Title	191ME112 / ENGINEERING GRAPHICS	2	2	0	3
Objectives	• To explain the importance of an engineering drawing and explain the role of computer aided design • To convey the basics of engineering drawing of curves and concepts of free hand sketching • To teach different methods of making views of simple objects resembling points, lines and surfaces • To relate the visualizations of simple solid objects as per principles of orthographic projection • To establish the importance of sections and developments made in drawing • To develop an intuitive understanding of underlying significance of using pictorial drawings				

	CONCEPTS AND CONVENTIONS (Not for Examination)	
Introduction to engineering graphics- Importance of graphics in engineering applications – Use of drafting instruments -Size and layout of drawing sheets. BIS Standards - Lettering and dimensioning.		
Unit-I	**PLANE CURVES AND FREE HAND SKETCHING**	**12**
Conics – Construction of ellipse, parabola and hyperbola by eccentricity method – Construction of cycloid – construction of involutes of square and circle – Drawing of tangents and normal to the above curves. Visualization concepts and Free Hand sketching: Visualization principles – Representation of Three Dimensional objects – Layout of views-Free hand sketching of multiple orthographic views from single pictorial view of objects.		
Unit-II	**PROJECTION OF POINTS, LINES AND PLANE SURFACES**	**12**
Orthographic projections - Introduction - Principles -Principal planes-First angle projection. Projection of points located in all quadrants. Projection of straight lines inclined to both the principal planes, Determination of true lengths and true inclinations by rotating line method, traces. Projection of planes (regular polygonal and circular surfaces) inclined to both the principal planes by rotating object method.		
Unit-III	**PROJECTION OF SOLIDS**	**12**
Projection of simple solids like prisms, pyramids, cylinder, cone and truncated solids when the axis is inclined to one of the principal planes by rotating object method.		
Unit-IV	**SECTION OF SOLIDS & DEVELOPMENT OF LATERAL SURFACES OF SOLIDS**	**12**
Sectioning of simple solids in vertical position when the cutting plane is inclined to one of the principal planes and perpendicular to the other – obtaining true shape of section. Development of lateral surfaces of simple and sectioned solids like Prisms, pyramids, cylinders and cones.		
Unit-V	**ISOMETRIC AND PERSPECTIVE PROJECTIONS**	**12**
Principles of isometric projection – Isometric scale –Isometric projections of simple solids and truncated solids - Prisms, pyramids, cylinders, and cones- combination of two solid objects in simple vertical positions - Perspective projection of simple solids like Prisms, pyramids and cylinders by visual ray method.		

Outcomes	On completion of the course, students will be able to 1. Draw engineering curves and apply the concepts of free hand sketching 2. Draw orthographic views of points, lines and surfaces 3. Draw visualizations of simple solid objects as per orthographic projections 4. Draw sections and developments made in drawing **5.** Draw pictorial drawings of simple objects
	TOTAL PERIODS 60

Text Books

1. N.D. Bhatt, Engineering Drawing, 49th edition, Charotar Publishing House, 2006.

References

1. Natarajan K.V., "A text book of Engineering Graphics", Dhanalakshmi Publishers, Chennai, 2009.
2. Basant Agarwal and Agarwal C.M., "Engineering Drawing", Tata McGraw Hill Publishing Company Limited, New Delhi, 2008
3. Venugopal K. and Prabhu Raja V., "Engineering Graphics", New Age International (P) Limited, 2008.
4. Gopalakrishna K.R., "Engineering Drawing" (Vol. I&II combined), Subhas Stores, Bangalore, 2007.

Semester	I	L	T	P	C
Course code/ Title	191PH10A/ Physics Laboratory	0	0	2	1
Objectives	• Students will be able to demonstrate an understanding of the scientific method, so thatthey may use the training beneficial in their higher pursuits				
LIST OF EXPERIMENTS					
1.	Determination of Rigidity modulus – Torsion pendulum				
2.	Determination of Young's modulus by non-uniform bending method				
3.	Determination of Planck's Constant and work function of materials using photo electric effect experiment				
4.	Determination of wavelength, and particle size using Laser				
5.	Determination of acceptance angle in an optical fiber				
Demonstration					
1.	Determination of wavelength of mercury spectrum – spectrometer grating				
2.	Demonstration of Crystal Growth Technique				
3.	Determination of fiber thickness – Air Wedge method.				
Outcomes	On completion of the course, students will be able to 1. Apply the principles of properties of matter in determining the various elastic properties 2. Have the hands on exercises which helps them to apply principles of optics 3. Attains the basic understanding of concepts of quantum mechanics				
TOTAL PERIODS 30					
REFERENCES					
1. Wilson J.D. and Hernandez C.A., -"Physics Laboratory Experiments", Houghton Mifflin Company, New York 2005.					

Semester	I	L	T	P	C
Course code/ Title	**191CH10A/ CHEMISTRY LABORATORY**	**0**	**0**	**2**	**1**
Objectives	• To enable the students to understand the basic concepts involved in the analyses.				

LIST OF EXPERIMENTS

1.	Determination of Na / K in water sample by Flame photometry (Demonstration)
2.	Determination of total, permanent, temporary, calcium and magnesium hardness of water by EDTA method.
3.	Conductometric titration - determination of strength of an acid
4.	Estimation of iron by potentiometry.
5.	Determination of molecular weight of polymer by viscosity average method
6.	Determination of dissolved oxygen in a water sample by Winkler's method
7.	Estimation of Copper in ore
8.	Estimation of nickel in steel
9.	Determination of total alkalinity and acidity of a water sample
10.	Determination of rate of corrosion by weight loss method

Outcomes	On completion of the course, students will be able to 1. Acquire knowledge on quantitative chemical analysis by instrumentation and volumetric method. 2. Analyse the water sample for hardness, chloride, sodium /potassium content, dissolved oxygen etc. 3. Solve analytical problems in spectrometer and flame photometer for the identification and quantification.

TOTAL PERIODS 30

REFERENCES

1. Vogel's Textbook of quantitative chemical Analysis (8^{th} edition, 2014)

Semester	II	L	T	P	C
Course Code/ Title	191MA201 ENGINEERING MATHEMATICS - II	2	2	0	3

Objectives

- To understand double and triple integrations and enable them to find area and volume using multiple integrals.
- To know the basics of vector calculus comprising gradient, divergence and curl and line, surface and volume integrals.
- To understand analytic functions of complex variables and conformal mappings.
- To know the basics of residues, complex integration and contour integration.
- To understand Laplace transform and use it to represent system dynamic models and evaluates their time responses.

Unit-I	MULTIPLE INTEGRALS	12

Double integration – Cartesian and polar coordinates – Change of order of integration –Triple integration in cartesian coordinates.

Unit-II	VECTOR CALCULUS	12

Gradient, divergence and curl – Directional derivative – Irrotational and solenoidal vector fields - Simple problems on Vector differentiation–Vector integration - Green's theorem in a plane, Gauss divergence theorem and Stoke's theorem (excluding proofs).

Unit-III	ANALYTIC FUNCTION	12

Functions of a complex variable – Analytic functions – Necessary conditions, Cauchy- Riemann equations in Cartesian coordinates and sufficient conditions (excluding proofs)– Properties of analytic function – Construction of analytic function by Milne Thomson method – Conformal mapping : $w = z + c$, cz , $1/z$ and bilinear transformation.

Unit-IV	COMPLEX INTEGRATION	12

Statement and applications of Cauchy's integral theorem and Cauchy's integral formula (excluding proofs) – Taylor's and Laurent's series expansions – Singularities – Residues – Cauchy's residue theorem (excluding proof) – Evaluation of real definite integrals as contour integrals around unit circle and semi-circle (excluding poles on the real axis).

Unit-V	LAPLACE TRANSFORM	12

Laplace transform –Sufficient condition for existence –Transform of elementary functions –Basic properties – Transforms of unit step function and impulse functions –Transform of periodic functions. Inverse Laplace transform -Statement of Convolution theorem –Initial and final value theorems– Solution of linear ODE of second order with constant coefficients using Laplace transformation techniques.

Outcomes

On completion of the course, students will be able to

1. Evaluate multiple integrals using change of variables.
2. Apply various integral theorems for solving engineering problems involving cubes and rectangular parallelepipeds.
3. Construct analytic functions of complex variables and transform functions using conformal mappings.
4. Estimate the real and complex integrals over suitable closed paths and contours.
5. Compute the solution of differential equations using Laplace transform techniques

TOTAL PERIODS 60

Text Books

1. Grewal B.S., Higher Engineering Mathematics, Khanna Publishers, Delhi, 42nd Edition, 2012.
2. Kreyzig E., Advanced Engineering Mathematics, John Wiley & Sons (Asia), Pvt, Ltd., Singapore, 10th Edition, 2010.

References

1. Veerarajan T., Engineering Mathematics (for First Year), Tata McGraw Hill, Pub. Co. Ltd., New Delhi, Revised Edition, 2007.
2. Venkataraman M.K., Engineering Mathematics, Volume - II, The National Pub. Co., Chennai, 2003.
3. Kandasamy P., Thilagavathy K. and Gunavathy K., Engineering Mathematics, S. Chand & Co., New Delhi, 2008.
4. Arunachalam T. and Sumathi K., Engineering Mathematics II, Sri Vignesh Publications, Coimbatore, Third Edition, 2011.

Semester	II	L	T	P	C
Course Code/ Title	191HS201 ENVIRONMENTAL SCIENCE AND ENGINEERING	3	0	0	3

Objectives

- This course provides the basic knowledge of structure and function of ecosystem and better understanding of natural resources, biodiversity and their conservation practices.
- It describes the need to lead more sustainable lifestyles, to use resources more equitably.
- It helps to create a concern for our environment that will trigger pro-environmental action, including activities we can do in our daily life to protect it. Furthermore, it deals the social issues and ethics to develop quality engineer in our country.

Unit-I	Environment - an overview	9

Ecosystem-concept-structure-function-types. Energy flow in ecosystem. Biodiversity and its conservation- values of biodiversity-threats to biodiversity conservation of biodiversity. Natural resources- types, uses.

Unit-II	Environmental impact of energy sources	9

Sources of primary energy- present and future consumption of energy- environmental impacts of energy development- oil, natural gas, coal, hydro electric, nuclear power, wind mill and solar panels- Urban problems related to energy - case studies.

Unit-III	Climatic change and solid waste management	9

Environmental pollution- air, water, soil, marine and noise pollution-green house gases- causes, effects- global warming, ozone layer depletion, acid rain-sources and effects. Pollution control strategies- preventive measures- green technologies-green building concepts- standards and regulations- role of individuals. Sustainable development. Hazardous wastes- e-waste- source- effect, management. Nuclear waste-sources, effects, management. Recycling of waste. Future challenges.

Unit-IV	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.

Unit-V	Environmental laws and Ethics	9

Legal provision in India- environmental acts-air, water, forest, soil and wildlife. Environmental ethics-theories and codes- resource consumption patterns, equity-disparity, urban-rural equity issues, need for gender equity, preserving resource for future generation, right of animals, ethical basis of environment education and awareness, ethical problem solving- changing attitude, conservation ethics and traditional value systems of India. Effect of social media on the adolescent.

Outcomes

On completion of the course, students will be able to

1. Interpret the concept of ecosystem, biodiversity and its conservation.
2. Demonstrate the environmental impacts of energy development.
3. Categorize the various environmental pollutions and select suitable preventive measures.
4. Perceive the environmental effects of human population and the implementation of welfare programs.
5. Recall the environmental ethics and legal provisions.

TOTAL PERIODS 45

Text Books

1. Erach Bharucha, “Text book for Environmental sciences for Undergraduate cources”, UGC, 2004
2. Kaushik, A &Kaushik, CP, Environmental Science and engineering”, 3rd Edition, New Age International (P) Limited, New Delhi, 2009.
3. Henry, JG & Heinke, GW, “Environmental Science and Engineering”, 2nd Edition, PHI Learning Private limited, New Delhi, 2011.

References

4. Masters, GM & Ela, WP, “Introduction to Environmental Engineering and Science”, 3rd Edition, PHI Learning Private limited, New Delhi, 2009.
5. Encyclopaedia of environmental ethics and philosophy. Available at www.gmu.ac.ir/download/booklibrary/e-library/Encyclopaedia of Environmental Ethics and philosophy.pdf

Semester	II	L	T	P	C
Course Code/ Title	191EE211 / NETWORK ANALYSIS AND SYNTHESIS	2	2	0	3

Objectives

- To Analysis the basic of DC and AC circuits behaviors.
- To Study the transient and steady state response of the circuits subjected to step and sinusoidal excitation.
- To analysis the time and frequency domain response of a network.
- Construct and appraise properties of two port networks and synthesis

Unit-I **Networks Laws and Theorems** **12**

Kirchoff's Laws- Loop and Nodal analysis, Superposition, Thevenin's and Norton's,Maximum power transfer, Reciprocity theorems, Tellegen's theorem, Source and Wye-Deltatransformation.

Unit-II **Time domain analysis** **12**

Transient analysis: Series and Parallel RC, RL, RLC networks, Significance of time constant, Natural frequency, Resonance, Q factor. Steady state sinusoidal analysis of reactive networks.

Unit-III **Frequency domain analysis** **12**

The concept of complex frequency, Solution of network equations using Laplace transforms. Network functions: driving point and transfer functions, Poles and Zeros, their locations and effects on the time and frequency domain responses, Restriction of poles and zeros in the driving point and transfer function, Time domain behaviour from the pole-zero plot.

Unit-IV **Two port networks** **12**

Analysis of two port network: Network parameters- Impedance, admittance, transmission and hybrid, Conversion formulae. Equivalents of T, Π, Ladder, bridged T and Lattice networks, Analysis of interconnected two port networks - parallel, series, and cascade connections, zeros of transmission.

Unit-V **Synthesis of Networks** **12**

Elements of Realizability Theory: Stability-Hurwitz Polynomials-Positive Real Functions- Elementary Synthesis Procedures – Cauer and Foster forms. Synthesis of One Port and two port Networks: Properties and synthesis of R-L, R-C, L-C Impedance and Admittance Functions. Filters and attenuators.

Outcomes

On completion of the course, students will be able to

1. Enable to impart knowledge on solving circuits using network theorems
2. Enable to apply the knowledge of differential equations, integrals, matrix theory, Laplace, Fourier and z-transformation for engineering problems
3. Enable to familiarize the phenomenon of resonance in coupled circuits
4. Enable to understand the transient response of circuits
5. Enable to define Basic science, Circuit theory, and to apply them to analyze complex engineering problems

TOTAL PERIODS 60

Text Books

1. Van Valkenberg, Network Analysis, Prentice-Hall of India, Third Edition, 2007.
2. William H Hayt& Jack E Kemmerly, Engineering Circuit Analysis, Tata McGraw Hill, 7th edition, 2010
3. Franklin F. Kuo, Network Analysis and Synthesis, Wiley India, Second Edition, 2006

References

1. Van Valkenberg, Synthesis, Prentice-Hall of India, Third Edition, 2007.
2. MahmoodNahvi and Joseph Edminister: Electric Circuits 5th Ed, Schaum‟s Outlines, Tata McGraw-Hill, 2016
3. John D Ryder, “Networks, Lines and Fields”, Second Edition, PHI, 2007
4. UmeshSinha, “Network Analysis and Synthesis” Satyaprakashan Publishers, 2013.

Semester	II	L	T	P	C
Course Code/ Title	191CS211 PROBLEM SOLVING AND PYTHON PROGRAMMING	3	0	0	3
Objectives	• To know the basics of algorithmic problem solving • To read and write simple Python programs. • To develop Python programs with conditionals and loops. • To define Python functions and call them. • To use Python data structures –- lists, tuples, dictionaries. • To do input/output with files in Python.				
Unit-I	ALGORITHMIC PROBLEM SOLVING				9
Algorithms, building blocks of algorithms (statements, state, control flow, functions), notation (pseudo code, flow chart, programming language), algorithmic problem solving, simple strategies for developing algorithms (iteration, recursion) Illustrative problems: find minimum in a list, insert a card in a list of sorted cards, Guess an integer number in a range, Towers of Hanoi.					
Unit-II	DATA, EXPRESSIONS, STATEMENTS				9
Python interpreter and interactive mode; values and types: int, float, boolean, string, and list; variables, expressions, statements, tuple assignment, precedence of operators, comments; modules and functions, function definition and use, flow of execution, parameters and arguments; Illustrative programs: exchange the values of two variables, circulate the values of n variables, distance between two points.					
Unit-III	CONTROL FLOW, FUNCTIONS				9
Conditionals: Boolean values and operators, conditional (if), alternative (if-else), chained conditional (if-elif-else); Iteration: state, while, for, break, continue, pass; Fruitful functions: return values, parameters, local and global scope, function composition, recursion; Strings: string slices, immutability, string functions and methods, string module; Lists as arrays. Illustrative programs: square root, gcd, exponentiation, sum an array of numbers, linear search, binary search.					
Unit-IV	LISTS, TUPLES, DICTIONARIES				9
Lists: list operations, list slices, list methods, list loop, mutability, aliasing, cloning lists, list parameters; Tuples: tuple assignment, tuple as return value; Dictionaries: operations and methods; advanced list processing - list comprehension; Illustrative programs: selection sort, insertion sort, mergesort, histogram.					
Unit-V	FILES, MODULES, PACKAGES				9
Files and exception: text files, reading and writing files, format operator; command line arguments, errors and exceptions, handling exceptions, modules, packages; Illustrative programs: word count, copy file.					
Outcomes	On completion of the course, students will be able to 1. Develop algorithmic solutions for simple computational problems. 2. Write and execute simple python programs. 3. Implement Python program with control structures and function for solving problems. 4. Represent compound data using Python list, tuples, and dictionaries. 5. Read and write data from/to files in Python programs.				
					TOTAL PERIODS 45
Text Books					

1. Allen B. Downey, ``Think Python: How to Think Like a Computer Scientist‘‘, 2nd edition, Updated for Python 3, Shroff/O‘Reilly Publishers, 2016 (http://greenteapress.com/wp/think-python/)
2. Guido van Rossum and Fred L. Drake Jr, ―An Introduction to Python – Revised and updated for Python 3.2, Network Theory Ltd., 2011.

References

1. John V Guttag, ―Introduction to Computation and Programming Using Python‘‘, Revised and expanded Edition, MIT Press , 2013
2. Robert Sedgewick, Kevin Wayne, Robert Dondero, ―Introduction to Programming in Python: An Inter-disciplinary Approach, Pearson India Education Services Pvt. Ltd., 2016.
3. Timothy A. Budd, ―Exploring Python‖, Mc-Graw Hill Education (India) Private Ltd.,, 2015.
4. Kenneth A. Lambert, ―Fundamentals of Python: First Programs‖, CENGAGE Learning, 2012.
5. Charles Dierbach, ―Introduction to Computer Science using Python: A Computational Problem-Solving Focus, Wiley India Edition, 2013.
6. Paul Gries, Jennifer Campbell and Jason Montojo, ―Practical Programming: An Introduction to Computer Science using Python 3‖, Second edition, Pragmatic Programmers, LLC, 2013.

Semester	II	L	T	P	C
Course Code/ Title	191EC221 / SEMICONDUCTOR DEVICES	3	0	0	3

Objectives

- To understand the concept of semiconductor diode
- To learn the operation and characteristics of BJT and FET transistors.
- To study various types of special semiconductor devices, power devices

Unit-I	Semiconductor Diode	9

PN junction diode, Current equations, Energy Band diagram, Diffusion and drift current densities, forward and reverse bias characteristics, Switching Characteristics, Transition and Diffusion Capacitances Breakdown in PN Junction Diodes

Unit-II	Bipolar Junction Transistor	9

BJT-Types NPN,PNP -Operations-Early effect-Current equations – Input and Output characteristics of Common Emitter, Common Base and Common Collector - h-parameter model, Ebers Moll Model- Gummel Poon-model, Multi Emitter Transistor.

Unit-III	Field Effect Transistors	9

JFETs – Drain and Transfer characteristics,-Current equations-Pinch off voltage and its significance-MOSFET- Characteristics- Threshold voltage -Channel length modulation, D-MOSFET, E-MOSFET Characteristics, Comparison of MOSFET with JFET.

Unit-IV	Special Semiconductor Devices	9

Metal-Semiconductor Junction- MESFET, Dual GATE MOSFET FINFET, PINFET, CNTFET, Schottky barrier diode-Zener diode-Varactor diode –Tunnel diode- Gallium Arsenide device, LASER diode, LDR.

Unit-V	Power Devices and Display Devices	9

Operation and Characteristics of UJT,SCR, DIAC,TRIAC, Power BJT- Power MOSFET- LED, LCD, Photo Diode, Photo transistor, Charge Coupled Device.

Outcomes

On completion of the course, students will be able to

1. Apply the knowledge of basic types of semiconductor devices on single junction devices
2. Analyze the performance bipolar junction devices in different configuration and its characteristics
3. To understand the concept of semiconductor diode
4. To learn the operation and characteristics of BJT and FET transistors.
5. To study various types of special semiconductor devices, power devices.

TOTAL PERIODS 45

Text Books

1. Donald A Neaman, "Semiconductor Physics and Devices", Third Edition, Tata McGrawHill Inc. 2007.
2. Robert Boylestad and Louis Nashelsky, "Electron Devices and Circuit Theory" Pearson Prentice Hall, 10th edition,July 2008.

References

1. Yang, "Fundamentals of Semiconductor devices", McGraw Hill International Edition, 1978.
2. R.S.Sedha, ― A Text Book of Applied Electronics‖ S.Chand Publications, 2006.
3. Salivahanan. S, Suresh Kumar. N, Vallavaraj.A, ―Electronic Devices and circuits‖, Third Edition, Tata McGraw- Hill, 2008.

Semester	II	L	T	P	C
Course code/ Title	191ME21A ENGINEERING PRACTICES LABORATORY	0	0	4	2
Objectives	• To provide exposure to the students with hands on experience on various basic engineering practices in Civil, Mechanical, Electrical and Electronics Engineering.				

GROUP A (CIVIL & MECHANICAL)

I CIVIL ENGINEERING PRACTICE		**13**
1.	**Buildings:** (a) Study of plumbing and carpentry components of residential and industrial buildings, Safety aspects.	
2.	**Plumbing Works:** (a) Study of pipeline joints, its location and functions: valves, taps, couplings, unions, reducers, and elbows in household fittings. (b) Study of pipe connections requirements for pumps and turbines. (c) Preparation of plumbing line sketches for water supply and sewage works. (d) Hands-on-exercise: Basic pipe connections – Mixed pipe material connection – Pipe connections with different joining components. (e) Demonstration of plumbing requirements of high-rise buildings.	
3.	**Carpentry using Power Tools only:** (a) Study of the joints in roofs, doors, windows and furniture. (b) Hands-on-exercise: Wood work, joints by sawing, planing and cutting.	
II MECHANICAL ENGINEERING PRACTICE		**18**
1.	**Welding:** (a) Preparation of butt joints, lap joints and T- joints by Shielded metal arc welding. (b) Gas welding practice	
2.	**Basic Machining:** (a) Simple Turning and Taper turning (b) Drilling Practice	
3.	**Sheet Metal Work:** (a) Forming & Bending (b) Model making – Trays and funnels (c) Different type of joints.	
4.	Machine assembly practice: (a) Study of centrifugal pump (b) Study of air conditioner	
5.	**Demonstration on:** (a) Smithy operations, upsetting, swaging, setting down and bending. Example – Exercise – Production of hexagonal headed bolt. (b) Foundry operations like mould preparation for gear and step cone pulley. Fitting – Exercises – Preparation of square fitting and V – fitting models	

GROUP B (ELECTRICAL & ELECTRONICS)

III ELECTRICAL ENGINEERING PRACTICE		**13**
1.	Residential house wiring using switches, fuse, indicator, lamp and energy meter.	
2.	Fluorescent lamp wiring.	
3.	Stair case wiring	
4.	Measurement of electrical quantities – voltage, current, power & power factor in RLC circuit.	
5.	Measurement of energy using single phase energy meter.	
6.	Measurement of resistance to earth of an electrical equipment.	
IV ELECTRONICS ENGINEERING PRACTICE		**16**
1.	Study of Electronic components and equipments – Resistor, colour coding measurement of AC signal parameter (peak-peak, rms period, frequency) using CR.	
2.	Study of logic gates AND, OR, EX-OR and NOT.	
3.	Generation of Clock Signal.	
4.	Soldering practice – Components Devices and Circuits – Using general purpose PCB.	
5.	Measurement of ripple factor of HWR and FWR.	
Outcomes	On completion of the course, students will be able to 1. Use mechanical and civil engineering equipments to join the structures and perform basic machining operations and fabricate models in sheet meta 2. Use electrical and electronics engineering equipments to test the respective electrical and electronic parameters	
TOTAL		**60 Periods**

LIST OF EQUIPMENTS

Requirements for a batch of 30 students

S.NO	Description of the Equipment	Quantity Required
	Civil	
1	Assorted components for plumbing consisting of metallic pipes, plastic pipes, flexible pipes, couplings, unions, elbows, plugs and other fittings.	15 sets
2	Carpentry vice (fitted to work bench)	15 Nos.
3	Standard woodworking tools	15 sets
4	Models of industrial trusses, door joints, furniture joints	5 Each
5	Power Tools: a) Rotary Hammer b) Demolition Hammer c) Circular Saw d) Planer e) Hand Drilling Machine f) Jigsaw	2 Nos 2 Nos 2 Nos. 2 Nos. 2 Nos. 2 Nos.
	MECHANICAL	
1	Arc welding transformer with cables and holders	5 Nos
2	Welding booth with exhaust facility	5 Nos
3	Welding accessories like welding shield, chipping hammer, wire brush, etc.	5 Nos
4	Oxygen and acetylene gas cylinders, blow pipe and other welding outfit.	2 Nos
5	Centre lathe	2 Nos
6	Hearth furnace, anvil and smithy tools	2 Nos
7	Moulding table, foundry tools	2 Nos
8	Power Tool: Angle Grinder	2 Nos
9	Study-purpose items: centrifugal pump, air-conditioner	One Each
	ELECTRICAL	
1	Assorted electrical components for house wiring	15 Nos
2	Electrical measuring instruments	10 Nos
3	Study purpose items: Iron box, fan and regulator, emergency lamp	1 No
4	Megger (250V/500V)	1 No
5	Power Tools: (a) Range Finder (b) Digital Live-wire detector	 2 Nos 2 Nos

	ELECTRONICS	
1	Soldering guns	10 Nos
2	Assorted electronic components for making circuits	50 Nos
3	Small PCBs	10 Nos
4	Multimeters	10 Nos
5	Study purpose items: Telephone, FM radio, low-voltage power supply	

Semester	II	L	T	P	C
Course code/ Title	191CS21A PROBLEM SOLVING AND PYTHON PROGRAMMING LAB	0	0	2	1
Objectives	• To write, test, and debug simple Python programs. • To implement Python programs with conditionals and loops. • Use functions for structuring Python programs. • Represent compound data using Python lists, tuples, dictionaries. • Read and write data from/to files in Python.				
List of Exercises					
1.	Compute the GCD of two numbers.				
2.	Find the square root of a number (Newton‘s method)				
3.	Exponentiation (power of a number)				
4.	Find the maximum of a list of numbers				
5.	Linear search and Binary search				
6.	Selection sort, Insertion sort				
7.	Merge sort				
8.	First n prime numbers				
9.	Multiply matrices				
10.	Programs that take command line arguments (word count)				
11.	Find the most frequent words in a text read from a file				
12.	Simulate elliptical orbits in Pygame				
13.	Simulate bouncing ball using Pygame				
Outcomes	On completion of the course, students will be able to 1. Solve problems using conditionals and loops in Python. 2. Develop Python programs by defining functions. 3. Represent lists, Tuples and dictionaries for compound data. 4. Develop Python programs using files.				
TOTAL	30 Periods				

List of Equipments
Requirements for a batch of 30 students

S.NO	Description of the Equipment	Quantity Required
1	Standalone desktops with Python (3 interpreter for Windows/Linux)	30
2	Server with Python (3 interpreter for Windows/Linux)	1

Semester	II	L	T	P	C
Course code/ Title	191EC22A / CIRCUITS AND DEVICES LABORATORY	0	0	4	2
Objectives	• To learn the characteristics of basic electronic devices such as Diode, BJT,FET, SCR • To understand the working of RL,RC and RLC circuits • To gain hand on experience in Thevenin & Norton theorem, KVL & KCL, and Super Position Theorems				
List of Exercises					
1.	Characteristics of PN Junction Diode.				
2.	Zener diode Characteristics & Regulator using Zener diode.				
3.	Common Emitter input-output Characteristics.				
4.	Common Emitter input-output Characteristics.				
5.	Common Base input-output Characteristics.				
6.	FET Characteristics.				
7.	SCR Characteristics.				
8.	Clipper and Clamper &FWR.				
9.	Verifications Of Thevenin & Norton theorem.				
10.	Verifications of maximum power transfer & reciprocity theorem.				
11.	Verifications Of Super Position Theorem.				
12.	Verifications Of KVL & KCL.				
13.	Determination Of Resonance Frequency of Series & Parallel RLC Circuits.				
Outcomes	On completion of the course, students will be able to 1. Construct and Analyze the characteristics of PN junction diode , Zener diode and Silicon Controlled Rectifier, FET. 2. Design and Implement the various Amplifiers like Common Emitter, Common Base and observe their frequency responses. 3. Verify different network theorems				
TOTAL	60 Periods				

LIST OF EQUIPMENTS

Requirements for a batch of 30 students

S.NO	Description of the Equipment	Quantity Required
1	BC107,BC148,2N2646,BFW10	25
2	IN4007,Zener diodes	25
3	Resistors, Capacitors, Inductors-	100
4	Bread Boards	15
5	CRO(30MHz)	15
6	Function Generators(3MHz)	10
7	Dual Regulated power Supplies(0-30V)	10

Semester	III	L	T	P	C
Course Code/ Title	191EC321/DIGITAL LOGIC CIRCUIT DESIGN	3	0	0	3
Objectives	• To present the Digital fundamentals, Boolean algebra and its applications in digital systems • To familiarize with the design of various combinational digital circuits using logic gates • To introduce the analysis and design procedures for synchronous and asynchronous sequential circuits • To explain the various semiconductor memories and related technology				

Unit-I	Boolean Algebra	9

Boolean algebra – Basic postulates, Theorems - Switching functions, canonical forms-logic gates-Simplification of logic functions using K-maps and Quine McClusky method - Implementation using logic gates.

