PANIMALAR ENGINEERING COLLEGE

Approved by AICTE, New Delhi | Affiliated to Anna University, Chennai

B.E - ELECTRONICS AND COMMUNICATION ENGINEERING

REGULATION 2021

CURRICULUM & SYLLABUS

PANIMALAR ENGINEERING COLLEGE

(An Autonomous Institution, Affiliated to Anna University, Chennai)

Bangalore Trunk Road, Varadharajapuram,

Poonamallee, Chennai – 600 123.

Department of Electronics and Communication Engineering

B.E- Electronics and Communication Engineering

Curriculum and Syllabus Regulation 2021

PROGRAMME EDUCATIONAL OBJECTIVES: (PEOs):

- To prepare students to analyze, design and implement electronic circuits and systems using the knowledge acquired from basic science and mathematics.
- To train students with good scientific and engineering knowledge so as to comprehend, analyze, design and create novel products and solutions for real life problems.
- To introduce the research world to the graduates not only in their own domain but also in multidisciplinary domain, so that they feel motivated for higher studies.
- To prepare graduates to exhibit professionalism, ethical attitude, communication skills, team work and leadership qualities in their profession and adapt to current trends by engaging in lifelong learning.
- To practice professionalism in a collaborative, team-oriented manner that embraces the multicultural environment of today's business world.

PROGRAMME OUTCOMES (POs):

1. **Engineering knowledge**
   Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
2. **Problem Analysis**
   Identify, formulate, research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
3. **Design/development of solutions**
   Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
4. **Conduct investigations of complex problems**
   Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information
5. **Modern tool usage**
   Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.

6. **The engineer and society**

   Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal, and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

7. **Environment and Sustainability**

   Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of need for sustainable development.

8. **Ethics**

   Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

9. **Individual and Team Work**

   Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

10. **Communication**

    Communicate effectively on complex engineering activities with the engineering community and with society at large. Some of them are, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

11. **Project Management and Finance**

    Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

12. **Lifelong 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 (PSOs):

PSO1: Graduates should demonstrate an understanding of the basic concepts in the primary area of Electronics and Communication Engineering, including: analysis of circuits containing both active and passive components, electronic systems, control systems, electromagnetic systems, digital systems, computer applications and communications.

PSO2: Graduates should demonstrate the ability to utilize the mathematics and the fundamental knowledge of Electronics and Communication Engineering to design complex systems which may contain both software and hardware components to meet the desired needs.

PSO3: The graduates are capable of excelling in Electronics and Communication Engineering industry/Academic /Software companies through professional careers.

PANIMALAR ENGINEERING COLLEGE . CHENNAI. JAISAKTHI EDUCATIONAL TRUST

PANIMALAR ENGINEERING COLLEGE

(An Autonomous Institution, Affiliated to Anna University, Chennai)
ELECTRONICS AND COMMUNICATION ENGINEERING
CHOICE BASED CREDIT SYSTEM
CURRICULA AND SYLLABI – R2021

SEMESTER I

Sl. No	Course Code	Course Title	Category	Contact Periods	L	T	P	C
THEORY								
1.	21HS1101	Communicative English & Language Skills Lab I Integrated	HS	5	3	0	2	4
2.	21MA1101	Engineering Mathematics - I	BS	4	3	1	0	4
3.	21PH1101	Engineering Physics	BS	3	3	0	0	3
4.	21CY1101	Engineering Chemistry	BS	3	3	0	0	3
5.	21ES1101	Problem Solving and Python Programming	ES	3	3	0	0	3
6.	21ES1102	Engineering Graphics	ES	5	3	0	2	4
PRACTICALS								
7.	21ES1111	Problem Solving and Python Programming Laboratory	ES	4	0	0	4	2
8.	21BS1111	Physics and Chemistry Laboratory	BS	4	0	0	4	2
		TOTAL		**31**	**18**	**1**	**12**	**25**

SEMESTER II

Sl. No	Course Code	Course Title	Category	Contact Periods	L	T	P	C
THEORY								
1.	21HS1201	Communicative English & Language Skills Lab II Integrated	HS	5	3	0	2	4
2.	21MA1201	Engineering Mathematics-II	BS	4	3	1	0	4
3.	21PH1201	Physics for Electronics Engineering	BS	3	3	0	0	3
4.	21BE1201	Basics of Electrical and Measurement Engineering	ES	3	3	0	0	3
5.	21EC1201	Circuit Analysis	PC	3	2	1	0	3
6.	21EC1202	Electronic Devices	PC	3	3	0	0	3
PRACTICALS								
7.	21EC1211	Circuits and Devices Laboratory	PC	4	0	0	4	2
8.	21ES1211	Engineering Practices Laboratory	ES	4	0	0	4	2
		TOTAL		**29**	**17**	**2**	**10**	**24**

SEMESTER III

Sl. No	Course Code	Course Title	Category	Contact Periods	L	T	P	C
THEORY								
1.	21MA1302	Linear Algebra and Numerical Analysis	BS	4	4	0	0	4
2.	21EC1301	Electromagnetic Fields	PC	3	3	0	0	3
3.	21EC1302	Electronic Circuits	PC	3	3	0	0	3
4.	21EC1303	Digital Electronics	PC	3	3	0	0	3
5.	21EC1304	Signals and Systems	PC	3	3	1	0	4
6.		Mandatory Course I	MC	2	2	0	0	0
PRACTICALS								
7.	21EC1311	Circuits and Simulation Laboratory	PC	4	0	0	4	2
8.	21EC1312	Digital Electronics Laboratory	PC	4	0	0	4	2
TOTAL				**26**	**18**	**1**	**8**	**21**

SEMESTER IV

Sl. No	Course Code	Course Title	Category	Contact Periods	L	T	P	C
THEORY								
1.	21MA1403	Probability and Random Processes	BS	4	3	1	0	4
2.	21EC1401	Artificial Intelligence and Machine Learning (Lab Integrated)	PC	4	3	0	2	4
3.	21EC1402	Control Systems Engineering	PC	4	3	1	0	4
4.	21EC1403	Fundamentals of Data structures in C	PC	3	3	0	0	3
5.	21EC1404	Analog Integrated Circuits	PC	3	3	0	0	3
6.		Mandatory Course II	MC	2	2	0	0	0
PRACTICALS								
7.	21EC1412	Analog Integrated Circuits Laboratory	PC	4	0	0	4	2
8.	21EC1413	Fundamentals of Data structures in C Laboratory	PC	4	0	0	4	2
TOTAL				**28**	**17**	**2**	**10**	**22**

SEMESTER V

Sl. No	Course Code	Course Title	Category	Contact Periods	L	T	P	C
THEORY								
1.	21EC1501	Analog and Digital Communication	PC	3	3	0	0	3
2.	21EC1502	Digital Signal Processing	PC	3	3	0	0	3
3.	21EC1503	Microcontrollers and Computer Architecture	PC	3	3	0	0	3
4.	21EC1504	Transmission Lines and Waveguides	PC	3	3	0	0	3
5.		Professional Elective – I	PE	3	3	0	0	3
6.		Open Elective 1	OE	3	3	0	0	3
PRACTICALS								
7.	21EC1511	Microcontrollers and Interfacing Laboratory	PC	4	0	0	4	2
8.	21EC1512	Digital Signal Processing Laboratory	PC	4	0	0	4	2
9.	21EC1513	Analog and Digital Communication Laboratory	PC	4	0	0	4	2
		TOTAL		**30**	**18**	**0**	**12**	**24**

SEMESTER VI

Sl. No	Course Code	Course Title	Category	Contact Periods	L	T	P	C
THEORY								
1.	21EC1601	Wireless Communication	PC	3	3	0	0	3
2.	21EC1602	Antenna Theory and Design	PC	3	3	0	0	3
3.	21EC1603	VLSI and Chip Design	PC	3	3	0	0	3
4.	21EC1604	Data Communication Networks	PC	3	3	0	0	3
5.		Professional Elective II	PE	3	3	0	0	3
6.		Open Elective II	OE	3	3	0	0	3
PRACTICALS								
7.	21EC1611	VLSI Design Laboratory	PC	4	0	0	4	2
8.	21EC1612	Wireless Communication and Networks Laboratory	PC	4	0	0	4	2
		TOTAL		**26**	**18**	**0**	**8**	**22**

SEMESTER VII

Sl. No	Course Code	Course Title	Category	Contact Periods	L	T	P	C
THEORY								
1.	21EC1701	Embedded Systems and Robotics	PC	3	3	0	0	3
2.	21EC1702	Microwave Devices and Circuits	PC	3	3	0	0	3
3.	21EC1703	Optical Communication and Networks	PC	3	3	0	0	3
4.		Professional Elective – III	PE	3	3	0	0	3
5.		Professional Elective – IV	PE	3	3	0	0	3
PRACTICALS								
6.	21EC1711	Embedded Systems and Robotics Laboratory	PC	4	0	0	4	2
7.	21EC1712	Advanced Communication Laboratory	PC	4	0	0	4	2
8.	21EC1713	Mini Project	EEC	2	0	0	2	1
		TOTAL		**25**	**15**	**0**	**10**	**20**

SEMESTER VIII

Sl. No	Course Code	Course Title	Category	Contact Periods	L	T	P	C
THEORY								
1.		Professional Elective – V	PE	3	3	0	0	3
2.		Professional Elective – VI	PE	3	3	0	0	3
PRACTICALS								
1.	21EC1811	Project Work	EEC	16	0	0	16	8
		TOTAL		**22**	**6**	**0**	**16**	**14**

Total No. of Credits: 172

PROFESSIONAL ELECTIVE COURSES: VERTICALS

Sl. No	Vertical I VLSI Chip Design and Testing	Vertical II Signal Processing	Vertical III RF Technologies	Vertical IV Biomedical Technologies	Vertical V Wireless Networks and IoT	Vertical VI Space Technologies	Vertical VII Radio Communication and Broadband Networks	Vertical VIII Emerging Technologies
1.	21EC1901 ASIC Design	21EC1908 DSP Architecture and Programming	21EC1915 Electromagnetic Interference and Compatability	21EC1922 Medical Electronics	21EC1929 Wireless Networks	21EC1936 Radar Technologies	21EC1943 Broadband Access Technologies	21EC1950 Cryptography and Security Practices
2.	21EC1902 CAD for VLSI Design	21EC1909 Advanced Digital Signal Processing	21EC1916 RFID systems and Applications	21EC1923 Wearable Medical Devices	21EC1930 Adhoc and Wireless Sensor Networks	21EC1937 Planetary Science	21EC1944 Software Defined Networks	21EC1951 Blockchain Technologies and Applications
3.	21EC1903 Mixed Signal IC Design	21EC1910 Digital Image and Video Processing	21EC1917 RF MEMS	21EC1924 Human Assist Devices	21EC1931 Cooperative Communications and Networking	21EC1938 Remote Sensing	21EC1945 Cognitive Radio Networks	21EC1952 Data Science and Analytics
4.	21EC1904 Low Power IC Design	21EC1911 VLSI Signal Processing	21EC1918 Smart Antennas	21EC1925 Medical Imaging Systems	21EC1932 IoT and its Applications	21EC1939 Navigation Systems	21EC1946 Wireless Broadband Networks	21EC1953 Machine Learning Algorithms
5.	21EC1905 VLSI Testing and Design for Testability	21EC1912 Speech Processing	21EC1919 RF System Design	21EC1926 Wireless Body Area Networks	21EC1933 IoT Based System Design	21EC1940 Satellite Communication	21EC1947 Massive MIMO Networks	21EC1954 Deep learning
6.	21EC1906 System on Chip	21EC1913 Computer Vision	21EC1920 Signal Integrity for High Speed Design	21EC1927 Brain Computer Interface and Applications	21EC1934 Industrial IoT 4.0	21EC1941 Avionics Systems	21EC1948 5G and beyond communication Networks	21EC1955 Human Computer Interaction
7.	21EC1907 Networks on Chip	21EC1914 Underwater Imaging Systems And Image Processing	21EC1921 Computational Electro magnetics	21EC1928 Therapeutic Equipment	21EC1935 Wireless Sensor Network Design	21EC1942 Rocketry and Space Mechanics	21EC1949 Photonic Networks	21EC1956 Augmented Reality and Virtual Reality

Registration of Professional Elective Courses from Verticals:

Professional Elective Courses will be registered in Semesters V to VIII. These courses are listed in groups called verticals that represent a particular area of specialization / diversified group. Students are permitted to choose all the Professional Electives from a particular vertical or from different verticals. Further, only one Professional Elective course shall be chosen in a semester horizontally (row-wise). However, two courses are permitted from the same row, provided one course is enrolled in Semester V and another in semester VI.

The registration of courses for B.E./B.Tech (Honours) or Minor degree shall be done from Semester V to VIII. The procedure for registration of courses explained above shall be followed for the courses of B.E/B.Tech (Honours) or Minor degree also. For more details on B.E./B.Tech (Honours) or Minor degree refer to the Regulations 2021.

List of Open Electives I (V SEMESTER)

Sl. No	Course Code	Course Title	Category	Contact Periods	L	T	P	C
1.	21EE1005	Energy Conservation and Management	OE	3	3	0	0	3
2.	21CS1001	Fundamentals of Database Management Systems	OE	3	3	0	0	3
3.	21CS1003	Cloud Computing	OE	3	3	0	0	3
4.	21EC1003	Basic of Biomedical Instrumentation	OE	3	3	0	0	3
5.	21EE1006	Intelligent Automation	OE	3	3	0	0	3
6.	21CB1001	Introduction to C Programming	OE	3	3	0	0	3
7.	21ML1001	Data Structures and Algorithms	OE	3	3	0	0	3
8.	21IT1003	Ethical Hacking	OE	3	3	0	0	3
9.	21EC1005	Product Design and Development	OE	3	3	0	0	3
10.	21ME1004	Industrial Pollution and Prevention	OE	3	3	0	0	3

List of Open Electives II (VI SEMESTER)

Sl. No	Course Code	Course Title	Category	Contact Periods	L	T	P	C
1.	21ME1917	Renewable Energy Resources	OE	3	3	0	0	3
2.	21ME1937	Industrial Safety and Maintenance	OE	3	3	0	0	3
3.	21EC1011	Telehealth Technology	OE	3	3	0	0	3
4.	21CS1002	Software Engineering	OE	3	3	0	0	3
5.	21EE1003	Logic and Distributed Control System	OE	3	3	0	0	3
6.	21EC1008	Robotics and Automation	OE	3	3	0	0	3
7.	21IT1001	Web Design and Management	OE	3	3	0	0	3
8.	21CB1002	Mobile Application Development	OE	3	3	0	0	3
9.	21EE1007	Intelligent Control of Electric Vehicles	OE	3	3	0	0	3
10.	21ME1934	Industrial Engineering	OE	3	3	0	0	3
11.	21ME1005	Hospital Management	OE	3	3	0	0	3

MANDATORY COURSES

Sl. No	Course Code	Course Title	Category	Contact Periods	L	T	P	C
1.	21MC1001	Environmental Science	MC	2	2	0	0	0
2.	21MC1002	Constitution of India	MC	2	2	0	0	0
3.	21MC1003	Human Values	MC	2	2	0	0	0
4.	21MC1004	Energy Studies	MC	2	2	0	0	0
5.	21MC1005	Essence of Indian Traditional Knowledge	MC	2	2	0	0	0
6.	21MC1006	Soft Skills and Personality Development	MC	2	2	0	0	0
7.	21MC1007	Value Education, Human Rights and Legislature Procedure	MC	2	2	0	0	0

Credit Distribution

Sl.No	Subject Area	CREDITS PER SEM								Total	Percentage
	Semester	**I**	**II**	**III**	**IV**	**V**	**VI**	**VII**	**VIII**		
1.	**HS**	4	4							8	4.65
2.	**BS**	12	7	4	4					27	15.69
3.	**ES**	9	5							14	8.13
4.	**PC**		8	17	18	18	16	13		90	52.32
5.	**PE**					3	3	6	6	18	10.46
6.	**OE**					3	3			6	3.48
7.	**EEC**							1	8	9	5.23
8.	**MC**			0	0					0	0
TOTAL		**25**	**24**	**21**	**22**	**24**	**22**	**20**	**14**	**172**	**100**

21HS1101	COMMUNICATIVE ENGLISH & LANGUAGE SKILLS LAB I INTEGRATED	L	T	P	C
		3	0	2	4

OBJECTIVES:

- To induce the basic reading and writing skills among the first year engineering and technology students.
- To assist the learners to develop their listening skills, which will enable them listening to lectures and comprehend them by asking questions and seeking clarifications
- To succor the learners to develop their speaking skills and speak fluently in real contexts.
- To motivate the learners to develop vocabulary of a general kind by developing their reading skills for meeting the competitive exams like GATE, TOFEL, GRE, IELTS, and other exams conducted by Central and State governments

UNIT - I INTRODUCING ONESELF 9

Listening: Listening and filling details, Listening to Speeches by Specialists and Completing Activities such as Answering Questions, Identifying the Main Ideas, Style, etc. Speaking: Introducing Oneself – Introducing Friend/ Family. Reading: Descriptive Passages (From Newspapers / Magazines).Writing: Writing a Paragraph (Native Place, School Life), Developing Hints. Grammar: Noun, Pronoun & Adjective. Vocabulary Development: One Word Substitution.

UNIT - II DIALOGUE WRITING 9

Listening: Listening to Conversations (Asking for and Giving Directions).Speaking: Making Conversation Using (Asking for Directions, Making an Enquiry), Role Plays, and Dialogues. Reading: Reading a Print Interview and Answering Comprehension Questions. Writing: Writing a Checklist, Dialogue Writing Grammar: Tenses and Voices. Vocabulary Development: Prefix &Suffix, Word formation.

UNIT - III DRAFTING OFFICIAL COMMUNICATIONS 9

Listening: Listening for specific information. Speaking: Giving Short Talks on a given Topic. Reading: Reading Motivational Essays on Famous Engineers and Technologists (Answering Open – Ended and Closed Questions).Writing: Writing Formal Letters / Emails. Grammar: Adverb, Prepositions & Conjunctions. Vocabulary Development: Collocations – Fixed Expressions.

UNIT - IV WRITTEN COMMUNICATION 9

Listening: Listening to Short Talks (5 Minutes Duration and Fill a Table, Gap-Filling Exercise) Note Taking/Note Making .Speaking: Small Group Discussion, Giving Recommendations .Reading: Reading Problem – Solution Articles/Essays Drawn From Various Sources .Writing: Making Recommendations Note Making – Complaint Letters. Grammar: Subject-Verb Agreement, Framing Questions. Vocabulary Development: Connectives, Reference Words, Technical Vocabulary.

UNIT - V WRITING DEFINITIONS AND PRODUCT DESCRIPTION 9

Listening: Listening to a Product Description (Labeling and Gap Filling) Exercises. Speaking: Describing a Product and Comparing and Contrasting it with Other Products. Reading: Reading Graphical Material for Comparison (Advertisements).Writing: Writing Definitions (Short and Long)– Compare and Contrast Paragraphs, Essay writing. Grammar:– Phrasal Verbs – Cause and Effect Sentences –Compound Nouns Vocabulary Development: Use of Discourse Markers.

TOTAL: 45 PERIODS

OUTCOMES:

On successful completion of the course student will be able to:

1. Comprehend conversations and short talks delivered in English
2. Participate effectively in informal conversations; introduce themselves and their friends and express opinions English
3. Read articles of a general kind in magazines and newspapers
4. Write short essays of a general kind and personal letters and emails in English
5. Recognize the use of grammar in speech and writing

TEXT BOOKS:

1. N P Sudharshana & C Savitha. English for Technical Communication Delhi: CUP, 2019. Board of Editors. English for Engineers and Technologists Volume 1 Orient Black Swan Limited, 2020.

REFERENCES:

1. Board of Editors. “Using English-A course book for Undergraduate engineers and Technologists”, Orient Black Swan Limited, 2017
2. Bailey, Stephen. “Academic Writing: A Practical Guide for Students”. New York: Rutledge,2011.
3. Comfort, Jeremy, et al. Speaking Effectively: Developing Speaking Skills for Business English. Cambridge University Press, Cambridge: Reprint 2011
4. Means,L. Thomas and Elaine Langlois. “English & Communication For Colleges. Cengage Learning” ,USA:2007
5. Redston, Chris & Gillies Cunningham, “Face2Face (Pre-intermediate Student’s Book & Workbook)”, Cambridge University Press, New Delhi: 2005.

LANGUAGE SKILLS LAB

List of exercises
Minimum of exercises to be conducted 15

1. Reading: Different text type
2. Reading: Predicting content using pictures and title.
3. Reading: Use of graphic organizers to review
4. Reading: Aid comprehension.
5. Reading: Understanding reference words
6. Reading: Use of connectors in a passage-
7. Reading: Speed reading Techniques.
8. Reading and Comprehending the passages in the competitive exams like GATE, TOFEL, GRE,IELTS, and other exams conducted by Central and State governments.
9. Reading: Sentence Completion: Exercises used in competitive exams.
10. Writing: Error Detection:
11. Writing: Spotting and reasoning the errors found from the passages in competitive exams.
12. Writing: Email writing
13. Writing: Job Application: Resume
14. Writing: Elements of a good essay-
15. Writing: Types of essays- Descriptive-Narrative- issue based.
16. Writing: Statement of Purpose
17. Writing: Letter of recommendation
18. Writing: Vision statement
19. Writing: Verbal Analogy,
20. Writing: Phrases, and Idioms associated with competitive exams.

TOTAL: 30 PERIODS

REFERENCES:

1. Suresh Kumar.E and et al. Enriching Speaking and Writing Skills. Second Edition. Orient Black swan: Hyderabad, 2012
2. Davis, Jason and Rhonda Liss. Effective Academic Writing (Level 3) Oxford University Press: Oxford, 2006
3. Withrow, Jeans and et al. Inspired to Write. Readings and Tasks to develop writing skills. Cambridge University Press: Cambridge, 2004
4. Goatly, Andrew. Critical Reading and Writing. Routledge: United States of America, 2000

ENGINEERING COLLEGE CHENNAI. ENDURANCE EDUCATIONAL TRUST

21MA1101	ENGINEERING MATHEMATICS – I	L	T	P	C
		3	1	0	4

OBJECTIVES:

- Matrix transforms are very useful within the world of computer graphics. A matrix algebra can be readily applied to the structural properties of graphs from an algebraic point of view.
- The aim of this course to get depth knowledge about calculus.
- Familiarize the functions of two variables and finding its extreme points.
- To make the students understand various techniques of integration.
- Apply multiple integral ideas in solving areas, volumes and other practical problems

UNIT - I MATRICES 9+3

Eigen values and Eigen vectors of a real matrix —Rank of the matrix – Characteristic equation — Properties of Eigenvalues and Eigen vectors — Cayley Hamilton theorem — Diagonalization of matrices— Reduction of a quadratic form to canonical form by orthogonal transformation and similarity transformation —Nature of quadratic forms.

UNIT - II DIFFERENTIAL CALCULUS 9+3

Representation of functions – Limit of a function – Continuity – Derivatives – Differentiation rules (Sum, Product & Quotient rule, Chain rule, logarithmic and implicit differentiation) – Maxima and Minima of functions of one variable-Rolle's theorem- Mean value theorem.

UNIT - III FUNCTIONS OF SEVERAL VARIABLES 9+3

Partial differentiation – Homogeneous functions and Euler's theorem – Total derivative – Change of variables – Jacobians – Partial differentiation of implicit functions – Taylor's series for functions of two variables – Maxima and minima of functions of two variables –Lagrange's method of undetermined multipliers.

UNIT - IV INTEGRAL CALCULUS 9+3

Definite and Indefinite integrals – Substitution rule – Techniques of Integration – Integration by parts – Bernoulli's formula- Trigonometric integrals – Trigonometric substitutions – Integration of rational functions by partial fraction – Integration of irrational functions – Improper integrals.

UNIT - V MULTIPLE INTEGRALS 9+3

Double integrals in modelling and polar coordinates – Change of order of integration in modelling coordinates– Area enclosed by plane curves – Change of variables in double integrals – Triple integrals –Volume of Solids.

TOTAL: 60 PERIODS

OUTCOMES:

On successful completion of the course student will be able to:

1. Find eigenvalues and eigen vectors, diagonalization of a matrix, symmetric matrices, positive definite matrices and similar matrices.
2. Apply limit definition and rules of differentiation to differentiate functions.
3. Understand familiarity in the knowledge of Maxima and Minima, Jacobian, Taylor series and apply the problems involving Science and Engineering
4. Understand the knowledge of Integration by parts, Trigonometric integrals, Trigonometric substitutions, Integration of rational functions by partial fraction.
5. Understand the knowledge of Area enclosed by plane curves, Change of variables in double integrals, Triple integrals, Volume of Solids.

TEXT BOOKS:

1. Grewal B.S., ―Higher Engineering Mathematics‖, Khanna Publishers, NewDelhi,43rd Edition, 2014.
2. James Stewart, ―Calculus: Early Transcendentals‖, Cengage Learning,7th Edition, NewDelhi, 2015.
3. Bali N., Goyal M. and Walkins C., ―Advanced Engineering Mathematics‖, Firewall Media (An imprint of Lakshmi Publications Pvt. Ltd.,), New Delhi, 7th Edition, 2009

REFERENCES:

1. Anton, H, Bivens, I and Davis, S, ―Calculus‖, Wiley, 10th Edition, 2016.
2. Jain R.K. and Iyengar S.R.K., ―Advanced Engineering Mathematics‖, Narosa Publications,NewDelhi, 3rd Edition, 2007.
3. Narayanan, S. and Manicavachagom Pillai, T. K., ―Calculus‖ Volume I and II, S. Viswanathan Publishers Pvt. Ltd., Chennai, 2007
4. Srimantha Pal and Bhunia, S.C, ―Engineering Mathematics‖ Oxford University Press, 2015.
5. Weir, M.D and Joel Hass, ―Thomas Calculus‖, 12th Edition, Pearson India, 2016.
6. B.V. Ramana, ― Higher Engineering Mathematics‖, McGraw Hill Education, India.
7. Erwin Kreyzig, Advanced Engineering Mathematics, John Wiley sons,10thedition,2015

21PH1101	ENGINEERING PHYSICS	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To enhance the fundamental knowledge in Physics and its applications relevant to various streams of Engineering and Technology.

UNIT - I MECHANICS 9

System of particles: centre of mass in one and two dimensions – rotational motion of continues system– torque – moment of inertia – conservation of angular momentum – Newton's laws for rotation – equations of rotational motion – work energy theorem for rotational motion. Stress, strain, Hooke's law and elastic moduli – twisting couple per unit twist for solid and hollow cylinders – torsional pendulum theory – bending moment of beam – cantilever and non-uniform bending theory – uniform bending theory – I shape girder.

UNIT - II ELECTROMAGNETIC THEORY 9

Divergence – curl – integral calculus – Gauss divergence theorem – Stoke's theorem – equation of continuity – displacement current – Maxwell's equations – Gauss's laws – Faraday's law –Ampere- Maxwell law – mechanism of electromagnetic wave propagation – Hertz observation – production and detection of electromagnetic wave – electromagnetic waves in free space and matter – energy carried by electromagnetic wave – momentum and radiation pressure – properties of electromagnetic waves.

UNIT - III THERMAL PHYSICS 9

Mode of heat transfer: conduction, convection and radiation – thermal expansion of solids – bimetallic strips – thermal conductivity – heat conduction through compound media (series & parallel) – Forbe's and Lee's disc method; theory and experiment – thermal insulation – applications – heat exchangers – refrigerators, solar water heater.

UNIT - IV OSCILLATORY MOTION, LASERS AND FIBER OPTICS 9

Spring mass system – differential equation-simple harmonic motion-damped oscillation-forced oscillation –analogy with LCR circuits and mechanical oscillation – plane wave equation – equations of wave motion in a rope and velocity of wave. Population of energy levels, Einstein's A and B coefficients derivation – optical amplification (qualitative) – Semiconductor lasers: homojunction and heterojunction –components and principle of fiber optics – numerical aperture and acceptance angle derivation – types of optical fibers (material, refractive index, mode) – losses associated with optical fibers – fiber as pressure and displacement sensors.

UNIT - V　　　　　　　　QUANTUM MECHANICS　　　　　　　　9

Blackbody radiation – Planck's hypothesis and derivation – wave particle duality of light: concepts of photon – Compton effect: theory and experiment – de Broglie hypotheses - concept of wave function and its physical significance – Schrödinger's wave equation – time independent and time dependent equations – particle in a one-dimensional box – tunnelling (qualitative) – scanning tunnelling microscope.

TOTAL: 45 PERIODS

OUTCOMES:

On successful completion of the course student will be able to:

1. Understand the basics of mechanics and especially elastic properties of materials.
2. Gain knowledge on the basic concepts of electromagnetic waves and its properties.
3. Acquire knowledge on the concepts of thermal properties of materials and their applications in heat exchangers.
4. Acquire knowledge on the concepts of oscillations, lasers and fiber optics and their technological applications
5. Get knowledge on advanced physics concepts of quantum theory and its applications in modelling microscopes.

TEXT BOOKS:

1. Gaur, R.K. & Gupta, S.L. ―Engineering Physics‖. Dhanpat Rai Publishers, 2012.
2. Santhosam, K. Russel Raj, K. & Maheswaran, A. ―Engineering Physics, KRAM Publications, 2021
3. Pandey, B.K. & Chaturvedi, S. ―Engineering Physics‖. Cengage Learning India, 2012.

REFERENCES:

1. Halliday, D., Resnick, R. & Walker, J. ―Principles of Physics‖. Wiley, 2015.
2. Tipler, P.A. & Mosca, G. ―Physics for Scientists and Engineers with Modern Physics'. W.H.Freeman, 2007.
3. Arthur Beiser, ―Concepts of Modern Physics‖, Mc Graw Hill, Sixth edition, 1994.
4. Douglas. C., Giancoli. ―Physics: Principles with applications‖, Pearson, 2014.

21CY1101 **ENGINEERING CHEMISTRY**

L	T	P	C
3	0	0	3

OBJECTIVES:

- To know about the importance of Chemistry in Engineering domain
- To understand the Chemistry background of industrial process.
- To apply Chemistry knowledge for Engineering disciplines.

UNIT - I **WATER TECHNOLOGY** **9**

Hardness –Types of hardness – Estimation by EDTA method – Boiler troubles-scale, sludge, priming, foaming, caustic embrittlement, Boiler corrosion – Internal Conditioning – Carbonate, phosphate, Calgon conditioning – External Conditioning – Zeolite and Demineralization process – Desalination, Reverse Osmosis Method – Domestic water treatment.

UNIT - II **HIGH POLYMERS AND NANOCHEMISTRY** **9**

Polymers – Introduction – Classification of Polymers (Origin/Source, Structure, Monomers, Inter- molecular Forces, Synthesis) – Commercial Polymers (Poly Vinyl Chloride (PVC), Polytetrafluoroethylene (PTFE), Nylon-6 6, Nylon-6, Polyethylene Terephthalate (PET) – Conducting Polymers – Polyaniline, Polythiophene, Trans-Polyacetylene – Basic definition – FRP – General Engineering applications of FRP (Civil Engineering Structures).**Nanomaterials** – Introduction, size dependent properties (Surface area, Electrical, Optical, Catalytic and Thermal properties). Synthesis of nanomaterials: Top-down and bottom-up approaches, Chemical Synthesis – Co precipitation, Sol-Gel process and Chemical vapor deposition, Nanoscale materials: Fullerenes, Carbon nanotubes and 8odellin – Characterization, properties and applications. Green synthesis of Nanoparticles.

UNIT - III **INSTRUMENTAL METHODS AND ANALYSIS** **9**

Introduction to Spectroscopy – Types of spectroscopy – Absorption spectra – Emission spectra – Wave length and Wave number- Electromagnetic radiation – Flame Photometry, Atomic Absorption Spectroscopy, UV-Visible spectrum. Introduction – basic principles – Instrumentation& Applications – Infrared Spectroscopy. Chromatographic methods – Types (column, Thin layer, paper, Gas, High Performance Liquid Chromatographic methods) – principle- Separation and quantification of Organic compounds by GC and HPLC. Conductometric Titrations: Instrumentation – Advantages – Applications Potentiometric Titrations: Instrumentation –Advantages-Applications. Measurement of pH: pH metry – Instrumentation – Applications.

UNIT - IV ELECTROCHEMISTRY AND CORROSION 9

Introduction- Electrode potentials-Electrochemical series-Electrochemical cell-redox reaction – measurement and applications – Nernst Equation Derivation- Electrochemical extraction of metals – Electrolytic refining of metals –Nano electrochemical Sensors. Corrosion – causes, factors, types, Chemical and Electrochemical Corrosion (Galvanic, Differential aeration) – Corrosion Control, Electrochemical protection – Sacrificial Anodic method – Impressed Current Cathodic Protection – Corrosion Inhibitors – Biocorrosion. Protective Coatings – Paints, Constituents, Functions- Surface preparation for metallic coatings, Electroplating and Electroless Plating.

UNIT - V ENERGY SOURCES AND STORAGE DEVICES 9

Introduction – Nuclear energy – Nuclear fission – Controlled Nuclear fission – Nuclear Fusion – Differences – Nuclear chain reactions –Nuclear Reactor – Classification of Nuclear Reactor – Light WaterNuclear Reactor, Breeder Reactor – Solar Energy, Conversion, Solar Cells – Wind Energy.Batteries and Fuel Cells – Types of batteries –– Zinc – carbon dry cell –Lead Storage battery– Nickel-Cadmium Battery – Lithium battery – Battery Engineering – Battery hazards – Biological Batteries.Fuel Cells – Hydrogen-Oxygen Fuel Cell – Hondas cell-Supercapacitors (elementary idea).

TOTAL: 45 PERIODS

OUTCOMES:

On successful completion of the course student will be able to:

1. Analyze the water quality parameters in purification and significance in industries, daily life.
2. Explain the types, fabrication and engineering applications of polymers. Develop economically ne methods of synthesizing nanomaterial and their applications.
3. Demonstrate the knowledge of analytical techniques using spectroscopy.
4. Relate the electrode potential for its feasibility inelectrochemical reaction. Illustrate the causes, co corrosion and to achieve its protection.
5. Compare the economic and efficient usage of non-conventional and conventional energy source and various storage devices.

TEXT BOOKS:

1. P.C.Jain and Monika Jain, ―Engineering Chemistry‖, Dhanpat Rai Publishing Company(P) LTD., New Delhi.
2. S. S. Dara and S.S. Umare, ―A Textbook of Engineering Chemistry‖ S. Chand and Company Ltd, New Delhi.
3. V.R.Gowariker, N.V.Viswanathan and JayadevSreedhar, ―Polymer Science‖, New Age International P (Ltd.,), Chennai, 2006
4. P. Kannan and A. Ravikrishnan, ―Engineering Chemistry‖, Sri Krishna Hitech Publishing Company Pvt. Ltd. Chennai, 2009. 16
5. S. Vairam, P. Kalyani and Suba Ramesh, ―Engineering Chemistry‖, Wiley India, 2011

REFERENCES:

1. Friedrich Emich, —Engineering Chemistry‖, Scientific International Pvt. Ltd., New Delhi.
2. PrasanthaRath, —Engineering Chemistry‖, Cengage Learning India Pvt., Ltd., Delhi.
3. P.W. Atkins and de Paula Julio, —Physical Chemistry‖, Oxford University Press, 8th Ed.,(Indian Student Edition) (2009).
4. K. K. Rohatgi-Mukherjee, —Fundamental of Photochemistry‖ New Age International (P) Ltd., New Delhi, 1986.
5. G.A. Ozin and A.C. Arsenault, —Nanochemistry: A Chemical Approach to Nanomaterials‖, RSC Publishing, 2005
6. Nanomaterials, B.Viswanathan, Alpha Science , ISBN: 9781842654941.