Unit-II	Combinational Logic Circuits	9

Analysis and Design of combinational circuits, Design of Half and Full Adders, Half and Full Subtractors, Decoders, Encoders, Multiplexers and Demultiplexers, Binary/ BCD adder, subtractor- Carry look ahead adder-magnitude comparator- parity generator and checker-Code convertors.

Unit-III	Synchronous Sequential Logic Circuits	9

General model of sequential circuits- flip-flops- latches - Master slave configuration - Mealy/Moore models – state diagram - state table, state reduction procedures - Design of synchronous sequential circuits -up/down counter, modulo N counters - shift registers – universal Shift Register , Ring counter, Johnson counter.

Unit-IV	Asynchronous Sequential Logic Circuits	9

Introduction to asynchronous sequential circuits - Analysis and Design of asynchronous sequential circuits - fundamental mode and pulse mode circuits, races-cycles- race free state assignment, Hazards, Essential Hazards, Design of Hazard free circuits.

Unit-V	Memory and Verilog	9

Classification of memories- ROM- RAM- SRAM- DRAM - Introduction to PLDs- PROM- PAL- PLA-Implementation of functions using PLDs.

Introduction to Hardware Description Language- Verilog description of combinational logic circuits. Verilog description of sequential logic circuits

Outcomes	On completion of the course, students will be able to 1. Apply the theorems and postulates of Boolean algebra, for simplification of logic functions. 2. Design combinational logic circuits for various applications and implement using logic gates. 3. Design and implement synchronous sequential logic circuits using different flip flops. 4. Analyze the given Asynchronous sequential logic circuit to determine its function. 5. Implementation of PLD's and simulate of combinational and sequential circuits using HDL.

TOTAL PERIODS 45

Text Books

1. M.Morris Mano & Michael D.Ciletti, Digital Design, First impression, Pearson, 2012.

2. John F. Wakerly, Digital Design Principles and Practices, Fifth Edition, Pearson Education, 2017.

References

1. Charles H. Roth Jr, Larry L. Kinney, Fundamentals of Logic Design, Sixth Edition, CENGAGE Learning, 2013
2. Stephen D. Brown, and ZvonkoVranesic, "Fundamentals of Digital Logic with VerilogDesign, 2nd Edition," McGraw Hill, June, 2007

3. J.Baskar, “A Verilog HDL Primer”, Third Edition,2005,Star Galaxy publishing
4. William Kleitz, “Digital Electronics: A Practical Approach with VHDL”, Ninth Edition, Pearson,2002.

Semester	III	L	T	P	C
Course Code/ Title	191EC322/ ELECTRONIC CIRCUITS I	3	0	0	3
Objectives	• To understand the methods of biasingtransistors • To design and analyze single stage amplifiercircuits • To design and analyze multistage and differential amplifier circuits. • To analyze the frequency response of amplifiers				

Unit-I	BIASING OF DISCRETE BJT, FET AND RECTIFIERS	9

DC Load Line and Bias Point – Various biasing methods of BJT – Bias Circuit Design - Thermal stability - Stability factors - Bias compensation techniques using Diode, thermistor and senses tor – Various biasing methods of JFET and MOSFET -Rectifiers and Filters

Unit-II	SMALL SIGNAL ANALYSIS OF BIPOLAR JUNCTION TRANSISTOR	9

AC Load line-Small Signal Hybrid π equivalent circuit of BJT – Early effect - Analysis of CE, CC and CB amplifiers using Hybrid π equivalent circuits-Current sources circuits-Small signal analysis of active load circuits.

Unit-III	SMALL SIGNAL ANALYSIS OF FIELD EFFECT TRANSISTOR	9

Small Signal Hybrid π equivalent circuit of JFET and MOSFET - Analysis of CS, CD and CG amplifiers using Hybrid π equivalent circuits

Unit-IV	MULTISTAGE AND DIFFERENTIAL AMPLIFIERS	9

Needformultistageamplifier-Gainofmultistageamplifier– Cascadeamplifiers-Cascodeamplifiers-Darlington amplifiers-Differential amplifier – Basic Differential pair BJT and FET - Frequency response of the Differential amplifier-CMRR.

Unit-V	FREQUENCY RESPONSEOFAMPLIFIERS	9

Amplifier frequency response – Frequency response of transistor amplifiers with circuit capacitors– BJT frequency response – short circuit current gain - cut off frequency – fα, fβ and unity gain bandwidth – Miller effect - frequency response of FET - High frequency response of transistor circuits - Transistor Switching Times.

Outcomes	On completion of the course, students will be able to 1. Understand the varies biasing techniques of BJT and FET 2. Interpret the performance of small signal equivalent BJT amplifier 3. Evaluate the performance of small signal JFET and MOSFET amplifier 4. Analyze the performance of multistage and differential amplifier. 5. Design and analyze the frequency response of amplifier in BJT and FET

TOTAL PERIODS 45

Text Books

1. Donald. A. Neamen, Electronic Circuits Analysis and Design, 3rd Edition, McGraw Hill Education (India)Private Ltd., 2010.
2. Robert L. Boylestadand Louis Nasheresky, -Electronic Devices and Circuit Theory‖, 11th Edition, Pearson Education, 2013.

References

1. Millman J, Halkias.C.and Sathyabrada Jit, Electronic Devices and Circuits, 4th Edition, McGraw Hill Education (India) Private Ltd., 2015.
2. Floyd, Electronic Devices, Ninth Edition, Pearson Education, 2012.
3. David A. Bell, Electronic Devices & Circuits, 5th Edition, Oxford University Press, 2008.

Semester	III	L	T	P	C
Course code/ Title	191EC323/ SIGNALS AND SYSTEMS	2	2	0	3

Objectives	• To familiarize with the basic concepts and properties of Signals & Systems • To analyze continuous time signals and systems using Fourier and Laplace transform • To understand the methods of characterization of LTI systems in time domain • To analyze discrete time signals and systems in the Fourier and Z transform domain

Unit-I	Classification of signals and systems	9

Standard signals- Step, Ramp, Pulse, Impulse, Real and complex exponentials and Sinusoids - Classification of signals – Continuous time (CT) and Discrete Time (DT) signals, Periodic & Aperiodic signals, Deterministic & Random signals, Energy & Power signals - Classification of systems- CT systems and DT systems- – Linear & Nonlinear, Static & Dynamic ,Time-variant & Time-invariant, Causal & Non-causal, Stable & Unstable.

Unit-II	Analysis of Continuous time signals	9

Fourier series for periodic signals - Fourier Transform and its properties- Laplace transforms and its properties

Unit-III	Linear Time Invariant continuous time systems	9

Impulse response - convolution integrals- Differential Equation- Fourier and Laplace transforms in Analysis of CT systems - Systems connected in series / parallel.

Unit-IV	Analysis of Discrete time signals	9

Fourier Transform of discrete time signals (DTFT) – Properties of DTFT - Z Transform & Properties- Baseband signal Sampling – Sampling and aliasing.

Unit-V	Linear Time Invariant- Discrete time systems	9

Impulse response – Difference equations-Convolution sum- Discrete Fourier Transform and Z Transform Analysis of Recursive & Non-Recursive systems-DT systems connected in series and parallel.

Outcomes	Upon completion of the course, students should able to: 1. Determine the various properties of signals and systems. 2. Analyze Continuous time signals using Fourier and Laplace Transforms. 3. Compute the output of continuous time LTI systems using Fourier and Laplace Transforms. 4. Analyze Discrete time signals using Z transform and DTFT. 5. Compute the output of Discrete time LTI systems using Z transform and DTFT.

TOTAL PERIODS 45

Text Books

1. Allan V.Oppenheim, S.Wilsky and S.H.Nawab, “Signals and Systems”, Pearson, 2015.

References

1.B. P. Lathi, “Principles of Linear Systems and Signals”, Second Edition, Oxford, 2009.
2.E.Zeimer, W.H.Tranter and R.D.Fannin, “Signals & Systems - Continuous and Discrete”, Pearson, 2007.
3.John Alan Stuller, “An Introduction to Signals and Systems”, Thomson, 2007.

Semester	III	L	T	P	C
Course Code/ Title	191MA304/Linear Algebra and Partial Differential Equations	2	2	0	3

Objectives

- To introduce the basic notions of groups, rings, fields which will then be used to solve related problems
- To understand the concepts of vector space, linear transformations and diagonalization.
- To apply the concept of inner product spaces in orthogonalization.
- To understand the procedure to solve partial differential equations.
- To give an integrated approach to number theory and abstract algebra, and provide a firm basis for further reading and study in the subject.

Unit-I	VECTOR SPACES	12

Vector spaces – Subspaces – Linear combinations and linear system of equations – Linear independence and linear dependence – Bases and dimensions.

Unit-II	LINEAR TRANSFORMATION AND DIAGONALIZATION	12

Linear transformation - Null spaces and ranges - Dimension theorem - Matrix representation of a linear transformations - Eigenvalues and eigenvectors – Diagonalizability.

Unit-III	INNER PRODUCT SPACES	12

Inner product, norms - Gram Schmidt orthogonalization process - Adjoint of linear operations - Least square approximation.

Unit-IV	PARTIAL DIFFERENTIAL EQUATIONS	12

Formation – Solutions of first order equations – Standard types and equations reducible to standard types – Singular solutions – Lagrange‟s linear equation – Integral surface passing through a given curve – Classification of partial differential equations - Solution of linear equations of higher order with constant coefficients – Linear non-homogeneous partial differential equations.

Unit-V	FOURIER SERIES SOLUTIONS OF PARTIAL DIFFERENTIAL	12

Dirichlet‟s conditions – General Fourier series – Half range sine and cosine series - Method of separation of variables – Solutions of one dimensional wave equation and one-dimensional heat equation – Steady state solution of two-dimensional heat equation – Fourier series solutions in Cartesian coordinates.

Outcomes

On completion of the course, students will be able to

1. Analyze the vectors in Rn geometrically and algebraically.
2. Relate the concepts of Span, Dimension and basics to various vector spaces.
3. Apply Gram – Schmidt process to find linearly independent vectors.
4. Understand how to solve the given standard partial differential equations.
5. Appreciate the physical significance of Fourier series techniques in solving one and two dimensional Heat flow problems

TOTAL PERIODS 60

Text Books

1. Grewal B.S., “Higher Engineering Mathematics”, Khanna Publishers, New Delhi, 43rd Edition, 2014.
2. Friedberg, A.H., Insel, A.J. and Spence, L., “Linear Algebra”, Prentice Hall of India, New Delhi, 2004

Semester	III	L	T	P	C
Course Code/ Title	191CS311/ Data Structures in C	3	0	0	3
Objectives	• To learn the features of C • To learn the linear and non-linear data structures • To explore the applications of linear and non-linear data structures • To learn to represent data using graph data structure • To learn the basic sorting and searching algorithms				

Unit-I	C Programming Basics	9

Structure of a C program – compilation and linking processes – Constants, Variables – Data Types – Expressions using operators in C – Managing Input and Output operations – Decision Making and Branching – Looping statements. Arrays – Initialization – Declaration – One dimensional and Two-dimensional arrays. Strings- String operations – String Arrays. Simple programs – sorting, searching – matrix operations.

Unit-II	Functions, Pointers, Structures and Unions	9

Functions – Pass by value – Pass by reference – Recursion – Pointers - Definition – Initialization – Pointers arithmetic. Structures and unions - definition – Structure within a structure - Union - Programs using structures and Unions – Storage classes, Pre-processor directives.

Unit-III	Linear Data Structures	9

Arrays and its representations – Stacks and Queues – Linked lists – Linked list-based implementation of Stacks and Queues – Evaluation of Expressions – Linked list based polynomial addition.

Unit-IV	Non-Linear Data Structures	9

Trees – Binary Trees – Binary tree representation and traversals –Binary Search Trees – Applications of trees. Set representations - Union-Find operations. Graph and its representations – Graph Traversals.

Unit-V	Searching and Sorting Algorithms	9

Linear Search – Binary Search. Bubble Sort, Insertion sort – Merge sort – Quick sort - Hash tables – Overflow handling.

Outcomes

On completion of the course, students will be able to

1. Describe the basics of C programming language
2. Illustrate the concepts of functions, pointers, structures and unions for the given application
3. Interpret and implement linear data structure operations in C
4. Analyze and evaluate non linear data structure for the given application
5. Apply the hashing concepts and choose the appropriate sorting and searching algorithm for an application

TOTAL PERIODS 45

Text Books

1. PradipDey and ManasGhosh, ―Programming in C, Second Edition, Oxford University Press, 2011.
2. Ellis Horowitz, SartajSahni, Susan Anderson-Freed, ―Fundamentals of Data Structures in C, Second Edition, University Press, 2008.

References

1. Mark Allen Weiss, ―Data Structures and Algorithm Analysis in C, Second Edition, Pearson Education, 1996
2. Alfred V. Aho, John E. Hopcroft and Jeffrey D. Ullman, ―Data Structures and Algorithms, Pearson Education, 1983.
3. Robert Kruse, C.L.Tondo, Bruce Leung, ShashiMogalla , ― Data Structures and Program Design in C, Second Edition, Pearson Education, 2007

4. Jean-Paul Tremblay and Paul G. Sorenson, ―An Introduction to Data Structures with Applications, Second Edition, Tata McGraw-Hill, 1991.

Semester	III	L	T	P	C
Course Code/ Title	191HS301/MANAGEMENT SCIENCE	3	0	0	3

Objectives	• It makes the students aware of what is management • Students learn how to overcome unexpected problems themselves • It makes them active listeners by which they can be effective speakers • Students become expertise in their written communication particularly • It improves the academic standards and the employability skills

Unit-I	Managerial Skills	9

Management Introduction - Time Management – Stress Management - employability and career Skills—grooming as a professional with values - General awareness of Current Affairs.

Unit-II	Listening Skills	9

Importance of listening – Active listening - Asking questions – Responding to the questions - Listen to the Audio – visual components – Listening Comprehension

Unit-III	Speaking Skills	9

General Conversation – Question and Answer sessions - Role play activities - Telephone skills - Public Speaking

Unit-IV	Writign Skills	9

Effective writing - Letter writing – E-mail writing – Paragraph writing – Report writing

Unit-V	Presentation Skills	9

Introduction to Presentation –Building up confidence - Effective Presentation – Body Language - Poster presentations – seminars relevant to Management

Outcomes	On completion of the course, students will be able to 1. Overcome the stress in their respective field 2. Be an active listener so as to respond accurately and effectively 3. Raise and respond to the queries without any hesitation 4. Write effectively and to draft letters, E-mails impressively. **5.** Deliver presentations confidently

TOTAL PERIODS 45

Text Books

1. Dhanavel, S. P. English and Communication Skills for Students of Science and Engineering, Orient Blackswan, Chennai – 2011.
2. Communication Skills. Sanjay Kumar and Pushp Lata. Oxford University Press. 2011.
3. Raman, Meenakshi and Sangeeta Sharma. Professional Communication. Oxford University Press: Oxford, 2014
4. S. Hariharanetal. Soft Skills. MJP Publishers: Chennai, 2010.

References

1. Mark Allen Weiss, ―Data Structures and Algorithm Analysis in C, Second Edition, Pearson Education, 1996
2. Alfred V. Aho, John E. Hopcroft and Jeffrey D. Ullman, ―Data Structures and Algorithms, Pearson Education, 1983.
3. Robert Kruse, C.L.Tondo, Bruce Leung, ShashiMogalla , ― Data Structures and Program Design in C, Second Edition, Pearson Education, 2007
4. Jean-Paul Tremblay and Paul G. Sorenson, ―An Introduction to Data Structures with Applications, Second Edition, Tata McGraw-Hill, 1991.

Semester	III	L	T	P	C
Course code/ Title	191EC32A/ Analog and Digital Electronics Laboratory	0	0	4	2
Objectives	• Study the Frequency response of CE, CB and CC Amplifier • Learn the frequency response of CS Amplifiers • Study the Transfer characteristics of differential amplifier • Perform experiment to obtain the bandwidth of single stage and multistage amplifiers • Perform SPICE simulation of Electronic Circuits • Design and implement the Combinational and sequential logic circuits				
Analog Experiments					
1.	Frequency Response of CE, CB, CC and CS amplifiers				
2.	Darlington Amplifier				
3.	Differential Amplifier Transfer characteristics, CMRR Measurement				
4.	Cascode and Cascade amplifiers				
5.	Determination of bandwidth of single stage and multistage amplifiers				
6.	Analysis of FET, MOSFET with fixed bias, self-bias and voltage divider bias using simulation software like Spice				
7.	Analysis of Cascode and Cascade amplifiers using Spice				
8.	Analysis of Frequency Response of BJT and FET using Spice				
Digital Experiments					
1.	Design and implementation of code converters using logic gates(i) BCD to excess 3 code and vice versa (ii) Binary to gray and vice-versa				
2.	Design and implementation of 4 bit binary Adder/ Subtractor and BCD adder using IC 7483				
3.	Design and implementation of Multiplexer and De multiplexer using logic gates				
4.	Design and implementation of encoder and decoder using logic gates				
5.	Construction and verification of 4 bit ripple counter and Mod -10 / Mod-12 Ripple counters				
6.	Design and implementation of 3-bit synchronous up/down counter				
Outcomes	On completion of the course, students will be able to 1. Design and analyze bandwidth of single stage and multi stage of BJT/FET amplifiers. 2. Simulate and analyze amplifier circuits using PSPICE. 3. Build combinational logic circuits for a given application using logic gates, multiplexers, decoders and encoders				
TOTAL PERIODS 60					

Semester	III	L	T	P	C
Course code/ Title	191CS31A/ Data Structures in C Laboratory	0	0	2	1
Objectives	• To understand and implement basic data structures using C • To apply linear and non-linear data structures in problem solving • To learn to implement functions and recursive functions by means of data structures • To implement searching and sorting algorithms				
List of Exercises					
1.	Basic C Programs – looping, data manipulations, arrays				
2.	Programs using strings – string function implementation				
3.	Programs using structures and pointers				
4.	Programs involving dynamic memory allocations				
5.	Array implementation of stacks and queues				
6.	Linked list implementation of stacks and queues				
7.	Application of Stacks and Queues				
8.	Implementation of Trees, Tree Traversals				
9.	Implementation of Binary Search trees				
10.	Implementation of Linear search and binary search				
11.	Implementation Insertion sort, Bubble sort, Quick sort and Merge Sort				
12.	Implementation Hash functions, collision resolution technique				
Outcomes	On completion of the course, students will be able to 1. Illustrate the basic and advanced program in C. 2. Implement the different operations of stack, queue, linked list and search trees.. 3. Demonstrate the graph traversal algorithms.				
TOTAL PERIODS 30					

Semester	IV	L	T	P	C
Course Code/ Title	191EC421/Analog communication	3	0	0	3

Objectives	• To introduce the concept of various amplitude modulations and their spectral characteristics. • To be familiarized with noise theory and its effects in communication systems. • To understand the performance of various receivers • To gain knowledge of information and coding techniques.

Unit-I	Amplitude Modulation	9

Amplitude Modulation- DSBSC, DSBFC, SSB, VSB - Modulation index, Spectra, Power relations and Bandwidth – AM Generation – Square law and Switching modulator, DSBSC Generation – Balanced and Ring Modulator, SSB Generation – Filter, Phase Shift and Third Methods, VSB Generation – Filter Method, Hilbert Transform, Pre-envelope & complex envelope –comparison of different AM techniques.

Unit-II	Analog Modulation	9

Phase and frequency modulation, Narrow Band and Wide band FM – Modulation index, Spectra, Power relations and Transmission Bandwidth - FM modulation –Direct and Indirect methods, FM Demodulation – FM to AM conversion, FM Discriminator - PLL as FM Demodulator.

Unit-III	Noise Theory	9

Narrow band noise – PSD of in-phase and Quadrature noise –Noise performance in AM systems – Noise performance in FM systems – Pre-emphasis and de-emphasis – Capture effect, threshold effect. Noise sources and types – Noise figure and noise temperature – Noise in cascaded systems.

Unit-IV	Receivers	9

Radio receiver – receiver types – Tuned Radio Frequency receiver, Super heterodyne receiver, RF section and Characteristics – Frequency changing and tracking, Intermediate frequency, AGC, FM receiver, Comparison with AM receiver.

Unit-V	Information Theory and Coding	9

Measure of information –Entropy - Discrete Memory less channels - Channel Capacity -Hartley - Shannon law - Source coding theorem - Huffman & Shannon - Fano codes.

Outcomes	**Upon completion of the course, the student should be able to:** 1. Apply the amplitude modulation techniques for band pass communication. 2. Describe various analog modulation techniques and bandwidth utilized. 3. Analyze the noise performance in AM and FM system. 4. Gain the knowledge of the components used in communication receivers 5. Evaluate source information and coding techniques used to minimize errors

TOTAL PERIODS 45

Text Books

1. J.G.Proakis, M.Salehi, ―Fundamentals of Communication Systems‖, Pearson Education 2014.
2. Simon Haykin, ―Communication Systems‖, Wiley Publication, New Delhi, 2011.

References

1 . Simon Haykin, ―Analog and digital communication, Wiley Publication, New Delhi, 2011.
2.WayneTomasi,'Advanced Electronic communication system,'6th Edition Pearson Education 2009.
3.Proakis J.G., ``Digital Communications", 4th Edition, McGraw Hill, 2000.

Semester	IV	L	T	P	C
Course Code/ Title	191EC422/ELETRONIC CIRCUITS-II	3	0	0	3
Objectives	• To give a comprehensive exposure to all types of amplifiers and oscillators, constructed with discrete components. This helps to develop a strong basis for building linear and digital integrated circuits • To understand the analysis and design of LC and RC oscillators, amplifiers, multivibrator and power amplifiers				

Unit-I	Feedback Amplifiers	9

Basic principles and types of feedback - Gain of an amplifier employing feedback - Effect of feedback (negative) on gain, stability, distortion and bandwidth of amplifier-Input and output impedances-Frequency compensation.

Unit-II	Oscillators	9

Use of positive feedback -Barkhausen criterion for oscillation – Different oscillator circuits -Phase shift, Wien bridge, Twin T - Hartley & Colpitt‘s oscillators – Clapp oscillator-Tuned oscillators, Ring oscillators and crystal oscillators – oscillator amplitude stabilization.

Unit-III	Tuned Amplifiers	9

Coil losses, unloaded and loaded Q of tank circuits, Analysis of single tuned amplifier, double tuned, stagger tuned amplifiers, instability of tuned amplifiers, stabilization techniques, Narrow band neutralization using coil, Broad banding using Hazeltineneutralization,ClassCtunedamplifiersandtheirapplications.EfficiencyofClassCtunedAmplifier.

Unit-IV	Wave Shaping and Multivibrator Circuits	9

Pulse circuits – RC integrator and differentiator circuits – diode clampers and clippers –Multivibrators Astable, monostable, bitable- Schmitt Trigger- UJT waveform generator.

Unit-V	Power Amplifiers	9

Difference between voltage and power amplifiers - Importance of impedance matching in amplifiers - Class A, Class B, Class AB, and Class C amplifiers –Switched mode Power Amplifier (SMPA)-Power BJTs.

Outcomes	**Upon completion of the course, the student should be able to:** 1. Describe the Basic Concepts of Feedback Amplifiers 2. Construct and develop the various types of Oscillators 3. Analyze the performance of Tuned Amplifiers 4. Design the different types of Wave Shaping and Multivibrator Circuits 5. Examine the performance of Power Amplifiers and Dc Convertors

TOTAL PERIODS 45

Text Books

1. Sedra and Smith, ―Micro Electronic Circuits‖; Sixth Edition, Oxford University Press, 2011.
2. Jacob Millman, Microelectronics, McGraw Hill, 2nd Edition, Reprinted, 2009.

References

1. Robert L. Boylestad and Louis Nasheresky, Electronic Devices and Circuit Theory‖, 10th Edition, Pearson Education / PHI, 2008
2. David A. Bell, ―Electronic Devices and Circuits, Fifth Edition, Oxford University Press, 2008.

Semester	IV	L	T	P	C
Course Code/ Title	191EC423/ELECTROMAGNETIC FIELDS	2	2	0	3

Objectives

- To gain conceptual and basic mathematical understanding of electric and magnetic fields in free space and in materials.
- To understand the coupling between electric and magnetic fields through Faraday's law, displacement current and Maxwell's equations.
- To understand wave propagation in lossless and in lossy media.
- To be able to solve problems based on the above concepts.

Unit-I **Introduction and Vector Analysis** **12**

Nature of scalar and vectors , Review of vector algebra, Rectangular, cylindrical and spherical coordinate systems, Vector differential operator, Gradient, Divergence, Curl operators, Divergence theorem, Stoke's theorem, Null identities, Helmholtz's theorem.