PANIMALAR ENGINEERING COLLEGE . CHENNAI.
JAISAKTHI EDUCATIONAL TRUST

21ES1101	PROBLEM SOLVING AND PYTHON PROGRAMMING	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To know the basic programming constructs –data types, decision structures, and control structures in python
- To know how to use libraries for string manipulation
- To Use python data structures – Lists, Tuples and Dictionary
- To know the basic concepts of Object-Oriented Programming
- To learn about 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); Python: Data types, variables, expressions, precedence of operators, 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, and guess an integer number in a range, Towers of Hanoi.

SUGGESTED ACTIVITIES:

- Developing Pseudo codes and flowcharts for real life activities such as railway ticket Booking using IRCTC, admission process to undergraduate course, academic schedules during a semester etc.
- Developing algorithms for basic mathematical expressions using arithmetic Operations
- Installing Python.
- Simple programs on print statements, arithmetic operations.

SUGGESTED EVALUATION METHODS:

- Quizzes on algorithm and basic python.
- Assignments on illustrative problems.
- Quizzes on simple python programs.

UNIT - II CONTROL FLOW, STRINGS & FUNCTIONS 9

Conditionals: Boolean values and operators, conditional (if), alternative (if-else), chained conditional (if-elif-else); Iteration: state, while, for, break, continue, pass; functions, function definition and use;Fruitful functions: return values, parameters and arguments, local and global scope, function composition, recursion; Strings: string slices, immutability, string functions and methods, string module. Illustrative programs: exchange the values of two variables, circulate the values of n variables, distance between two points.

SUGGESTED ACTIVITIES:

- Simple Python program implementation using Operators, Conditionals, Iterative Constructs and Functions.

  Developing simple applications like

-

SUGGESTED EVALUATION METHODS:

- Quizzes on strings.
- Assignments on illustrative problems.
- Quizzes on control flow and functions.

UNIT - III 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; Lists as arrays. Illustrative programs: selection sort, insertion sort, merge sort, histogram.

SUGGESTED ACTIVITIES:

- Implementing python program using lists, tuples, sets for the following scenario:
- Simple sorting techniques
- Student Examination Report
- Billing Scheme during shopping.
- Implementing any application using List and Tuple data structures.

SUGGESTED EVALUATION METHODS:

- Quizzes on list slices.
- Assignments on illustrative problems.
- Quizzes on tuples and dictionaries.

UNIT - IV OBJECT ORIENTED PROGRAMMING WITH PYTHON 9

Classes and OOP: classes, objects, attributes and methods; defining classes; design with classes, data 11odelling; persistent storage of objects – inheritance, polymorphism, operator overloading; abstract classes; exception handling, try block. Illustrative programs: demonstrate the concept of class and objects.

SUGGESTED ACTIVITIES:

- Features of OOP.
- Persistent storage of objects
- Operators and its usage.
- Simple programs using OOP concepts.

SUGGESTED EVALUATION METHODS:

- Quizzes on basic OOP concepts.
- Assignments on illustrative problems.
- Quizzes on inheritance and exception handling.

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.

SUGGESTED ACTIVITIES:

- Developing modules using Python to handle files and apply various operations onfiles
- Usage of exceptions, multiple except blocks – for applications that use delimiters likeage,range of numerals etc.
- Implementing Python program to open a non-existent file using exceptions.

SUGGESTED EVALUATION METHODS:

- Quizzes on basic file operations.
- Assignments on illustrative problems.
- Quizzes on packages and modules

TOTAL: 45 PERIODS

OUTCOMES:

On successful completion of the course student will be able to:

1. Develop algorithmic solutions to simple computational problems.
2. Write and execute simple Python programs.
3. Familiarize with python string handling techniques and user defined functions.
4. Represent compound data using Python lists, tuples and dictionaries.
5. Understand the concept of object oriented programming techniques.
6. Read and write data from/to files in Python Programs.

TEXT BOOKS:

1. Reema Thareja, ``Problem Solving and Programming with Python'', 2nd edition, OXFORD University Press, New Delhi, 2019.(UNIT 1,2,3,4(Exception Handling) and 5).
2. Bill Lubanovic, ―Introducing Python-Modern Computing in Simple Package‖, 2nd edition, O'REILLY, 2019.(UNIT 4(Object Oriented Programming)).

REFERENCES:

1. Steven F. Lott, ―Modern Python Cookbook'', 2nd Edition, O'REILLY, 2020.
2. Ryan Marvin, Mark Ng'ang'a, Amos Omondi, ―Python Fundamentals, Packt Publishing., 2018.
3. Paul J. Deitel, Python for Programmers, Pearson India Education Services Pvt. Ltd,2020.
4. Martin C. Brown, Python: The Complete Reference, McGraw Hill Education; Forthedition, 2018.

21ES1102 **ENGINEERING GRAPHICS**

L	T	P	C
3	0	2	4

OBJECTIVES:

- Drawing free hand sketches of basic geometrical shapes and multiple views of objects.
- Drawing orthographic projections of lines and planes.
- Drawing orthographic projections of solids.
- Drawing development of the surfaces of objects.
- Drawing isometric and perspective views of simple solids.

CONCEPTS AND CONVENTIONS (Not for Examination): 2

Importance of graphics in engineering applications – Use of drafting instruments.BIS conventions and specifications. Size, layout and folding of drawing sheets – Lettering and dimensioning. Introduction to drafting packages like CAD and demonstration of their use in engineering fields.

UNIT - I PLANE CURVES AND FREEHAND SKETCHING 14

Basic Geometrical constructions, Curves used in engineering practices-Conics: Construction of Ellipse, Parabola and Hyperbola by eccentricity method – Construction of cycloid, Involutes of square, pentagon and circle – Drawing of tangents and normal to the above curves. Free Hand sketching-Orthographic projection – Orthographic views of simple three-Dimensional objects.

UNIT - II PROJECTION OF POINTS, LINES AND PLANE SURFACES 15

Orthographic projection- principles-Principle planes-First angle projection-Projection of points. Projection of straight lines (only First angle projections) inclined to both the principal planes- Determination of true lengths eg and true inclinations by rotating line method and traces. Projection of planes (polygonal and circular surfaces) inclined to both the principal planes by rotating object method.

UNIT - III PROJECTION OF SOLIDS 15

Projection of simple solids like prisms, pyramids, cylinder, and cone when the axis is inclined to one principle planes by rotating object method and auxiliary plane method.

UNIT - IV PROJECTION OF SECTIONED SOLIDS AND DEVELOPMENT OF SURFACES 15

Sectioning of solids in simple vertical position when the cutting plane is inclined to the one of the principal planes and perpendicular to the other – obtaining true shape of section. Development of lateral surfaces of simple solids and frustum and truncated solids – Prisms, pyramids cylinders and cones.

UNIT - V ISOMETRIC AND PERSPECTIVE PROJECTIONS 14

Principles of isometric projection – isometric scale –Isometric projections of simple solids and frustum and truncated solids – Prisms, pyramids, cylinders, cones- combination of two solid objects in simple vertical positions.Perspective projection of simple solids-Prisms, pyramids and cylinders by visual ray method.

TOTAL: 75 PERIODS

OUTCOMES:

On successful completion of the course student will be able to:

1. Draw free hand sketching of basic geometrical shapes and multiple views of objects.
2. Draw orthographic projections of lines and planes
3. Draw orthographic projections of solids
4. Draw development of the surfaces of objects
5. Draw isometric and perspective views of simple solids.

TEXT BOOKS:

1. Natarajan, K. V., ―A text book of Engineering Graphics‖, 28th Ed., Dhanalakshmi Publishers, Chennai, 2015.
2. Venugopal, K. and Prabhu Raja, V., ―Engineering Graphics‖, New Age, 2008.

REFERENCES:

1. Bhatt, N.D.,Panchal V M and Pramod R. Ingle, ―Engineering Drawing‖, Charotar Publishing House, 53rd Edition, 2014.
2. Parthasarathy, N. S. and Vela Murali, ―Engineering Drawing‖, Oxford University Press, 2015
3. Agrawal, B. and Agrawal C.M., ―Engineering Drawing‖, Tata McGraw, N.Delhi, 2008.

21ES1111	PROBLEM SOLVING AND PYTHON PROGRAMMING LABORATORY	L	T	P	C
		0	0	4	2

OBJECTIVES:

- To write, test, and debug simple Python programs.
- To implement Python programs with conditions and loops.
- To use functions for structuring Python programs.
- To represent compound data using Python lists, tuples, dictionaries.
- To use OOPS concepts in Python.
- To read and write data from/to files in Python

LIST OF EXPERIMENTS

1. Basic Python Programs.
2. Write programs to demonstrate different number data types in python.
3. Develop python programs to demonstrate various conditional statements.
4. Implement user defined functions using python.
5. Develop python scripts to demonstrate functions.
6. Develop python programs to perform various string operations like slicing, indexing& formatting.
7. Develop python programs to perform operations on List & Tuple.
8. Demonstrate the concept of Dictionary with python programs.
9. Develop python codes to demonstrate concept of class and objects.
10. Demonstrate OOPS concepts like inheritance and polymorphism with python programs.
11. Demonstrate python codes to print try, except and finally block statements.
12. Implement python programs to perform file operations.
13. Implement python programs using modules and packages.
14. Simulate bouncing ball using Pygame.

Mini Project :Suggested Topics(but not limited to)

1. Dice roll simulator.
2. Guess the number game.
3. Sending emails using python.
4. Random password generator.
5. Alarm clock.
6. URL shortener.

TOTAL: 60 PERIODS

OUTCOMES:

On successful completion of the course student will be able to:

1. Write, test, and debug simple Python programs.
2. Implement Python programs with conditions and loops.
3. Use functions for structuring Python programs.
4. Represent compound data using Python lists, tuples, dictionaries.
5. Use OOPS concepts in Python.
6. Read and write data from/to files in Python

21BS1111	**PHYSICS AND CHEMISTRY LABORATORY**	**L**	**T**	**P**	**C**
		0	**0**	**4**	**2**

PHYSICS LABORATORY

OBJECTIVES:

- To introduce different experiments to test basic understanding of physics concepts applied in optics, thermal physics, properties of matter and liquids.

LIST OF EXPERIMENTS
(Minimum of experiments to be conducted: 5 Experiments)

1. Determination of rigidity modulus – Torsion pendulum.
2. Determination of Young's modulus by non-uniform bending method.
3. (a)Determination of wavelength, and particle size using Laser
   (b)Determination of acceptance angle in an optical fiber
4. Determination of thermal conductivity of a bad conductor – Lee's Disc method.
5. Determination of velocity of sound and compressibility of liquid – Ultrasonic interferometer..
6. Determination of wavelength of mercury spectrum – spectrometer grating.
7. Determination of band gap of a semiconductor.
8. Determination of thickness of a thin wire –Air wedge method.

TOTAL: 30 PERIODS

OUTCOMES:

On successful completion of the course student will be able to:

1. Apply principles of elasticity, optics and thermal properties for engineering applications.

TEXT BOOKS:

1. Ruby Das, C.S. Robinson, Rajesh Kumar, Prashant Kumar Sahu, A Textbook of Engineering Physics Practical, University Science Press, Delhi, II Edition 2016.
2. Harnam Singh, Dr.P.S. Hemne, B.Sc., Practical Physics, S.Chand & Company Ltd, New Delhi, Edition 2011.

CHEMISTRY LABORATORY

OBJECTIVES:

- To inculcate experimental skills to test basic understanding of water quality parameters such as, alkalinity, hardness, DO and chloride.
- To induce the students to familiarize with electroanalytical techniques such as,pH metry,potentiometry and conductometry in the determination of aqueous solutions.

LIST OF EXPERIMENTS
(Minimum of experiments to be conducted: 5 Experiments)

1. Estimation of HCl using Na2CO3 as primary standard and Determination of alkalinity in Water sample.
2. Determination of total, temporary & permanent hardness of water by EDTA method.
3. Determination of DO content of water sample by Winkler‟s method.
4. Determination of chloride content of water sample by argentometric method.
5. Estimation of copper content of the given solution by Iodometry.
6. Determination of strength of given hydrochloric acid using pH meter. Determination of strength of acids in a mixture of acids using conductivity meter
7. Estimation of iron content of the given solution using potentiometer.
8. Determination of total, temporary & permanent hardness of water by EDTA method.
9. Estimation of iron content of the water sample using spectrophotometer (1, 10- 26, Phenanthroline / thiocyanate method).
10. Estimation of sodium and potassium present in water using flame photometer.
11. Determination of molecular weight of polyvinyl alcohol using Ostwald viscometer.
12. Pseudo first order kinetics-ester hydrolysis.
13. Corrosion experiment-weight loss method.
14. Phase change in a solid.

TOTAL: 30 PERIODS

OUTCOMES:

On successful completion of the course student will be able to:

1. Analyse the quality of water samples with respect to their acidity, alkalinity, hardness and DO
2. Quantitatively analyse the aqueous solution by electroanalytical techniques

TEXT BOOKS:

1. Laboratory Manual-Department of Chemistry CEGC, Anna University (2014).
2. Vogel’s Textbook of Quantitative Chemical Analysis (8th edition, 2014).

21HS1201	COMMUNICATIVE ENGLISH & LANGUAGE SKILLS LAB II INTEGRATED	L	T	P	C
		3	0	2	4

OBJECTIVES:

- To develop linguistic and strategic competence in workplace context and to enhance language proficiency and thereby the employability of budding engineers and technologists.
- To improve the relevant language skills necessary for professional communication.
- To help learners to develop their listening skills, which will, enable them to listen to lectures and comprehend them by asking questions; seeking clarification and developing their speaking skills and to speak fluently in real contexts
- To Introduce them to life skills, their importance in leading Personal & professional life, key concepts of business communication and Communicative skills.

UNIT - I INTERPERSONAL COMMUNICATION 9

Listening: Listening to Telephone Conversations Speaking: Role Play Exercises Based on Workplace Contexts, Introducing Oneself - PEP Talks. Reading: Reading the Interview of an Achiever and Completing Exercises (Skimming, Scanning and Predicting).Writing: Writing a Short Biography of an Achiever Based on Given Hints, Grammar: Adjective, Sentence pattern. Vocabulary Development: Idioms and Phrases.

UNIT - II TECHNICAL COMMUNICATION 9

Listening: Listening to Talks/Lectures Both General and Technical and Summarizing the Main Points. **Speaking:** Participating in Debates, TED Talks. **Reading:** Reading Technical Essays/ Articles and Answering Comprehension Questions. **Writing:** Summary Writing ,Minutes of the meeting. **Grammar:** Participle Forms, Relative Clauses. **Vocabulary Development:** Compound Words, Abbreviations and Acronyms.

UNIT - III PROCESS DESCRIPTION 9

Listening: Listening to a Process Description and Drawing a Flowchart **Speaking:** Participating in Group Discussions, Giving Instructions, Presentation **Reading:** Reading Instruction Manuals. **Writing:** Process Descriptions – Writing Instructions. **Grammar:** Use of Imperatives, Active and Passive Voice, Sequence Words. **Vocabulary Development:** Misspelt words, Homophones and Homonyms.

UNIT - IV REPORT WRITING 9

Listening: Listening to a Presentation and Completing Gap-Filling Exercises. **Speaking:** Making Formal Presentations. **Reading:** Reading and Interpreting Charts/Tables and Diagrams **Writing:** Interpreting Charts/Tables and Diagrams, Writing a Report **Grammar:** Direct into Indirect Speech, Use of Phrases. **Vocabulary Development:** Reporting Words, Technical Jargon.

UNIT - V　　APPLYING FOR JOBS　　9

Listening: Listening to a Job Interview and Completing Gap-Filling Exercises. **Speaking:** Mock Interview, Telephone Interviews, GD. **Reading:** Reading a Job Interview, SOP, Company Profile and Completing Comprehension Exercises. **Writing:** Job Applications and Resumes. **Grammar:** Conditional Clauses, Modal verbs. **Vocabulary Development:** Technical Vocabulary, Purpose Statement.

TOTAL: 45 PERIODS

OUTCOMES:

On successful completion of the course student will be able to:

1. Read and comprehend technical texts effortlessly.
2. Write thoughts and insights of their own.
3. Recognize the need for life skills, apply them to different situations, the basic communication practices in different types of communication.
4. Gain confidence to communicate effectively in various situations to acquire employability skills.
5. Become an active listener of professional contexts.

TEXT BOOKS:

1. Richards, C. Jack. Interchange, New Delhi: CUP, 2017
2. Board of Editors. English for Engineers and Technologists Volume 2 Orient Black Swan Limited, 2020.

REFERENCES:

1. Kumar, Suresh. E. Engineering English. Orient Blackswan: Hyderabad,2015
2. Raman, Meenakshi and Sharma, Sangeetha- Technical Communication Principles and Practice. Oxford University Press: New Delhi, 2014.
3. Grussendorf, Marion, English for Presentations, Oxford University Press, Oxford: 2007
4. Means, L. Thomas and Elaine Langlois, English & Communication For Colleges. Cengage Learning, USA: 2007
5. Kumar, Suresh. E. Engineering English. Orient Blackswan: Hyderabad,2015 Students can be asked to read Tagore, Chetan Bhagat and for supplementary reading

LANGUAGE SKILLS LAB

List of exercises
Minimum of exercises to be conducted 15

1. Listen to lectures - articulate a complete idea as opposed to producing fragmented utterances – Tedtalks, Science Fiction – My fair lady
2. Listening to a process information – General Competitive Examinations, GRE
3. Listening for specific information: accuracy and fluency – BEC
4. Listening - following, responding to explanations, giving directions and instructions in academic and business contexts – IELTS, TOEFL.
5. Listening to transcripts and answer to the questions.
6. Listening: Read aloud in class and gap - filling.
7. Listening: Recognizing and interpreting non - verbal cues.
8. Listen first, speak second - Having the mindset of a listener.
9. Speaking – sharing personal information - Self introduction
10. Speaking – Small talk or Pep Talk
11. Speaking – Group discussion, Visume –visual presentation of resume
12. Speaking – Presentation – Formal and Informal
13. Speaking – Mock interview
14. Speaking – FAQ‟S on Job interview
15. Speaking : Simulations - (show and tell)
16. Speaking: News brief - Ripped from today's headlines.
17. Speaking: Who's telling the truth?
18. Speaking: JAM
19. Speaking: Debate
20. Speaking: Story Narration

TOTAL: 30 PERIODS

TEXT BOOKS:

1. Brooks, Margret. Skills for Success. Listening and Speaking. Level 4 Oxford University Press,
2. Richards, C. Jack. & David Bholke. Speak Now Level 3. Oxford University Press, Oxford: 2010

REFERENCES:

1. Bhatnagar, Nitin and Mamta Bhatnagar. Communicative English for Engineers and Professionals. Pearson: New Delhi, 2010.
2. Ladousse, Gillian Porter. Role Play. Oxford University Press: Oxford, 2014.
3. Richards C. Jack. Person to Person (Starter). Oxford University Press: Oxford, 2006.
4. Vargo, Mari. Speak Now Level 4. Oxford University Press: Oxford, 2013.
5. E. Suresh Kumar et al. Communication for Professional Success. Orient Blackswan: Hyderabad, 2015.
6. Raman, Meenakshi and Sangeeta Sharma. Professional Communication. Oxford University Press: Oxford, 2014.

21MA1201 ENGINEERING MATHEMATICS II

L	T	P	C
3	1	0	4

OBJECTIVES: To impart Knowledge on the following topics:

- Vectors are very helpful for the engineering students as it will give the insight into how to trace along the different types of curves.
- To develop an understanding of the standard technique of a complex variable theory in particular of analytic functions and its mapping property.
- Complex integration is an intuitive extension of real integration. Complex variable techniques have been used in a wide variety of areas of engineering. This has been particularly true in areas such as electromagnetic field theory, fluid dynamics, aerodynamics and elasticity.
- To solve the linear differential equations with constant coefficients.
- Laplace Transform is very useful for the electronics students, this gives the basics of how to solve the problems in electronic circuits.

UNIT - I VECTOR CALCULUS 12

Gradient, divergence and curl – Directional derivative – Irrotational and solenoidal vector fields – Vector integration – Green's theorem in a plane - Gauss divergence theorem and Stoke's theorem (excluding proofs) – Simple applications involving cubes, rectangular parallelopiped, sphere and cylinder.

UNIT - II ANALYTIC FUNCTIONS 12

Functions of a complex variable – Analytic functions - Cauchy-Riemann equations - Necessary and sufficient conditions– Harmonic and orthogonal properties of analytic function – Harmonic conjugate, Construction of analytic functions by Milne Thomson method– Conformal mapping: w =z+c, cz, 1/z, z2 and bilinear transformation.

UNIT - III COMPLEX INTEGRATIONS 12

Line integrals- Cauchy's integral theorem-Cauchy's integral formula - Singularities - Residues– Cauchy's residue theorem - Taylor's and Laurent's series expansions – Application of residue theorem for evaluation of real definite integrals – Use of circular contour and semi- circular contour (excluding poles on the real axis).

UNIT - IV ORDINARY DIFFERENTIAL EQUATIONS 12

Higher order linear differential equations with constant coefficients -Method of variation of parameters – Homogenous equation of Euler's and Legendre's type – System of simultaneous linear differential equations with constant coefficients - Method of undetermined coefficients.

UNIT - V LAPLACE TRANSFORMS 12

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

TOTAL: 60 PERIODS

OUTCOMES:

On successful completion of the course student will be able to:

1. Identify the Gradient, divergence and curl of a vector point function and related identities. Evaluation of line, surface and volume integrals using Gauss, Stokes and Green‟s theorems and their verification.
2. Understand analytic functions, harmonic functions, conformal mapping.
3. Determine the types of singularities, residues, contour integration.
4. Apply various techniques in solving differential equations.
5. solve differential equations using laplace transforms.
6. Identify the Gradient, divergence and curl of a vector point function and related identities. Evaluation of line, surface and volume integrals using Gauss, Stokes and Green‟s theorems and their verification.
7. Understanding analytic functions, harmonic functions, conformal mapping.

TEXT BOOKS:

1. Grewel. B.S, “Higher Engineering Mathematics”, 43rd Edition, Khanna Publications, Delhi, 2014.
2. B.V. Ramana, “ Higher Engineering Mathematics”, McGraw Hill Education, India.
3. Bali N., Goyal M. and Walkins C., “Advanced Engineering Mathematics”, Firewall Media (An imprint of Lakshmi Publications Pvt. Ltd.,), New Delhi, 7th Edition, 2009.

REFERENCES:

1. Kreyszig Erwin, Advanced Engineering Mathematics”, John wiley and Sons, 10th Edition, New Delhi.
2. Jain R.K. and Iyengar S.R.K., “Advanced Engineering Mathematics”, Narosa Publications, New Delhi, 3rd Edition, 2007.
3. O‟Neil, P.V. “Advanced Engineering Mathematics”, Cengage Learning India Pvt. Ltd, New Delhi, 2007.
4. Sastry, S.S, “Engineering Mathematics”, Vol.I & II, PHI Learnig Pvt. Ltd, 4th Edition, New Delhi, 2014.
5. Wyile, R.C. and Barrett, L.C., “Advanced Engineering Mathematics “Tata McGraw Hill Education Pvt Ltd, 6th Edition, New Delhi, 2012.

21PH1201 PHYSICS FOR ELECTRONICS ENGINEERING

L	T	P	C
3	0	0	3

OBJECTIVES:

- To understand the essential principles of Physics of semiconductor device and Electron transport properties. Become proficient in magnetic, dielectric and optical properties of materials and Nano devices.

UNIT - I ELECTRICAL PROPERTIES OF MATERIALS 9

Classical free electron theory – postulates – expression for electrical conductivity – expression for thermal conductivity – Wiedemann–Franz law – success and failures – quantum free electron theory – postulates – Fermi-Dirac statistics – density of energy states – band theory of solids – postulates – Bloch theorem – energy bands from electron wave reflections – metals, semiconductors and insulators – electron effective mass (qualitative) – concept of hole.

UNIT - II SEMICONDUCTOR PHYSICS 9

Crystal structure of Si – Czochralski method - Intrinsic Semiconductors – energy band diagram – carrier concentration in intrinsic semiconductors - extrinsic semiconductors – carrier concentration in N-type & P-type semiconductors – variation of carrier concentration with temperature - variation of Fermi level with temperature and impurity concentration - drift and diffusion transport of carriers – Einstein‟s relation – Hall effect and applications – Zener and avalanche breakdown in p-n junctions – Ohmic contacts –– Schottky diode – degenerate and non-degenerate semiconductors – tunnel diode

UNIT - III MAGNETIC AND SUPERCONDUCTING PROPERTIES OF MATERIALS 9

Magnetism in materials – magnetic field and induction – magnetic permeability and susceptibility – classifications of magnetic materials – ferromagnetic domain theory – M versus H behaviour - hard and soft magnetic materials - examples and uses magnetic principle in computer data storage magnetic hard disc. Superconductivity – zero resistance and Meissner effect – critical field and critical current density – BCS theory (qualitative) – Type I and Type II superconductors – maglev train – Josephson junction.

UNIT - IV DIELECTRIC AND OPTICAL PROPERTIES OF MATERIALS 9

Relative permittivity – polarization processes – internal field and Clausius-Mosotti relation – dielectric loss – dielectric breakdown (definition only) – high-k dielectrics.Classification of optical materials – carrier generation and recombination processes – Absorption and emission of light in metals, insulators and semiconductors (concepts only) – photocurrent in a P-N diode – photo detectors – pin diode – solar cell – LED.

UNIT - V NANODEVICES 9

Introduction – electron density in bulk material – size dependence of Fermi energy – quantum confinement – quantum structures – density of states in quantum well, quantum wire and quantum dot structures – excitons – quantum confined Stark effect - resonant tunneling – quantum interference effects – ballistic transport quantum resistance and conductance Coulomb blockade effects – single electron phenomena and single electron transistor – carbon nanotubes: properties and applications.

TOTAL: 45 PERIODS

OUTCOMES:

On successful completion of the course student will be able to:

1. gain knowledge on classical and quantum electron theories, and energy band structures.
2. acquire knowledge on basics of semiconductor crystalline materials and its applications in various devices.
3. get knowledge on magnetic and dielectric properties of materials.
4. have the necessary understanding on the functioning of optical materials for optoelectronics.
5. understand the basics of quantum structures and their applications in spintronics and carbon electronics.

TEXT BOOKS:

1. Kasap, S.O., Principles of Electronic Materials and Devices, 4th Edition, McGraw-Hill Education, 2018.
2. Donald A. Neamen, Semiconductor Physics and Devices: Basic Principles, 4th edition, McGrawHill, 2012.
3. K. Santhosam, K. Russel Raj and A, Maheswaran, “Electrical Engineering Materials”, Chess Educational Publishers, 2021.

REFERENCES:

1. Hanson, G.W. —Fundamentals of Nanoelectronics. Pearson Education, 2009.
2. Rolf E. Hummel, “Electronic Properties of Materials”, Springer, 2011.
3. Charles Kittel, “Introduction to Solid State Physics”, Wiley, 2012.
4. A.J.Dekker, “Solid State Physics”, Prentice – Hall, Inc., 1969.
5. Rogers, B., Adams, J. & Pennathur, S. “Nanotechnology: Understanding Small Systems”, CRC Press, 2014.

21BE1201 BASICS OF ELECTRICAL AND MEASUREMENT ENGINEERING

L	T	P	C
3	0	0	3

OBJECTIVES: To impart Knowledge on the following topics:

- To understand the basic concepts of electric energy utilization.
- To understand the operation of AC and DC machines.
- To understand the operation and applications of special electrical components
- To understand the working principle of electrical and mechanical measurements.

UNIT - I UTILIZATION OF ENERGY 9

Principle of wind and solar energy systems. Electrical wiring - Domestic and Industrial Illumination - Fluorescent and LED lamps. Protection- Need for Earthing, fuses and circuit breakers -Energy tariff.

UNIT - II ELECTRICAL MACHINES 9

Principle of operation DC machines- Characteristics of DC motor - Single phase transformers, three phase and single-phase induction motors – Speed Control.

UNIT - III SPECIAL ELECTRICAL COMPONENTS 9

Permanent magnet synchronous motor – Brushless DC Motor - Stepper motor – Switched reluctance motor, Electromechanical Relays.

UNIT - IV ELECTRICAL MEASUREMENTS 9

Classification of instruments – moving coil and moving iron meters -- Induction type, dynamometer type wattmeter – Energy meter – Instrument transformers (CT & PT) – Wheatstone bridge for measurement of unknown resistance, Maxwell bridge for unknown inductance and Schering Bridge for unknown capacitance –Instrumentation Amplifiers.

UNIT - V MECHANICAL MEASUREMENTS 9

Classification of transducers, strain, RTD, thermocouples, Piezo-electric transducer, LVDT, Turbine and electromagnetic flow meters, level transducers ultrasonic and fiber optic transducers, type of sensors, elastic sensors, viscosity, moisture and pH sensors, Digital transducers, vibrating wire instruments like load cells, stress meter, etc.

TOTAL: 45 PERIODS

OUTCOMES:

On successful completion of the course student will be able to:

1. Understand the basics of utilization of energy
2. Understand the operation of electrical machines
3. Develop and understand the special electrical components
4. Develop the capacity in measuring electrical parameters
5. Develop the capacity in measuring mechanical parameters

TEXT BOOKS:

1. Del Toro, "Electrical Engineering Fundamentals‟ Pearson Education, New Delhi, 2007
2. Alan S. Moris, Principles of Measurements and Instruments, Prentice-Hall of India Pvt. Ltd., New Delhi, 1999.
3. SmarjitGhosh, "Fundamentals of Electrical and Electronics Engineering", 2nd Edition 2007
4. Rajendra Prasad,"Fundamentals of Electrical engineering‟ Prentice Hall of India, 2006

REFERENCES:

1. Sanjeev Sharma, "Basics of Electrical Engineering‟ S.K International Publishers, New Delhi 2007.
2. John Bird, Electrical Circuits theory and Technology, Elsevier, First India Edition, 2006.
3. Doebelin, E.O., Measurements Systems – Application and Design‟, McGraw Hill Publishing Co, 1990.

21EC1201 **CIRCUIT ANALYSIS**

L	T	P	C
2	1	0	3

OBJECTIVES:

- To introduce electric circuits and its analysis
- To develop the ability to solve the DC circuits.
- To impart knowledge on solving circuit equations using network theorems
- To study the transient and steady state response of the circuits subjected to step and sinusoidal excitations
- To educate on obtaining the transient response and resonance of circuits.
- To introduce coupled circuits and topology

UNIT - I DC CIRCUIT ANALYSIS 9+3

Basic Components of electric Circuits, Charge, current, Voltage and Power, Voltage and Current Sources, Ohms Law, Kirchoff„s Current Law, Kirchoff„s voltage law, The single Node – Pair Circuit, series and Parallel Connected Independent Sources, Resistors in Series and Parallel, voltage and current division, Nodal analysis, Mesh analysis.

UNIT - II NETWORK THEOREM AND DUALITY 9+3

Useful Circuit Analysis techniques - Linearity and superposition, Thevenin and Norton Equivalent Circuits, Maximum Power Transfer, Delta-Wye Conversion. Duals, Dual circuits.

UNIT - III SINUSOIDAL STEADY STATE ANALYSIS 9+3

Sinusoidal Steady – State analysis , Characteristics of Sinusoids, The Complex Forcing Function, The Phasor, Phasor relationship for R, L, and C, impedance and Admittance, Nodal and Mesh Analysis, Phasor Diagrams, AC Circuit Power Analysis, Instantaneous Power, Average Power, apparent Power and Power Factor, Complex Power.

UNIT - IV TRANSIENTS AND RESONANCE IN RLC CIRCUITS 9+3

Basic RL and RC Circuits, The Source- Free RL Circuit, The Source-Free RC Circuit, The Unit-Step Function, Driven RL Circuits, Driven RC Circuits, RLC Circuits, Frequency Response, Parallel Resonance, Series Resonance, Quality Factor.

UNIT - V COUPLED CIRCUITS AND TOPOLOGY 9+3

Magnetically Coupled Circuits, mutual Inductance, the Linear Transformer, the Ideal Transformer, An introduction to Network Topology, Trees and General Nodal analysis, Links and Loop analysis.

TOTAL: 60 PERIODS

OUTCOMES:

On successful completion of the course student will be able to:

1. Comprehend the basics of circuit analysis
2. Solve electrical circuits using theorems
3. Analyse the sinusoidal steady state response
4. Analyse the transient and resonance in RLC circuits
5. Understand coupled circuits and topology

TEXT BOOKS:

1. William H. Hayt Jr, Jack E. Kemmerly and Steven M. Durbin, “Engineering Circuits Analysis”, McGraw Hill publishers, edition, New Delhi, 2013.
2. Charles K. Alexander, Mathew N.O. Sadiku, “Fundamentals of Electric Circuits”, Second Edition, McGraw Hill, 2013. 36
3. Allan H. Robbins, Wilhelm C. Miller, “Circuit Analysis Theory and Practice”, Cengage Learning India, 2013
4. Sudhakar A and Shyam Mohan SP, “Circuits and Network Analysis and Synthesis”, McGraw Hill, 2015.

REFERENCES:

1. Chakrabarti A, “Circuits Theory (Analysis and synthesis), Dhanpath Rai & Sons, New Delhi, 1999.
2. Jegatheesan, R., “Analysis of Electric Circuits,” McGraw Hill, 2015.
3. Joseph A. Edminister, Mahmood Nahri, “Electric circuits”, Schaum‟s series, McGrawHill, New Delhi, 2010.
4. M E Van Valkenburg, “Network Analysis”,Prentice-Hall of India Pvt Ltd, New Delhi, 2015.
5. Mahadevan, K., Chitra, C., “Electric Circuits Analysis,” Prentice-Hall of India Pvt Ltd., New Delhi, 2015.
6. Richard C. Dorf and James A. Svoboda, “Introduction to Electric Circuits”, 7th Edition, John Wiley & Sons, Inc. 2015.

21EC1202	ELECTRONIC DEVICES	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To acquaint the students with the construction, theory and operation of the basic electronic devices such as PN junction diode, Bipolar and Field effect Transistors, Power control devices, LCD and other Opto-electronic devices.

UNIT - I SEMICONDUCTOR DIODE 9

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

UNIT - II BIPOLAR JUNCTION TRANSISTORS 9

NPN -PNP - Operations-Early effect-Current equations – Input and Output characteristics of CE, CB, CC - h-parameter model, Ebers Moll 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, FINFET, PINFET, CNTFET, DUAL GATE MOSFET, Zener diode-Varactor diode - Gallium Arsenide device, LDR.

UNIT - V POWER DEVICES AND DISPLAY DEVICES 9

UJT, SCR, Diac, Triac, Power BJT- Power MOSFET- DMOS-VMOS, LCD, Photo transistor, Opto Coupler, CCD.

TOTAL: 45 PERIODS

OUTCOMES:

On successful completion of the course student will be able to:

1. Explain the V − I characteristics of semiconductor diode.
2. Classify the configurations of BJT and understand its equivalence circuits.
3. Understand the drain – transfer characteristics of FET.
4. Illustrate the characteristics of special semiconductor devices.
5. Outline the concepts of power devices.
6. Outline the concepts of display devices.

TEXT BOOKS:

1. Donald A Neaman,Semiconductor Physics and Devices‖, Fourth Edition, Tata Mc GrawHill Inc. 2012.

2. Salivahanan. S, Suresh Kumar. N, Vallavaraj.A, Electronic Devices and circuits, Third Edition, Tata McGraw- Hill, 2008.