Unit-II **Electrostatics** **12**

Electric field intensity , Electric flux density- Electric field intensity due to different charge distribution, Coulomb's law, Gauss's law and applications, Gauss divergence theorem, Boundary conditions, Capacitance, Parallel, cylindrical and spherical capacitors, Electrostatic energy and energy density

Unit-III **Magnetostatics** **12**

Magnetic field intensity, , Magnetic flux density, Biot- Savart law and applications , Ampere's circuital law, Lorentz force equation, Scalar and Vector magnetic potential, Boundary conditions, Inductor- Inductance evaluation of Toriod, Coaxial cable, Transmission line, electromagnetic boundary condition

Unit-IV **Time-Varying Fields And Maxwell's Equations** **12**

Faraday's law, Displacement current and Maxwell-Ampere law, Maxwell's equations, Potential functions, Electromagnetic boundary conditions, Wave equations and solutions, Time-harmonic fields.

Unit-V **Plane Electromagnetic Waves** **12**

Plane waves in lossless media, Plane waves in lossy media (low-loss dielectrics and good conductors), Group velocity, Electromagnetic power flow and Poynting vector, Normal incidence at a plane conducting boundary, Normal incidence at a plane dielectric boundary

Outcomes

Upon completion of the course, the student should be able to:

1. Describe the fundamental electromagnetic laws and concepts.
2. Solve simple problems requiring estimation of electric quantities based on these concepts and laws
3. Executing simple problems requiring the estimation of magnetic quantities based on these concepts.
4. Reviewing Maxwell's equations in integral, differential forms and their physical meaning.
5. Experimenting electromagnetic wave propagation in lossy and in lossless media.

TOTAL PERIODS 60

Text Books

1.D.K. Cheng, Field and wave electromagnetics, 2nd ed., Pearson (India), 1989 (UNIT I, II,III IV,V).
2.W.H. Hayt and J.A. Buck, Engineering electromagnetics, 7th ed., McGraw-Hill (India), 2006 (UNIT I-V).

References

1. M.N.O Sadiku and S.V Kulkarni, Principles of electromagnetic, 6th ed., Oxford(Asian Edition), 2015
2. D.J Griffiths, Introduction to electrodynamics, 4th ed., pearson (India), 2013.
3. Narayana Rao, N: Engineering Electromagnetics, 3rd ed., Prentice Hall, 1997.

Semester	IV	L	T	P	C
Course Code/ Title	191EC424/ LINEAR INTEGRATED CIRCUITS	3	0	0	3

Objectives

- To learn the basics concepts, characteristics and linear and non-linear applications of operational Amplifier.
- To understand the operation and applications of Timer 555 and PLL.
- To learn the need and types of ADC and DAC
- To learn the operation of Voltage Regulators and concepts of waveform generation.

Unit-I — **Operational Amplifiers and its Characteristics** — **9**

Introduction to OP-AMPs- Characteristics of an Ideal Operational Amplifier –AC Characteristics-CMRR-Slew Rate - Frequency response-DC Characteristics-JFET OP-AMP TL082-Open and closed loop configurations:- Inverting and Non inverting amplifiers - Voltage Follower.

Unit-II — **Applications of operational amplifier** — **9**

Summing amplifier - Differential amplifier-Log and Antilog amplifier - Instrumentation amplifier - Integrator and Differentiator – V-I and I-V Convertors. Active filters - Low pass, High pass, Band pass and Band stop Butterworth filters - Precision diode- Half Wave and Full wave Rectifiers –Comparators-Clipper and Clamper.

Unit-III — **Timer IC and Phase Locked Loop** — **9**

IC 555 Timer Functional block diagram and description – Astable and Monostable operation - Voltage Controlled Oscillator-PLL: - Principle of operation - Building blocks - Characteristics - Derivations of expressions for Lock and Capture ranges - Applications: Frequency Synthesis - Frequency Translation - AM and FM detection.

Unit-IV — **A-D and D-A Converters** — **9**

Digital to Analog converters - Binary weighed and R-2R Ladder types - Analog to digital converters - Sample and Hold circuit - successive approximation, single, dual slope and parallel types - DAC/ADC performance characteristics.

Unit-V — **Waveform Generators and Voltage Regulators** — **9**

Sinusoidal Oscillators-Wein Bridge, RC Phase oscillators – Multivibrators using IC741-Astable, Monostable and Schmitt Trigger. Voltage Regulators- Series and Shunt regulators- Current limiting and protection circuits - Switched mode power supplies – IC723 General purpose voltage regulators.

Outcomes

Upon completion of the course, the student should be able to:

1. Analyze the internal circuit of OP-AMP and its Characteristics.
2. Interpret the Linear and Non-Linear Applications of OP-AMP.
3. Describe the operation of PLL, VCO and its applications.
4. Design Analog to Digital and Digital to Analog Convertor by using OP-AMP.
5. Construct various waveforms using OP-AMP circuits and Special Function ICs.

TOTAL PERIODS 45

Text Books

1.Roy Choudhury and Shail Jain "Linear Integrated Circuits", Wiley Eastern, New Delhi,5th Edition,Reprint 2018.

2.Sonde, B.S, ―Introduction to System Design using Integrated Circuits‖, Second Edition, Wiley Eastern Limited, New Delhi, 1994.

References

1.Gayakwad. A.R ―OP- AMPS and Linear Integrated Circuits‖, Fourth edition, Prentice Hall of India, New Delhi, 2003.

2.Michael Jacob .J, ―Analog Integrated Circuits and Applications‖, First edition, Prentice Hall of India, New Delhi, April 2000.

3.Robert F Coughlin and Fedrick F Driscoll ―Operational amplifiers and linear Integrated Circuits‖, Fifth edition, Prentice Hall of India,New Delhi 2001

Semester	IV	L	T	P	C
Course Code/ Title	191EC425/MICROPROCESSORS AND MICROCONTROLLERS	3	0	0	3
Objectives	• To understand the Architecture of Microprocessor and Microcontroller • To interface Microcontroller with supporting chips. • To study the Architecture of RISC Processor. • To design a microcontroller based system				

Unit-I	THE 8086 MICROPROCESSOR	9

Overview of Microprocessors, 8086 – Architecture ,Signals, Addressing modes , Instruction set and assembler directives ,Assembly language programming , Stacks , Procedures ,Macros , Interrupts and interrupt service routines , System bus timing.

Unit-II	8051 MICROCONTROLLER	9

Functional block diagram and pin diagram of 8051- Power supply, clock and reset circuit- Program Counter and ROM space in 8051-Program and Data Memory organization-addressing modes. Instruction Set: data transfer, arithmetic and logical, program branching instructions and Boolean variable manipulation.

Unit-III	ON-CHIP PERIPHERALS AND PROGRAMMING TECHNIQUES	9

Parallel Port Structure and bit-manipulation programming, timer/counter-Operating Modes-Programming 8051 Timers - Counter Programming-Serial Communication: Basics of Serial Communication-UART-Operating Modes-RS232 Standards-8051 connection to RS232-Serial Port Programming. Interrupt: 8051 Interrupt- External and Internal Interrupts- Programming timer Interrupts, external hardware interrupts and serial communication interrupts -Interrupt Priority and Programming. Power Saving Modes.

Unit-IV	PERIPHERAL INTERFACING AND PROGRAMMING	9

Parallel communication interface, Serial communication interface, D/A and A/D Interface, Timer, Keyboard /display controller ,Traffic Light control and Stepper Motor Interfacing Techniques

Unit-V	RISC ARCHITECTURE	9

Overview of RISC processor, Hybrid architecture, Advantages of RISC, Features of RISC, Design issues of RISC Processor, Performance issues in pipelined system, Architecture of ARM7 and Sun Ultra SPARC.

Outcomes	**Upon completion of the course, the student should be able to:** 1. Analyze and implement programs on 8086 microprocessor. 2. Interpret 8051 Microcontrollers architecture and its functionalities. 3. Design and develop microcontroller based systems for real time applications 4. Interface the peripherals and I/O devices using 8051 microcontroller. 5. Analyze the architecture of RISC processors.

TOTAL PERIODS 45

Text Books

1. Muhammad Ali Mazidi, J.G. Mazidi, R.D. McKinlay,"The 8051 Microcontroller and Embedded Systems", Second Edition, Prentice Hall of India Pvt. Ltd., 2007.
2. A.K.Ray,K.M.Bhurchandi, "Advanced Microprocessors and Peripherals" 3rd edition, Tata McGrawHill, 2012

References

1. Krishna Kant, — "Microprocessors and Microcontrollers- Architecture, programming and system design 8085, 8086, 8051,8096", Prentice Hall of India, New Delhi, 2007.
2. Kenneth J Ayala, — "The 8051 Microcontroller – Architecture, Programming and Applications", Penram International Publications, Mumbai India, 1996.
3.Doughlas V.Hall,"Microprocessors and Interfacing, Programming and Hardware", TMH, 2012

Semester	IV	L	T	P	C
Course Code/ Title	191MA401/ Probability and Random Process	2	2	0	3

Objectives

- Acquire skills in handling situations involving more than one random variable and functions of random variables.
- Be introduced to the notion of sampling distributions and have acquired knowledge of statistical techniques useful in making rational decision in management problems.
- Be exposed to statistical methods designed to contribute to the process of making scientific judgments in the face of uncertainty and variation.

Unit-I	Probability And Random Variables	9

Probability -Axioms of probability – Conditional probability – Baye's theorem - Random variable - Probability mass function - Probability density function - Cumulative distribution function - Moments - Moment generating functions.

Unit-II	Standard Distributions	9

Discrete distributions - Binomial, Poisson, Geometric distributions - Continuous distributions- Uniform- Exponential, and Normal distributions

Unit-III	Two Dimensional Random Variables	9

Random variables-One and two dimensional random variables-Joint distributions - Marginal and conditional distributions – Covariance - Correlation and regression.

Unit-IV	Random Processes	9

Random process-Classification – definition and examples-Stationary process –first and second order-strict and wide sense process-problems - Ergodic process – Markov process-Poisson process.

Unit-V	Correlation And Spectral Densities	9

Auto correlation-Cross correlation-properties-problems-Power spectral density-Cross spectral density-properties-Relationship between cross power spectrum and cross correlation function.

Outcomes

Upon completion of the course, the student should be able to:

1. Demonstrate and apply the basic probability axioms and concepts in their core areas.
2. Apply the concepts of probability distributions in an appropriate place of science and Engineering.
3. Calculate the relationship of two dimensional random variables using correlation techniques and to study the properties of two dimensional random variables.
4. Estimate the functions of time when the probability measure is associated through random process.
5. Evaluate the concept of spectral density functions.

TOTAL PERIODS 45

Text Books

1. Ibe.O.C., "Fundamentals of Applied Probability and Random Process",Elaevier,1st Indian Reprint,2007.

2. Peebles. P.Z., "Probability, Random Variables and Random Signal Principles", Tata McGraw Hill, 4th Edition, New Delhi, 2002.

References

1. Yates. R.D. and Goodman. D.J., “Probability and Stochastic Processes”, 2nd Edition, Wiley India Pvt. Ltd., Bangalore, 2012.
2. Stark. H., and Woods. J.W., “Probability and Random Processes with Applications to Signal Processing”, 3rd Edition,Pearson Education, Asia, 2002.
3. Miller. S.L. and Childers. D.G., “Probability and Random Processes with Applications to Signal Processing and Communications”, Academic Press, 2004.

Semester	IV	L	T	P	C
Course Code/ Title	191EC42A/Integtated Circuits and Simulation Laboratory	0	0	2	1
Objectives	• To gain hands on experience in designing electronic circuits • To learn simulation software used in circuit design • To learn the fundamental principles of amplifier circuits • To differentiate feedback amplifiers and oscillators. • To differentiate the operation of various multivibrators				
DESIGN AND ANALYSIS OF THE FOLLOWING CIRCUITS					
1.	Series and Shunt feedback amplifiers Frequency response, Input and output impedance				
2.	Inverting, Non inverting and differential amplifiers				
3.	RC Phase shift oscillator and Wien Bridge Oscillator Using transistor and IC741.				
4.	Hartley Oscillator and Colpitts Oscillator				
5.	Single Tuned Amplifier				
6.	Integrator and Differentiator circuits in active and passive mode.				
7.	Astable and Monostable multivibrators using transistor and IC NE 555.				
8.	Instrumentation amplifier				
SIMULATION USING SPICE					
1.	Tuned Collector Oscillator Using transistor				
2.	Twin T Oscillator/ Wein Bridge Oscillator Using IC741				
3.	Double and Stagger tuned Amplifiers Using transistor				
4.	Bistable Multivibrator Using IC741				
5.	Schmitt Trigger circuit with Predictable hysteresis				
6.	Analysis of power amplifier Using transistor				
Outcomes	**Upon completion of the course, the student should be able to:** 1. Analyze various applications using Transistors. 2. Simulate feedback amplifiers, oscillators and multivibrators using SPICE Tool. 3. Design and Analyze various applications using IC 741 operational Amplifier.				
TOTAL PERIODS 30					

Semester	IV	L	T	P	C
Course Code/Title	191EC42B/Microprocessors and Microcontrollers Laboratory	0	0	2	1
Objectives	• To Introduce ALP concepts, features and Coding methods • Write ALP for arithmetic and logical operations in 8086 and8051 • Differentiate Serial and Parallel Interface • Interface different I/Os with Microprocessors • Be familiar with MASM				
8086 Programs using kits and MASM					
1.	Basic arithmetic and Logical operations				
2.	Move a data block without overlap				
3.	Code conversion, decimal arithmetic and Matrix operations.				
4.	Floating point operations, string manipulations, sorting and searching				
5.	Password checking, Print RAM size and system date				
6.	Counters and Time Delay				
Peripherals and Interfacing Experiments					
7.	Traffic light controller				
8.	Stepper motor control				
9.	Digital clock				
10.	Key board and Display				
11.	Printer status				
12.	Serial interface and Parallel interface				
13.	A/D and D/A interface and Waveform Generation				
8051 Experiments using kits and MASM					
14.	Basic arithmetic and Logical operations				
15.	Square and Cube program, Find 2‘s complement of a number				
16.	Unpacked BCD toASCII				
Outcomes	**Upon completion of the course, the student should be able to:** 1. Implement the ALP Programmes for fixed and Floating Point and Arithmetic operations 2. Demonstrate the interfacing circuits for different I/Os using microprocessor 3. Implement the basic programs in 8051 microcontroller				
TOTAL PERIODS 30					

Semester	V	L	T	P	C
Course Code/ Title	191EC521/Digital Communication	3	0	0	3

Objectives

- To introduce the basic concepts of Digital Communication in baseband and pass band domains.
- 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.
- To understand baseband and bandpass signal transmission and reception techniques.
- 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	Digital Communication System	9

Introduction to Analog Pulse Communication Systems – Digital Communication Systems–Functional description, Channel classification, Performance Measure; Geometric representation of Signals, Bandwidth , Mathematical Models of Communication Channel.

Unit-II	Baseband Formatting Techniques	9

Sampling – Impulse sampling, Natural Sampling, Sampler Implementation; Quantization– Uniform and Non-uniform; Encoding Techniques for Analog Sources- Temporal waveform encoding, Spectral waveform encoding, Model-based encoding, Comparison of speech encoding methods.

Unit-III	Baseband Coding Techniques	9

Error Control Codes - Block Codes, Convolutional Codes, Concept of Error Free Communication; Classification of line codes, desirable characteristics and power spectra of line codes.

Unit-IV	Baseband Reception Techniques	9

Noise in Communication Systems; Receiving Filter – Correlator type, Matched Filter type; Equalising Filter - Signal and system design for ISI elimination, Implementation, Eye Pattern analysis; Synchronization; Detector – Maximum Likelihood Detector, Error Probability, Figure-of-Merit for Digital Detection.

Unit-V	Band pass Signal Transmission And Reception	9

Memory less modulation methods - Representation and Spectral characteristics, ASK,PSK, QAM, QPSK, FSK; Bandpass receiving filter, Error performance – Coherent and Non-coherent detection systems.

Outcomes

Upon completion of the course, students should able to:

1. Understand the basic concepts of digital communication for designing digital systems
2. Generate baseband signals by using baseband formatting techniques
3. Apply concept of error coding techniques to generate error free signals
4. Implement various filters to rectify errors after reception of signals.
5. Design the transmitter and receiver using pass band communication techniques.

TOTAL PERIODS 45

Text Books

1. Amitabha Bhattacharya, “Digital Communications”, Tata McGraw Hill, 2006.

References

1. John.G. Proakis, “Fundamentals of Communication Systems”, Pearson Education,2006.
2. Simon Haykin, “Digital Communications”, John Wiley, 2006.
3. Bernard Sklar, Digital Communication, 2nd Edition, Paerson Education, 2006
4. Herbert Taub & Donald L Schilling – Principles of Communication Systems (3rdEdition) – Tata McGraw Hill, 2008.
5. Leon W. Couch, Digital and Analog Communication Systems, 6th Edition, Pearson Education, 2001.

Semester	V	L	T	P	C
Course Code/ Title	191EC522/Digital Signal Processing	2	2	0	3

Objectives

- To familiarize the concepts of Discrete Fourier transform, properties of DFT and its application to linear filtering
- To understand the characteristics of digital filters, design digital IIR and FIR filters and apply these filters to filter undesirable signals in various frequency bands
- To understand the effects of finite precision representation on digital filters
- To study the concept of Multi-rate and adaptive filters

Unit-I	Discrete Fourier transform	12

Review of signals and systems, Discrete Fourier transform (DFT) - properties of DFT, Linear filtering using DFT, Filtering long data sequences - overlap save and overlap add method, Fast computation of DFT - Radix-2 Decimation-in-time (DIT) Fast Fourier transform (FFT), Decimation-in-frequency (DIF) Fast Fourier transform (FFT), Linear filtering using FFT.

Unit-II	Infinite Impulse Response Filters	12

Structure of IIR filter, Characteristics of commonly used analog filters - Butterworth filters, Chebyshev filters. Design of IIR filters from analog filters (LPF, HPF, BPF, BRF) - Approximation of derivatives, Impulse invariance method, Bilinear transformation. Frequency transformation in the analog domain.

Unit-III	Finite Impulse Response Filters	12

FIR filter structures - linear phase structure and direct form realizations, Design of FIR filters - symmetric and Anti-symmetric FIR filters - design of linear phase FIR filters using Fourier series method, using windows (Rectangular, Hamming and Hanning window), Frequency sampling method.

Unit-IV	Finite Word Length effects	12

Fixed point and floating point number representation - ADC - quantization - truncation and rounding - quantization noise - input / output quantization - coefficient quantization error - product quantization error - overflow error - limit cycle oscillations due to product quantization and summation - scaling to prevent overflow

Unit-V	Introduction to Digital Signal Processor and its applications	12

DSP architecture, – Fixed and Floating point architecture principles, Multi-rate signal processing: Decimation, Interpolation, Sampling rate conversion by a rational factor– Adaptive Filters: Introduction, Applications of adaptive filtering to equalization

Outcomes

Upon completion of the course, students should able to:

1. Apply DFT for the analysis of digital signals & systems
2. Design IIR filters
3. Design FIR filters
4. Characterize the effects of finite precision representation on digital filters
5. Evaluate the Fundamentals of Digital signal processor and its applications

TOTAL PERIODS 60

Text Books

1. John G. Proakis & Dimitris G.Manolakis, ―Digital Signal Processing – Principles, Algorithms & Applications‖, Fourth Edition, Pearson Education / Prentice Hall, 2007.

References

1. Emmanuel C. Ifeachor& Barrie. W. Jervis, ―Digital Signal Processing, Second Edition, Pearson Education / Prentice Hall, 2002.
2. A. V. Oppenheim, R.W. Schafer and J.R. Buck, ―Discrete-Time Signal Processing, 8th Indian Reprint, Pearson, 2004.
3. Sanjit K. Mitra, ―Digital Signal Processing – A Computer Based Approach, Tata McGraw Hill, 2007.
4. Andreas Antoniou, ―Digital Signal Processing‖, Tata McGraw Hill, 2006.

Semester	V	L	T	P	C
Course Code/ Course Name	191EC523/Transmission Lines and RF Systems	3	0	0	3

Objectives

- To introduce the various types of transmission lines and its characteristics
- To give thorough understanding about high frequency line, power and impedance measurements
- To impart technical knowledge in impedance matching using smith chart
- To impart knowledge on waveguide theories
- To get acquaintance with RF system transceiver design

Unit-I	Transmission Line Theory	9

General theory of Transmission lines - the transmission line - general solution - 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.

Unit-II	High Frequency Transmission Lines.	9

Transmission line equations at radio frequencies - Line 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 - Reflection losses - Measurement of VSWR and wavelength.

Unit-III	Impedance Matching in High Frequency Lines	9

Impedance matching: Quarter wave transformer - Impedance matching by stubs - Single stub and double stub matching - Smith chart - Solutions of problems using Smith chart - Single and double stub matching using Smith chart.

Unit-IV	Waveguides	9

General Wave behavior along uniform guiding structures – Transverse Electromagnetic Waves, Transverse Magnetic Waves, Transverse Electric Waves – TM and TE Waves between parallel plates. Field Equations in rectangular waveguides, TM and TE waves in rectangular waveguides, Bessel Functions, TM and TE waves in Circular waveguides.

Unit-V	RF System Design Concepts	9

High Frequency parameters, Formulation of S parameters, Properties of S parameters, Reciprocal and lossless Network, Basic concepts of RF design, Mixers, Low noise amplifiers, voltage control oscillators, Power amplifiers, transducer power gain and stability considerations.

Outcomes

Upon completion of the course, the student should be able to:

1. Understand the basic concept of signal propagation through transmission lines
2. Illustrate the concept of the design of high frequency transmission lines
3. Design high frequency components and systems with proper matching
4. Analyze the characteristics of TE and TM waves
5. Design a RF receiver for Wireless Communication

TOTAL PERIODS 45

Text Books

1. John D Ryder, ―Networks, lines and fields‖, 2nd Edition, Prentice Hall India, 2015. (UNIT I-IV)
2. Mathew M. Radmanesh, ―Radio Frequency &Microwave Electronics‖, Pearson Education Asia, Second Edition,2002. (UNIT V)

References

1. Reinhold Ludwig and Powel Bretchko,‖ RF Circuit Design – Theory and Applications‖, Pearson Education Asia, First Edition,2001.
2. D. K. Misra, ―Radio Frequency and Microwave Communication Circuits- Analysis and Design‖, John Wiley & Sons, 2004.
3. E.C.Jordan and K.G. Balmain, ―Electromagnetic Waves and Radiating Systems Prentice Hall of India, 2006.

4. G.S.N Raju, "Electromagnetic Field Theory and Transmission Lines Pearson Education, First edition 2005.

Semester	V	L	T	P	C
Course Code/ Title	191EE511/ Control Systems Engineering	3	0	0	3

Objectives

- To introduce the components and their representation of control systems
- To learn various methods for analyzing the time response, the frequency response
- To learn various methods of stability analysis of the systems.
- To learn different types of the compensator design to improve stability

Unit-I	Systems Components and Their Representation	9

Introduction to the control problem-Terminology and Basic Structure-Feed forward and Feedback control theory-Electro Mechanical Transfer Function Models-Block diagram Models-Signal flow graphs models

Unit-II	Time Domain Analysis	9

Introduction-Performance specification-Transient Response-Steady state error constants and system-Type number -Characteristics of Proportional mode of control-Characteristics of Integral mode of control-Characteristics of Derivative mode of control, PID Controllers

Unit-III	Frequency Domain Analysis	9

Closed loop frequency response-Performance specification in frequency domain-Frequency response of standard second order system- Bode Plots-Polar plots.

Unit-IV	S Domain Analysis and System Stability	9

Concept of stability-Bounded - Input Bounded - Output stability-Routh stability criterion-Relative stability-Root locus concept-Guidelines for sketching root locus-Nyquist stability criterion

Unit-V	Compensator Design	9

Introduction to Design and Compensation -Cascade lead compensation-Cascade lag compensation-Cascade lag-lead compensation- Design using Bode plots.

Outcomes

Upon completion of the course, students should able to:

1. Discuss about systems and its classification and to develop the mathematical model.
2. Examine time response analysis of LTI systems and to conclude about steady state error
3. Solve frequency domain analysis of control systems required for stability analysis
4. Formulate with analysis of the system in s-domain and to attain the stability of the system
5. Design various types of compensation required for stability analysis using bode plot

TOTAL PERIODS 45

Text Books

1. M.Gopal, "Control System – Principles and Design", Tata McGraw Hill, 4th Edition, 2012.
2. Nagrath I.J and Gopal M., "Control Systems Engineering", New Age International Publishers, 5th Edition (Reprint), 2016.

References

1. Benjamin C. Kuo, "Automatic Control systems", Pearson Education, New Delhi, 2009.
2. K. Ogata, 'Modern Control Engineering', 5th edition, PHI, 2012.
3. S.K.Bhattacharya, Control System Engineering, 3rd Edition, Pearson, 2013.
4. Richard.C. Dorf and Robert H. Bishop, "Modern Control Systems", Addidon – Wesley, 2011.
5. Salaivahanan. S, Rengaraj. R, Venkatakrishnan. G. R., "Control Systems Engineering", Pearson India Education Services Pvt. Ltd., 2015.

Semester	V	L	T	P	C
Course Code/ Title	191EC52A/Communication systems Laboratory	0	0	2	1
Objectives	• To visualize the effects of sampling and TDM • To Implement AM & FM modulation and demodulation. • To implement PCM & DM • To design FSK, PSK and DPSK circuits and simulate the results. • To implement Error control coding schemes and verify results.				
Design communication experiments and verify results using equipment kits and simulate using MATLAB / SCILAB or equivalent software					
1.	Signal Sampling and reconstruction.				
2.	Time Division Multiplexing.				
3.	AM Modulator and Demodulator				
4.	FM Modulator and Demodulator				
5.	Pulse Code Modulation and Demodulation				
6.	Delta Modulation and Demodulation				
7.	Observation (simulation) of signal constellations of BPSK, QPSK and QAM.				
8.	Line coding schemes.				
9.	FSK, PSK and DPSK schemes (Simulation)				
10.	Error control coding schemes – Linear Block Codes (Simulation)				
Outcomes	Upon completion of the course, students should able to: 1. Simulate & validate the various functional modules of a communication system 2. Demonstrate their knowledge in base band signaling schemes through implementation. 3. Apply various channel coding schemes & demonstrate their capabilities.				
	TOTAL PERIODS 30				

Semester	V	L	T	P	C
Course Code/ Title	191EC52B/Digital Signal Processing Laboratory	0	0	2	1
Objectives	• To perform basic signal processing operations such as Linear Convolution, Circular Convolution, Auto Correlation, Cross Correlation and Frequency analysis in MATLAB • To implement FIR and IIR filters in MATLAB and DSP Processor • To study the architecture of DSP processor • To design a DSP system to demonstrate the Multi-rate and Adaptive signal processing concepts.				
MATLAB / Equivalent Software Package					
1.	Generation of elementary Discrete-Time sequences				
2.	Linear and Circular convolutions				
3.	Auto correlation and Cross Correlation				
4.	Frequency Analysis using DFT				
5.	Design of FIR filters (LPF/HPF/BPF/BSF) and demonstrates the filtering operation				
6.	Design of Butterworth and Chebyshev IIR filters (LPF/HPF/BPF/BSF) and demonstrate the filtering operations				
DSP Processor Based Implementation					
1.	Study of architecture of Digital Signal Processor				
2.	Perform MAC operation using various addressing modes				
3.	Generation of various signals and random noise				
4.	Design and demonstration of FIR Filter for Low pass, High pass, Band pass and Band stop filtering				
5.	Design and demonstration of Butter worth and Chebyshev IIR Filters for Low pass, High pass, Band pass and Band stop filtering				
6.	Implement an Up-sampling and Down-sampling operation in DSP Processor				
Outcomes	Upon completion of the course, students should able to: 1. Carryout basic signal processing operations 2. Demonstrate their abilities towards MATLAB based implementation of various DSP systems 3. Design and Implement the FIR and IIR Filters in DSP Processor.				
	TOTAL PERIODS 30				

Semester	VI	L	T	P	C
Course Code/ Title	191EC621/Antennas and Microwave Engineering	3	0	0	3
Objectives	• To understand the basic principles in antenna and microwave system design • To enhance the knowledge in the area of various antenna designs. • To enhance the knowledge in the antenna arrays • To enhance the knowledge in the area of microwave components and antenna for practical applications • To deal with the microwave generation				
Unit-I	Introduction to Microwave Systems and Antennas				9
Definition of antenna parameters – Gain, Directivity, Effective aperture, Radiation Resistance, Band width, Beam width, Input Impedance. Matching – Baluns, Polarization mismatch, Antenna noise temperature,Microwave frequency bands,Friis transmission equation, Link budget and link margin, Noise Characterization of a microwave receiver.					
Unit-II	Radiation Mechanisms and Design Aspects				9
Radiation from oscillating dipole, Half wave dipoleand Loop antennas Horn antenna, Reflector antenna, Slot antennas, Microstrip antennas Principle of frequency independent antennas –Spiral antenna, Helical antenna, Log periodic.					
Unit-III	Antenna Arrays and Applications				9
Two-element array, Array factor, Pattern multiplication, Uniformly spaced arrays with uniform and non-uniform excitation amplitudes, Smart antennas					
Unit-IV	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					
Unit-V	Microwave Generation and Design Principles				9
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,Microwave Amplifier Design, Microwave Mixer Design, Microwave Oscillator Design					
Outcomes	**Upon completion of the course, the student should be able to:** 1. Understand the basic principles in antenna and microwave system design. 2. Develop the knowledge in the area of various antenna designs. 3. Analyse the different antenna arrays and smart antennas. 4. Enhance knowledge in the area of microwave components and antenna for practical applications. 5. Generate Microwave signals and design of microwave amplifiers.				