REFERENCES:

1. Robert Boylestad and Louis Nashelsky, Electron Devices and Circuit Theory Pearson Prentice Hall, 10th edition, July 2008.
2. R.S.Sedha, — A Text Book of Applied Electronics Chand Publications, 2006.
3. Yang, —Fundamentals of Semiconductor devices, McGraw Hill International Edition.

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21EC1211	CIRCUITS AND DEVICES LABORATORY	L	T	P	C
		0	0	4	2

OBJECTIVES:

- To learn the characteristics of basic electronic devices
- To learn the characteristics of transistors and SCR
- To design RL, RC and RLC circuits
- To understand Thevinin & Norton theorem KVL & KCL, and Super Position Theorems.

LIST OF EXPERIMENTS

Minimum of experiments to be conducted: 12

1. Characteristics of PN Junction Diode
2. Zener diode Characteristics & Regulator using Zener diode
3. Common Emitter input-output Characteristics
4. Common Base input-output Characteristics
5. FET Characteristics
6. SCR Characteristics
7. Verifications of Thevenin & Norton theorem
8. Verifications of KVL & KCL
9. Verifications of Super Position Theorem
10. verifications of maximum power transfer & reciprocity theorem
11. Determination of Resonance Frequency of Series & Parallel RLC Circuits
12. Transient analysis of RL and RC circuits

TOTAL: 60 PERIODS

OUTCOMES:

On successful completion of the course student will be able to:

1. Understand the characteristics of Electronic devices
2. Understand the behaviour of the transistors and SCR
3. Design RL, RC and RLC circuits
4. Verify Thevenin & Norton theorem, KVL & KCL, and Super Position Theorems

TEXT BOOKS:

1. Donald A Neaman, “Semiconductor Physics and Devices”, Tata McGrawHill Inc. 2012.
2. Robert Boylestad and Louis Nashelsky, -Electron Devices and Circuit Theory Pearson prentice Hall,10th edition, July 2008.
3. William H. HAyt, Jr. Jack E. Kemmerly and steven M. Durbin, “Engineering Circuit Analysis”, McGraw Hill Science Engineering, Eighth Edition, 11th Reprint 2016.

21ES1211 ENGINEERING PRACTICES LABORATORY

L	T	P	C
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 & ELECTRICAL

I CIVIL ENGINEERING PRACTICES 15

Plumbing Work:

a. Connecting various basic pipe fittings like valves, taps, coupling, unions, reducers, elbows and
b. Other components which are commonly used in household.
c. Preparing plumbing line sketches.
d. Laying pipe connection to the suction side of a pump
e. Laying pipe connection to the delivery side of a pump.
f. Connecting pipes of different materials: Metal, plastic and flexible pipes used in household

Wood Work:

a. Introduction to Tools and Equipments
b. Simple Planning and sawing practice
c. Making Half Lap, Dovetail, Mortise and Tenon joints

Wood Work Study:

a. Studying joints in door panels and wooden furniture
b. Studying common industrial trusses using models.

II ELECTRICAL ENGINEERING PRACTICES: 15

a. Residential house wiring using switches, fuse, indicator, lamp and energy meter.
b. Fluorescent lamp wiring.
c. Stair case wiring
d. Measurement of electrical quantities – voltage, current, power & power factor in RLC circuit.
e. Measurement of energy using single phase energy meter.
f. Measurement of resistance to earth of electrical equipment.

GROUP- B
MECHANICAL AND ELECTRONICS

I MECHANICAL ENGINEERING PRACTICES **15**

Basic Machining Work

a. Introduction to Lathe machine, Tools and Equipments
b. Simple Turning and facing
c. Step turning
d. Simple Drilling and Tapping of flat plate

Welding Work:

a. Introduction to Arc welding
b. Welding of Butt Joints

Assembly Work:

a. Assembling a centrifugal pump.
b. Assembling an air conditioner.

Sheet Metal Work:

a. Demonstrating basic sheet metal operations

Foundry Work:

a. Demonstrating basic foundry operations.

II ELECTRONICS ENGINEERING PRACTICES: **15**

a. Study of Electronic components and equipments – Resistor, color coding
b. Measurement of AC signal parameter (peak-peak, rms period, frequency) using CRO.
c. Study of logic gates AND, OR, EX-OR and NOT.
d. Generation of Clock Signal.
e. Soldering practice – Components Devices and Circuits – Using general purpose PCB.
f. Measurement of ripple factor of HWR and FWR.

TOTAL: 60 PERIODS

OUTCOMES:

On successful completion of the course student will be able to:

1. Connect various basic pipe fittings and other components which are commonly used in household and to know about the various tools, Equipment and making different joints
2. Know the Lathe machine, Tools and Equipment with machining experiments and have knowledge about Arc welding, Tools and Equipments with making different joints
3. Carry out basic home electrical works and appliances and measure the electrical quantities
4. Analyze the basic electronic circuits and to solder simple components on PCB and test simple electronic circuits

TEXT BOOKS:

1. Jeyapoovan T., Saravanapandian M. & Pranitha S., “Engineering Practices Lab Manual”, Vikas Publishing House Pvt.Ltd, (2006)
2. Kannaiah P. & Narayana K.L., “Manual on Workshop Practice”, Scitech Publications, (1999).
3. Jeyachandran K., Natarajan S. & Balasubramanian S., “A Primer on Engineering Practices Laboratory”, Anuradha Publications, (2007).
4. S. Gowri & T. Jeyapoovan, “Enginering Practices Lab Manual 5/E”, S. Chand Publishing, 2019

REFERENCES:

1. K.C. John, "Mechanical workshop practice", Second edition, PHI learning Pvt Ltd, New Delhi
2. Bawa H.S., “Workshop Practice”, Tata McGraw – Hill Publishing Company Limited, (2007)

III SEMESTER

21MA1302	LINEAR ALGEBRA AND NUMERICAL ANALYSIS	L	T	P	C
		4	0	0	4

OBJECTIVES:

- To understand the concepts of vector space and Sub space.
- To understand the concepts of linear Transformations and diagonalization.
- To apply the concept of inner product spaces in orthogonalization.
- To introduce the basic concepts of solving algebraic and transcendental equations.
- To introduce the numerical techniques of interpolation in various intervals in real life situations.

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 SOLUTION OF EQUATIONS AND EIGENVALUE PROBLEMS 12

Solution of algebraic and transcendental equations : Fixed point theorem (without proof)– Newton Raphson method - Solution of linear system of equations : Gauss elimination method – Gauss Jordan method - Iterative methods of Gauss Jacobi and Gauss Seidel – Eigenvalues of a matrix by Power method.

UNIT - V INTERPOLATION AND APPROXIMATION 12

Interpolation with unequal intervals: Lagrange's interpolation – Newton’s divided difference interpolation - Interpolation with equal intervals: Newton’s forward and backward difference formulae.

TOTAL: 60 PERIODS

OUTCOMES:

On successful completion of the course student will be able to:

1. Understand the concepts of vector space.
2. Understand the concepts of linear transformations.
3. Understand the concepts of diagonalization
4. Apply the concept of inner product spaces in orthogonalization
5. Understand the basic concepts and techniques of solving algebraic and transcendental equations.
6. Apply the numerical techniques of interpolation and error approximations in various intervals in real life situations.

TEXT BOOKS:

1. Friedberg, A.H., Insel, A.J. and Spence, L., ―Linear Algebra‖, Prentice Hall of India, New Delhi, 2004.
2. Grewal, B.S., and Grewal, J.S., "Numerical Methods in Engineering and Science", Khanna Publishers, 10th Edition, New Delhi, 2015.
3. Kumaresan, S., ―Linear Algebra – A Geometric Approach, Prentice – Hall of India, New Delhi, Reprint, 2010.
4. Kandasamy, P., Thilagavathy, K.,andGunavathy,S., ‘Numerical Methods’, Chand and Co.,2013.

REFERENCES:

1. Kolman, B. Hill, D.R., ―Introductory Linear Algebra‖, Pearson Education, New Delhi, First Reprint, 2009.
2. Lay, D.C., ―Linear Algebra and its Applications‖, 5th Edition, Pearson Education, 2015.
3. Burden, R.L. and Faires, J.D, "Numerical Analysis", 9th Edition, Cengage Learning, 2016.
4. Sundarapandian, V. ―Numerical Linear Algebra‖, Prentice Hall of India, New Delhi, 2008.

21EC1301 ELECTROMAGNETIC FIELDS

L	T	P	C
3	0	0	3

OBJECTIVES:

- To impart knowledge on the basics of static electric field and the associated laws
- To impart knowledge on the basics of static magnetic field and the associated laws
- To give insight into coupling between electric and magnetic fields through Faraday's law, displacement current and Maxwell's equations
- To gain the behavior of the propagation of EM waves

UNIT - I INTRODUCTION 9

Electromagnetic model, Units and constants, Review of vector algebra, Rectangular, cylindrical and spherical coordinate systems, Line, surface and volume integrals, Gradient of a scalar field, Divergence of a vector field, Divergence theorem, Curl of a vector field, Stoke's theorem, Null identities, Helmholtz's theorem , Verify theorems for different path, surface and volume.

UNIT - II ELECTROSTATICS 9

Electric field, Coulomb's law, Gauss's law and applications, Electric potential, Conductors in static electric field, Dielectrics in static electric field, Electric flux density and dielectric constant, Boundary conditions, Electrostatics boundary value problems Capacitance, Parallel, cylindrical and spherical capacitors, Electrostatic energy, Poisson's and Laplace's equations, Uniqueness of electrostatic solutions, Current density and Ohm's law, Electromotive force and Kirchhoff's voltage law, Equation of continuity and Kirchhoff's current law.

UNIT - III MAGNETOSTATICS 9

Lorentz force equation, Law of no magnetic monopoles, Ampere's law, Vector magnetic potential, Biot-Savart law and applications, Magnetic field intensity and idea of relative permeability, Calculation of magnetic field intensity for various current distributions Magnetic circuits, Behaviour of magnetic materials, Boundary conditions, Inductance and inductors, Magnetic energy, Magnetic forces and torques.

UNIT - IV TIME-VARYING FIELDS AND MAXWELL's EQUATIONS 9

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 9

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.

TOTAL: 45 PERIODS

OUTCOMES:

On successful completion of the course student will be able to:

1. Relate the fundamentals of vector, coordinate system to electromagnetic concepts.
2. Analyze the characteristics of Electrostatic field.
3. Interpret the concepts of Electric field in material space and solve the boundary conditions.
4. Explain the concepts and characteristics of Magneto Static field in material space and solve boundary conditions.
5. Determine the significance of time varying fields.
6. Evaluate the electromagnetic wave propagation in lossy and lossless medium.

TEXT BOOKS:

1. Edward C. Jordan & Keith G. Balmain,Electromagnetic waves and Radiating Systems, Second Edition, Prentice-Hall Electrical Engineering Series.
2. M.N.O.Sadiku and S.V. Kulkarni, Principles of electromagnetics, 6th ed., Oxford(Asian Edition), 2015

REFERENCES:

1. D.K. Cheng, Field and wave electromagnetics, 2nd ed., Pearson (India), 1989
2. W.H. Hayt and J.A. Buck, Engineering electromagnetics, 7th ed., McGraw-Hill (India), 2006
3. B.M. Notaros, Electromagnetics, Pearson: New Jersey, 2011

21EC1302 **ELECTRONIC CIRCUITS**

L	T	P	C
3	0	0	3

OBJECTIVES:

- To understand the methods of biasing transistors.
- To design and analyse BJT, FET amplifier circuits.
- To analyse the frequency response of amplifiers.
- To study about feedback amplifiers and oscillators principles.
- To analyse tuned amplifiers.
- To acquaint the students about Power Amplifiers.

UNIT - I **BIASING OF DISCRETE BJT, JFET** **9**

Need for Biasing-DC Load line-Operating point- Methods of BJT Biasing -Bias compensation- Thermal stability - Biasing of JFET

UNIT - II **BJT & FET AMPLIFIERS** **9**

Small signal Analysis of Common Emitter, Common Collector and Common Base amplifiers - Introduction to Multi stage Amplifiers - Darlington Amplifier - Small signal Analysis of FET amplifiers.

UNIT - III **FREQUENCY ANALYSIS OF AMPLIFIERS** **9**

Low and High frequency Response of BJT Amplifiers-Short circuit current gain- cut off frequency- Unity Gain Bandwidth - Frequency Response of CS amplifier - Bandwidth of Multi stage amplifiers.

UNIT - IV **FEEDBACK AMPLIFIERS AND OSCILLATORS** **9**

Feedback topologies-Voltage Series, Current Series, Voltage Shunt, Current Shunt- General characteristics of negative feedback amplifiers-Effect of negative feedback on Input and output Resistance- Oscillators- Barkhausen Criterion- Analysis of RC phase shift, Wien-bridge oscillators- Hartley, Colpitts oscillators-Crystal oscillators

UNIT - V **TUNED AMPLIFIERS AND POWER AMPLIFIERS** **9**

Introduction-Analysis of single tuned amplifier - effect of cascading single tuned tuned amplifiers on bandwidth -Stagger tuned amplifier-Hazeltine neutralization – Power amplifiers-Class A, Class B.

TOTAL: 45 PERIODS

OUTCOMES:

On successful completion of the course student will be able to:

1. Choose appropriate Biasing circuits of BJT,JFET
2. Design and analysis of BJT, FET amplifiers.
3. Study about frequency response of amplifiers.
4. Analyze the Feedback Amplifier and Oscillator circuits.
5. Study about Tuned amplifiers.
6. Summarize the operation of Power Amplifiers.

TEXT BOOKS:

1. S Salivahanan and N Suresh Kumar, Electronic Devices and Circuits, 4th Edition, Mc Graw Hill Education (India) Private Ltd., 2017.
2. Jacob Millman, Christos C Halkias, Satyabrata JIT ,Electronic Devices and circuits , 4th Edition, Mc Graw Hill Education (India) Private Ltd., 2015.

REFERENCES:

1. Robert L. Boylestad and Louis Nasheresky, Electronic Devices and Circuit Theory, 11th Edition, Pearson Education
2. David A. Bell,Electronic Devices and Circuits, Fifth Edition, Oxford University Press,2008.
3. Floyd, Electronic Devices, Ninth Edition, Pearson Education, 2012.
4. Donald .A. Neamen, Electronic Circuit Analysis and Design, 3rd Edition, Tata McGraw Hill, 2010.

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21EC1303 **DIGITAL ELECTRONICS**

L	T	P	C
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 sequential circuits.
- To introduce the analysis and design procedures for asynchronous sequential circuits.
- To explain the various semiconductor memories and related technology.
- To introduce the electronic circuits involved in the making of logic gates

UNIT - I **DIGITAL FUNDAMENTALS** **9**

Number Systems – Decimal, Binary, Octal, Hexadecimal, 1's and 2's complements, Codes – Binary, BCD, Excess 3, Gray, Alphanumeric codes, Boolean theorems, Logic gates, Universal gates, Sum of products and product of sums, Minterms and Maxterms, Karnaugh map Minimization and Quine- McCluskey method of minimization.

UNIT - II **COMBINATIONAL CIRCUIT DESIGN** **9**

Design of Half and Full Adders, Half and Full Subtractors, Binary Parallel Adder – Carry look ahead Adder, BCD Adder, Multiplexer, Demultiplexer, Magnitude Comparator, Decoder, Encoder, Priority Encoder.

UNIT - III **SYNCHRONOUS SEQUENTIAL CIRCUITS** **9**

Flip flops – SR, JK, T, D, Master/Slave FF – operation and excitation tables, Triggering of FF, Analysis and design of clocked sequential circuits – Design - Moore/Mealy models, state minimization, state assignment, circuit implementation – Design of Counters- Ripple Counters, Ring Counters, Shift registers, Universal Shift Register.

UNIT - IV **ASYNCHRONOUS SEQUENTIAL CIRCUITS** **9**

Stable and Unstable states, output specifications, cycles and races, state reduction, race free assignments, Hazards, Essential Hazards, Pulse mode sequential circuits, Design of Hazard free circuits.

UNIT - V **PROGRAMMABLE LOGIC DEVICES AND DIGITAL INTEGRATED CIRCUITS** **9**

Programmable Logic Devices: Programmable Logic Array (PLA) - Programmable Array Logic (PAL)Field Programmable Gate Arrays (FPGA) - Implementation of combinational logic circuits using PLA, PAL.
Digital integrated circuits: Logic levels, propagation delay, power dissipation, fan-out and fan-in, noise margin, logic families and their characteristics-TTL, CMOS.

TOTAL: 45 PERIODS

OUTCOMES:

On successful completion of the course student will be able to:

1. Use digital concepts and its applications in Digital systems.
2. Design various combinational digital circuits using logic gates.
3. Design and Analyze synchronous sequential circuits.
4. Design and Analyze asynchronous sequential circuits.
5. Use the semiconductor memories and related technology.
6. Use electronic circuits involved in the design of logic gates.

TEXT BOOKS:

1. M. Morris Mano and Michael D. Ciletti, "Digital Design", 5th Edition, Pearson, 2014.
2. Ronald J. Tocci , Neal S. Widmer and Gregory L. Moss,"Digital Systems: Principles and Applications" , Tenth Edition, Pearson Education, 2009.

REFERENCES:

1. Charles H.Roth. "Fundamentals of Logic Design", 6th Edition, Thomson Learning, 2013.
2. Thomas L. Floyd, "Digital Fundamentals", 10th Edition, Pearson Education Inc, 2011.
3. Leach, Malvino and Saha "Digital Principles and Applications", McGraw Hill Education, 8th Edition, 2014.
4. Anil K.Maini "Digital Electronics", Wiley, 2014.
5. Soumitra Kumar Mandal " Digital Electronics", McGraw Hill Education Private Limited, 2016.
6. Dr.P.Kannan, M.Saraswathi, "Digital Electronics", Sree Kamalamani Publication, Second Edition, 2017.

ENGINEERING COLLEGE CHENNAI. SAKTHI EDUCATIONAL TRUST

21EC1304	SIGNALS AND SYSTEMS	L	T	P	C
		3	1	0	4

OBJECTIVES:

- To understand the basic properties of signals.
- To analyze the basic systems using properties.
- To analyze the characteristics of continuous time signals in the Fourier and Laplace domain
- To analyze LTI – Continuous time systems in Time domain and Frequency domain
- To analyze the characteristics of Discrete time signals in the Fourier and Z transform domain
- To analyze LTI - Discrete time systems in Time domain

UNIT - I CLASSIFICATION OF SIGNALS AND SYSTEMS 12

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, Time-variant & Time-invariant, Causal & Non-causal, Stable & Unstable.

UNIT - II ANALYSIS OF CONTINUOUS TIME SIGNALS 12

Fourier Series for periodic signals -Analysis of Continuous Time Signals using Fourier Transform –Inverse FT -Properties of FT, CT Signal analysis using Laplace Transform-Unilateral LT and Bilateral LT-Inverse LT- Properties of Unilateral LT.

UNIT - III LINEAR TIME INVARIANT CONTINUOUS TIME SYSTEMS 12

Impulse response - convolution integral – Graphical method - Properties of convolution integral- Overall impulse response for interconnected systems - Fourier and Laplace transforms in Analysisof CT systems - Solving of Differential Equation.

UNIT - IV ANALYSIS OF DISCRETE TIME SIGNALS 12

Baseband signal sampling -Analysis of Discrete Time Signals using Discrete Time Fourier Transform (DTFT)- Inverse DTFT–Properties of DTFT- Analysis of Discrete Time Signals using Z-Transform – Inverse Z-Transform - Properties of Z-Transform.

UNIT - V LINEAR TIME INVARIANT-DISCRETE TIME SYSTEMS 12

Impulse response – Convolution sum –Graphical method - Properties of Discrete Convolution- Overall impulse response for interconnected systems -Solving of Difference equations- Solution of Difference equation using DTFT- solution of difference equation using Z-transform.

TOTAL: 60 PERIODS

OUTCOMES:

On successful completion of the course student will be able to:

1. Understand the basics of signals and its classifications
2. Analyze the basic systems and its classifications
3. Determine the frequency Response for Deterministic signal and also analyze in S-domain.
4. Apply the Fourier and Laplace Transform for the analysis of LTI -Continuous Time systems.
5. Analyze the Characteristics of DT signals by using DTFT and Z-transform.
6. Apply the Fourier and Z- Transform for the analysis of LTI –Discrete Time systems.

TEXT BOOKS:

1. Allan V.Oppenheim, S.Wilsky and S.H.Nawab, “Signals and Systems”,Pearson,2015.
2. S. Haykin and B. Van Veen, "Signals and Systems", 2nd Edition, Wiley, 2007.

REFERENCES:

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

JAISAKTHI EDUCATIONAL TRUST

21EC1311 CIRCUITS AND SIMULATION LABORATORY

L	T	P	C
0	0	4	2

OBJECTIVES:

- To study the Frequency response of BJT Amplifiers
- To learn the frequency response of CS Amplifiers
- To design feedback amplifiers
- To design oscillator circuits
- To study about Tuned Amplifiers
- To perform SPICE simulation of Electronic circuits

LIST OF EXPERIMENTS

1. Fixed bias common emitter amplifier circuit
2. Common base amplifier
3. Common collector amplifier with voltage divider bias
4. Common source amplifier
5. Series and Shunt feedback amplifiers-Frequency response, Input and output impedance calculation
6. RC Phase shift oscillator and Wien Bridge Oscillator
7. Hartley Oscillator and Colpitts Oscillator
8. Single Tuned Amplifier

SIMULATION USING SPICE (Using Transistor):

1. Common emitter amplifier
2. Common source amplifier
3. Class A power amplifier

TOTAL: 60 PERIODS

OUTCOMES:

On successful completion of the course student will be able to:

1. Design and analyse BJT amplifiers
2. Design and analyse FET amplifiers
3. Design feedback amplifiers.
4. Design oscillator circuits
5. Study Tuned Amplifiers
6. Simulate and analyse Electronic circuits using PSpice.

REFERENCES:

1. Donald. A. Neamen, Electronic Circuits Analysis and Design, 3rd Edition, Mc Graw Hill Education (India) Private Ltd., 2010.
2. Robert L. Boylestad and Louis Nasheresky, “Electronic Devices and Circuit Theory”, 11th Edition, Pearson Education, 2013.

21EC1312	DIGITAL ELECTRONICS LABORATORY	L	T	P	C
		0	0	4	2

OBJECTIVES:

- To learn the basic operation of gates.
- To understand the basic digital circuits and to verify their operation.
- To know the concepts of Combinational circuits and sequential circuits.
- To understand the concepts of flip-flops, registers.
- To understand the concept of counters.

LIST OF EXPERIMENTS

1. Study of Logic gates and verify its truth table.
2. 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
3. Design and implementation of 4 bit binary Adder/ Subtractor and BCD adder using IC 7483.
4. Design and implementation of Multiplexer and De-multiplexer using logic gates
5. Design and implementation of encoder and decoder using logic gates.
6. Design and implementation of 2-bit magnitude comparator using logic gates, 8-bit magnitude comparator using IC 7485.
7. Design and implementation of 16 bit odd/even parity checker /generator using IC74180.
8. Construction and verification of 4 bit ripple counter and Mod-10 / Mod-12 Ripple counters
9. Design and implementation of 3-bit synchronous up/down counter.
10. Implementation of SISO, SIPO, PISO and PIPO shift registers using flip-flops.

TOTAL: 60 PERIODS

OUTCOMES:

On successful completion of the course student will be able to:

1. Implement and Verify basic function of digital circuits.
2. Construct basic combinational circuits and verify their functionalities.
3. Apply the design procedures to design basic sequential circuits.
4. Design different types of counters.
5. Implement and analyze the working of Shift registers.
6. Design and Test the digital logic circuits.

REFERENCES:

1. M. Morris Mano and Michael D. Ciletti, “Digital Design”, 5th Edition, Pearson, 2014.
2. Ronald J. Tocci , Neal S. Widmer and Gregory L. Moss,“Digital Systems: Principles and Applications” , Tenth Edition, Pearson Education, 2009.

IV SEMESTER

21MA1403 PROBABILITY AND RANDOM PROCESSES

L	T	P	C
3	1	0	4

OBJECTIVES:

- To provide necessary basic concepts in probability and random processes for applications such as random signals, linear systems in communication engineering.
- To understand the basic concepts of probability, one and two dimensional random variables and to introduce some standard distributions applicable to engineering which can describe real life phenomenon.
- To understand the basic concepts of random processes which are widely used in IT fields.
- To understand the concept of correlation and spectral densities.
- To understand the significance of linear systems with random inputs.

UNIT - I RANDOM VARIABLES 12

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

UNIT - II TWO - DIMENSIONAL RANDOM VARIABLES 12

Joint distributions – Marginal and conditional distributions – Covariance – Correlation and linear regression – Transformation of random variables – Central limit theorem for Independent Identically Distributed random variable (Without Proof).

UNIT - III RANDOM PROCESSES 12

Classification – Stationary process – Markov process - Markov chain - Poisson process.

UNIT - IV CORRELATION AND SPECTRAL DENSITIES 12

Auto correlation functions – Cross correlation functions – Properties – Power spectral density – Cross spectral density – Properties.

UNIT - V LINEAR SYSTEMS WITH RANDOM INPUTS 12

Linear time invariant system – System transfer function – Linear systems with random inputs – Auto correlation and cross correlation functions of input and output.

TOTAL: 60 PERIODS

OUTCOMES:

On successful completion of the course student will be able to:

1. Understand the fundamental knowledge of the concepts of probability and have knowledge of standard distributions which can describe real life phenomenon.

2. Understand the basic concepts of one dimensional random variables and apply in engineering applications.
3. Understand the basic concepts of two dimensional random variables and apply in engineering applications.
4. Apply the concept random processes in engineering disciplines.
5. Understand and apply the concept of correlation and spectral densities.
6. Analyze the response of random inputs to linear time invariant systems.

TEXT BOOKS:

1. Ibe, O.C.," Fundamentals of Applied Probability and Random Processes ", 1st Indian Reprint, Elsevier, 2007.
2. Peebles, P.Z., "Probability, Random Variables and Random Signal Principles ", Tata McGraw Hill, 4th Edition, New Delhi, 2002.
3. Veerarajan T, "Probability, Statistics and Random Processes with Queueing Theory", Mc Graw Hill, 1st Edition, 2018.

REFERENCES:

1. Cooper. G.R., McGillem. C.D., "Probabilistic Methods of Signal and System Analysis", Oxford University Press, New Delhi, 3rd Indian Edition, 2012.
2. Hwei Hsu, "Schaum's Outline of Theory and Problems of Probability, Random Variables and Random Processes ", Tata McGraw Hill Edition, New Delhi, 2004.
3. Miller. S.L. and Childers. D.G., —Probability and Random Processes with Applications to Signal Processing and Communications ", Academic Press, 2004.
4. Stark. H. and Woods. J.W., —Probability and Random Processes with Applications to Signal Processing ", Pearson Education, Asia, 3rd Edition, 2002.
5. Yates. R.D. and Goodman. D.J., —Probability and Stochastic Processes", Wiley India Pvt. Ltd., Bangalore, 2nd Edition, 2012.

21EC1401	ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING (LAB INTEGRATED)	L	T	P	C
		3	0	2	4

OBJECTIVES:

- To study the fundamental knowledge about Artificial Intelligence.
- To learn the prologs involved in Artificial Intelligence.
- To discuss the details of Natural Language processing.
- To learn about the details of Machine Learning.
- To study the details of Machine Learning techniques.
- To study the algorithms involved in Machine Learning.

UNIT - I INTRODUCTION TO ARTIFICIAL INTELLIGENCE 9

Meaning and definition of artificial intelligence, Physical Symbol System Hypothesis, production systems, Characteristics of production systems; Breadth first search and depth first search techniques. Heuristic search Techniques: Hill Climbing, Iterative deepening DFS, bidirectional search. Analysis of search methods. A* algorithm, and their analysis. Introduction to Genetic Algorithm.

UNIT - II INTRODUCTION TO PROLOG 9

Knowledge Representation, Problems in representing knowledge, knowledge representation using propositional and predicate logic, logical consequences, syntax and semantics of an expression, semantic Tableau Forward and backward reasoning. Proof methods, substitution and unification, conversion to clausal form, normal forms, resolution, refutation, deduction, theorem proving, in ferencing, monotonic and non monotonic reasoning. Introduction to Prolog.

UNIT - III NATURAL LANGUAGE PROCESSING 9

Network-based representation and reasoning, Semantic networks, Conceptual Graphs, frames. Description logic (DL), concept language, reasoning using DL

UNIT - IV INTRODUCTION TO MACHINE LEARNING 9

Preliminaries, what is machine learning; varieties of machine learning, learning input/output functions, bia, sample application. Boolean functions and their classes, CNF, DNF, decision lists. Version spaces for learning, version graphs, learning search of a version space

UNIT - V MACHINE LEARNING TECHNIQUES 9

Statistical Learning, background and general method, learning belief networks, nearest neighbor. Decision-trees, supervised learning of uni-variance decision trees, network equivalent of decision trees

TOTAL: 45 PERIODS

OUTCOMES:
On successful completion of the course student will be able to:

1. Use appropriate search algorithms for any AI problem
2. Represent a problem using first order and predicate logic
3. Understand the NLP that use Artificial Intelligence
4. Understand the various approaches for Machine Learning techniques
5. Apply the Bayesian Belief concepts to machine learning
6. Discuss the decision tree algorithm and overcome the problem of overfitting

TEXT BOOKS:

1. Artificial Intelligence: Elaine Rich, Kevin Knight, Mc-GrawHill.
2. Introduction to Machine learning, Nils J.Nilsson S Salivahanan and N Suresh.

REFERENCES:

1. Introduction to AI & Expert System: Dan W.Patterson, PHI.
2. Artificial Intelligence by Luger (Pearson Education)
3. Russel&Norvig, Artificial Intelligence: A Modern Approach, Pearson Education.
4. Machine learning for dummies, IBM Limited ed, by Judith Hurwitz and Daniel Kirsch
5. Introduction to Machine Learning with Python A guide for data scientists, Andreas, C. Muller & Sarah Guido, O'Reilly

Experiments of Artificial Intelligence and Machine Learning Laboratory

Artificial Intelligence

1. Installation of gnu-prolog, Study of Prolog (gnu-prolog), its facts, and rules.
2. Write simple facts for the statements and querying it.
3. Write a program for Family-tree.
4. Write Program for Monkey-banana Problem.
5. Write a program which behaves a small expert for medical Diagnosis.
6. Write programs for computation of recursive functions like factorial Fibonacci numbers, etc.

Machine Learning

1. Implement and demonstrate the FIND-S algorithm for finding the most specific hypothesis based on a given set of training data samples. Read the training data from a .CSV le
2. For a given set of training data examples stored in a .CSV file, implement and demonstrate the Candidate- Elimination algorithm. Output a description of the set of all hypotheses consistent with the training examples.
3. Write a program to demonstrate the working of the decision tree based ID3 algorithm. Use an appropriate data set for building the decision tree and apply this knowledge to classify a new sample.
4. Build an Artificial Neural Network by implementing the Back propagation algorithm and test the same using appropriate data sets.

TOTAL: 30 PERIODS

21EC1402 CONTROL SYSTEMS ENGINEERING

L	T	P	C
3	1	0	4

OBJECTIVES:

- To identify the various control system components and their representations.
- To analyze the various time domain parameters.
- To analyze the various frequency response plots and its system.
- To analyze the different compensation techniques required for the systems
- To apply the concepts of various system stability criterions.
- To Design various transfer functions of digital control system using state variable models.

UNIT - I SYSTEMS COMPONENTS AND THEIR REPRESENTATION 12

Control System: Terminology and Basic Structure-Feed forward and Feedback control theory- Electrical and Mechanical Transfer Function Models-Block diagram Models-Signal flow graphs models

Suggested Activities:

Solving of problems based on transfer function models, block diagram reduction and signal flow graph.

Suggested Evaluation Methods:

Assignment on application examples on open loop and closed loop control system
Quizzes on System component representations

UNIT - II TIME RESPONSE ANALYSIS 12

Transient response - steady state response - Measures of performance of the standard first order and second order system - effect on an additional zero and an additional pole - steady error constant and system - type number - PID control-Analytical design for PD, PI,PID control systems

Suggested Activities:

Solving of problems on steady error constant and system
Obtaining of time response using suitable software tools

Suggested Evaluation Methods:

Assignments based on problems in first order and second order systems
Quizzes on Time domain specifications.

UNIT - III FREQUENCY RESPONSE AND SYSTEM ANALYSIS 12

Closed loop frequency response - Performance specification in frequency domain - Frequency response of standard second order system - Bode Plot - Polar Plot - Nyquist plots - Design of compensators using Bode plots - Cascade lead compensation-Cascade lag compensation-Cascade lag-lead compensation

Suggested Activities:

Solving of problems in Bode plot and compensators
Frequency response analysis using suitable software tools

Suggested Evaluation Methods:

Assignments on Polar plot and Nyquist plot
Quizzes on frequency domain specifications

UNIT - IV STABILITY ANALYSIS 12

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

Suggested Activities:

Solving of Problem in RH criterion,

Analyzing system stability using suitable software tools

Suggested Evaluation Methods:

Assignments on Root Locus,

Quizzes on Stability criterions

UNIT - V ANALYSIS OF STATE VARIABLE METHODS 12

State variable representation - Conversion of state variable models to transfer functions - Conversion of transfer functions to state variable models - Solution of state equations - Concepts of Controllability and Observability - Stability of linear systems - Equivalence between transfer function and state variable representations - State variable analysis of digital control system - Digital control design using state feedback.

Suggested Activities:

Solving of problems in Observability and Controllability, State space models and equations

State Space analysis using suitable software tools

Suggested Evaluation Methods:

Assignment in conversion of state variable models to transfer functions

Quizzes on State space representation and analysis

TOTAL: 60 PERIODS

OUTCOMES:

On successful completion of the course student will be able to:

1. Acquire the knowledge of signals, systems and its classifications.
2. Analyze various system using time domain specifications.
3. Analyze various system using frequency domain specifications.
4. Analyze the different compensation techniques required for the systems.
5. Apply the concepts of stability of the system using RH and Nyquist methods.
6. Design transfer functions of digital control system using state variable models.

TEXT BOOKS:

1. M. Gopal, “Control System – Principles and Design”, Tata McGraw Hill, 4th Edition, 2012.
2. J. Nagrath and M. Gopal, “Control System Engineering”, New Age International Publishers, 5th Edition, 2007.

REFERENCES:

1. A. Nagoor Kani, “Control System Engineering”, CBS Publication and Distributors, 2020.
2. Richard C. Dorf, Robert H. Bishop, “Modern Control System”, Pearson, 13th Edition, 2016

21EC1403 FUNDAMENTALS OF DATA STRUCTURES IN C

L	T	P	C
3	0	0	3

OBJECTIVES:

- To understand the basic concepts of the C-programming language
- To learn the different data types, Understand searching and sorting algorithms
- To identify different types of data structures and its operations for real-time programming applications.
- To know stack and queues in processing data for real-time applications
- To understand tree data storage structure for real-time applications.
- To use algorithms to find shortest data search in graphs for real-time application development

UNIT - I FUNDAMENTAL OF C PROGRAMMING 9

Structure of a C program, Compilation and linking processes, Constants, Variables, Data Types, Types of operators in C, Managing Input and Output operations, Decision Making and Branching - Looping statements.

SUGGESTED ACTIVITIES:

Implementing programs using data types, arithmetic operators and basic input/output operations.
Developing programs using if-else, do-while, while, for, switch, break, continue, enum.
Create an application that performs operations like String manipulation.
Create an application that performs operations like String manipulation.