Text Books

1. John D Krauss, Ronald J Marhefka and Ahmad S. Khan, "Antennas and Wave Propagation: Fourth Edition, Tata McGraw-Hill, 2006. (UNIT I, II, III)
2. David M. Pozar, "Microwave Engineering", Fourth Edition, Wiley India, 2012.(UNIT I,IV,V)

References

1. Constantine A.Balanis, ―Antenna Theory Analysis and Design‖, Third edition, John Wiley India Pvt Ltd., 2005.
2. R.E.Collin,"Antennas and Radiowave Propagation", McGraw Hill 1985.
3. Constantine.A.Balanis "Antenna Theory Analysis and Design", Wiley Student Edition, 2006.
4. R.E.Collin, "Foundations for Microwave Engineering", Second edition, IEEE Press, 2001
5. Robert E Colin, "Foundations for Microwave Engineering", John Wiley & Sons Inc, 2005

Semester	VI	L	T	P	C
Course Code/ Title	191EC622/ Digital VLSI Design	3	0	0	3
Objectives	• Study the fundamentals of CMOS circuits and its characteristics. • Learn the design and realization of combinational & sequential digital circuits. • Architectural choices and performance tradeoffs involved in designing and realizing the circuits in CMOS technology are discussed • Learn the different FPGA architectures and testability of VLSI circuits				

Unit-I	Introduction to MOS Transistor	9

MOS Transistor, CMOS logic, Inverter, Pass Transistor, Transmission gate, Layout Design Rules, Gate Layouts, Stick Diagrams, Long-Channel I-V Charters tics, C-V Charters tics, Non ideal I-V Effects, DC Transfer characteristics, Elmore Delay, Linear Delay Model, Logical effort, Parasitic Delay, Delay in Logic Gate, Scaling.

Unit-II	Combinational MOS Logic Circuits	9

Circuit Families: Static CMOS, Ratioed Circuits, Cascode Voltage Switch Logic, Dynamic Circuits, Pass Transistor Logic, Transmission Gates, Domino, Dual Rail Domino, CPL, DCVSPG, DPL. Power: Dynamic Power, Static Power, Low Power Architecture.

Unit-III	Sequential Circuit Design	9

Static latches and Registers, Dynamic latches and Registers, Pulse Registers, Sense Amplifier Based Register, Pipelining, Schmitt Trigger, Monostable Sequential Circuits, Astable Sequential Circuits.

Unit-IV	Design of Arithmetic Building Blocks and Memories	9

Arithmetic Building Blocks: Data Paths, Adders, Multipliers, Shifters, power and speed tradeoffs. Designing Memory and Array structures: Memory Architectures and Building Blocks, Memory Core, Memory Peripheral Circuitry

Unit-V	Implementation Strategies and Testing	9

FPGA Building Block Architectures, FPGA Interconnect Routing Procedures.Design for Testability:
Ad Hoc Testing, Scan Design, BIST, IDDQ Testing, Design for Manufacturability, Boundary Scan.

Outcomes	**Upon completion of the course, the student should be able to:** 1. Realize the concepts of digital building blocks using MOS transistor 2. Design combinational MOS circuits and power strategies. 3. Design and construct Sequential Circuits. 4. Model the architecture of digital systems. 5. Analyze the implementation and testing techniques of chip design using programmable devices

Text Books

1.Neil H.E. Weste, David Money Harris ―CMOS VLSI Design: A Circuits and Systems Perspective‖, 4th Edition, Pearson , 2017 (UNIT I,II,V)

2.Jan M. Rabaey ,AnanthaChandrakasan, Borivoje. Nikolic, ‖Digital Integrated Circuits:A Design perspective‖, Second Edition , Pearson , 2016.(UNIT III,IV)

References

1.M.J. Smith, ―Application Specific Integrated Circuits‖, Addisson Wesley, 1997

2. Sung-Mo kang, Yusuf leblebici, Chulwoo Kim ―CMOS Digital Integrated Circuits:Analysis& Design‖,4th edition McGraw Hill Education,2013

3.Wayne Wolf, ―Modern VLSI Design: System On Chip‖, Pearson Education, 2007

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

Semester	VI	L	T	P	C
Course Code/ Title	191EC62A/Digital VLSI Design Laboratory	0	0	4	2
Objectives	• To learn Hardware Descriptive Language(Verilog/VHDL) • To learn the fundamental principles of VLSI circuit design in digital and analog domain • To familiarize fusing of logical modules on FPGAs • To provide hands on design experience with professional design (EDA) platforms				
Digital System Design using HDL and FPGA (24 Periods)					
1.	Design an Adder (Min 8 Bit) using HDL. Simulate it using Xilinx/Altera Software and implement by Xilinx/Altera FPGA				
2.	Design a Multiplier (4 Bit Min) using HDL. Simulate it using Xilinx/Altera Software and implement by Xilinx/Altera FPGA				
3.	Design a Shift Register using HDL. Simulate it using Xilinx/Altera Software and implement by Xilinx/Altera FPGA				
4.	Design Finite State Machine (Moore/Mealy) using HDL. Simulate it using Xilinx/Altera Software and implement by Xilinx/Altera FPGA				
5.	Design Memories using HDL. Simulate it using Xilinx/Altera Software and implement by Xilinx/Altera FPGA				
6.	Design and simulate a CMOS inverter using digital flow				
7.	Design and simulate a CMOS Basic Gates and Flip-Flops				
8.	Design and simulate a 4-bit synchronous counter using a Flip-Flops				
9.	Design and Simulate a CMOS Inverting Amplifier				
10.	Design and simulate simple 5 transistor differential amplifier. Analyze Gain, Bandwidth and CMRR by performing Schematic Simulations.				
Outcomes	**Upon completion of the course, the student should be able to:** 1. Write HDL code for basic as well as advanced digital integrated circuits. 2. Import the logic modules into FPGA boards, Synthesize, Place and Route the digital IPs and compare the various routing algorithms. 3. Design, Simulate and Extract the layouts of Analog IC Blocks using EDA tools.				

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Semester	VI	L	T	P	C
Course Code/ Title	191EC62B/Microwave Engineering Laboratory	0	0	4	2
Objectives	• Know about the behavior of the microwave components. • Practice microwave measurement procedures • Gain knowledge about the antenna design parameters				
List of Experiment					
Antenna and Microwave Experiment					
1.	Reflex klystron or Gunn diode characteristics and basic microwave parameter measurement such as VSWR, frequency, wavelength.				
2.	Directional Coupler Characteristics.				
3.	Radiation Pattern of Horn Antenna.				
4.	S-parameter Measurement of the following microwave components (Isolator, Circulator, E plane Tee, H Plane Tee, Magic Tee)				
5.	Attenuation and Power Measurement.				
6.	Impedance Measurement and Impedance Matching				
7.	Microwave IC – Filter Characteristics				
List of equipment for a batch of 30 students 3 students per experiment:					
1.	Microwave test Bench at X band to determine Directional coupler characteristics. - 2 Nos				
2.	Microwave test Bench at X band and Antenna turn table to measure Radiation pattern of Horn antenna, Horn antennas. - 2 Nos				
3.	Microwave test Bench at X band to determine VSWR for Isolator and Circulator, VSWR meter, Isolator, Circulator, E Plane Tee, H plane Tee. - 2 Nos				
4.	Microwave test Bench at X band, Variable attenuator, Detector and 20 MHz Digital / Analog Oscilloscope. - 2 Nos				
Notes:Microwave test bench comprises of Reflex klystron or Gunn diode with power supply, Gunn oscillator, PIN modulator, Isolator, Fixed and Variable Attenuator, frequency meter, Slotted section, Wave guides, detector with mount, Termination, Movable short, Slide screw tuner, Horn antenna, Directional coupler and 20 MHz Digital / Analog Oscilloscope.					
Outcomes	**Upon completion of the course, the student should be able to:** 1. Analyse the radiation pattern of antenna. 2. Test the various microwave components. 3. Understand the Microwave System design				

Semester	VII	L	T	P	C
Course Code/ Title	191EC721/Embedded and Real Time Systems	3	0	0	3
Objectives	• Understand the concepts of embedded system design and analysis • Learn the architecture and programming of ARM processor • Be exposed to the basic concepts of embedded programming • Learn the real time operating systems				
Unit-I	INTRODUCTION TO EMBEDDEDSYSTEM 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 systems- Preemptive real-time operating systems- Priority based scheduling- Interprocess communication mechanisms – Evaluating operating system performance- power optimization strategies for processes – Example Real time operating systems-POSIX-Windows CE. - Distributed embedded systems – MPSoCs and shared memory multiprocessors. – Design Example - Audio player, Engine control unit – Video accelerator.					
Outcomes	**Upon completion of the course, the student should be able to:** 1. Describe the architecture and programming of ARM processor 2. Outline the concepts of embedded systems 3. Explain the basic concepts of real time operating system design 4. Model real-time applications using embedded-system concepts				

Text Books

1.Marilyn Wolf, ―Computers as Components - Principles of Embedded Computing System Design‖, Third Edition ―Morgan Kaufmann Publisher (An imprint from Elsevier), 2012. (UNIT I, II, III, V)

2. Jane W.S.Liu,‖ Real Time Systems‖, Pearson Education, Third Indian Reprint, 2003.(UNIT IV)

References

1.LylaB.Das, ―Embedded Systems : An Integrated Approach‖ Pearson Education, 2013.

2. Jonathan W.Valvano, ―Embedded Microcomputer Systems Real Time Interfacing‖, Third Edition Cengage Learning, 2012.

3. David. E. Simon, ―An Embedded Software Primer‖, 1st Edition, Fifth Impression, Addison-Wesley Professional, 2007.

4. Raymond J.A. Buhr, Donald L.Bailey, ―An Introduction to Real-Time Systems- From Design to Networking with C/C++‖, Prentice Hall, 1999.

5. C.M. Krishna, Kang G. Shin, ―Real-Time Systems‖, International Editions, McGraw Hill 1997

6. K.V.K.K.Prasad, ―Embedded Real-Time Systems: Concepts, Design & Programming‖, Dream Tech Press, 2005.

7. Sriram V Iyer, Pankaj Gupta, ―Embedded Real Time Systems Programming‖, Tata McGraw Hill, 2004.

Semester	VII	L	T	P	C
Course Code/ Title	**191EC722/ Optical Communication and Networks**	3	0	0	3
Objectives	• To study about the various optical fibers, modes and configuration. • To analysis various losses in optical fibers. • To learn about the various optical sources and detectors. • To explore various idea about optical fiber measurements and various coupling techniques. • To enrich the knowledge about optical communication systems and networks				

Unit-I	**Introduction to Optical Fibers**	9

Evolution of fiber optic system- Element of an Optical Fiber Transmission link– Total internal reflection-Acceptance angle –Numerical aperture-Optical Fiber **Modes** and Configurations -Mode theory of Circular Wave guides- Overview of Modes-Key Modal concepts- Linearly Polarized Modes -Single Mode Fibers-Graded Index fiber structure.

Unit-II	**Transmission Characteristic of Optical Fiber**	9

Attenuation – Absorption losses, Scattering losses, Bending Losses, Core and Cladding losses, Information Capacity determination -Group Delay-Material Dispersion, Wave guide Dispersion, Polarization Mode dispersion, Intermodal dispersion, Pulse Broadening in GI fibers-Design Optimization of SM fibers-RI profile and cut-off wavelength.

Unit-III	**Fiber Optical Sources and Coupling**	9

Direct and indirect Band gap materials-LED structures -Light source materials -Quantum efficiency and LED power, Modulation of a LED, lasers Diodes-Modes and Threshold condition -Rate equations -External Quantum efficiency -Resonant frequencies -Temperature effects, Fiber amplifiers, Lencing schemes, Fiber -to- Fiber joints, Fiber splicing, Detector response time.

Unit-IV	**Fiber Optic Receiver and Measurements**	9

Fundamental receiver operation, Pre amplifiers, Error sources – Receiver Configuration– Probability of Error .Fiber Attenuation measurements- Dispersion measurements – Fiber Refractive index profile measurements – Fiber cut- off Wave length Measurements – Fiber Numerical Aperture Measurements – Fiber diameter measurements.

Unit-V	**Optical Networks**	9

Basic Networks – SONET / SDH – Broadcast – and –select WDM Networks –Wavelength Routed Networks – Link Power budget -Rise time budget- Solutions – Optical CDMA – Ultra High Capacity Networks, High speed light wave Links-OADM configuration-Optical ETHERNET

Outcomes	Upon completion of the course, the student should be able to: 1. Realize basic elements in optical fibers, different modes and configurations 2. Analyze the transmission characteristics associated with dispersion and polarization techniques. 3. Design optical sources and detectors with their use in optical communication system. 4. Construct fiber optic receiver systems, measurements and coupling techniques. 5. • Design optical communication systems and its networks

Text Books

1.1. Gerd Keiser, "Optical Fiber Communication" McGraw -Hill International, 4th Edition.,2010.
2. John M. Senior , “Optical Fiber Communication”, Second Edition, Pearson Education,2007.

References

1.P Chakrabarti, "Optical Fiber Communication‖, McGraw Hill Education (India)Private Limited, 2016
2.GredKeiser,"Optical Fiber Communication‖, McGraw Hill Education (India) Private Limited. Fifth Edition, Reprint 2013.

Semester	VII	L	T	P	C
Course Code/ Title	191EC72A/Embedded System Laboratory	0	0	2	1
Objectives	Learn the working of ARM processor • Understand the Building Blocks of Embedded Systems • Learn the concept of memory map and memory interface • Write programs to interface memory, I/Os with processor • Study the interrupt performance				

List of Experiments	
1.	Study of ARM evaluation system
2.	Interfacing ADC and DAC.
3.	Interfacing LED and PWM.
4.	Interfacing real time clock and serial port.
5.	Interfacing keyboard and LCD.
6.	Interfacing EPROM and interrupt.
7.	Mailbox.
8.	Interrupt performance characteristics of ARM and FPGA.
9.	Flashing of LEDS.
10.	Interfacing stepper motor and temperature sensor.
11.	Implementing zigbee protocol with ARM
Outcomes	At the end of the course, the student should be able to: 1. Write programs in ARM for a specific Application 2. Interface memory, A/D and D/A convertors with ARM system 3. Analyze the performance of interrupt 4. Write program for interfacing keyboard, display, motor and sensor. 5. Formulate a mini project using embedded system

Semester	VII	L	T	P	C
Course Code/ Title	191EC72B/Optical Communication Laboratory	0	0	2	1
Objectives	**The student should be made to:** • Develop understanding of simple optical communication link • Analysis attenuation in optical fiber • Understand the working principle of optical sources, detector, fibers • Understand the calculation of BER • Understand the calculate Numerical Aperture				

List of Experiments	
1.	Measurement of fiber attenuation losses
2.	Measurement of connector losses
3.	Bending Loss measurement
4.	Fiber Numerical Aperture measurement
5.	Fiber Mode Characteristics of Fibers
6.	DC Characteristics of LED and PIN Photo diode
7.	Fiber optic Analog - frequency response
8.	Fiber optic Digital Link- frequency response
9.	Fiber optic Analog – BER Calculation
10.	Fiber optic Digital – BER Calculation
Outcomes	On completion of this lab course, the student would be able to 1. Analyze the performance of simple optical link by measurement of losses and Analyzing the mode characteristics of fiber 2. Analyze the attenuation of optical fiber and the impact on BER

Professional Elective - I (Semester - V)

Semester	V	L	T	P	C
Course Code/ Title	191EC531/ Computer Architecture and Organization	3	0	0	3
Objectives	• To make students understand the basic structure and operation of digital computer • To familiarize with implementation of fixed point and floating-point arithmetic operations • To study the design of data path unit and control unit for processor • To understand the concept of various memories and interfacing • To introduce the parallel processing technique				

Unit-I	Computer Organization & Instructions	9

Basics of a computer system: Evolution, Ideas, Technology, Performance, Power wall, Uniprocessors to Multiprocessors. Addressing and addressing modes. Instructions: Operations and Operands, Representing instructions, Logical operations, control operations.

Unit-II	Arithmetic	9

Fixed point Addition, Subtraction, Multiplication and Division. Floating Point arithmetic, High performance arithmetic, Sub word parallelism

Unit-III	The Processor	9

Introduction, Logic Design Conventions, Building a Data path - A Simple Implementation scheme - An Overview of Pipelining - Pipelined Data path and Control. Data Hazards: Forwarding versus Stalling, Control Hazards, Exceptions, Parallelism via Instructions.

Unit-IV	Memory and I/O Organization	9

Memory hierarchy, Memory Chip Organization, Cache memory, Virtual memory. Parallel Bus Architectures, Internal Communication Methodologies, Serial Bus Architectures, Mass storage, Input and Output Devices.

Unit-V	Advanced Computer Architecture	9

Parallel processing architectures and challenges, Hardware multithreading, Multicore and shared memory multiprocessors, Introduction to Graphics Processing Units, Clusters and Warehouse scale computers - Introduction to Multiprocessor network topologies.

Outcomes	At the end of the course, the student should be able to 1. Describe data representation, instruction formats and the operation of a digital computer 2. Illustrate the fixed point and floating-point arithmetic for ALU operation 3. Discuss about implementation schemes of control unit and pipeline performance 4. Explain the concept of various memories, interfacing and organization of multiple processors 5. Discuss parallel processing technique and unconventional architectures

Text books

1.David A. Patterson and John L. Hennessey, -Computer Organization and Design‖, Fifth edition, Morgan Kauffman / Elsevier, 2014. (UNIT I-V)

2. Miles J. Murdocca andVincent P. Heuring, -Computer Architecture and Organization: An Integrated approach‖, Second edition, Wiley India Pvt Ltd, 2015 (UNIT IV,V)

References

1. V.CarlHamacher,ZvonkoG.VaranesicandSafatG.Zaky,-ComputerOrganization―,Fifth edition, McGraw-Hill Education India Pvt Ltd,2014.
2. William Stallings ―Computer Organization and Architecture‖, Seventh Edition, Pearson Education, 2006.
3. Govindarajalu,―Computer Architecture and Organization, Design Principles and Applications", Second edition, McGraw-Hill Education India Pvt Ltd,2014.

Semester	V	L	T	P	C
Course Code/ Title	191EC532/ Human Rights	3	0	0	3
Objectives	• To sensitize the Engineering students to various aspects of Human Rights.				
Unit-I				9	
Human Rights – Meaning, origin and Development. Notion and classification of Rights – Natural, Moral and Legal Rights. Civil and Political Rights, Economic, Social and Cultural Rights; collective / Solidarity Rights.					
Unit-II				9	
Evolution of the concept of Human Rights Magana carta – Geneva convention of 1864. Universal Declaration of Human Rights, 1948. Theories of Human Rights.					
Unit-III				9	
Theories and perspectives of UN Laws – UN Agencies to monitor and compliance.					
Unit-IV				9	
Human Rights in India – Constitutional Provisions / Guarantees.					
Unit-V				9	
Human Rights of Disadvantaged People – Women, Children, Displaced persons and Disabled persons, including Aged and HIV Infected People. Implementation of Human Rights – National and State Human Rights Commission – Judiciary – Role of NGO's, Media, Educational Institutions, Social Movements.					
Outcomes	**Upon completion of the course, the student should be able to:** 1. Engineering students will acquire the basic knowledge of human rights				

References

1. Kapoor S.K.,-Human Rights under International law and Indian Laws, Central Law Agency, Allahabad,2014.
2. Chandra U.,-Human Rights, Allahabad LawAgency,Allahabad,2014.
3. Upendra Baxi, The Future of Human Rights, Oxford University Press, New Delhi.

Semester	V	L	T	P	C
Course Code/ Title	191EC533/ Medical Electronics	3	0	0	3

Objectives

- 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
- To study about the various assist devices used in the hospitals
- 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

Sources of bio medical signals, Bio-potentials, Bio potential electrodes, biological amplifiers, ECG, EEG, EMG, PCG, typical waveforms and signal characteristics

Unit-II	Bio-Chemical and Non Electrical Parameter Measurement	9

pH, PO2, PCO2, Colorimeter, Blood flow meter, Cardiac output, respiratory, blood pressure, temperature and pulse measurement, Blood Cell Counters.

Unit-III	Assist Devices	9

Cardiac pacemakers, DC Defibrillator, Dialyzer, Ventilators, Magnetic Resonance Imaging Systems, Ultrasonic Imaging Systems.

Unit-IV	Physical Medicine and Biotelemetry	9

Diathermies- Shortwave, ultrasonic and microwave type and their applications, Surgical Diathermy, Biotelemetry.

Unit-V	Recent Trends in Medical Instrumentation	9

Telemedicine, Insulin Pumps, Radio pill, Endomicroscopy, Brain machine interface, Lab on a chip.

Outcomes

On successful completion of this course, the student should be able to:

1. Describe the concept of bioelectric potentials generated in human body and related equipments.
2. Measure the bio-chemical & physiological information of circulatory & respiratory system.
3. To demonstrate various Assist Devices used in hospitals.
4. Apply the application of electronics in diagnostic therapeutic area & bio - telemetry system.
5. Interpret various computer aided devices and recent trends in Biomedical Applications.

Text books

1 Leslie Cromwell, -Biomedical Instrumentation and Measurement, Prentice Hall of India, New Delhi, 2007. (UNIT I – V)

References

1. Khandpur, R.S., ―Handbook of Biomedical Instrumentation‖, TATA McGraw-Hill, New Delhi, 2003.
2. John G.Webster, ―Medical Instrumentation Application and Design‖, 3rd Edition, Wiley India Edition, 2007
3. Joseph J.Carr and John M.Brown, ―Introduction to Biomedical Equipment Technology, JohnWiley and Sons, New York, 2004.

Semester	V	L	T	P	C
Course Code/ Title	191EC534/ Operating Systems	3	0	0	3

Objectives

- To understand the basic concepts and functions of operating systems.
- To understand Processes and Threads
- To analyze Scheduling algorithms.
- To understand the concept of Deadlocks.
- To analyze various memory management schemes.
- To understand I/O management and File systems.
- To be familiar with the basics of Linux system and Mobile OS like iOS and Android.

Unit-I	Operating System Overview	9

Computer System Overview-Basic Elements, Instruction Execution, Interrupts, Memory Hierarchy, Cache Memory, Direct Memory Access, Multiprocessor and Multicore Organization. Operating system overview-objectives and functions, Evolution of Operating System.- Computer System Organization Operating System Structure and Operations- System Calls, System Programs, OS Generation and System Boot.

Unit-II	Process Management	9

Processes - Process Concept, Process Scheduling, Operations on Processes, Interprocess Communication; CPU Scheduling - Scheduling criteria, Scheduling algorithms, Multiple-processor scheduling, Real time scheduling; Threads- Overview, Multithreading models, Threading issues; Process Synchronization - The critical-section problem, Synchronization hardware, Mutex locks, Semaphores, Classic problems of synchronization, Critical regions, Monitors; Deadlock - System model, Deadlock characterization, Methods for handling deadlocks, Deadlock prevention, Deadlock avoidance, Deadlock detection, Recovery from dead lock.

Unit-III	Storage Management	9

Main Memory – Background, Swapping, Contiguous Memory Allocation, Paging, Segmentation, Segmentation with paging, 32 and 64 bit architecture Examples; Virtual Memory – Background, Demand Paging, Page Replacement, Allocation, Thrashing; Allocating Kernel Memory, OS Examples.

Unit-IV	File Systems and I/O Systems	9

Mass Storage system – Overview of Mass Storage Structure, Disk Structure, Disk Scheduling and Management, swap space management; File-System Interface - File concept, Access methods, Directory Structure, Directory organization, File system mounting, File Sharing and Protection; File System Implementation- File System Structure, Directory implementation, Allocation Methods, Free Space Management, Efficiency and Performance, Recovery; I/O Systems – I/O Hardware, Application I/O interface, Kernel I/O subsystem, Streams, Performance.

Unit-V	Case Study	9

Linux System - Design Principles, Kernel Modules, Process Management, Scheduling, Memory Management, Input-Output Management, File System, Interprocess Communication; Mobile OS - iOS and Android - Architecture and SDK Framework, Media Layer, Services Layer, Core OS Layer, File System.

Outcomes

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

1. Analyze various scheduling algorithms.
2. Understand deadlock, prevention and avoidance algorithms.
3. Compare and contrast various memory management schemes.
4. Understand the functionality of file systems.
5. Perform administrative tasks on Linux Servers and compare iOS and android Operating Systems.

Text books
1. Abraham Silberschatz, Peter Baer Galvin and Greg Gagne, -Operating System Concepts‖, 9th Edition, John Wiley and Sons Inc., 2012.
References
1. Ramaz Elmasri,A.Gil Carrick,David Levine,-Operating Systems–A Spiral Approach, Tata McGraw Hill Edition,2010. 2. AchyutS.Godbole, AtulKahate, ―Operating Systems‖, McGraw Hill Education,2016. 3. AndrewS.Tanenbaum,-Modern Operating Systems,Second Edition, Pearson Education,2004. 4. Gary Nutt,-Operating Systems ,Third Edition, Pearson Education, 2004. 5. Harvey M.Deital,-OperatingSystems‖,ThirdEdition,PearsonEducation,2004. 6. Daniel P Bovet and Marco Cesati, -Understanding the Linux kernel‖, 3rd edition, O'Reilly, 2005. 7. NeilSmyth,-iPhoneiOS4DevelopmentEssentials–Xcode,FourthEdition,Payloadmedia, 2011.

Semester	V	L	T	P	C
Course Code/ Title	191EC535/ Robotics and Automation	3	0	0	3
Objectives	• To understand the basic concepts associated with the design, functioning, applications and social aspects of robots • To study about the electrical drive systems and sensors used in robotics for various applications • To learn about analyzing robot kinematics, dynamics through different methodologies and study various design aspects of robot arm manipulator and end-effector • To learn about various motion planning techniques and the associated control architecture • To understand the implications of AI and other trending concepts of robotics				
Unit-I	Foundation For Beginners				9
Introduction -- brief history, definition, anatomy, types, classification, specification and need based applications; role and need of robots for the immediate problems of the society, future of mankind and automation-ethical issues; industrial scenario local and global, case studies on mobile robot research platform and industrial serial arm manipulator					
Unit-II	Building Blocks of a Robot				9
Types of electric motors - DC, Servo, Stepper; specification, drives for motors - speed & direction control and circuitry, Selection criterion for actuators, direct drives, non-traditional actuators; Sensors for localization, navigation, obstacle avoidance and path planning in known and unknown environments – optical, inertial, thermal, chemical, biosensor, other common sensors; Case study on choice of sensors and actuators for maze solving robot and self-driving cars					
Unit-III	Kinematics, Dynamics and Design of Robots & End-Effectors				9
Robot kinematics - Geometric approach for 2R, 3R manipulators, homogenous transformation using D-H representation, kinematics of WMR, Lagrangian formulation for 2R robot dynamics; Mechanical design aspects of a 2R manipulator, WMR; End-effector - common types and design case study.					
Unit-IV	Navigation, Path Planning and Control Architecture				9
Mapping & Navigation – SLAM, Path planning for serial manipulators; types of control architectures - Cartesian control, Force control and hybrid position/force control, Behavior based control, application of Neural network, fuzzy logic, optimization algorithms for navigation problems, programming methodologies of a robot					
Unit-V	AI and Other Research Trends in Robotics				9
Application of Machine learning - AI, Expert systems; Tele-robotics and Virtual Reality, Micro &Nano robots, Unmanned vehicles, Cognitive robotics, Evolutionary robotics, Humanoids					
Outcomes	**Upon completion of the course, the student should be able to:** 1. Describe the basic concepts associated with the design, functioning and applications 2. Understand the electrical drive systems and sensors used in robotics for various applications 3. Analyzing robot kinematics, dynamics through different methodologies. 4. Summarize the various motion planning techniques and the associated control architecture 5. Measuring the implications of AI and other trending concepts of robotics				
Text books					
1. Saeed. B. Niku, Introduction to Robotics, Analysis, system, Applications, Pearson educations,2002 2. Roland Siegwart, Illah Reza Nourbakhsh, Introduction to Autonomous Mobile Robots, MIT Press,2011					
References					

1. Richard David Klafter, Thomas A. Chmielewski, Michael Negin, Robotic engineering: an integrated approach, Prentice Hall, 1989
2. Craig, J. J., Introduction to Robotics: Mechanics and Control, 2nd Edition, Addison-Wesley, 1989.
3. K.S. Fu, R.C. Gonzalez and C.S.G. Lee, Robotics: Control, Sensing, Vision and Intelligence,McGraw-Hill, 1987.
4. Wesley E Snyder R, Industrial Robots, Computer Interfacing and Control, Prentice Hall International Edition, 1988.
5. Robin Murphy, Introduction to AI Robotics, MIT Press, 2000
6. Ronald C. Arkin, Behavior-based Robotics, MIT Press, 1998
7. N. P. Padhy, Artificial Intelligence and Intelligent Systems, Oxford University Press, 2005
8. Stefano Nolfi, Dario Floreano, Evolutionary Robotics – The Biology, Intelligence and Technology of Self–Organizing Machines (Intelligent Robotics and Autonomous Agents series), MIT Press, 2004.

Semester	V	L	T	P	C
Course Code/ Title	191HS531/ Principles of Management	3	0	0	3
Objectives	To enable the students to study the evolution of Management, to study the functions and principles of management and to learn the application of the principles in an organization				

Unit-I	Introduction to Management and Organizations	9

Definition of Management – Science or Art – Manager Vs Entrepreneur - types of managers - managerial roles and skills – Evolution of Management – Scientific, human relations , system and contingency approaches – Types of Business organization - Sole proprietorship, partnership, company-public and private sector enterprises - Organization culture and Environment – Current trends and issues in Management.

Unit-II	Planning	9

Nature and purpose of planning – planning process – types of planning – objectives – setting objectives – policies – Planning premises – Strategic Management – Planning Tools and Techniques – Decision making steps and process.

Unit-III	Organising	9

Nature and purpose – Formal and informal organization – organization chart – organization structure – types – Line and staff authority – departmentalization – delegation of authority – centralization and decentralization – Job Design - Human Resource Management – HR Planning, Recruitment, selection, Training and Development, Performance Management , Career planning and management.

Unit-IV	Directing	9

Foundations of individual and group behavior – motivation – motivation theories – motivational techniques – job satisfaction – job enrichment – leadership – types and theories of leadership – communication – process of communication – barrier in communication – effective communication – communication and IT.

Unit-V	Controlling	9

System and process of controlling – budgetary and non-budgetary control techniques – use of computers and IT in Management control – Productivity problems and management – control and performance – direct and preventive control – reporting.

Outcomes	Upon completion of the course, 1. students will be able to have clear understanding of managerial functions like planning, organizing, staffing, leading & controlling and have same basic knowledge on international aspect of management

Text books

1. Stephen P. Robbins & Mary Coulter, “Management”, 10th Edition, Prentice Hall (India) Pvt. Ltd., 2009.

2. JAF Stoner, Freeman R.E and Daniel R Gilbert “Management”, 6 th Edition, Pearson Education, 2004.

References

1. Stephen A. Robbins & David A. Decenzo& Mary Coulter, “Fundamentals of Management” 7 th Edition, Pearson Education, 2011.

2. Robert Kreitner & Mamata Mohapatra, “Management”, Biztantra, 2008.

3. Harold Koontz & Heinz Weihrich “Essentials of management” Tata McGraw Hill, 1998. 4. Tripathy PC & Reddy PN, “Principles of Management”, Tata McGraw Hill, 1999.

Professional Elective - II (Semester - VI)

Semester	VI	L	T	P	C
Course Code/ Title	191EC631/ CMOS Analog IC Design	3	0	0	3
Objectives	• To study the fundamentals of analog circuits and MOS device models • To gain knowledge on various configurations of MOS transistors and feedback concepts • To study the characteristics of noise and frequency response of the amplifier To learn the concepts of Op-Amp frequency compensation, capacitor switches and PLLs				

Unit-I	Introduction to Analog IC Design and Current Mirrors	9

Concepts of Analog Design - General consideration of MOS devices – MOS I/V Characteristics – Second order effects – MOS device models. Basic current mirrors- Cascode current mirrors- Active current mirrors- Large and Small signal analysis- Common mode properties.

Unit-II	Amplifiers and Feedback	9

Basic Concepts – Common source stage- Source follower- Common gate stage- Cascode stage. Single ended and differential operation- Basic Differential pair- Common mode response- Differential pair with MOS loads- Gilbert Cell. Feedback- General Consideration of feedback circuits- Feedback topologies- Effect of loading- Effect of feedback on Noise.

Unit-III	Frequency Response of Amplifiers and Noise	9

General considerations- Miller Effect and Association of Poles with Nodes, Common source stage- Source followers- Common gate stage- Cascode stage- Differential pair. Noise- Statistical characteristicsofnoise- Typesofnoise-Representationofnoiseincircuits-Noiseinsinglestage amplifiers- Noise in differential pairs- Noise Bandwidth.

Unit-IV	Operational Amplifier Stability and Frequency Compensation	9

General Considerations- One and Two Stage Op Amps- Gain Boosting- Comparison- Common mode feedback- Input range limitations- Slew rate- Power Supply Rejection- Noise in Op Amps- General consideration of stability and frequency compensation- Multipole system- Phase margin- Frequency compensation- Compensation of two stage op Amps- Other compensation techniques.

Unit-V	Switched Capacitor Circuits and PLLs	9

General Considerations- Sampling switches- Switched Capacitor Amplifiers- Switched Capacitor Integrator- Switched Capacitor Common mode feedback. Phase Locked Loops-Simple PLL- Charge pump PLLs - Non ideal Effects in PLLs- Delay locked loops- its Applications.

Outcomes	**Upon completion of the course, student should be able to:** 1. Realize the concepts of Analog MOS devices and current mirror circuits. 2. Design different configuration of Amplifiers and feedback circuits. 3. Analyze the characteristics of frequency response of the amplifier and its noise. 4. Analyze the performance of the stability and frequency compensation techniques of Op- Amp Circuits. 5. Construct switched capacitor circuits and PLLs

Text books

1. Behzad Razavi, -Design of Analog CMOS Integrated Circuits, Tata McGraw Hill, 2001, 33rd re-print,2016.

References

1. Phillip Allen and Douglas Holmberg -CMOS Analog Circuit Design‖ Second Edition, Oxford University Press, 2004.

2. Paul R. Gray, Paul J. Hurst, Stephen H. Lewis, Robert G. Meyer, Analysis and Design of Analog Integrated Circuits, 5th Edition, Wiley, 2009.

3. Grebene, -Bipolar and MOS Analog Integrated circuit design‖, John Wiley &sons, Inc., 2003

Semester	VI	L	T	P	C
Course Code/ Title	191EC632/Computer Networks	3	0	0	3
Objectives	1. 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. Learn the flow control and congestion control algorithms				
Unit-I	Fundamentals & Link Layer				9
Network Topology- Network types –Layering and protocols – Layers in TCP/IP protocol suite – OSI Model- Switching Techniques. Connecting devices- Hubs, Switches, Routers-Data Link Layer Services.					
Unit-II	Media Access & Internetworking				9
Ethernet and multiple access networks 802.3 -Wireless: WiFi, Bluetooth, Cellphone technologies - Basic internetworking-IP, ARP, DHCP, ICMP- IPV4					
Unit-III	Routing				9
Unicast Routing (RIP, OSPF)– Multicast addresses – Multicast Routing (DVMRP, PIM) — Global Internet Areas, BGP- Overview of IPV6 Addressing – Transition from IPV4 to IPV6					
Unit-IV	Transport Layer				9
Transport Layer services – Simple, Stop-and-wait, Go-Back-N, Selective Repeat, Piggy backing. Transport Layer Protocols - User Datagram Protocols (UDP) and Transmission Control Protocols (TCP) –Services – Features – TCP Connection – State Transition Diagram – Flow, Error and Congestion Control - Congestion avoidance (DECbit, RED) – QoS					
Unit-V	Application Layer				9
Traditional applications -Electronic Mail (SMTP, POP3, IMAP, MIME) – HTTP – DNS – Introduction to Peer to Peer Networks – Client Server programming, Cryptography basics: Public and Private key, Firewalls.					
Outcomes	1. Identify the required functionality at each layer for given application and the importance of physical connectivity, networking models and devices. 2. Analyze the functions of data link layer. 3.Construct solutions for the various routing algorithms in packet switched networking. 4. Examine the performance of transport layer protocols and the beneficial effects of adopting suitable congestion control schemes. 5.Determine the features and protocols of application layer.				

Text Books

1. Behrouz A. Forouzan, ―Data communication and Networking, Fifth Edition, Tata McGraw – Hill, 2013
2.Larry L. Peterson, Bruce S. Davie, "Computer Networks: A Systems Approach", Fifth Edition, Morgan Kaufmann Publishers, 2011.

References

1. James F. Kurose, Keith W. Ross, Computer Networking - A Top-Down Approach Featuring the Internet, Seventh Edition, Pearson Education, 2016.
2. Nader. F. Mir, Computer and Communication Networks, Pearson Prentice Hall Publishers, 2nd Edition, 2014.
3. Ying-Dar Lin, Ren-Hung Hwang, Fred Baker, Computer Networks: An Open Source Approach‖, McGraw Hill Publisher, 2011.

Semester	VI	L	T	P	C
Course Code/ Title	191EC633/Cryptography and Network Security	3	0	0	3
Objectives	To understand Cryptography Theories, Algorithms and Systems. To understand necessary Approaches and Techniques to build protection mechanisms in order to secure computer networks.				

Unit-I	Introduction	9

Security trends - Legal, Ethical and Professional Aspects of Security, Need for Security at Multiple levels, Security Policies - Model of network security – Security attacks, services and mechanisms – OSI security architecture – Classical encryption techniques: substitution techniques, transposition techniques, steganography).- Foundations of modern cryptography: perfect security – information theory – product cryptosystem – cryptanalysis.

Unit-II	Symmetric Cryptography	9

MATHEMATICS OF SYMMETRIC KEY CRYPTOGRAPHY: Algebraic structures - Modular arithmetic-Euclid‘s algorithm- Congruence and matrices - Groups, Rings, Fields- Finite fields- SYMMETRIC KEY CIPHERS**:** SDES – Block cipher Principles of DES – Strength of DES – Differential and linear cryptanalysis - Block cipher design principles – Block cipher mode of operation – Evaluation criteria for AES – Advanced Encryption Standard - RC4 – Key distribution

Unit-III	Public Key Cryptography	9

MATHEMATICS OF ASYMMETRIC KEY CRYPTOGRAPHY: Primes – Primality Testing – Factorization – Euler‘s totient function, Fermat‘s and Euler‘s Theorem - Chinese Remainder Theorem – Exponentiation and logarithm - ASYMMETRIC KEY CIPHERS: RSA cryptosystem – Key distribution – Key management – Diffie Hellman key exchange - ElGamal cryptosystem – Elliptic curve arithmetic-Elliptic curve cryptography.

Unit-IV	Message Authentication and Integrity	9

Authentication requirement – Authentication function – MAC – Hash function – Security of hash function and MAC – SHA –Digital signature and authentication protocols – DSS- Entity Authentication: Biometrics, Passwords, Challenge Response protocols- Authentication applications - Kerberos, X.509

Unit-V	Security Practice and System Security	9

Electronic Mail security – PGP, S/MIME – IP security – Web Security - SYSTEM SECURITY: Intruders – Malicious software – viruses –Firewalls.

Outcomes

Upon completion of the course, the student should be able to:

1. Understand the fundamentals of networks security, security architecture, threats and vulnerabilities
2. Apply the different cryptographic operations of symmetric cryptographic algorithms
3. Apply the different cryptographic operations of public key cryptography
4. Apply the various Authentication schemes to simulate different applications.
5. Understand various Security practices and System security standards

Text books

1.William Stallings, Cryptography and Network Security: Principles and Practice, PHI 3rd Edition, 2006.

References

1. C K Shyamala, N Harini and Dr. T R Padmanabhan: Cryptography and Network Security, Wiley India Pvt.Ltd
2. BehrouzA.Foruzan, Cryptography and Network Security, Tata McGraw Hill 2007.
3. Charlie Kaufman, Radia Perlman, and Mike Speciner, Network Security: PRIVATE Communication in a PUBLIC World, Prentice Hall, ISBN 0-13-046019-2

emester	VI	L	T	P	C
Course Code/ Title	191EC634/ Disaster Management	3	0	0	3
Objectives	• To provide students an exposure to disasters, their significance and types. • To ensure that students begin to understand the relationship between vulnerability, disasters, disaster prevention and risk reduction • To gain a preliminary understanding of approaches of Disaster Risk Reduction(DRR) • To enhance awareness of institutional processes in the country • To develop rudimentary ability to respond to their surroundings with potential disaster response in areas where they live, with due sensitivity				

Unit-I	Introduction to Disasters	9

Definition: Disaster, Hazard, Vulnerability, Resilience, Risks – Disasters: Types of disasters – Earthquake, Landslide, Flood, Drought, Fire etc - Classification, Causes, Impacts including social, economic, political, environmental, health, psychosocial, etc.- Differential impacts- in terms of caste, class, gender, age, location, disability - Global trends in disasters: urban disasters, pandemics, complex emergencies, Climate change- Dos and Don'ts during various types of Disasters.

Unit-II	Approaches to Disaster Risk Reduction(DRR)	9

Disaster cycle - Phases, Culture of safety, prevention, mitigation and preparedness community based DRR, Structural- nonstructural measures, Roles and responsibilities of- community, Panchayati Raj Institutions/Urban Local Bodies (PRIs/ULBs), States, Centre, and other stake- holders- Institutional Processes and Framework at State and Central Level- State Disaster Management Authority(SDMA) – Early Warning System – Advisories from Appropriate Agencies.

Unit-III	Inter-Relationship Between Disasters and Development	9

Factors affecting Vulnerabilities, differential impacts, impact of Development projects such as dams, embankments, changes in Land-use etc.- Climate Change Adaptation- IPCC Scenario and Scenarios in the context of India - Relevance of indigenous knowledge, appropriate technology and local resources.

Unit-IV	Disaster Risk Management in India	9

Hazard and Vulnerability profile of India, Components of Disaster Relief: Water, Food, Sanitation, Shelter, Health, and Waste Management, Institutional arrangements (Mitigation, Response and Preparedness, Disaster Management Act and Policy - Other related policies, plans, programs and legislation – Role of GIS and Information Technology Components in Preparedness, Risk Assessment, Response and Recovery Phases of Disaster – Disaster Damage Assessment

Unit-V	Disaster Management: Applications and Case Studies and Field Works	9

Landslide Hazard Zonation: Case Studies, Earthquake Vulnerability Assessment of Buildings and Infrastructure: Case Studies, Drought Assessment: Case Studies, Coastal Flooding: Storm Surge Assessment, Floods: Fluvial and Pluvial Flooding: Case Studies; Forest Fire: Case Studies, Man Made disasters: Case Studies, Space Based Inputs for Disaster Mitigation and Management and field works related to disaster management.

Outcomes	**The students will be able to** 1. Differentiate the types of disasters, causes and their impact on environment and society 2. Assess vulnerability and various methods of risk reduction measures as well as mitigation. 3. Draw the hazard and vulnerability profile of India, Scenarios in the Indian context, Disaster damage assessment and management.

Text books

1. SinghalJ.P.-DisasterManagement‖,LaxmiPublications,2010.ISBN-10:9380386427ISBN- 13:978-9380386423
2. TusharBhattacharya,-DisasterScienceandManagement‖,McGrawHillIndiaEducationPvt. Ltd., 2012. **ISBN-10:** 1259007367, **ISBN-13:**978-1259007361]
3. Gupta Anil K, Sreeja S. Nair. Environmental Knowledge for Disaster Risk Management, NIDM, New Delhi,2011

4. Kapur Anu Vulnerable India: A Geographical Study of Disasters, IIAS and Sage Publishers, New Delhi,2010.

References

1. Govt. of India: Disaster Management Act , Government of India, New Delhi,2005
2. Government of India, National Disaster ManagementPolicy,2009.

Semester	VI	L	T	P	C
Course Code/ Title	191EC635/ MEMS and NEMS	3	0	0	3

Objectives

- To introduce the concepts of micro and nano electromechanical devices
- To know the fabrication process of Microsystems
- To know the design concepts of micro sensors and micro actuators
- To introduce the concepts of quantum mechanics and Nanosystems

Unit-I	Introduction to MEMS and NEMS	9

Introduction to Design of MEMS and NEMS, Overview of Nano and Micro electro mechanical Systems, Applications of Micro and Nano electro mechanical systems, Materials for MEMS and NEMS: Silicon, silicon compounds, polymers, metals.

Unit-II	MEMS Fabrication Technologies	9

Photolithography, Ion Implantation, Diffusion, Oxidation, CVD, Sputtering Etching techniques, Micromachining: Bulk Micromachining, Surface Micromachining, LIGA.

Unit-III	Micro Sensors	9

MEMS Sensors: Design of Acoustic wave sensors, Vibratory gyroscope, Capacitive Pressure sensors, Case study: Piezoelectric energy harvester

Unit-IV	Micro Actuators	9

Design of Actuators: Actuation using thermal forces, Actuation using shape memory Alloys, Actuation using piezoelectric crystals, Actuation using Electrostatic forces, Case Study: RF Switch.

Unit-V	NANO Devices	9

Atomic Structures and Quantum Mechanics, Shrodinger Equation, ZnO nanorods based NEMS device: Gas sensor.

Outcomes

Upon completion of the course, students will be able to:

1. Interpret the basics of micro/nano electromechanical systems including their applications and advantages
2. Recognize the use of materials in micro fabrication and describe the fabrication processes including surface micromachining, bulk micromachining and LIGA.
3. Analyze the key performance aspects of electromechanical transducers including sensors and actuators
4. Comprehend the theoretical foundations of quantum mechanics and Nanosystems

References

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

Semester	VI	L	T	P	C
Course Code/ Title	191EC636/Speech Signal Processing	3	0	0	3

Objectives

- To introduce speech production and related parameters of speech.
- To show the computation and use of techniques such as short time Fourier transform, linear predictive coefficients and other coefficients in the analysis of speech.
- To understand different speech modeling procedures such as Markov and their implementation issues.

Unit-I **Basic Concepts** **9**

Speech Fundamentals: Articulatory Phonetics – Production and Classification of Speech Sounds; Acoustic Phonetics – Acoustics of speech production; Review of Digital Signal Processing concepts; Short-Time Fourier Transform, Filter-Bank and LPC Methods.

Unit-II **Speech Analysis** **9**

Features, Feature Extraction and Pattern Comparison Techniques: Speech distortion measures– mathematical and perceptual – Log–Spectral Distance, Cepstral Distances, Weighted Cepstral Distances and Filtering, Likelihood Distortions, Spectral Distortion using a Warped Frequency Scale, LPC, PLP and MFCC Coefficients, Time Alignment and Normalization – Dynamic Time Warping, Multiple Time – Alignment Paths.

Unit-III **Speech Modeling** **9**

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

Unit-IV **Speech Recognition** **9**

Large Vocabulary Continuous Speech Recognition: Architecture of large vocabulary continuous speech recognition system – acoustics and language models – n-grams, context dependent sub-word units; Applications and present status.

Unit-V **Speech Synthesis** **9**

Text-to-Speech Synthesis: Concatenative and waveform synthesis methods, sub-word units for TTS, intelligibility and naturalness – role of prosody, Applications and present status.

Outcomes

Upon completion of the course, students will be able to:

1. Model speech production system and describe the fundamentals of speech.
2. Extract and compare different speech parameters.
3. Choose an appropriate statistical speech model for a given application.
4. Design a speech recognition system.
5. Use different speech synthesis techniques.

Text books

1. Lawrence Rabiner and Biing-Hwang Juang, “Fundamentals of Speech Recognition”, Pearson Education, 2003.
2. Daniel Jurafsky and James H Martin, “Speech and Language Processing – An Introduction to Natural Language Processing, Computational Linguistics, and Speech Recognition”, Pearson Education, 2002.
3. Frederick Jelinek, “Statistical Methods of Speech Recognition”, MIT Press, 1997.

References

1. Steven W. Smith, “The Scientist and Engineer‟s Guide to Digital Signal Processing”, California Technical Publishing, 1997.
2. Thomas F Quatieri, “Discrete-Time Speech Signal Processing – Principles and Practice”, Pearson Education, 2004.
3. Claudio Becchetti and LucioPrinaRicotti, “Speech Recognition”, John Wiley and Sons, 1999.
4. Ben Gold and Nelson Morgan, “Speech and Audio Signal Processing, Processing and Perception of Speech and Music”, Wiley- India Edition, 2006.

Professional Elective - III (Semester - VI)

Semester	VI	L	T	P	C
Course Code/ Title	191EC637/ Cognitive Radio	3	0	0	3
Objectives	• To understand the evolving software defined radio and cognitive radio techniques and their essential functionalities • To study the basic architecture and standard for cognitive radio • To understand the physical, MAC and Network layer design of cognitive radio • To expose the student to evolving applications and advanced features of cognitive radio				
Unit-I	Introduction to Software-Defined Radio and Cognitive Radio				9
Evolution of Software Defined Radio and Cognitive radio: goals, benefits, definitions, architectures, relations with other radios, issues, enabling technologies, radio frequency spectrum and regulations.					
Unit-II	Cognitive Radio Architecture				9
Cognition cycle – orient, plan, decide and act phases, Organization, SDR as a platform for Cognitive Radio – Hardware and Software Architectures, Overview of IEEE 802.22 standard for broadband wireless access in TV bands.					
Unit-III	Spectrum Sensing and Dynamic Spectrum Access				9
Introduction – Primary user detection techniques – energy detection, feature detection, matched filtering, cooperative detection and other approaches, Fundamental Tradeoffs in spectrum sensing, Spectrum Sharing Models of Dynamic Spectrum Access - Unlicensed and Licensed Spectrum Sharing, Fundamental Limits of Cognitive Radio.					
Unit-IV	MAC and Network Layer Design For Cognitive Radio				9
MAC for cognitive radios – Polling, ALOHA, slotted ALOHA, CSMA, CSMA / CA, Network layer design – routing in cognitive radios, flow control and error control techniques.					
Unit-V	Advanced Topics in Cognitive Radio				9
Overview of security issues in cognitive radios, auction based spectrum markets in cognitive radio networks, public safety and cognitive radio, cognitive radio for Internet of Things.					
Outcomes	Upon completion of the course, students should able to: 1. Gain knowledge on the design principles on software defined radio and cognitive radio 2. Develop the ability to design and implement algorithms for cognitive radio spectrum sensing and dynamic spectrum access 3. Build experiments and projects with real time wireless applications 4. Apply the knowledge of advanced features of cognitive radio for real world applications				

Text books

1. Alexander M. Wyglinski, Maziar Nekovee, Thomas Hou, -Cognitive Radio Communications and Networks‖, Academic Press, Elsevier, 2010. (Unit I to IV)
2. Huseyin Arslan (Ed.), -Cognitive Radio, Software Defined Radio, and Adaptive Wireless Systems, Springer, 2007. (Unit V)

References

1. Bruce Fette,-Cognitive Radio Technology‖,Newnes,2006.
2. Kwang-Cheng Chen, Ramjee Prasad, ―Cognitive Radio Networks‖, John Wiley and Sons, 2009.
3. EzioBiglieri, Professor Andrea J. Goldsmith, Dr Larry J. Greenstein, Narayan B.Mandayam,H.VincentPoor,Principles of Cognitive Radio,Cambridge University Press,2012.

Semester	VI	L	T	P	C
Course Code/ Title	191EC638/ Intellectual Property Rights	3	0	0	3
Objectives	• To give an idea about IPR, registration and its enforcement.				

Unit-I	Introduction	9

Introduction to IPRs, Basic concepts and need for Intellectual Property - Patents, Copyrights, Geographical Indications, IPR in India and Abroad – Genesis and Development – the way from WTO to WIPO –TRIPS, Nature of Intellectual Property, Industrial Property, technological Research, Inventions and Innovations – Important examples of IPR.

Unit-II	Registration of IPRs	9

Meaning and practical aspects of registration of Copy Rights, Trademarks, Patents, Geographical Indications, Trade Secrets and Industrial Design registration in India and Abroad.

Unit-III	Agreements and Legislations	9

International Treaties and Conventions on IPRs, TRIPS Agreement, PCT Agreement, Patent Act of India, Patent Amendment Act, Design Act, Trademark Act, Geographical Indication Act.

Unit-IV	Digital Products and Law	9

Digital Innovations and Developments as Knowledge Assets – IP Laws, Cyber Law and Digital Content Protection – Unfair Competition – Meaning and Relationship between Unfair Competition and IP Laws – Case Studies.

Unit-V	Enforcement of IPRs	9

Infringement of IPRs, Enforcement Measures, Emerging issues – Case Studies.

Outcomes	Upon completion of the course, students should able to: 1. Ability to manage Intellectual Property portfolio to enhance the value of thefirm.

Text books

1. V. ScopleVinod, Managing Intellectual Property, Prentice Hall of India pvt Ltd,2012
2. S.V.Satakar,-IntellectualPropertyRightsandCopyRights,EssEssPublications,NewDelhi, 2002.