SUGGESTED EVALUATION METHODS:

Assignment on conditionals and loops.
Evaluation of the programs implemented.

UNIT - II ADVANCED - C PROGRAMMING 9

Functions - Pass by value - Pass by reference, Recursion, Pointers – Definition – Initialization - Pointer's arithmetic. Structures and unions – definition - Programs using structures and Unions, Dynamic Memory Allocation, Pre-processor directives.

SUGGESTED ACTIVITIES:

Demonstration of Function programs using Call by Value and by reference.
Demonstration of C programs using Recursion and pointers
Programs using dynamic memory.

SUGGESTED EVALUATION METHODS:

Quizzes on structures & union.
Assignments on C programs to implement concepts of pointers and functions.
Quizzes on Dynamic Memory Allocation operations.

UNIT - III LINEAR DATA STRUCTURES 9

Array-Operations on Arrays–Insertion and Deletion-Applications on Arrays. Abstract Data Types (ADTs), List ADT, Array Based Implementation - Stacks and Queues, Linked List - Linked list-based implementation of Stacks and Queues– Applications of Stacks and Queues

SUGGESTED ACTIVITIES:

Converting an algorithm from recursive to non-recursive using stack.
Demonstrating stack for Towers of Hanoi application.
Developing any application using all the linear data structures.

SUGGESTED EVALUATION METHODS

Quizzes on abstract data types.
Assignments linked list and stack.
Quizzes on queue and applications.

UNIT - IV NON-LINEAR DATA STRUCTURE 9

Trees-General Trees-Tree Terminologies-Tree epresentation - Binary Trees, Tree Traversals, Expression Trees, Binary Search Tree, Applications of trees. Graphs - Representation of Graph – Types of graphs - Breadth-first traversal – Depth- first traversal – Applications

SUGGESTED ACTIVITIES:

Implementing binary tree and tree traversals.
Solving expressions using expression trees by determining infix, prefix and postfix expressions.
Implementing graph traversals.

SUGGESTED EVALUATION METHODS:

Quizzes on basic tree operations.
Assignments on tree traversals and some sample expressions.
Assignment on Graphs and applications.

UNIT - V SORTING AND SEARCHING TECHNIQUES 9

Algorithms – Sorting - Insertion Sort, Quick Sort, Merge Sort, Algorithms–rching Techniques-Linear and Binary Search.

SUGGESTED ACTIVITIES:

Implementation of all sorting techniques.
Demonstration of searching techniques under best- and worst-case inputs.

SUGGESTED EVALUATION METHODS:

Quizzes on sorting and searching.
Assignments on insertion sort and quick sort.
Seminar and Quiz on searching methods.

TOTAL: 45 PERIODS

OUTCOMES:

On successful completion of the course student will be able to:

1. Develops the use of the C programming language to implement various algorithms, and develops the basic concepts and terminology of programming in general.
2. Identify linear and non-linear data structures. Create algorithms for searching and sorting.

3. Create the different types of linked lists and evaluate its operations
4. Construct stack and queue data structures and evaluate its operations
5. Create tree data structures and evaluate its types and operations
6. Create graph data structure, evaluate its operations, implement algorithms to identify shortest path.

TEXT BOOKS:

1. ReemaThareja, ``Programming in C'', 2nd edition, OXFORD University Press, New Delhi, 2019. (Units 1 and 2)
2. ReemaThareja, ``Data Structures Using C'', 2nd edition, OXFORD University Press, New Delhi, 2016. (Units 3,4 5)

REFERENCES:

1. E.Balagurusam,"Programming in ANSI C",8thedition,McGraw Hill Education India,2019.
2. Paul Deitel and Harvey Deitel, "C How to Program", Seventh edition, Pearson Publication.
3. Aho, Hopcroft and Ullman,"Data Structures and Algorithms", Pearson Education,1983.
4. Stephen G. Kochan,"Programming in C", 3rd edition, Pearson Education.
5. Ellis Horowitz, SartajSahni, Susan Anderson-Freed, "Fundamentals of Data Structures in C", Second Edition, University Press, 2008

21EC1404	ANALOG INTEGRATED CIRCUITS	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To introduce the basic building blocks of analog integrated circuits.
- To learn the linear and non-linear applications of operational amplifiers.
- To introduce the theory and applications of analog multipliers and PLL.
- To learn the theory of ADC and DAC.
- To introduce the concepts of waveform generation using op-amps.
- To introduce, study and analyze some special function ICs.

UNIT - I BUILDING BLOCKS OF ANALOG INTEGRATED CIRCUITS 9

Current mirror and current sources, Current sources as active loads, Voltage sources, Voltage References, BJT Differential amplifier with active loads, Basic information about op-amps – Ideal Operational Amplifier - General operational amplifier stages -and internal circuit diagrams of IC 741, DC and AC performance characteristics, slew rate, Open and closed loop configurations – JFET Operational Amplifiers – LF155 and TL082.

UNIT - II APPLICATIONS OF OPERATIONAL AMPLIFIERS 9

Sign Changer, Scale Changer, Phase Shift Circuits, Voltage Follower, V-to-I and I-to-V converters, adder, subtractor, Instrumentation amplifier, Integrator, Differentiator, Logarithmic amplifier, Antilogarithmic amplifier, Comparators, Schmitt trigger, Precision rectifier, peak detector, clipper and clamper, Low-pass, high-pass and band- pass Butterworth filters.

UNIT - III ANALOG MULTIPLIER AND PLL 9

Analog Multiplier using Emitter Coupled Transistor Pair - Gilbert Multiplier cell – Variable transconductance technique, analog multiplier ICs and their applications, Operation of the basic PLL, Closed loop analysis, Voltage controlled oscillator, Monolithic PLL IC 565, application of PLL for AM detection, FM detection, FSK modulation and demodulation and Frequency synthesizing and clock synchronisation.

UNIT - IV ANALOG TO DIGITAL AND DIGITAL TO ANALOG CONVERTERS 9

Analog and Digital Data Conversions, D/A converter – specifications - weighted resistor type, R-2R Ladder type, Voltage Mode and Current-Mode R - 2R Ladder types - switches for D/A converters, high speed sample-and-hold circuits, A/D Converters – specifications - Flash type - Successive Approximation type - Single Slope type – Dual Slope type - A/D Converter using Voltage-to-Time Conversion - Over-sampling A/D Converters, Sigma – Delta converters.

UNIT - V WAVEFORM GENERATORS AND SPECIAL FUNCTION ICS 9

Sine-wave generators, Multivibrators and Triangular wave generator, Saw-tooth wave generator, ICL8038 function generator, Timer IC 555, IC Voltage regulators – Three terminal fixed and adjustable voltage regulators - IC 723 general purpose regulator - Monolithic switching regulator, Low Drop – Out(LDO) Regulators - Switched capacitor filter IC MF10, Frequency to Voltage and Voltage to Frequency converters, Audio Power amplifier, Video Amplifier, Isolation Amplifier, Optocouplers and fibre optic IC.

TOTAL: 45 PERIODS

OUTCOMES:

On successful completion of the course student will be able to:

1. Infer basic building blocks of Analog ICs.
2. Demonstrate linear and nonlinear applications of op-amps.
3. Illustrate the functions of analog multiplier and Phase Locked Loop (PLL).
4. Compare the working principles of data conversion methods (ADCs & DACs).
5. Explain waveform generators using op-amps.
6. Analyze special function ICs.

TEXT BOOKS:

1. Michael Jacob, “Applications and Design with Analog Integrated Circuits”, Prentice Hall of India, 1996.
2. Sergio Franco, “Design with Operational Amplifiers and Analog Integrated circuits” 4th Edition, Tata Mc Graw-Hill, 2016.

REFERENCES:

1. D.Roy Choudhry, ShailJain,“Linear Integrated Circuits”, New Age International Pvt. Ltd., 2000. Circuits”, 3rd Edition, Tata McGraw-Hill, 2007.
2. Robert F.Coughlin, Frederick F.Driscoll, “ Operational Amplifiers and Linear Integrated Circuits”, Sixth Edition, PHI,2001.
3. B.S.Sonde, “System design using Integrated Circuits”, 2nd Edition, New Age Pub, 2001
4. Gray and Meyer, “Analysis and Design of Analog Integrated Circuits”, Wiley International, 2005.
5. Ramakant A.Gayakwad, “OP-AMP and Linear ICs”,4th Edition, Prentice Hall /Pearson Education, 2001.
6. William D.Stanley, “Operational Amplifiers with Linear Integrated Circuits”, Pearson Education, 2004.
7. S.Salivahanan & V.S. Kanchana Bhaskaran, “Linear Integrated Circuits”, TMH, 2008.

21EC1412	ANALOG INTEGRATED CIRCUITS LABORATORY	L	T	P	C
		0	0	4	2

OBJECTIVES:

- To design oscillators and amplifiers using op-amps.
- To design filters different types of filters using OPAMP and analyze its frequency response.
- To analyze the working of PLL and use PLL as frequency multiplier.
- To design DC power supply using Monolithic ICs.
- To test the performance of filters using PSPICE Programs.
- To utilize PSPICE Software for circuit design using schematic entry for analog Multiplier, ADC and 555 IC Timer circuits.

LIST OF EXPERIMENTS

Design and Testing of the Following Circuits

1. Inverting, Non inverting and differential amplifiers.
2. Integrator and Differentiator.
3. Instrumentation amplifier
4. Active low-pass, High-pass and band-pass filters.
5. Astable and Monostable multivibrators using Op-amp
6. Schmitt Trigger using op-amp.
7. Phase shift and Wien bridge oscillators using Op-amp.
8. Astable and Monostable multivibrators using NE555 Timer.
9. PLL characteristics and its use as Frequency Multiplier, Clock synchronization
10. R-2R Ladder Type D- A Converter using Op-amp.
11. DC power supply using LM317 and LM723.
12. Study of SMPS

Simulation using Pspice

1. Active low-pass, High-pass and band-pass filters using Op-amp
2. Astable and Monostable multivibrators using NE555 Timer.
3. A/ D converter
4. Analog multiplier

TOTAL: 60 PERIODS

OUTCOMES:

On successful completion of the course student will be able to:

1. Design Oscillators and Amplifiers using operational amplifiers.
2. Design filters using OPAMP and perform experiment on frequency response.
3. Analyze the working of PLL and use PLL as frequency multiplier.
4. Design DC power supply using ICs.

5. Analyze the performance of filters using PSPICE. Utilize PSPICE Software for circuit design.

REFERENCES:

1. Michael Jacob, " Applications and Design with Analog Integrated Circuits ", Prentice Hall of India, 1996 .
2. D.Roy Choudhry, ShailJain,"Linear Integrated Circuits", New Age International Pvt. Ltd., 2000. Circuits", 3rd Edition, Tata McGraw-Hill, 2007.
3. S.Salivahanan & V.S. Kanchana Bhaskaran, "Linear Integrated Circuits", TMH, 2008.

21EC1413 FUNDAMENTALS OF DATA STRUCTURES IN C LABORATORY

L	T	P	C
0	0	4	2

OBJECTIVES:

- To develop programs in C using basic constructs.
- To develop applications in C using arrays.
- To develop applications in C using strings, pointers, functions and structures
- To understand and implement basic data structures using C
- To apply linear and non-linear data structures in problem solving and searching and sorting algorithms

LIST OF EXPERIMENTS

1. Basic C Programs –control statement, looping, data manipulations.
2. Programs using Arrays – one and two dimensional.
3. Programs using strings – string function implementation
4. Programs using function – Call by value, call by reference.
5. Programs using pointer, Structure and Union.
6. Programs involving dynamic memory allocations
7. Array implementation of stacks and queues
8. Linked list implementation of stacks and queues
9. Application of Stacks and Queues
10. Implementation of Trees, Tree Traversals
11. Implementation of Binary Search trees
12. Implementation of Linear search and binary search
13. Implementation Insertion sort, Bubble sort, Quick sort and Merge Sort

TOTAL: 60 PERIODS

OUTCOMES:

On successful completion of the course student will be able to:

1. Write basic and advanced programs in C
2. Implement functions and recursive functions in C
3. Understand practical knowledge on the applications of data structures
4. Choose appropriate sorting algorithm for an application and implement it in a modularized way
5. Design and analyze the time and space efficiency of the data structure
6. Identity the appropriate data structure for given problem.

V SEMESTER

21EC1501	ANALOG AND DIGITAL COMMUNICATION	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To familiarize with various Amplitude Modulation Schemes
- To understand Angle Modulation Techniques
- To analyze Noise in Continuous Wave Modulation Techniques
- To acquaint the fundamentals of Source coding Techniques
- To impart knowledge in various waveform coding
- To introduce the various band pass signaling schemes

UNIT - I AMPLITUDE MODULATION 9

Introduction to Communication systems- Amplitude Modulation- - Modulation index, Spectra, Power relations and Bandwidth – AM Generation – Square law and Switching modulator, AM Detection-Envelope Detector. DSBSC Generation – Balanced and Ring Modulator, DSBSC Detection-Coherent Detection and COSTAS loop detector. SSB Generation – Filter, Phase Shift and Third Methods, SSB Detection-Coherent detector. VSB Generation – Filter Method, Super heterodyne Receiver, Noise performance analysis in AM.

UNIT - II ANGLE 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. Noise performance analysis in FM.

UNIT - III INFORMATION THEORY 9

Discrete Memoryless source, Information, Entropy, Source coding theorem - Shannon – Fano & Huffman codes. Mutual Information.

UNIT - IV WAVEFORM CODING 9

Low pass sampling – Aliasing- Signal Reconstruction-Quantization - Uniform & non-uniform quantization - quantization noise - Logarithmic Companding, PCM, DPCM, ADPCM - Delta Modulation and ADM principles-Linear Predictive Coding.

UNIT - V DIGITAL MODULATION SCHEME 9

Geometric Representation of signals – Functional Block Diagram of Digital Communication system. Generation, detection and BER of Coherent BPSK, QPSK, DPSK, QAM and BFSK - Carrier Synchronization - Structure of Non-coherent Receivers

TOTAL: 45 PERIODS

OUTCOMES:

On successful completion of the course student will be able to:

1. Compare and contrast various amplitude modulation techniques
2. Analyze Noise in Continuous Wave Modulation Techniques
3. Understand the concepts Angle Modulation schemes
4. Apply the concepts of Source Coding to improve coding efficiency
5. Gain knowledge in sampling and quantization, Waveform Encoding schemes
6. Discuss the importance of Digital modulation techniques

TEXT BOOKS:

1. Simon Haykins," Communication Systems", Wiley, 5^{th} Edition, 2009.
2. Simon Haykins "Digital Communication", Wiley, 2009.
3. B.P.Lathi, "Modern Digital and Analog Communication Systems", 4^{th} Edition, Oxford University Press, 2011.

REFERENCES:

1. Wayner Tomasi, Electronic Communication System, 5^{th} Edition, Pearson Education,2008.
2. D.Roody, J.Coolen, Electronic Communications, 4^{th} edition PHI 2006.
3. B.Sklar, "Digital Communications Fundamentals and Applications", 2^{nd} Edition Pearson Education 2007.
4. H P Hsu, Schaum Outline Series - "Analog and Digital communications" TMH 2006.
5. Couch.L., "Modern Communication Systems", Pearson, 2001.

21EC1502	DIGITAL SIGNAL PROCESSING	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To learn Discrete Fourier Transform (DFT), properties of DFT and its application to linear filtering.
- To understand the characteristics of digital filters, design digital IIR filters and apply these filters to filter undesirable signals in various frequency bands
- To understand the characteristics of digital filters, design digital 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 understand the fundamental concepts DSP processor and multi rate signal processing.
- To introduce the concepts of adaptive filters and its application to communication engineering.

UNIT - I DISCRETE FOURIER TRANSFORM 9

Analysis & synthesis equations for Discrete Fourier transform (DFT) - Properties of DFT - periodicity, symmetry, circular convolution, 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 9

Characteristics of practical frequency selective filters, characteristics of commonly used analog filters - Butterworth filters, Chebyshev filters, Design of IIR filters from analog filters (LPF, HPF, BPF, BRF) - Impulse invariance method, Bilinear transformation, Frequency transformation in the analog domain, Structure of IIR filter - direct form I, direct form II, Cascade, parallel realizations.

UNIT - III FINITE IMPULSE RESPONSE FILTERS 9

Introduction of FIR filters - Design of linear phase FIR filters using windows - Rectangular, Hamming and Hanning window, Frequency sampling method. FIR filter structures - linear phase structure, direct form realizations.

UNIT - IV FINITE WORD LENGTH EFFECTS 9

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 DSP ARCHITECTURE AND APPLICATIONS 9

DSP Fixed-Point Architecture- Blocks of DSP Processor-Addressing modes, Multirate signal processing - Decimation, Interpolation, Sampling rate conversion by a rational factor, Adaptive Filters – Introduction - Applications of adaptive filter - Equalization.

TOTAL: 45 PERIODS

OUTCOMES:

On successful completion of the course student will be able to:

1. Apply DFT for the analysis of digital signals and systems
2. Design IIR filters
3. Design FIR Filters.
4. Characterize the effects of finite precision representation on digital filter.
5. Design multirate filters with fixed point DSP Processor.
6. Apply adaptive filters appropriately in communication systems

TEXT BOOKS:

1. John G. Proakis, Dimitris G. Manolaxis,"Discrete-Time Signal Processing", 4th Edition, Pearson, 2007.
2. Emmanuel C. Ifeachor& Barrie. W. Jervis, "Digital Signal Processing", Second Edition, Pearson Education / Prentice Hall, 2002.
3. A. V. Oppenheim, R.W. Schafer and J.R. Buck, "Discrete-Time Signal Processing", 8th Indian Reprint, Pearson, 2004.

REFERENCES:

1. P. Ramesh Babu, "Digital Signal Processing", Scitech Publications in 2011.
2. B.P.Lathi, "Principles of Linear Systems and Signals", Second Edition,Oxford,2009.
3. Sanjit K. Mitra, "Digital Signal Processing – A Computer Based Approach", Tata Mc Graw Hill, 2007.
4. Andreas Antoniou,"Digital Signal Processing", Tata Mc Graw Hill, 2006.