References

1. DeborahE.Bouchoux,-Intellectual Property: The Law of Trademarks, Copyrights, Patents and Trade Secrets‖, Cengage Learning, Third Edition,2012.
2. Prabuddha Ganguli ,Intellectual Property Rights: Unleashing the Knowledge Economy‖, McGraw Hill Education,2011.
3. Edited by Derek Bosworth and Elizabeth Webster, The Management of Intellectual Property, Edward Elgar Publishing Ltd., 2013

Semester	VI	L	T	P	C
Course Code/ Title	191EC639/Mixed Signal IC Design	3	0	0	3

Objectives

- Study the mixed signal of submicron CMOS circuits
- Understand the various integrated based filters and topologies
- Learn the data converters architecture, modeling and signal to noise ratio
- Study the integrated circuit of oscillators and PLLs

Unit-I	Submicron CMOS Circuit Design	9

Submicron CMOS: Overview and Models, CMOS process flow, Capacitors and Resistors. Digital circuit design: The MOSFET Switch, Delay Elements, An Adder. Analog Circuit Design: Biasing, Op-Amp Design, Circuit Noise.

Unit-II	Integrator Based CMOS Filters	9

Integrator Building Blocks- low pass filter, Active RC integrators, MOSFET-C Integrators, gm- C integrators, Discrete time integrators. Filtering Topologies: The Bilinear transfer function, The Biquadratic transfer function, Filters using Noise shaping.

Unit-III	Data Converter Architectures	9

DAC Architectures- Resistor string, R-2R ladder Networks, Current Steering, Charge Scaling DACs, Cyclic DAC, and Pipeline DAC. ADC Architectures- Flash, Two-step flash ADC, Pipeline ADC, Integrating ADC's, Successive Approximation ADC.

Unit-IV	Data Converter Modeling and SNR	9

Sampling and Aliasing: A modeling approach, Impulse sampling, The sample and Hold, Quantization noise. Data converter SNR: An overview, Clock Jitter, Improving SNR using Averaging, Decimating filter for ADCs, Interpolating filter for DACs, Band pass and High pass sinc filters - Using feedback to improve SNR.

Unit-V	Oscillators and PLL	9

LC oscillators, Voltage Controlled Oscillators. Simple PLL, Charge pumps PLLs, Non ideal effects in PLLs, Delay Locked Loops.

Outcomes

Upon completion of the course, students should able to:

1. Apply the concepts for mixed signal MOS circuit.
2. Analyze the characteristics of IC based CMOS filters.
3. Design of various data converter architecture circuits.
4. Analyze the signal to noise ratio and modeling of mixed signals.
5. Design of oscillators and phase lock loop circuit.

References

1. R.Jacob Baker -CMOS Mixed Signal Circuit Design -Wiley India, IEEE Press, reprint 2008.
2. R.Jacob Baker -CMOS Circuit Design, Layout and Simulation - Wiley India, IEEE Press, Second Edition, reprint 2009.
3.BehzadRazavi -Design of Analog CMOS Integrated Circuits - McGraw Hill, 33rd Re- print, 2016.

Semester	VI	L	T	P	C
Course Code/ Title	191EC6310/Sensors and Transducers	3	0	0	3
Objectives	• To understand the concepts of measurement technology. • To learn the various sensors used to measure various physical parameters. • To learn the fundamentals of signal conditioning, data acquisition and communication systems used in mechatronics system development.				
Unit-I	INTRODUCTION			9	
Basics of Measurement – Classification of errors – Error analysis – Static and dynamic characteristics of transducers – Performance measures of sensors – Classification of sensors – Sensor calibration techniques – Sensor Output Signal Types.					
Unit-II	MOTION, PROXIMITY AND RANGING SENSORS			9	
Motion Sensors – Potentiometers, Resolver, Encoders – Optical, Magnetic, Inductive, Capacitive, LVDT – RVDT – Synchro – Microsyn, Accelerometer.,– GPS, Bluetooth, Range Sensors – RF beacons, Ultrasonic Ranging, Reflective beacons, Laser Range Sensor (LIDAR).					
Unit-III	FORCE, MAGNETIC AND HEADING SENSORS			9	
Strain Gage, Load Cell, Magnetic Sensors –types, principle, requirement and advantages: Magneto resistive – Hall Effect – Current sensor Heading Sensors – Compass, Gyroscope, Inclinometers.					
UNIT IV	OPTICAL, PRESSURE AND TEMPERATURE SENSORS			9	
Photo conductive cell, photo voltaic, Photo resistive, LDR – Fiber optic sensors – Pressure – Diaphragm, Bellows, Piezoelectric – Tactile sensors, Temperature – IC, Thermistor, RTD, Thermocouple. Acoustic Sensors – flow and level measurement, Radiation Sensors - Smart Sensors - Film sensor, MEMS & Nano Sensors, LASER sensors.					
Unit-V	SIGNAL CONDITIONING and DAQ SYSTEMS			9	
Amplification – Filtering – Sample and Hold circuits – Data Acquisition: Single channel and multi channel data acquisition – Data logging - applications - Automobile, Aerospace, Home appliances, Manufacturing, Environmental monitoring.					
Outcomes	Upon completion of the course, students should able to: • Expertise in various calibration techniques and signal types for sensors. • Apply the various sensors in the Automotive and Mechatronics applications • Study the basic principles of various smart sensors. • Implement the DAQ systems with different sensors for real time applications				

Text books

1. Ernest O Doebelin, “Measurement Systems – Applications and Design”, Tata McGraw-Hill, 2009.
2. Sawney A K and Puneet Sawney, “A Course in Mechanical Measurements and Instrumentation and Control”, 12th edition, Dhanpat Rai & Co, New Delhi, 2013.

References

1. Patranabis D, “Sensors and Transducers”, 2nd Edition, PHI, New Delhi, 2010.
2. John Turner and Martyn Hill, “Instrumentation for Engineers and Scientists”, Oxford Science Publications, 1999.
3. Richard Zurawski, “Industrial Communication Technology Handbook” 2nd edition, CRC Press, 2015.

Semester	VI	L	T	P	C
Course Code/ Title	191EC6311/Telecommunication Network Management	3	0	0	3

Objectives

- To understand the concept of network management standards.
- To design the common management information service element model.
- To understand the various concept of information modelling.
- To analyze the concept of SNMPv1 and SNMPv2 protocol.
- To analyze the concept of examples of network management.

Unit-I	FOUNDATIONS	9

Network management standards–network management model– organization model– information model abstract syntax notation 1 (ASN.1) – encoding structure– macros–functional model. Network management application functional requirements: Configuration management– fault management–performance management–Error correlation technology– security management–accounting management– common management–report management– polity based management–service level management–management service–community definitions– capturing the requirements– simple and formal approaches–semi formal and formal notations.

Unit-II	COMMON MANAGEMENT INFORMATION SERVICE ELEMENT	9

CMISE model–service definitions–errors–scooping and filtering features– synchronization–functional units–association services– common management information protocol specification.

Unit-III	INFORMATION MODELING FOR TMN	9

Rationale for information modeling–management information model–object oriented modeling paradigm–structure of management information–managed object class definition–management information base.

UNIT IV	SIMPLE NETWORK MANAGEMENT PROTOCOL	9

SNMPv1: managed networks–SNMP models– organization model–information model–SNMPv2 communication model–functional model–major changes in SNMPv2–structure of management information, MIB–SNMPv2 protocol– compatibility with SNMPv1– SNMPv3– architecture–applications–MIB security, remote monitoring–SMI and MIB– RMQN1 and RMON2.

Unit-V	NETWORK MANAGEMENT EXAMPLES	9

ATM integrated local management interface–ATM MIB–M1– M2–M3– M4– interfaces–ATM digital exchange interface management–digita1 subscriber loop and asymmetric DSL technologies–ADSL configuration management–performance management Network management tools: Network statistics management–network management system–management platform case studies: OPENVIEW–ALMAP.

Outcomes

Upon completion of the course, students should able to:

- Design and analyze of fault management.
- Analyze the common management information protocol specifications.
- Design and analyze of management information model.
- Design the simple network management protocol.
- Design the various types of network management tools.

Text books

1.Mani Subramanian, “Network Management: Principles and Practice” Pearson Education, Second edition, 2010

2. Lakshmi G Raman, “Fundamentals of Telecommunications Network Management” ,Wiley, 1999

References

1. Henry Haojin Wang, “Telecommunication Network Management”, Mc- Graw Hill ,1999

2. Salah Aidarous & Thomas Plevyak, “Telecommunication Network Management: Technologies and Implementations” , Wiley,1997

Semester	VI	L	T	P	C
Course Code/ Title	191EC6312/ Wireless Communication	3	0	0	3
Objectives	• To study the characteristic of wireless channel. • To understand the design of a cellular system • To study the various digital signaling techniques and multipath mitigation techniques • To understand the concepts of multiple antenna techniques				

Unit-I	Wireless Channels	9

Large scale path loss – Path loss models: Free Space and Two-Ray models -Link Budget design – Small scale fading- Parameters of mobile multipath channels – Time dispersion parameters-Coherence bandwidth – Doppler spread & Coherence time, fading due to Multipath time delay spread – flat fading – frequency selective fading – Fading due to Doppler spread – fast fading – slow fading.

Unit-II	Cellular Architecture	9

Multiple Access techniques - FDMA, TDMA, CDMA – Capacity calculations–Cellular concept- Frequency reuse - channel assignment- hand off- interference & system capacity- trunking & grade of service – Coverage and capacity improvement.

Unit-III	Digital Signaling For Fading Channels	9

Structure of a wireless communication link, Principles of Offset-QPSK, p/4-DQPSK, Minimum Shift Keying, Gaussian Minimum Shift Keying, Error performance in fading channels, OFDM principle – Cyclic prefix, Windowing PAPR.

Unit-IV	Multipath Mitigation Techniques	9

Equalization – Adaptive equalization, Linear and Non-Linear equalization, Zero forcing and LMS Algorithms. Diversity – Micro and Macro diversity, Diversity combining techniques, Error probability in fading channels with diversity reception, Rake receiver.

Unit-V	Multiple Antenna Techniques	9

MIMO systems – spatial multiplexing -System model -Pre-coding - Beam forming -transmitter diversity, receiver diversity- Channel state information-capacity in fading and non-fading channels.

Outcomes	Upon completion of the course, students should able to: 1. Characterize a wireless channel and evolve the system design specifications 2. Design a cellular system based on resource availability and traffic demands 3. Identify suitable signalling and multipath mitigation techniques for the wireless channel and system under consideration.

Text books

1. Rappaport,T.S., ―Wireless communications‖, Pearson Education, Second Edition, 2010.(UNIT I, II, IV)
2. Andreas.F. Molisch, ―Wireless Communications‖, John Wiley – India, 2006. (UNIT II,V)

References

1. Andrea GoldsmithWireless Communication –, Cambridge University Press, 2011
2. Van Nee, R. and Ramji Prasad, ―OFDM for wireless multimedia communications, Artech House, 2000
3. David Tse and Pramod Viswanath, ―Fundamentals of Wireless Communication, Cambridge University Press,2005.
4. UpenaDalal, ―Wireless Communication‖, Oxford University Press,2009.

Semester	**V**	**L**	**T**	**P**	**C**
Course Code/ Title	**191EC731/DATA CONVERTERS**	**3**	**0**	**0**	**3**
Objectives	• To explain the basic operational and design principles of CMOS Analog to Digital and Digital to Analog converter architectures. • To introduce the design calculations for developing the various blocks associated with a typical CMOS AD or DA converter. • To make students decide the dimensions and bias conditions of all the MOS transistors involved in the design.				
Unit-I	**SAMPLE AND HOLD CIRCUITS**				**9**
Sampling switches, Conventional open loop and closed loop sample and hold architecture, Open loop architecture with miller compensation, multiplexed input architectures, recycling architecture switched capacitor architecture.					
Unit-II	**SWITCH CAPACITOR CIRCUITS AND COMPARATORS**				**9**
Switched-capacitor amplifiers, switched capacitor integrator, switched capacitor common mode feedback. Single stage amplifier as comparator, cascaded amplifier stages as comparator, latched comparators.					
Unit-III	**DIGITAL TO ANALOG CONVERSION**				**9**
Performance metrics, reference multiplication and division, switching and logic functions in AC, Resistor ladder DAC architecture, current steering DAC architecture.					
UNIT IV	**ANALOG TO DIGITAL CONVERSION**				**9**
Performance metric, Flash architecture, Pipelined Architecture, Successive approximation architecture, Time interleaved architecture.					
Unit-V	**PRECISION TECHNIQUES**				**9**
Comparator offset cancellation, Op Amp offset cancellation, Calibration techniques, range overlap and digital correction.					
Outcomes	Upon completion of the course, students should able to: • Explain sample and hold circuits • Design ADC/DAC circuits • Analyze ADC/DAC Architecture and Performance • Discuss calibration techniques				
Text books					
: 1. Behzad Razavi, “Principles of data conversion System Design”, IEEE press, 1995.					
References					
1. Franco Maloberti, “Data Converters”, Springer, 2007. 2. Rudy Van de Plassche, “CMOS Integrated Analog-to-Digital and Digital-to-Analog Converters”, Kluwer Acedamic Publishers, Boston, 2003.					

emester	VII	L	T	P	C
Course Code/ Title	191EC732/Design Compressive Sensing	3	0	0	3
Objectives	• To present the basic theory and ideas showing when it is possible to reconstruct sparse or nearly sparse signals from under sampled data • To expose students to recent ideas in modern convex optimization allowing rapid signal recovery • To give students a sense of real time applications that might benefit from compressive sensing ideas				

Unit-I	Introduction to Compressed Sensing	9

Introduction; Motivation; Mathematical Background; Traditional Sampling; Traditional Compression; Conventional Data Acquisition System; Drawbacks of Transform coding; Compressed Sensing(CS).

Unit-II	Sparsity and Signal Recovery	9

Signal Representation; Basis vectors; Sensing matrices; Restricted Isometric Property; Coherence; Stable recovery; Number of measurements.

Unit-III	Recovery Algorithms	9

Basis Pursuit algorithm: L1 minimization; Matching pursuit: Orthogonal Matching Pursuit(OMP), Stagewise OMP, Regularized OMP, Compressive Sampling Matching Pursuit (CoSaMP); Iterative Thresholding algorithm: Hard thresholding, Soft thresholding; Model based : Model based CoSaMP, Model based HIT.

Unit IV	Compressive Sensing for WSN	9

Basics of WSN; Wireless Sensor without Compressive Sensing; Wireless Sensor with Compressive Sensing; Compressive Wireless Sensing: Spatial compression in WSNs, Projections in WSNs, Compressed Sensing in WSNs.

Unit-V	Applications of Compressive Sensing	9

Compressed Sensing for Real-Time Energy-Efficient Compression on Wireless Body Sensor Nodes; Compressive sensing in video surveillance; An Application of Compressive Sensing for Image Fusion; Single-Pixel Imaging via Compressive Sampling.

Outcomes	Upon completion of the course, students should able to: 1. Appreciate the motivation and the necessity for compressed sensing technology. 2. Design a new algorithm or modify an existing algorithm for different application areas in wireless sensor network.

Text books

1. Radha S, Hemalatha R, Aasha Nandhini S, -Compressive Sensing for Wireless Communication: Challenges and Opportunities‖, River publication, 2016. (UNIT I-V)
2. Mark A. Davenport, Marco F. Duarte, Yonina C. Eldar and Gitta Kutyniok, -Introduction to Compressed Sensing,‖ in Compressed Sensing: Theory and Applications, Y. Eldar and G. Kutyniok, eds., Cambridge University Press, 2011 (UNIT I)

References

1. Duarte, M.F.; Davenport, M.A.; Takhar, D.; Laska, J.N.; Ting Sun; Kelly, K.F.; Baraniuk, R.G.; , "Single-Pixel Imaging via Compressive Sampling," Signal Processing Magazine,IEEE, vol.25, no.2, pp.83-91, March 2008.
2. TaoWan.;ZengchangQin.; ,-An application of compressive sensing forimagefusion‖,CIVR'10 Proceedings of the ACM International Conference on Image and Video Retrieval, Pages 3-9.
3. H. Mamaghanian , N. Khaled , D. Atienza and P. Vandergheynst "Compressed sensing for real-time energy-efficient ecg compression on wireless body sensor nodes", IEEE Trans.Biomed. Eng., vol. 58, no. 9, pp.2456 - 2466 2011.

Semester	VII	L	T	P	C
Course Code/ Title	191EC733/ Electromagnetic Interference and Compatibility	3	0	0	3
Objectives	• To introduce the basic concepts of Electromagnetic Interference • To teach the importance of Electromagnetic Compatible designs • To explain the existing standards for Electromagnetic Compatibility.				
Unit-I	EMI/EMC Concepts			9	
EMI-EMC definitions; Sources and Victims of EMI; Conducted and Radiated EMI Emission and Susceptibility; Case Histories; Radiation Hazards to humans.					
Unit-II	EMI Coupling Principles			9	
Conducted, radiated and transient coupling; Common ground impedance coupling; Common mode and ground loop coupling; Differential mode coupling; Near field cable to cable coupling; Field to cable coupling; Power mains and Power supply coupling; Transient EMI, ESD.					
Unit-III	EMI Control			9	
Shielding; EMI Filters; Grounding; Bonding; Isolation transformer; Transient suppressors; EMI Suppression Cables.					
UNIT IV	EMC Design for Circuits and PCBs			9	
Noise from Relays and Switches; Nonlinearities in Circuits; Cross talk in transmission line and cross talk control; Component selection and mounting; PCB trace impedance; Routing; Power distribution decoupling; Zoning; Grounding; VIAs; Terminations.					
Unit-V	EMI Measurements and Standards			9	
Open area test site; TEM cell; EMI test shielded chamber and shielded ferrite lined anechoic chamber; Line impedance stabilization networks; EMI Rx and spectrum analyzer; Civilian standards - CISPR, FCC, IEC, EN; Military standards-MIL461E/462.					
Outcomes	Upon completion of the course, students should able to: 1. Identify the various types and mechanisms of Electromagnetic Interference 2. Propose a suitable EMI mitigation technique 3. Describe the various EMC Standards and methods to measure them.				

Text books

1. V.P.Kodali, -Engineering EMC Principles, Measurements and Technologies‖, IEEE Press, Newyork, 1996. (Unit I –V).
2. Henry W.Ott., Noise Reduction Techniques in Electronic Systems‖, A Wiley Inter Science Publications, John Wiley and Sons, Newyork, 1988. (Unit – IV).

References

1. C.R.Paul,‖IntroductiontoElectromagneticCompatibility‖,JohnWileyandSons,Inc,1992.
2. Bemhard Keiser, -Principles of Electromagnetic Compatibility‖, 3rd Ed, Artechhouse, Norwood, 1986.
3. Don R.J.White Consultant Incorporate,-Handbook of EMI/EMC ,VolI-V,1988.

Semester	VII	L	T	P	C
Course Code/ Title	191EC734/ Satellite Communication	3	0	0	3

Objectives

- Understand the basics of satellite orbits
- Understand the satellite segment and earth segment
- Analyze the various methods of satellite access
- Understand the applications of satellites
- Understand the basics of satellite Networks

Unit-I	Satellite Orbits	9

Kepler‟s Laws, Newton‟s law, orbital parameters, orbital perturbations, station keeping, geo stationary and non Geo-stationary orbits – Look Angle Determination- Limits of visibility – eclipse-Sub satellite point –Sun transit outage-Launching Procedures - launch vehicles and propulsion.

Unit-II	Space Segment	9

Spacecraft Technology- Structure, Primary power, Attitude and Orbit control, Thermal control and Propulsion, communication Payload and supporting subsystems, Telemetry, Tracking and command-Transponders-The Antenna Subsystem.

Unit-III	Satellite Link Design	9

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

UNIT IV	Satellite Access and Coding Methods	9

Modulation and Multiplexing: Voice, Data, Video, Analog – digital transmission system, Digital video Broadcast, multiple access: FDMA, TDMA, CDMA, DAMA Assignment Methods, compression – encryption, Coding Schemes.

Unit-V	Satellite Applications	9

INTELSAT Series, INSAT, VSAT, Mobile satellite services: GSM, GPS, INMARSAT, LEO, MEO, Satellite Navigational System. GPS Position Location Principles, Differential GPS,
Direct Broadcast satellites (DBS/DTH).

Outcomes

Upon completion of the course, students should able to:

1. Analyze the satellite orbits
2. Analyze the earth segment and space segment
3. Analyze the satellite Link design
4. Design various satellite applications

Text books

1. Dennis Roddy,-Satellite Communication‖, 4thEdition,McGrawHill International,2006.
2. Timothy,Pratt,Charles,W.Bostain,JeremyE.Allnutt,"SatelliteCommunication‖,2nd Edition, WileyPublications,2002

References

1. Wilbur L.Pritchard, Hendri G. Suyderhoud, Robert A. Nelson, -Satellite Communication Systems Engineering‖, Prentice Hall/Pearson, 2007.
2. N.Agarwal,-DesignofGeosynchronousSpaceCraft‖,PrenticeHall,1986.
3. Bruce R. Elbert, -The Satellite Communication Applications‖, Hand Book, Artech House Bostan London, 1997.
4. TriT.Ha,-Digital Satellite Communication‖,IIndedition,1990.
5. Emanuel Fthenakis, -Manual of Satellite Communications‖, McGraw HillBook Co.,1984.
6. Robert G. Winch, -Telecommunication Trans Mission Systems‖, McGraw-Hill Book Co., 1983.

Semester	VII	L	T	P	C
Course Code/ Title	191EC735/ Video Analytics	3	0	0	3
Objectives	• To understand the need for video Analytics • To understand the basic configuration of video analytics • To understand the functional blocks of a video analytic system • To get exposed to the various applications of video analytics				
Unit-I	Video Analytic Components				9
Need for Video Analytics-Overview of video Analytics- Foreground extraction- Feature extraction- classifier - Preprocessing- edge detection- smoothening- Feature space-PCA-FLD-SIFT features.					
Unit-II	Foreground Extraction				9
Background estimation- Averaging- Gaussian Mixture Model- Optical Flow based- Image Segmentation- Region growing- Region splitting-Morphological operations- erosion-Dilation- Tracking in a multiple camera environment.					
Unit-III	Classifiers				9
Neural networks (back propagation) - Deep learning networks- Fuzzy Classifier- Bayesian classifier-HMM based classifier					
Unit-IV	Video Analytics for Security				9
Abandoned object detection- human behavioral analysis -human action recognition- perimeter security- crowd analysis and prediction of crowd congestion					
Unit-V	Video analytics for Business Intelligence & Traffic Monitoring and Assistance				9
Customer behavior analysis - people counting- Traffic rule violation detection- traffic congestion identification for route planning- driver assistance- lane change warning					
Outcomes	Upon completion of the course, students should able to: 1. Design video analytic algorithms for security applications 2. Design video analytic algorithms for business intelligence 3. Design custom made video analytics system for the given target application				

References

1. Graeme A. Jones (Editor), Nikos Paragios(Editor), Carlo S. Regazzoni(Editor) Video-Based Surveillance Systems: Computer Vision and Distributed Processing , Kluwer academic publisher, 2001
2. Nilanjan Dey (Editor), Amira Ashour(Editor) and Suvojit Acharjee(Editor), Applied Video Processing in Surveillance and Monitoring Systems (IGI global)2016
3. Zhihao Chen (Author), Ye Yang (Author), Jingyu Xue(Author), Liping Ye (Author), Feng Guo(Author), The Next Generation of Video Surveillance and Video Analytics: The Unified Intelligent Video Analytics Suite, CreateSpace Independent Publishing Platform,2014
4. Caifeng Shan(Editor),Fatih Porikli(Editor),Tao Xiang(Editor),Shaogang Gong (Editor) Video Analytics for Business Intelligence, Springer,2012

Semester	VII	L	T	P	C
Course Code/ Title	191EC736/ Wireless Networks	3	0	0	3

Objectives

- To understand the concept about Wireless networks, protocol stack and standards
- To understand and analyse the network layer solutions for Wireless networks
- To study about fundamentals of 3G Services, its protocols and applications
- To have in depth knowledge on internetworking of WLAN and WWAN
- To learn about evolution of 4G Networks, its architecture and applications

Unit-I	Wireless LAN	9

Introduction-WLAN technologies: - IEEE802.11: System architecture, protocol architecture, 802.11b, 802.11a – Hiper LAN: WATM, BRAN, HiperLAN2 – Bluetooth: Architecture, WPAN – IEEE 802.15.4, Wireless USB, Zigbee, 6LoWPAN, Wireless HART

Unit-II	Mobile Network Layer	9

Introduction - Mobile IP: IP packet delivery, Agent discovery, tunneling and encapsulation, IPV6-Network layer in the internet- Mobile IP session initiation protocol - mobile ad-hoc network: Routing: Destination Sequence distance vector, IoT: CoAP

Unit-III	3G Overview	9

Overview of UTMS Terrestrial Radio access network-UMTS Core network Architecture: 3GPP Architecture, User equipment, CDMA2000 overview- Radio and Network components, Network structure, Radio Network, TD-CDMA, TD –SCDMA.

UNIT IV	Internetworking between WLAN and WWANs	9

Internetworking objectives and requirements, Schemes to connect WLANS and 3G Networks, Session Mobility, Internetworking Architecture for WLAN and GPRS, System Description, Local Multipoint Distribution Service, Multichannel Multipoint Distribution System.

Unit-V	4G & Beyond	9

Introduction – 4G vision – 4G features and challenges - Applications of 4G – 4G Technologies: Multicarrier Modulation, Smart antenna techniques, IMS Architecture, LTE, Advanced Broadband Wireless Access and Services, MVNO

Outcomes

Upon completion of the course, students should able to:

1. Conversant with the latest 3G/4G networks and its architecture
2. Design and implement wireless network environment for any application using latest wireless protocols and standards
3. Ability to select the suitable network depending on the availability and requirement
4. Implement different type of applications for smart phones and mobile devices with latest network strategies

Text books

1. Jochen Schiller-Mobile Communications-Second Edition, Pearson Education 2012.(UnitI,II,III).
2. Vijay Garg, -Wireless Communications and networking, First Edition, Elsevier 2007.(Unit IV,V)

References

1. Erik Dahlman, Stefan Parkvall, Johan Skold and Per Beming, "3G Evolution HSPA and LTE for Mobile Broadband‖, Second Edition, Academic Press, 2008.
2. Anurag Kumar,D.Manjunath,Joykuri,-Wireless Networking‖,FirstEdition,Elsevier2011.
3. Simon Haykin , Michael Moher, David Koilpillai, -Modern Wireless Communications‖, First Edition, Pearson Education 2013.

Professional Elective - V (Semester - VII)

Semester	VII	L	T	P	C
Course Code/ Title	191EC737/ Digital Image Processing	3	0	0	3
Objectives	• To become familiar with digital image fundamentals • To get exposed to simple image enhancement techniques in Spatial and Frequency domain. • To learn concepts of degradation function and restoration techniques. • To study the image segmentation and representation techniques. • To become familiar with image compression and recognition methods				
Unit-I	Digital Image Fundamentals				9
Steps in Digital Image Processing – Components – Elements of Visual Perception – Image Sensing and Acquisition – Image Sampling and Quantization – Relationships between pixels - Color image fundamentals - RGB, HSI models, Two-dimensional mathematical preliminaries, 2D transforms - DFT, DCT.					
Unit-II	Image Enhancement				9
Spatial Domain: Gray level transformations – Histogram processing – Basics of Spatial Filtering– Smoothing and Sharpening Spatial Filtering, Frequency Domain: Introduction to Fourier Transform– Smoothing and Sharpening frequency domain filters – Ideal, Butterworth and Gaussian filters, Homomorphic filtering, Color image enhancement.					
Unit-III	Image Restoration				9
Image Restoration - degradation model, Properties, Noise models – Mean Filters – Order Statistics – Adaptive filters – Band reject Filters – Band pass Filters – Notch Filters – Optimum Notch Filtering – Inverse Filtering – Wiener filtering					
Unit-IV	Image Segmentation				9
Edge detection, Edge linking via Hough transform – Thresholding - Region based segmentation – Region growing – Region splitting and merging – Morphological processing- erosion and dilation, Segmentation by morphological watersheds – basic concepts – Dam construction – Watershed segmentation algorithm.					
Unit-V	Image Compression and Recognition				9
Need for data compression, Huffman, Run Length Encoding, Shift codes, Arithmetic coding, JPEG standard, MPEG. Boundary representation, Boundary description, Fourier Descriptor, Regional Descriptors – Topological feature, Texture - Patterns and Pattern classes - Recognition based on matching.					
Outcomes	Upon completion of the course, students should able to: 1. Know and understand the basics and fundamentals of digital image processing, such as digitization, sampling, quantization, and2D-transforms. 2. Operate on images using the techniques of smoothing, sharpening and enhancement. 3. Understand the restoration concepts and filtering techniques. 4. Learn the basics of segmentation, features extraction, compression and recognition methods for color models.				

Text books

1. Rafael C. Gonzalez, RichardE. Woods, ‗Digital Image Processing', Pearson, Third Edition, 2010.
2. Anil K.Jain, ‗Fundamentals of Digital Image Processing', Pearson,2002.

References

1. Kenneth R.Castleman, ‗DigitalImageProcessing',Pearson,2006.
2. RafaelC.Gonzalez,RichardE.Woods,StevenEddins, ‗DigitalImageProcessingusing MATLAB', Pearson Education, Inc., 2011.
3. D,E.Dudgeonand RM.Mersereau, ‗Multidimensional Digital Signal Processing', Prentice Hall Professional Technical Reference, 1990.
4. WilliamK.Pratt, ‗Digital Image Processing',JohnWiley,NewYork, 2002
5. Milan SonkaetalImage processing, analysis and machine vision',Brookes/Cole,Vikas Publishing House, 2nd edition, 1999.

Semester	VII	L	T	P	C
Course Code/ Title	191EC738/DSP Architecture and Programming	3	0	0	3

Objectives	• Basics on Digital Signal Processors • Programmable DSP's Architecture, On-chip Peripherals and Instruction set • Programming for signal processing applications • Advanced Programmable DSP Processors

Unit-I	Fundamentals of Programmable DSPs	9

Introduction to Programmable DSPs, Architectural Features of PDSPs - Multiplier and Multiplier accumulator – Modified Bus Structures and Memory access – Multiple access memory – Multi-port memory – VLIW architecture- Pipelining – Special Addressing modes in P-DSPs – On chip Peripherals, Applications of Programmable DSPs.

Unit-II	TMS320C5XProcessor	9

Architecture of C5X Processor – Addressing modes – Assembly language Instructions - Pipeline structure, On-chip Peripherals – Block Diagram of DSP starter kit (DSK) – Software Tools, DSK on-board peripherals, Application Programs for processing real time signals.

Unit-III	TMS320C6X Processor	9

Architecture of the C6x Processor - Instruction Set – Addressing modes, Assembler directives, On- chip peripherals, DSP Development System: DSP Starter Kit - Code Composer Studio - Support Files – Introduction to AIC23 codec and other on-board peripherals, Real-Time Programming Examples for Signals and Noise generation, Frequency analysis, Filter design.

Unit-IV	ADSP Processors	9

Architecture of ADSP-21XX and ADSP-210XX series of DSP processors- Addressing modes and assembly language instructions – Application programs –Filter design, FFT calculation.

Unit-V	Advanced Processors	9

Study of TI's advanced processors - TMS320C674x and TMS320C55x DSPs, ADSP's Blackfin and Sigma DSP Processors, NXP's DSP56Fxx Family of DSP Processors, Comparison of the features of TI, ADSP and NXP DSP family processors.

Outcomes	**At the end of the course, the student should be able to:** 1. Analyze the concepts of Digital Signal Processors 2. Demonstrate their ability to program the DSP processor for signal processing applications 3. Discuss, compare and select the suitable Advanced DSP Processors for real-time signal processing applications

References

1. B. Venkataramani and M. Bhaskar, -Digital Signal Processors – Architecture, Programming and Applications‖ – Tata McGraw – Hill Publishing Company Limited. New Delhi, 2003.
2. Avtar Singh and S. Srinivasan, Digital Signal Processing – Implementations using DSP Microprocessors with Examples from TMS320C54xx, Cengage Learning India Private Limited, Delhi 2012.
3. Rulph Chassaing and Donald Reay, Digital Signal Processing and Applications with the C6713 and C6416 DSK, John Wiley & Sons, Inc., Publication, 2012 (Reprint).
4. User guides Texas Instruments, Analog Devices and NXP.

Semester	VII	L	T	P	C
Course Code/ Title	191EC739/ Electronics Packaging and Testing	3	0	0	3
Objectives	• To introduce and discuss various issues related to the system packaging				

Unit-I	Overview of Electronic Systems Packaging	9

Functions of an Electronic Package, Packaging Hierarchy, IC packaging: MEMS packaging, consumer electronics packaging, medical electronics packaging, Trends, Challenges, Driving Forces on Packaging Technology, Materials for Microelectronic packaging, Packaging Material Properties, Ceramics, Polymers, and Metals in Packaging, Material for high density interconnect substrates

Unit-II	Electrical Issues in Packaging	9

Electrical Issues of Systems Packaging, Signal Distribution, Power Distribution, Electromagnetic Interference, Transmission Lines, Clock Distribution, Noise Sources, Digital and RF Issues. Design Process Electrical Design: Interconnect Capacitance, Resistance and Inductance fundamentals; Packaging roadmaps - Hybrid circuits - Resistive, Capacitive and Inductive parasitics

Unit-III	Chip Packages	9

IC Assembly - Purpose, Requirements, Technologies, Wire bonding, Tape Automated Bonding, Flip Chip, Wafer Level Packaging, reliability, wafer level burn – in and test. Single chip packaging: functions, types, materials processes, properties, characteristics, trends. Multi chip packaging: types, design, comparison, trends. System – in - package (SIP); Passives: discrete, integrated, and embedded

Unit-IV	PCB, Surface Mount Technology and Thermal Considerations	9

Printed Circuit Board: Anatomy, CAD tools for PCB design, Standard fabrication, Micro via Boards. Board Assembly: Surface Mount Technology, Through Hole Technology, Process Control and Design challenges. Thermal Management, Heat transfer fundamentals, Thermal conductivity and resistance, Conduction, convection and radiation – Cooling requirements

Unit-V	Testing	9

Reliability, Basic concepts, Environmental interactions. Thermal mismatch and fatigue – failures – thermo mechanically induced –electrically induced – chemically induced. Electrical Testing: System level electrical testing, Interconnection tests, Active Circuit Testing, Design for Testability

Outcomes

Upon completion of the course, the student should be able to:

1. Give a comprehensive introduction to the various packaging types used along with the associated thermal, speed, signal and integrity power issues
2. Enable design of packages which can withstand higher temperature, vibrations and shock
3. Design of PCBs which minimize the EMI and operate at higher frequency
4. Analyze the concepts of Testing and testing methods

Text books

1. Tummala, Rao R., Fundamentals of Microsystems Packaging, McGraw Hill, 2001

References

1. Blackwell (Ed), The electronic packaging handbook, CRC Press, 2000.
2. Tummala, Rao R, Microelectronics packaging handbook, McGraw Hill, 2008.
3. Bosshart, Printed Circuit Boards Design and Technology, Tata McGraw Hill, 1988.
4. R.G. Kaduskar and V.B.Baru, Electronic Product design, Wiley India, 2011
5. R.S.Khandpur, Printed Circuit Board, Tata McGraw Hill, 2005
6. Recent literature in Electronic Packaging
7. Michael L. Bushnell &Vishwani D. Agrawal,‖ Essentials of Electronic Testing for Digital, memory & Mixed signal VLSI Circuits‖, Kluwer Academic Publishers.2000.
8. M. Abramovici, M. A. Breuer, and A.D. Friedman, ―Digital System Testing and Testable Design‖, Computer Science Press,1990

Semester	VII	L	T	P	C
Course Code/ Title	191EC7310/ Fundamentals of Nanoscience	3	0	0	3
Objectives	• To learn about basis of nano material science, preparation method, types and application				

Unit-I	Introduction	9

Nanoscale Science and Technology- Implications for Physics, Chemistry, Biology and Engineering-Classifications of nano structured materials- nano particles- quantum dots, nanowires- ultra-thin films-multilayered materials. Length Scales involved and effect on properties: Mechanical, Electronic, Optical, Magnetic and Thermal properties. Introduction to properties and motivation for study (qualitative only).

Unit-II	General Methods of Preparation	9

Bottom-up Synthesis-Top-down Approach: Co-Precipitation, Ultrasonication, Mechanical Milling, Colloidal routes, Self-assembly, Vapour phase deposition, MOCVD, Sputtering, Evaporation, Molecular Beam Epitaxy, Atomic Layer Epitaxy, MOMBE

Unit-III	Nano Materials	9

Nanoforms of Carbon - Buckminster fullerene- graphene and carbon nanotube, Single wall carbon Nanotubes (SWCNT) and Multi wall carbon nanotubes (MWCNT)- methods of synthesis(arc- growth, laser ablation, CVD routes, Plasma CVD), structure-property Relationships applications- Nanometal oxides-ZnO, TiO2,MgO, ZrO2, NiO, Nano alumina, CaO, AgTiO2, Ferrites, Nano clays-functionalization and applications-Quantum wires, Quantum dots-preparation, properties and applications.

Unit-IV	Characterization Techniques	9

X-ray diffraction technique, Scanning Electron Microscopy - environmental techniques, Transmission Electron Microscopy including high-resolution imaging, Surface Analysis techniques- AFM, SPM, STM, SNOM, ESCA, SIMS-Nanoindentation.

Unit-V	Applications	9

Nano InfoTech: Information storage- Nano computer, molecular switch, super chip, nanocrystal, Nano biotechnology: nanoprobes in medical diagnostics and biotechnology, Nano medicines, Targeted drug delivery, Bioimaging - Micro Electro Mechanical Systems (MEMS), Nano Electro Mechanical Systems (NEMS)- Nano sensors, nano crystalline silver for bacterial inhibition, Nanoparticles for sun barrier products - In Photostat, printing, solar cell, battery.

Outcomes	**Upon completion of the course, the student should be able to:** 1. Will familiarize about the science of nanomaterials 2. Will demonstrate the preparation of nanomaterials 3. Will develop knowledge in characteristic nanomaterial

Text books

1. A.S. Edelstein and R.C.Cammearata,eds.,-Nanomaterials:Synthesis, Properties and Applications‖, Institute of Physics Publishing, Bristol and Philadelphia,1996.
2. N JohnDinardo,-NanoscaleCharacterizationofsurfaces&Interfaces‖, 2nd edition, Weinheim Cambridge, Wiley-VCH,2000.

References

1. G Timp, ―Nanotechnology‖, AIP press/Springer, 1999.
2. Akhlesh Lakhtakia,―The Hand Book of Nano Technology, Nanometer Structure, Theory, Modeling and Simulations‖. Prentice-Hall of India (P) Ltd, New Delhi, 2007.

Semester	VII	L	T	P	C
Course Code/ Title	191EC7311/ Total Quality Managements	3	0	0	3
Objectives	• To facilitate the understanding of Quality Management principles and process				

Unit-I	Introduction	9

Introduction - Need for quality - Evolution of quality - Definitions of quality - Dimensions of product and service quality - Basic concepts of TQM - TQM Framework - Contributions of Deming, Juran and Crosby - Barriers to TQM - Customer focus - Customer orientation, Customer satisfaction, Customer complaints, Customer retention.

Unit-II	TQM Principles	9

Leadership - Quality Statements, Strategic quality planning, Quality Councils - Employee involvement - Motivation, Empowerment, Team and Teamwork, Recognition and Reward, Performance appraisal - Continuous process improvement - PDCA cycle, 5S, Kaizen - Supplier partnership - Partnering, Supplier selection, Supplier Rating.

Unit-III	TQM Tools and Techniques I	9

The seven traditional tools of quality - New management tools - Six sigma: Concepts, Methodology, applications to manufacturing, service sector including IT - Bench marking - Reason to bench mark, Bench marking process - FMEA - Stages, Types.

Unit-IV	TQM Tools and Techniques II	9

Quality Circles - Cost of Quality - Quality Function Deployment (QFD) - Taguchi quality loss function - TPM - Concepts, improvement needs - Performance measures.

Unit-V	Quality ManagementSystem	9

Introduction—Benefits of ISO Registration—ISO 9000 Series of Standards—Sector-Specific Standards—AS 9100, TS16949 and TL 9000-- ISO 9001 Requirements—Implementation—Documentation—Internal Audits—Registration-

ENVIRONMENTAL MANAGEMENT SYSTEM: Introduction—ISO 14000 Series Standards—Concepts of ISO 14001—Requirements of ISO 14001—Benefits of EMS.

Outcomes	At the end of the course, the student should be able to: 1. The student would be able to apply the tools and techniques of quality management to manufacturing and services processes.

Text books

2. Dale H.Besterfiled, Carol B.Michna,Glen H. Besterfield,MaryB.Sacre,Hemant Urdhwaresheand RashmiUrdhwareshe, -Total Quality Management|, Pearson Education Asia, Revised Third Edition, Indian Reprint, Sixth Impression,2013

References

1. James R. Evans and William M. Lindsay, "The Management and Control of Quality", 8th Edition, First Indian Edition, Cengage Learning, 2012.
2. Janakiraman. B and Gopal .R.K., "Total Quality Management - Text and Cases", Prentice Hall (India) Pvt. Ltd., 2006.
3. Suganthi.L and Anand Samuel, "Total Quality Management", Prentice Hall (India) Pvt. Ltd., 2006.
4. ISO9001-2015 standards

Semester	**VIII**	**L**	**T**	**P**	**C**
Course Code/ Title	**191EC832/Foundation Skills in Integrated Product Development**	**3**	**0**	**0**	**3**
Objectives	• To understand the global trends and development methodologies of various types of products and services • To conceptualize, prototype and develop product management plan for a new product based on the type of the new product and development methodology integrating the hardware, software, controls, electronics and mechanical systems • To understand requirement engineering and know how to collect, analyze and arrive at requirements for new product development and convert them in to design specification • To understand system modeling for system, sub-system and their interfaces and arrive at the optimum system specification and characteristics • To develop documentation, test specifications and coordinate with various teams to validate and sustain up to the EoL (End of Life) support activities for engineering customer				

Unit-I	**Fundamentals of Product Development**	**9**

Global Trends Analysis and Product decision - Social Trends - Technical Trends- Economical Trends - Environmental Trends - Political/Policy Trends **- Introduction to Product Development Methodologies and Management -** Overview of Products and Services - Types of Product Development - Overview of Product Development methodologies - Product Life Cycle – Product Development Planning and Management.

Unit-II	**Requirements and System Design**	**9**

Requirement Engineering - Types of Requirements - Requirement Engineering - traceability Matrix and Analysis - Requirement Management - **System Design & Modeling -** Introduction to System Modeling - System Optimization - System Specification - Sub-System Design - Interface Design.

Unit-III	**Design and Testing**	**9**

Conceptualization - Industrial Design and User Interface Design - Introduction to Concept generation Techniques – **Challenges in Integration of Engineering Disciplines** - Concept Screening & Evaluation - **Detailed Design -** Component Design and Verification – **Mechanical, Electronics and Software Subsystems -** High Level Design/Low Level Design of S/W Program - Types of Prototypes, S/W Testing- Hardware Schematic, Component design, Layout and Hardware Testing – **Prototyping -** Introduction to Rapid Prototyping and Rapid Manufacturing - **System Integration, Testing, Certification and Documentation**

Unit-IV	**Sustenance Engineering and End-of-Life (EoL)Support**	**9**

Introduction to Product verification processes and stages - Introduction to Product Validation processes and stages - Product Testing Standards and Certification - Product Documentation - **Sustenance -**Maintenance and Repair – Enhancements - **Product EoL –** Obsolescence Management – Configuration Management - EoL Disposal

Unit-V	**Business Dynamics – Engineering Services Industry**	**9**

The Industry - Engineering Services Industry - Product Development in Industry versus Academia –**The IPD Essentials -** Introduction to Vertical Specific Product Development processes -Manufacturing/Purchase and Assembly of Systems - Integration of Mechanical, Embedded and Software Systems – Product Development Trade-offs - Intellectual Property Rights and Confidentiality – Security and Configuration Management.

Outcomes	Upon completion of the course, students should able to: 1. Define, formulate and analyze a problem 2. Solve specific problems independently or as part of a team 3. Gain knowledge of the Innovation & Product Development process in the Business Context 4. Work independently as well as in teams

	5. Manage a project from start to finish

Text books

1. Book specially prepared by NASSCOM as per the MoU.
2. Karl T Ulrich and Stephen D Eppinger, "Product Design and Development", Tata McGraw Hill, Fifth Edition, 2011.
3. John W Newstorm and Keith Davis, "Organizational Behavior", Tata McGraw Hill, Eleventh Edition, 2005.

References

1. HiriyappaB,-Corporate Strategy–Managing theBusiness‖,AuthorHouse,2013.
2. PeterF Drucker,-People and Performance‖,Butterworth– Heinemann [Elsevier],Oxford, 2004.
3. Vinod Kumar Garg and Venkita Krishnan N K, -Enterprise Resource Planning – Concepts ‖, Second Edition, Prentice Hall, 2003.
4. Mark S Sanders and Ernest J McCormick, "Human Factors in Engineering and Design", McGraw Hill Education, Seventh Edition, 2013

Semester	VIII	L	T	P	C
Course Code/ Title	191EC831/Ad hoc and Wireless Sensor Networks	3	0	0	3
Objectives	• Learn Ad hoc network and Sensor Network fundamentals • Understand the different routing protocols • Have an in-depth knowledge on sensor network architecture and design issues • Understand the transport layer and security issues possible in Ad hoc and Sensor networks • Have an exposure to mote programming platforms and tools				

Unit-I	Ad hoc Networks – Introduction and Routing Protocols	9

Elements of Ad hoc Wireless Networks, Issues in Ad hoc wireless networks, Example commercial applications of Ad hoc networking, Ad hoc wireless Internet, Issues in Designing a Routing Protocol for Ad Hoc Wireless Networks, Classifications of Routing Protocols, Table Driven Routing Protocols - Destination Sequenced Distance Vector (DSDV), On–Demand Routing protocols –Ad hoc On–Demand Distance Vector Routing(AODV).

Unit-II	Sensor Networks – Introduction & Architectures	9

Challenges for Wireless Sensor Networks, Enabling Technologies for Wireless Sensor Networks, WSN application examples, Single-Node Architecture - Hardware Components, Energy Consumption of Sensor Nodes, Network Architecture - Sensor Network Scenarios, Transceiver Design Considerations, Optimization Goals and Figures of Merit

Unit-III	WSN Networking Concepts and Protocols	9

MAC Protocols for Wireless Sensor Networks, Low Duty Cycle Protocols And Wakeup Concepts - S-MAC, The Mediation Device Protocol, Contention based protocols - PAMAS, Schedule based protocols – LEACH, IEEE 802.15.4 MAC protocol, Routing Protocols- Energy Efficient Routing, Challenges and Issues in Transport layer protocol.

Unit-IV	Sensor Network Security	9

Network Security Requirements, Issues and Challenges in Security Provisioning, Network Security Attacks, Layer wise attacks in wireless sensor networks, possible solutions for jamming, tampering, black hole attack, flooding attack. Key Distribution and Management, Secure Routing – SPINS, reliability requirements in sensor networks.

Unit-V	Sensor Network Platforms and Tools	9

sensor node hardware – berkeley motes, programming challenges, node-level software platforms – tinyos, nesc, contikios, node-level simulators – ns2 and its extension to sensor networks, cooja, tossim, programming beyond individual nodes – state centric programming.

Outcomes	Upon completion of the course, students should able to: 1. Know the basics of Ad hoc networks and Wireless Sensor Networks 2. Apply this knowledge to identify the suitable routing algorithm based on the network and user requirement 3. Apply the knowledge to identify appropriate physical and MAC layer protocols 4. Understand the transport layer and security issues possible in Ad hoc and sensor networks. 5. Be familiar with the OS used in Wireless Sensor Networks and build basic modules

Text books

1. C. Siva Ram Murthy and B. S. Manoj, ‐Ad Hoc Wireless Networks Architectures and Protocols‖, Prentice Hall, PTR, 2004. (UNIT I)
2. Holger Karl , Andreas willig, ‐Protocol and Architecture for Wireless Sensor Networks‖, John wiley publication, Jan 2006.(UNIT II-V)

References

1. FengZhao, Leonidas Guibas, ‐Wireless Sensor Networks: an information processing approach‖, Elsevier publication,2004.
2. Charles E. Perkins,‐AdHoc Networking‖,AddisonWesley,2000.
3. I.F. Akyildiz, W. Su, Sankarasubramaniam, E. Cayirci, ‐Wireless sensor networks: a survey‖, computer networks, Elsevier, 2002, 394 ‐422.

Semester	VII	L	T	P	C
Course Code/ Title	191EC833/ Low Power SoC Design	3	0	0	3

Objectives

- Identify sources of power in an IC.
- Understand basic principle of System on Chip design
- Learn optimization of power in combinational and sequential logic machines for SoC Design
- Identify suitable techniques to reduce the power dissipation and design circuits with low power dissipation.

Unit-I **Power Consumption In CMOS** **9**

Physics of power dissipation in CMOS FET devices – Hierarchy of limits of power – Sources of power consumption – Static Power Dissipation, Active Power Dissipation - Designing for Low Power, Circuit Techniques for Leakage Power Reduction - Basic principle of low power design, Logic level power optimization – Circuit level low power design.

Unit-II **System-on-Chip Design** **9**

System-on-Chip Concept, Design Principles in SoC Architecture, SoC Design Flow, Platform- based and IP based SoC Designs, Basic Concepts of Bus-Based Communication Architectures. High performance algorithms for ASICs/ SoCs as case studies – Canonic Signed Digit Arithmetic, KCM, Distributed Arithmetic, High performance digital filters for sigma-delta ADC.

Unit-III **Power Optimization of Combinational and Sequential Logic Machines for SoC** **9**

Introduction to Standard Cell-Based Layout – Simulation - Combinational Network Delay - Logic and interconnect Design - Power Optimization - Switch Logic Networks. Introduction - Latches and Flip-Flops - Sequential Systems and Clocking Disciplines - Sequential System Design - Power Optimization - Design Validation - Sequential Testing.

UNIT IV **Design of Low Power Circuits for Sub System on a SoC** **9**

Subsystem Design Principles - Combinational Shifters – Adders – ALUs – Multipliers – High Density Memory – Field Programmable Gate Arrays - Programmable Logic Arrays - Computer
arithmetic techniques for low power system – low voltage low power static Random access and dynamic Random access memories, low power clock, Inter connect and layout design.

Unit-V **Floor Planning** **9**

Floor-planning Methods – Block Placement & Channel Definition - Global Routing - switchbox Routing - Power Distribution - Clock Distributions - Floor-planning Tips - Design Validation - Off- Chip Connections – Packages, The I/O Architecture - PAD Design.

Outcomes

Upon completion of the course, students should able to:

1. Analyze and design low-power VLSI circuits using different circuit technologies for system on chip design.

Text books

1. J.Rabaey,-Low Power Design Essentials(Integrated Circuits and Systems)‖, Springer, 2009.
2. WayneWolf,-ModernVLSIDesign–System–on–ChipDesign‖,PrenticeHall,3rdEdition, 2008.

References

1. J.B.Kuo&J.H.Lou,-Low-voltage CMOS VLSICircuits‖,Wiley,1999.
2. A.Bellaowar& M.I.Elmasry,‖Low power Digital VLSI Design, Circuits and Systems‖, Kluwer,1996.
3. WayneWolf,-Modern VLSI Design–IPbased Design ‖,Prentice Hall,4thEdition,2008.
4. M.J.S. Smith : Application Specific Integrated Circuits, Pearson, 2003
5. Sudeep Pasricha and Nikil Dutt, On-Chip Communication Architectures System on Chip Interconnect, Elsevier, 2008
6. Recent literature in Low Power VLSI Circuits.
7. Recent literature in Design of ASICs

Semester	VIII	L	T	P	C
Course Code/ Title	191EC834/Multimedia Compression and Communication	3	0	0	3

Objectives

- To understand the compression schemes for text, voice, image and video
- To understand the QoS issues in multimedia network
- To know the communication protocols for multimedia networking

Unit-I	Audio Compression	9

Sampling and Quantization of Speech (PCM) - Adaptive differential PCM - Delta Modulation - Vector Quantization- Linear predictive coding (LPC) - Code excited Linear predictive Coding (CELP)

Unit-II	Image and Video Compression	9

Graphics Interchange format- Tagged image file format-Digitized documents- Digitized pictures- JPEG-Video Encoding-Motion estimation –Overview of H.263 and MPEG-2

Unit-III	Text Compression	7

Static and Dynamic Huffman coding – Arithmetic coding –Lempel-Ziv coding – LZW coding

Unit-IV	Guaranteed Service Model	10

Best Effort service model – Scheduling and Dropping policies – Network Performance Parameters – Quality of Service and metrics – WFQ and its variants – Random Early Detection – QoS aware Routing – Admission Control – Resource Reservation – RSVP - Traffic Shaping Algorithms – Caching – Laissez Faire Approach - Possible Architectures – An Overview of QoS Architectures

Unit-V	Multimedia Communication	10

Stream characteristics for Continuous media – Temporal Relationship – Object Stream Interactions, Media Levity, Media Synchronization – Models for Temporal Specifications – Streaming of Audio and Video – Jitter – Fixed playout and Adaptive playout – Recovering from packet loss – RTSP — Multimedia Communication Standards – RTP/RTCP – SIP and H.263

Outcomes

Upon completion of the course, students should able to:

1. Design audio compression techniques
2. Configure Text, image and video compression techniques
3. Select suitable service model for specific application
4. Configure multimedia communication network

Text books

1. Fred Halsall, ―Multimedia communication-Applications, Networks,Protocols and Standards‖, Pearson education,2007.

References

1. Tay Vaughan, ―Multimedia Making it work ,McGraw-Hill Osborne Media, 2006.
2. Kurose and W. Ross, ―Computer Networking ―A Top Down Approach, Pearson education, 3rd ed, 2005.
3. KR. Rao,Z S Bojkovic, D A Milovanovic, ―Multimedia Communication Systems: Techniques, Standards and Networks‖, Pearson Education 2007
4. R. Steimnetz, K. Nahrstedt, ―Multimedia Computing, Communications and Applications‖, Pearson Education, First ed, 1995.
5. Nalin K Sharda,_Multimedia Information Networking‘, Prentice Hall ofIndia,1999
6. Aura Ganz, Zvi Ganzand Kitti Wongthawaravat,_Multimedia Wireless Networks: Technologies, Standards and QoS‘, Prentice Hall, 2003.
7. Ellen KayataWesel,_Wireless Multimedia Communications: Networking Video, Voice and Data‘, Addision Wesley, 1998

Semester	VIII	L	T	P	C
Course Code/ Title	191EC835/Principles of RADAR	3	0	0	3
Objectives	To expose the students to the working principles of a radar from a signal processing perspective.				

Unit-I	9
Radar equation. Radar cross section. Cross section of small targets. Target scattering matrices. Area and volume targets.	
Unit-II	**9**
Radar signals. Ambiguity function and its properties. Uncertainty principle. Pulse compression. linear FM pulse. Pulse compression by Costas FM and binary phase coding.	
Unit-III	**9**
Radar detection. Optimum Bayesian decision rules. Detection criteria for different target models.	
Unit-IV	**9**
Range and Doppler measurements and tracking. Range and Doppler frequency resolutions. Optimum receivers. Optimum filters for Doppler measurements. Coherent and non coherent implementations.	
Unit-V	**9**
Angle measurement and tracking. Angle measurement and tracking by conical scan and mono pulse. Optimum mono pulse systems.	

Outcomes	Upon completion of the course, students should able to: 1. Understand the principle behind radar range equation and different types of targets available. 2. Appreciate the different compression techniques of radar pulse signals 3. Distinguish between different detection methods of radar signals. 4. Appreciate the building blocks for optimum receiver and Doppler measurements. 5. Understand the tracking and scanning methods in the mono pulse systems.

Text books

- P.Z.Peebles, Radar Principles, Wiley,1998.
- Merrill I. Skolink, Introduction to Radar Systems, (3/e), Tata MG Graw Hill,2001

References

1. N.Levanon, Radar Signals, Wiley,2005.
2. D.Wehnar : High Resolution Radar, Artech Hous,1987.
3. D.K.Barton : Radar systems Analysis , Prentice Hall,1976.
4. Recent literature in Principles of Radar.

Semester	VIII	L	T	P	C
Course Code/ Title	191EC836/Professional Ethics in Engineering	3	0	0	3
Objectives	• To enable the students to create an awareness on Engineering Ethics and Human Values, to instil Moral and Social Values and Loyalty and to appreciate the rights of others.				

Unit-I	Human Values	10

Morals, values and Ethics – Integrity – Work ethic – Service learning – Civic virtue – Respect for others – Living peacefully – Caring – Sharing – Honesty – Courage – Valuing time – Cooperation – Commitment – Empathy – Self confidence – Character – Spirituality – Introduction to Yoga and meditation for professional excellence and stress management.

Unit-II	Engineering Ethics	9

Senses of ‗Engineering Ethics' – Variety of moral issues – Types of inquiry – Moral dilemmas – Moral Autonomy – Kohlberg's theory – Gilligan's theory – Consensus and Controversy – Models of professional roles - Theories about right action – Self-interest – Customs and Religion – Uses of Ethical Theories.

Unit-III	Engineering as Social Experimentation	9

Engineering as Experimentation – Engineers as responsible Experimenters – Codes of Ethics – A Balanced Outlook on Law.

Unit-IV	Safety, Responsibilities and Rights	9

Safety and Risk – Assessment of Safety and Risk – Risk Benefit Analysis and Reducing Risk - Respect for Authority – Collective Bargaining – Confidentiality – Conflicts of Interest – OccupationalCrime– ProfessionalRights–EmployeeRights–IntellectualPropertyRights(IPR) – Discrimination.

Unit-V	Global Issues	8

Multinational Corporations – Environmental Ethics – Computer Ethics – Weapons Development – Engineers as Managers – Consulting Engineers – Engineers as Expert Witnesses and Advisors – Moral Leadership –Code of Conduct – Corporate Social Responsibility.

Outcomes	Upon completion of the course, students should able to: 1. Apply ethics in society, discuss the ethical issues related to engineering and realize the responsibilities and rights in the society.

Text books

1. Mike W.Martin and Roland Schinzinger, -Ethics in Engineering ,Tata McGrawHill,NewDelhi, 2003.
2. Govindarajan M,Natarajan S,SenthilKumarV.S,-Engineering Ethics‖, Prentice Hall of India, New Delhi,2004.

References

1. Charles B.Fleddermann,-Engineering Ethics‖,Pearson Prentice Hall,NewJersey, 2004.
2. Charles E. Harris, MichaelS. Pritchard and Michael J. Rabins, -Engineering Ethics – Concepts and Cases‖, Cengage Learning,2009.
3. John R Boatright,-Ethics and the Conduct of Business‖, PearsonEducation,NewDelhi,2003
4. Edmund G Seebauerand Robert L Barry, -Fundamentals of Ethics for Scientists and Engineers‖, Oxford University Press, Oxford,2001.
5. Laura P. Hartman and Joe Desjardins, -Business Ethics: Decision Making for Personal IntegrityandSocialResponsibility‖McGrawHilleducation,IndiaPvt.Ltd.,NewDelhi,2013.
6. World Community Service Centre, ‗Value Education', Vethathiri publications, Erode,2011.

Open Elective

Semester	V	L	T	P	C
Course Code/ Title	191CS547/ INTERNET - OF - THINGS	3	0	0	3
Objectives	• To understand the fundamentals of IoT. • To understand the concepts of IoT Architectures and smart objects in IoT • To learn about the basics of IoT Protocols. • To build simple IoT systems with Arduino and Raspberry Pi. • To apply the concept of IoT in the real-world Scenario.				
Unit-I	**Introduction to IoT**				9
Internet of Things - Physical Design- Logical Design- IoT Enabling Technologies - IoT Levels & Deployment Templates - Domain Specific IoTs - IoT and M2M - IoT System Management with NETCONF-YANG- IoT Platforms Design Methodology					
Unit-II	**IoT Architectures**				9
IoT Architectures: oneM2M, 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-III	**IoT Protocols**				9
IoT Access Technologies: Physical and MAC layers, topology and Security of IEEE 802.15.4, 802.15.4g, 802.15.4e, 1901.2a, 802.11ah and LoRaWAN, Network Layer: IP versions, Constrained Nodes and Constrained Networks, Optimizing IP for IoT: From 6LoWPAN to 6Lo, Routing over Low Power and Lossy Networks.					
Unit-IV	**Design and Development**				9
Design Methodology, Embedded computing logic, Microcontroller, System on Chips, IoT system building blocks, Arduino, Board details, IDE programming, Raspberry Pi, Interfaces and Raspberry Pi with Python Programming.					
Unit-V	**Case Studies and Real-World Applications**				9
Real world design constraints - Applications - Asset management, Industrial automation, smart grid, Commercial building automation, Smart cities - participatory sensing - Data Analytics for IoT – Software & Management Tools for IoT Cloud Storage Models & Communication APIs – Cloud for IoT – Amazon Web Services for IoT.					
Outcomes	**On successful completion of this course, the student should be able to:** 1. Explain the concept of IoT. 2. Analyze various protocols for IoT. 3. Design a Portable of an IoT system using Rasperry Pi/Arduino. 4. Deploy an IoT application and connect to the cloud. 5. Analyze applications of IoT in real time scenario.				
					TOTAL PERIODS 45

Text Books

1. 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.

References

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.
https://www.ibm.com/smarterplanet/us/en/?ca=v_smarterplanet.

Semester	V	L	T	P	C
Course Code/ Title	191CS5413/ SOFTWARE PROJECT MANAGEMENT	3	0	0	3

Objectives

- To understand the Software Project Planning and Evaluation techniques.
- To plan and manage projects at each stage of the software development life cycle (SDLC).
- To learn about the activity planning and risk management principles.
- To manage software projects and control software deliverables.
- To develop skills to manage the various phases involved in project management and people management.
- To deliver successful software projects that support organization‘s strategic goals.

Unit-I **Project Evaluation and Project Planning** **9**

Importance of Software Project Management, Activities, Methodologies, Categorization of Software Projects, Setting objectives, Management Principles, Management Control, Project portfolio Management, Cost-benefit evaluation technology, Risk evaluation, Strategic program Management, Stepwise Project Planning.

Unit-II **Project Life Cycle and Effort Estimation** **9**

Software process and Process Models, Choice of Process models, Rapid Application development, Agile methods, Dynamic System Development Method, Extreme Programming, Managing interactive processes, Basics of Software estimation, Effort and Cost estimation techniques, COSMIC Full function points, COCOMO II, a Parametric Productivity Model.

Unit-III **Activity Planning and Risk Management** **9**

Objectives of Activity planning, Project schedules, Activities, Sequencing and scheduling, Network Planning models, Formulating Network Model, Forward Pass & Backward Pass techniques, Critical path (CRM) method, Risk identification, Assessment, Risk Planning, Risk Management, PERT technique, Monte Carlo simulation, Resource Allocation, Creation of critical paths, Cost schedules.

Unit-IV **Project Management and Control** **9**

Framework for Management and control, Collection of data, Visualizing progress, Cost monitoring, Earned Value Analysis, Prioritizing Monitoring, Project tracking, Change control, Software Configuration Management, Managing contracts, Contract Management.

Unit-V **Staffing In Software Projects** **9**

Managing people, Organizational behavior, Best methods of staff selection, Motivation, The Oldham – Hackman job characteristic model, Stress, Health and Safety, Ethical and Professional concerns, Working in teams, Decision making, Organizational structures, Dispersed and Virtual teams, Communications genres, Communication plans, Leadership.

Outcomes

On successful completion of this course, the student should be able to:

1. Identify the Project Management principles while developing software.
2. Gain extensive knowledge about the basic project management concepts and framework.
3. Estimate the risks involved in various project activities
4. Define the checkpoints, project reporting structure, project progress and tracking mechanisms
5. Analyze staff selection process and the issues related to people management.

TOTAL PERIODS 45

Text Books

1. Bob Hughes, Mike Cotterell and Rajib Mall, “Software Project Management”, Fifth Edition, Tata McGraw Hill, New Delhi, 2012.

References

1. Robert K. Wysocki, “Effective Software Project Management” – Wiley Publication, 2011.
2. Walker Royce, “Software Project Management”, Addison-Wesley, 1998.
3. Gopalaswamy Ramesh, “Managing Global Software Projects”, McGraw Hill Education (India), Fourteenth Reprint 2013.

Semester	VI	L	T	P	C
Course Code/ Title	191CS544/HUMAN COMPUTER INTERACTION	3	0	0	3

Objectives	• Define the foundations of Human Computer Interaction. • Organize the design technologies for individuals and persons with disabilities. • Identify the issues and models of HCI • Summarize the concepts of mobile HCI. • Recognize the guidelines for user interface.

Unit-I	Foundations of HCI	9

The Human: I/O channels, Memory, Reasoning and problem solving; The Computer: Devices, Memory, processing and networks; Interaction: Models, frameworks, Ergonomics, styles, elements, interactivity, Paradigms, Case Studies

Unit-II	DESIGN & SOFTWARE PROCESS	9

Interactive Design: Basics, process, scenarios, navigation, screen design, Iteration and prototyping. HCI in software process: The software life cycle Usability engineering Iterative design and prototyping Design Focus: Prototyping in practice Design rationale Design rules Principles to support usability Standards Golden rules and heuristics HCI patterns Evaluation techniques, Goals of evaluation, Evaluation through expert analysis, Evaluation through user participation, Choosing an evaluation method. Universal design, Universal design principles Multi-modal interaction

Unit-III	MODELS AND THEORIES	9

HCI Models: Cognitive models: Goal and task hierarchies Design Focus: GOMS saves money Linguistic Models The challenge of display-based systems Physical and device models Cognitive architectures Ubiquitous computing and augmented realities. Socio-Organizational issues and stakeholder requirements, Communication and collaboration models, Hypertext, Multimedia and WWW.

Unit-IV	MOBILE HCI	9

Mobile Ecosystem: Platforms, Application frameworks, Types of Mobile Applications: Widgets, Applications, Games- Mobile Information Architecture, Mobile 2.0, Mobile Design: Elements of Mobile Design, Tools, Case Studies.

Unit-V	WEB INTERFACE DESIGN	9

Designing Web Interfaces, Drag & Drop, Direct Selection, Contextual Tools, Overlays, Inlays and Virtual Pages, Process Flow, Case Studies.

Outcomes	**On successful completion of this course, the student should be able to:** • Design effective dialog for HCI. • Design effective HCI for individuals and persons with disabilities. • Assess the importance of user feedback. • Explain the HCI implications for designing multimedia/ ecommerce/ e-learning Web sites. • Develop meaningful user interface.

TOTAL PERIODS 45

References

1. Alan Dix, Janet Finlay, Gregory Abowd, Russell Beale, "Human Computer Interaction", 3rd Edition, Pearson Education, 2004 (UNIT I, II & III)
2. Brian Fling, "Mobile Design and Development", First Edition, O'Reilly Media Inc., 2009 (UNIT – IV)
3. Bill Scott and Theresa Neil, "Designing Web Interfaces", First Edition, O'Reilly, 2009. (UNIT-V)

Semester	VI	L	T	P	C
Course Code/ Title	191IT548/SOFTWARE ENGINEERING AND DESIGN	3	0	0	3

Objectives

- To understand the concepts of process, product and project development.
- To elucidate the knowledge of requirement analysis.
- To provide the knowledge of software design.
- To understand the concepts of analysis modelling.
- To provide the knowledge of software testing.

Unit-I	FUNDAMENTALS OF SOFTWARE ENGINEERING	9

Software Engineering Fundamentals- Software processes: Software life-cycle and process models Process assessment models- Overview of Project Management activities

Unit-II	REQUIREMENTS ENGINEERING	9

Software requirements and specifications- Requirements elicitation- Requirements analysis modeling techniques- Functional and nonfunctional requirements- User requirements, System requirements, requirement validation and software requirement specification document.

Unit-III	SOFTWARE DESIGN	9

Design Concepts & Principles - Design Process - Design Concepts - Modular Design - Design Effective Modularity - Introduction to Software Architecture - Data Design - Transform Mapping - Transaction Mapping - Object Oriented Design - System design process- Object design process - Design Patterns.

Unit-IV	ANALYSIS	9

Analysis Modeling - Data Modeling - Functional Modeling & Information Flow - Behavioral Modeling- Structured Analysis - Object Oriented Analysis - Domain Analysis-Object oriented Analysis process - Object Relationship Model - Object Behaviour Model, Design modelling with UML.

Unit-V	IMPLEMENTATION, TESTING & MAINTENANCE	9

Top - Down, Bottom-Up, object oriented product Implementation & Integration. Software Testing methods- White Box, Basis Path-Control Structure - Black Box - Unit Testing - Integration testing - Validation & System testing - Testing Tools – Software Maintenance & Reengineering.

Outcomes

On successful completion of this course, the student should be able to:

- Analyze the software development life cycle.
- Identify different process models and the approach adopted in gathering requirements.
- Demonstrate the various software design concepts and understand different designs like architectural, structured, object oriented and user interface.
- Use the concept and standards of quality and getting knowledge about software quality assurance group.
- Apply software validation and testing for real time applications. Discuss software maintenance issues and challenges.

TOTAL PERIODS 45

Text Books

1. Roger. S. Pressman and Bruce R. Maxim, "Software Engineering – A Practitioner's Approach", seventh Edition, McGraw Hill, 2015.
2. Ian Sommerville, "Software Engineering", eighth edition, Pearson Education, New Delhi, 2011.
3. Bill Brykczynski, Richard D. Stutz ,"Software Engineering Project Management", Wiley India Edition, IEEE computer society, 2007.
4. Craig Larman, Applying UML and Patterns: An Introduction to Object-Oriented Analysis and Design and Iterative Development (3rd Edition), Pearson Education, 2008.

References

1. R. S. Pressman, Software Engineering- A Practitioner's Approach, Eighth Edition, Mc Graw Hill Higher Education, 2014.
2. K. V. K. K. Prasad, "Software Testing Tools", Dreamtech, 2004.
3. Fairley R, "Software Engineering Concepts", second edition, Tata McGraw Hill,New Delhi, 2003.
4. Jalote P, "An Integrated Approach to Software Engineering", third edition, Narosa Publishers, New Delhi,

2013.
5. Grady Booch, James Rumbaugh, Ivar Jacobson - "the Unified Modeling Language User Guide" - Addison Wesley, 1999.
6. Ali Bahrami, “Object Oriented Systems Development” 1st Edition, The McGraw-Hill Company, 1999

Semester	VI	L	T	P	C
Course Code/ Title	191CS5412/SOFTWARE TESTING	3	0	0	3

Objectives

- To learn the criteria for test cases.
- To learn the design of test cases.
- To understand the needs of the testing.
- To Evaluate working products
- To apply test automation techniques

Unit-I **INTRODUCTION** **9**

Testing as an Engineering Activity, Testing as a Process, Testing Maturity Model, Testing axioms, Basic definitions, Software Testing Principles, The Tester‘s Role in a Software Development Organization, Origins of Defects, Cost of defects, Defect Classes, The Defect Repository and Test Design, Defect Examples, Developer/Tester Support of Developing a Defect Repository.

Unit-II **TEST CASE DESIGN STRATEGIES** **9**

Test case Design Strategies, Using Black Box Approach to Test Case Design, Boundary Value Analysis, Equivalence Class Partitioning, State based testing, Cause-effect graphing, Compatibility testing, user documentation testing, domain testing, Random Testing, Requirements based testing, Using White Box Approach to Test design, Test Adequacy Criteria, static testing vs structural testing, code functional testing, Coverage and Control Flow Graphs, Covering Code Logic, Paths, code complexity testing, Additional White box testing approaches, Evaluating Test Adequacy Criteria.

Unit-III **LEVELS OF TESTING** **9**

The need for Levels of Testing, Unit Test, Unit Test Planning, Designing the Unit Tests, The Test Harness, Running the Unit tests and Recording results, Integration tests, Designing Integration Tests, Integration Test Planning, Scenario testing, Defect bash elimination System Testing, Acceptance testing, Performance testing, Regression Testing, Internationalization testing, Ad-hoc testing, Alpha, Beta Tests, Testing OO systems, Usability and Accessibility testing, Configuration testing, Compatibility testing, Testing the documentation, Website testing.

Unit-IV **TEST MANAGEMENT** **9**

People and organizational issues in testing, Organization structures for testing teams, testing services, Test Planning, Test Plan Components, Test Plan Attachments, Locating Test Items, test management, test process, Reporting Test Results, Introducing the test specialist, Skills needed by a test specialist, Building a Testing Group, The Structure of Testing Group, The Technical Training Program.

Unit-V **TEST AUTOMATION** **9**

Software test automation, skills needed for automation, scope of automation, design and architecture for automation, requirements for a test tool, challenges in automation, Test metrics and measurements, project, progress and productivity metrics. **Selenium tools**

Outcomes

On successful completion of this course, the student should be able to:

- Design test cases suitable for a software development for different domains.
- Identify suitable tests to be carried out.
- Prepare test planning based on the document.
- Document test plans and test cases designed.
- Make use of the latest test tool for functional and performance testing.

TOTAL PERIODS 45

Text Books

1. SrinivasanDesikan and Gopalaswamy Ramesh, “Software Testing – Principles and Practices”, Pearson Education, 2006.
2. Ron Patton, “Software Testing”, Second Edition, Sams Publishing, Pearson Education, 2007.

References

1. 1. Ilene Burnstein, “Practical Software Testing”, Springer International Edition, 2003.
2. Edward Kit, “Software Testing in the Real World – Improving the Process”, Pearson Education, 1995.
3. Boris Beizer, “Software Testing Techniques” – 2nd Edition, Van Nostrand Reinhold, New York, 1990.
4. Aditya P. Mathur, “Foundations of Software Testing _ Fundamental Algorithms and Techniques”, Dorling Kindersley (India) Pvt. Ltd., Pearson Education, 2008.

Semester	VI	L	T	P	C
Course Code/ Title	191ME543/ENERGY CONSERVATION AND MANAGEMENT	3	0	0	3
Objectives	• To expose students to analysis the energy data of industries, carryout energy accounting and balancing, conduct energy audit and suggest methodologies for energy savings and utilize the available resources in optimal ways.				

Unit-I	INTRODUCTION	9

Energy - Power – Past & Present scenario of World; National Energy consumption Data – Environmental aspects associated with energy utilization – Energy Auditing: Need, Types, Methodology and Barriers. Role of Energy Managers. Instruments for energy auditing.

Unit-II	ELECTRICAL SYSTEMS	9

Components of EB billing – HT and LT supply, Transformers, Cable Sizing, Concept of Capacitors, Power Factor Improvement, Harmonics, Electric Motors - Motor Efficiency Computation, Energy Efficient Motors, Illumination – Lux, Lumens, Types of lighting, Efficacy, LED Lighting and scope of Encon in Illumination.

Unit-III	THERMAL SYSTEMS	9

Stoichiometry, Boilers, Furnaces and Thermic Fluid Heaters – Efficiency computation and encon measures. Steam: Distribution &U sage: Steam Traps, Condensate Recovery, Flash Steam Utilization, Insulators& Refractories.

Unit-IV	ENERGY CONSERVATION IN MAJOR UTILITIES	9

Energy conservation inPumps, Fans, Blowers, Compressed Air Systems, Refrigeration and Air Conditioning Systems – Cooling Towers – D.G. sets.

Unit-V	ECONOMICS	9

Energy Economics – Discount Rate, Payback Period, Internal Rate of Return, Net Present Value, Life Cycle Costing –ESCO concept.

Outcomes

On successful completion of this course, the student should be able to:

- Relate the analyze the energy data of industries and carry out energy accounting and balancing
- Calculate the energy savings in electrical systems.
- Calculate the energy savings in thermal systems
- Carry out energy conservation procedures in major utilities
- Suggest methodologies for energy savings

TOTAL PERIODS 45

References

1. Energy Manager Training Manual (4 Volumes) available at www.energymanager training.com, a website administered by Bureau of Energy Efficiency (BEE), a statutory body under Ministry of Power, Government of India, 2004.
2. Witte. L.C., P.S. Schmidt, D.R. Brown, “Industrial Energy Management and Utilisation” Hemisphere Pub., Washington, 1988.
3. Callaghn, P.W. “Design and Management for Energy Conservation”, Pergamon Press, Oxford, 1981.
4. Dryden. I.G.C., “The Efficient Use of Energy” Butterworths, London, 1982
5. Turner. W.C., “Energy Management Hand book”, Wiley, New York, 1982.
6. Murphy. W.R. and G. Mc KAY, “Energy Management”, Butterworths, London 1987.

Semester	VII	L	T	P	C
Course Code/ Title	191ME546/ RENEWABLE ENERGY SOURCES	3	0	0	3
Objectives	• To introduce the new methodologies technologies for effective utilization of renewable energy sources.				

Unit-I	Introduction	9

World Energy Use – Reserves of Energy Resources – Environmental Aspects of Energy Utilisation – Renewable Energy Scenario in Tamil Nadu, India and around the World – Potentials – Achievements Applications – Economics of renewable energy systems.

Unit-II	Solar Energy	9

Solar Radiation – Measurements of Solar Radiation - Flat Plate and Concentrating Collectors – Solar direct Thermal Applications – Solar thermal Power Generation - Fundamentals of Solar Photo Voltaic Conversion – Solar Cells – Solar PV Power Generation – Solar PV Applications.

Unit-III	WIND ENERGY	9

Wind Data and Energy Estimation – Types of Wind Energy Systems – Performance – Site Selection – Details of Wind Turbine Generator – Safety and Environmental Aspects

Unit-IV	BIO ENERGY	9

Biomass direct combustion – Biomass gasifiers – Biogas plants – Digesters – Ethanol production – Bio diesel – Cogeneration - Biomass Application, Biomass Feedstocks, Biomass to Biofuel Supply Chain

Unit-V	OTHER RENEWABLE ENERGY SOURCES	9

Tidal energy – Wave Energy – Open and Closed OTEC Cycles – Small Hydro-Geothermal Energy – Hydrogen and Storage - Fuel Cell Systems – Hybrid Systems, Greenhouse Gas and its effect on climate change.

Outcomes

On successful completion of this course, the student should be able to:

- Identify the ways for effective utilization of renewable energy sources.
- Relate and analyze the various solar energy based renewable energy generation.
- Relate and analyze the various wind energy based renewable energy generation
- Relate and analyze the various Bio-energy based renewable energy generation
- Identify the merits of new methodologies and technologies for renewable energy generation

TOTAL PERIODS 45

References

1. Rai. G.D., "Non Conventional Energy Sources", Khanna Publishers, New Delhi, 2011.
2. Twidell, J.W. & Weir, A., "Renewable Energy Sources", EFN Spon Ltd., UK, 2006.
3. Sukhatme. S.P., "Solar Energy", Tata McGraw Hill Publishing Company Ltd., New Delhi, 1997.
4. Godfrey Boyle, "Renewable Energy, Power for a Sustainable Future", Oxford University Press, U.K., 1996.
5. Tiwari. G.N., Solar Energy – "Fundamentals Design, Modelling & Applications", Narosa Publishing House, New Delhi, 2002.
6. Freris. L.L., "Wind Energy Conversion Systems", Prentice Hall, UK, 1990.
7. Johnson Gary, L. "Wind Energy Systems", Prentice Hall, New York, 1985
8. David M. Mousdale – "Introduction to Biofuels", CRC Press, Taylor & Francis Group, USA 2010
9. Chetan Singh Solanki, Solar Photovoltaics, "Fundamentals, Technologies and Applications", PHI Learning Private Limited, New Delhi, 2009.

Semester	VII	L	T	P	C
Course Code/ Title	191IT544/CLOUD COMPUTING	3	0	0	3
Objectives	• To understand the concept of cloud computing. • To appreciate the evolution of cloud from the existing technologies. • To have knowledge on the various issues in cloud computing. • To be familiar with the lead players in cloud. • To appreciate the emergence of cloud as the next generation computing paradigm.				
Unit-I	Introduction				9
Introduction to Cloud Computing – Definition of Cloud – Evolution of Cloud Computing –Underlying Principles of Parallel and Distributed Computing – Cloud Characteristics – Elasticity in Cloud – On-demand Provisioning.					
Unit-II	CLOUD ENABLING TECHNOLOGIES				9
Service Oriented Architecture – REST and Systems of Systems – Web Services – Publish Subscribe Model – Basics of Virtualization – Types of Virtualization – Implementation Levels of Virtualization – Virtualization Structures – Tools and Mechanisms – Virtualization of CPU –Memory – I/O Devices Virtualization Support and Disaster Recovery.					
Unit-III	CLOUD ARCHITECTURE, SERVICES AND STORAGE				9
Layered Cloud Architecture Design – NIST Cloud Computing Reference Architecture – Public, Private and Hybrid Clouds – laaS – PaaS – SaaS – Architectural Design Challenges – Cloud Storage – Storage-as-a-Service – Advantages of Cloud Storage – Cloud Storage Providers – S3.					
Unit-IV	RESOURCE MANAGEMENT AND SECURITY IN CLOUD				9
Inter Cloud Resource Management – Resource Provisioning and Resource Provisioning Methods – Global Exchange of Cloud Resources – Security Overview – Cloud Security Challenges –Software-as-a-Service Security – Security Governance – Virtual Machine Security – IAM –Security Standards.					
Unit-V	CLOUD TECHNOLOGIES AND ADVANCEMENTS				9
Hadoop – MapReduce – Virtual Box — Google App Engine – Programming Environment for Google App Engine — Open Stack –Federation in the Cloud – Four Levels of Federation –Federated Services and Applications – Future of Federation.					
Outcomes	**On successful completion of this course, the student should be able to:** •				
					TOTAL PERIODS 45

TEXT BOOKS

1. Kai Hwang, Geoffrey C. Fox, Jack G. Dongarra, "Distributed and Cloud Computing, From Parallel Processing to the Internet of Things", Morgan Kaufmann Publishers, 2012.
2. Rittinghouse, John W., and James F. Ransome, "Cloud Computing: implementation, management and Security", CRC Press, 2017.

References

1. Rajkumar Buyya, Christian Vecchiola, S. ThamaraiSelvi, "Mastering Cloud Computing", Tata Mcgraw Hill, 2013.
2. Toby Velte, Anthony Velte, Robert Elsenpeter, "Cloud Computing – A Practical Approach", Tata Mcgraw Hill, 2009.