21EC1503	MICROCONTROLLERS AND COMPUTER ARCHITECTURE	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To study the Architecture of 8051 microcontroller.
- To design a 8051 microcontroller based system.
- To understand about PIC microcontroller architecture
- To design a PIC microcontroller based system.
- To understand the concept of various memories and interfacing.
- To study the parallel processing technique of advanced processor.

UNIT - I 8051 MICROCONTROLLER 9

Architecture of 8051 – Special Function Registers(SFRs) - I/O Pins Ports and Circuits -Instruction set - Addressing modes - Assembly language programming.

UNIT - II INTERFACING WITH 8051 MICROCONTROLLER 9

Programming 8051 Timers - Serial Port Programming - Interrupts Programming – LCD & Keyboard Interfacing - ADC, DAC & Sensor Interfacing - External Memory Interface- Stepper Motor and Waveform generation.

UNIT - III PIC MICROCONTROLLER 9

Introduction to PIC 16C6X microcontrollers, architecture and memory organization, registers, I/O ports, interrupts, timer, instruction sets, Basic programming in PIC Microcontroller, Sensor interfacing, motor control.

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.

TOTAL: 45 PERIODS

OUTCOMES:

On successful completion of the course student will be able to:

1. Design and implement 8051 microcontroller based systems.
2. Interface various devices with 8051
3. Design and implement PIC microcontroller based systems.
4. Interface various devices with PIC microcontroller.
5. Explain the concept of various memories, interfacing and organization of multiprocessors.

6. Gain knowledge in parallel processing technique and unconventional architectures

TEXT BOOKS:

1. Mohamed Ali Mazidi, Janice Gillispie Mazidi, Rolin McKinlay, “The 8051 Microcontroller and Embedded Systems: Using Assembly and C”, Second Edition, Pearson education, 2011.
2. Muhammod Ali Mazidi, Rolin D. Mckinlay & Danny Sansey, “PIC Microcontroller and Embeded System SPI, UART using Assembly & C for PICI8,” Pearson International Edition, 2008.

REFERENCES:

1. Doughlas V.Hall,”Microprocessors and Interfacing, Programming and Hardware”,TMH,2012
2. Miles J. Murdocca and Vincent P. Heuring, “Computer Architecture and Organization: An Integrated approach”, Second edition, Wiley India Pvt Ltd, 2015
3. A.K.Ray,K.M.Bhurchandi, "Advanced Microprocessors and Peripherals" 3rd edition, Tata McGrawHill, 2012.
4. John .B.Peatman , “Design with PIC Microcontroller”, Prentice Hall, 1997.
5. David A. Patterson and John L. Hennessey, “Computer Organization and Design”, Fifth edition, Morgan Kauffman / Elsevier, 2014.

21EC1504	TRANSMISSION LINES AND WAVEGUIDES	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To give an insight on filters.
- To introduce the characteristics of transmission lines at low and high frequencies.
- To give thorough understanding about impedance transformation and matching.
- To use Smith chart in problem solving.
- To impart knowledge on waveguide theories.

UNIT - I FILTERS 9

Characteristic impedance of symmetrical networks, Constant K filters: Low Pass, High Pass, Band Pass, and Band Elimination, m-derived filters: Low pass and High pass, Composite filter.

UNIT - II TRANSMISSION LINE THEORY 9

General theory of Transmission lines, General solution, The infinite line, Wavelength, Velocity of propagation, Waveform distortion, Distortion-less line, Line not terminated in Z0, Reflection coefficient, Calculation of current, voltage, power delivered and efficiency of transmission, Input impedance, Open and short circuited lines.

UNIT - III HIGH FREQUENCY TRANSMISSION LINES 9

Transmission line equations at radio frequencies, Voltage and current on the dissipation-less line, Standing Waves, Standing Wave Ratio, Input impedance, Impedance matching - Quarter wave transformer, Single stub matching, Solutions of problems using Smith chart.

UNIT - IV GUIDED WAVES BETWEEN PARALLEL PLATES 9

Transmission of TM, TE and TEM waves between Parallel plates, Characteristics of TE, TM and TEM waves - Cut-off frequency, Phase velocity, Group velocity, Phase constant, Wavelength and Impedance.

UNIT - V RECTANGULAR AND CIRCULAR WAVEGUIDES 9

Rectangular waveguide and circular waveguide: Transmission of TM and TE waves, Characteristics of TE and TM waves - Cut-off frequency, Phase velocity, Group velocity, Phase constant, Wavelength and Impedance, Impossibility of TEM waves in waveguide, Excitation of modes.

TOTAL: 45 PERIODS

OUTCOMES:

On successful completion of the course student will be able to:

1. Understand the theory and design of filters.
2. Explain the theory of transmission lines and calculate its parameters.
3. Analyze signal propagation in transmission line at high frequency.
4. Design impedance matching devices for high frequency lines.
5. Solve transmission line related problems using Smith chart.
6. Explain the structure and operation of waveguides.

TEXT BOOKS:

1. John D Ryder, "Networks, lines and fields", Second Edition, Prentice Hall India, 2009.
2. E.C.Jordan and K.G. Balmain, "Electromagnetic Waves and Radiating Systems", Prentice Hall of India, 2006.

REFERENCES:

1. G.S.N Raju "Electromagnetic Field Theory and Transmission Lines", Pearson Education, First edition 2005
2. Magnusson, P., Weisshaar, A., Tripathi, V., Alexander, G., "Transmission Lines and Wave Propagation", 4th edition, CRC Press. 2017.
3. Joseph Edminister, Schaum's Series, Electromagnetics, TMH, 2007.

21EC1511	MICROCONTROLLERS AND INTERFACING LABORATORY	L	T	P	C
		0	0	4	2

OBJECTIVES:

- To understand architecture and advanced features of microcontrollers.
- To understand PIC/ARM processor registers, instruction pipeline, interrupts and architecture.
- To learn about instructions, addressing modes, conditional instructions
- To learn programming of advanced microcontrollers.
- To write a assembly language program for microcontroller.
- To write a program for interfacing of external devices with microcontroller.

LIST OF EXPERIMENTS

Assembly language programming experiments using 8051 and PIC:

14. Addition/Subtraction/multiplication/division of 8/16 bit data.
15. Data transfer/exchange between specified memory locations.
16. Largest/smallest from a series.
17. Sorting (Ascending/Descending) of data.
18. Square/cube/square root of 8-bit data
19. Code conversion-(Hex to Decimal / ASCII to Decimal and vice versa.

Interfacing experiments using 8051

5. Display (LED/Seven segment/LCD) and keyboard interface
6. ADC interface.
7. DAC interface with wave form generation.
8. Stepper motor interface
9. DC motor interface
10. Traffic Light Controller.
11. Mini Projects using anyone microcontroller.

TOTAL: 60 PERIODS

OUTCOMES:

On successful completion of the course student will be able to:

7. Interpret assembly language Program for 8051 microcontrollers
8. Interpret assembly language Program for PIC microcontrollers
9. Interface various peripheral devices with 8051 microcontroller
10. Function effectively as an individual and in a team to accomplish the given task.
11. Gain knowledge to identify microcontroller and design a system for given application.
12. Provide Solutions to Real time Application

21EC1512 DIGITAL SIGNAL PROCESSING LABORATORY

L	T	P	C
0	0	4	2

OBJECTIVES:

- To implement generation of sequences.
- To realize Linear Convolution, Circular Convolution and Correlation.
- To analyze Frequency spectrum analysis (DFT).
- To design and realize IIR filters.
- To design and realize FIR filters.
- To implement signal processing algorithms using digital signal processor.

LIST OF EXPERIMENTS

MATLAB / EQUIVALENT SOFTWARE PACKAGE

1. Generation of elementary Discrete-Time sequences
2. Linear and Circular convolution
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

TOTAL: 60 PERIODS

OUTCOMES:

On successful completion of the course student will be able to:

1. Generate basic signal sequences.
2. Design and implement the basic signal processing operations like convolution and correlation helps to resolve real time applications.
3. Frequency domain analysis using DFT.
4. Design of IIR Filters for performing filtering operations over real-time signals.
5. Design of FIR Filters for performing filtering operations over real-time signals.
6. Implementation of signal processing algorithms using digital signal processor.

TEXT BOOKS:

1. John G. Proakis, Dimitris G. Manolaxis, —Discrete-Time Signal Processing‖, 4th Edition, Pearson, 2007.

REFERENCES:

1. P. Ramesh Babu, —Digital Signal Processing‖, Scitech Publications in 2011.
2. Sanjit K. Mitra, —Digital Signal Processing – A Computer Based Approach, Tata Mc Graw Hill, 2007.

21EC1513	ANALOG AND DIGITAL COMMUNICATION LABORATORY	L	T	P	C
		0	0	4	2

OBJECTIVES:

- To study the AM & FM Modulation and Demodulation.
- To learn and realize the effects of sampling and TDM.
- To understand the PCM and DM modulation and Demodulation
- To understand the Digital modulation and Demodulation
- To simulate Waveform Coding Techniques & Digital Modulation Schemes.
- To implement Error Control Coding Schemes.

LIST OF EXPERIMENTS

1. AM- Modulator and Demodulator
2. FM - Modulator and Demodulator
3. Signal sampling.
4. TDM.
5. Line Coding Techniques
6. Pulse Code Modulation and Demodulation.
7. Digital Modulation – ASK, PSK, FSK.
8. Delta Modulation and Demodulation.
9. Simulation of DM, Slope Overload Distortion & Granular Noise
10. Simulation of ADM
11. Simulation of ASK FSK, and BPSK Generation and Detection Schemes.
12. Simulation of DPSK, QPSK and QAM Generation and Detection Schemes.
13. Simulation of Linear Block and Convolutional Schemes.

TOTAL: 60 PERIODS

OUTCOMES:

On successful completion of the course student will be able to:

1. Design AM, FM & Digital Modulators for specific applications.
2. Compute the sampling frequency for digital modulation.
3. Demonstrate their knowledge in waveform coding signaling schemes
4. Demonstrate their knowledge in Digital Modulation schemes
5. Simulate & validate the various Digital Modulation Schemes.
6. Apply various channel coding schemes & demonstrate their capabilities towards the improvement of the noise performance of Communication system.

VI SEMESTER

21EC1601	WIRELESS COMMUNICATION	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To understand the importance of Channel coding.
- To understand the design of a cellular system.
- To study the various digital signaling techniques.
- To study the multipath mitigation techniques.
- To understand the concepts of multiple antenna techniques.

UNIT - I WIRELESS CHANNEL CODING TECHNIQUES 9

Channel coding theorem - Linear Block codes –Cyclic Codes- Convolutional codes - Viterbi Decoder.

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, π/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

ISI, Equalization – Adaptive equalization, Linear and Non-Linear equalization, Zero forcing and LMS Algorithms. Diversity – Micro and Macro diversity, Diversity combining techniques, 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.

TOTAL: 45 PERIODS

OUTCOMES:

On successful completion of the course student will be able to:

1. Analyze problems &arrive at feasible solutions for error control using Channel Coding Methods
2. Design a cellular system based on resource availability and traffic demands
3. Identify suitable signaling techniques for the wireless channel and system under consideration.
4. Identify suitable multipath mitigation techniques for the wireless channel and system under consideration.
5. Understand The concepts of multiple antenna techniques

TEXT BOOKS:

1. Rappaport,T.S., “Wireless communications”, Pearson Education, Second Edition, 2010.
2. Andreas.F. Molisch, “Wireless Communications”, John Wiley – India, 2006.

REFERENCES:

1. Andrea Goldsmith ,“Wireless Communication”, Cambridge University Press, 2011.
2. Van Nee, R. and Ramji Prasad,“OFDM for wireless multimedia communications”, Artech House, 2000.
3. David Tse and PramodViswanath,,”Fundamentals of Wireless Communication”, Cambridge University Press, 2005.
4. Upena Dalal, “Wireless Communication”, Oxford University Press, 2009.

21EC1602 ANTENNA THEORY AND DESIGN

L	T	P	C
3	0	0	3

OBJECTIVES:

- To give insight of antenna radiation and its parameters.
- To give a thorough understanding of the radiation characteristics of different types of antennas and antenna arrays.
- To instill knowledge on antenna measurements

UNIT - I INTRODUCTION TO ANTENNAS 9

Physical concept of radiation, Near and far-field regions, Antenna Gain, Directivity and Efficiency, Radiation resistance, Radiation pattern, Beam width, Bandwidth, Aperture Efficiency and Effective Area, Polarization, Antenna Noise Temperature, Friis transmission equation, Link budget and link margin.

UNIT - II RADIATION MECHANISMS AND DESIGN ASPECTS 9

Radiation Mechanisms of Linear Wire and Loop antennas, Design considerations and applications - Yagi antenna, Slot antenna, Horn antenna, Parabolic reflector antennas, Microstrip antennas.

UNIT - III ANTENNA ARRAYS 9

Two-element array, n-element linear array – Broadside and End fire array, Array factor, Pattern multiplication, Uniformly spaced arrays with non-uniform excitation – Binomial and Dolph Chebyshev array.

UNIT - IV SPECIAL ANTENNAS 9

Rhombic antenna, Frequency independent antennas - Helical antenna, Spiral antenna, Log Periodic Dipole Array (LPDA), PIFA, Smart antenna, Reconfigurable antenna, Active antenna, Dielectric antennas.

UNIT - V ANTENNA MEASUREMENTS 9

Antenna Measurement range - Elevated Range, Reflection Range, Near Field Range, Far Field Range, Compact Range, Slant range, Indoor range, Measurement of Gain, Directivity, Polarization and Radiation pattern.

TOTAL: 45 PERIODS

OUTCOMES:

On successful completion of the course student will be able to:

1. Understand the physical concept of radiation and antenna parameters.
2. Explain the radiation mechanism of dipole, loop, aperture, microstrip and reflector antennas.
3. Understand the mathematical design and applications of linear wire and aperture antennas.
4. Apply the basic principles to analyze antenna arrays.
5. Explain the structure, operation and applications of various special antennas.
6. Understand the various methods of antenna measurements.

TEXT BOOKS:

1. John D Krauss, Ronald J Marhefka and Ahmad S. Khan, “Antennas and Wave Propagation”: Fourth Edition, Tata McGraw-Hill, 2006.
2. Constantine A.Balanis, “Antenna Theory Analysis and Design”, Third edition, John Wiley India Pvt Ltd., 2005.

REFERENCES:

1. Rajeswari Chatterjee, “Antenna Theory and Practice” Revised Second Edition New Age International Publishers, 2006.
2. A.R.Harish, M.Sachidanada, “Antennas and Wave propagation, Oxford University Press, 2007.
3. S. Drabowitch, “Modern Antennas” Second Edition, Springer Publications, 2007.
4. Robert S.Elliott “Antenna Theory and Design” Wiley Student Edition, 2006.

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21EC1603 **VLSI AND CHIP DESIGN**

L	T	P	C
3	0	0	3

OBJECTIVES:

- To study the fundamentals of CMOS circuits and its characteristics.
- To gain the knowledge about IC fabrication process.
- To learn the design and realization of combinational circuits.
- To learn the design and realization of sequential digital circuits.
- To familiarize with the Data Path Architectural choices and memory subsystems.
- To learn the different FPGA architectures and testability of VLSI circuits.

UNIT - I INTRODUCTION TO CHIP DESIGN 9

MOS Transistor, Long-Channel I-V Characteristics, C-V Characteristics, Non ideal I-V Effects, Linear Delay model, Logical effort, Scaling, Stick Diagrams, Layout design rules.

Fabrication process of pMOS, nMOS, CMOS and BiCMOS technologies, Comparison of different technologies.

UNIT - II COMBINATIONAL CIRCUIT DESIGN 9

Circuit Families - Static CMOS, Pass Transistor, Transmission Gates, Ratioed Circuits, Dynamic Circuits, Domino, Cascode Voltage Switch Logic, Adiabatic Logic.

Power Consumption in CMOS - Dynamic Power, Static Power, Various power optimization techniques-MTCMOS, Power Gating.

UNIT - III SEQUENTIAL CIRCUIT DESIGN 9

Static latches and Registers-MUX based, Transmission Gate based, Pass Transistor based (SR, Master Slave, D latch), Dynamic latches and Registers - C2MOS, TSPC, TSPCR, Pulse Registers, Sense Amplifier Based Register, Pipelining, Monostable and Astable Sequential Circuits.

Timing Issues - Synchronous Design, Clock Distribution Techniques.

UNIT - IV DESIGN OF ARITHMETIC BUILDING BLOCKS AND SUBSYSTEM 9

Arithmetic Building Blocks - Data Paths, Adders- Static CMOS Full Adder, Ripple Carry Adder, Carry Bypass Adder, Carry Look Ahead Adder, Koggestone Adder, Carry Save Adder, Multipliers-Array Multiplier, Wallace tree Multiplier, Booth Multiplier, Dadda Multiplier, Barrel Shift Register, ALU. Semiconductor Memories - SRAM and DRAM.

UNIT - V FPGA ARCHITECTURES AND TESTING 9

Types of ASIC - Full Custom and Semi-Custom, FPGA Architectures: SRAM and Flash type, Study of FPGA Development Boards-ZYNQ 7000 series and PYNQ boards.Design for Testability - BIST, IDDQ Testing, Boundary Scan.

TOTAL: 45 PERIODS

OUTCOMES:

On successful completion of the course student will be able to:

1. Realize the fundamental concepts of MOS transistor.
2. Understand the concept of IC fabrication process
3. Design combinational MOS circuits and power strategies.
4. Design and construct Sequential Circuits and Timing systems.
5. Design arithmetic building blocks and memory subsystems.
6. Apply and implement FPGA design flow and testing.

TEXT BOOKS:

1. Neil H.E. Weste, David Money Harris, "CMOS VLSI Design: A Circuits and Systems Perspective", 4th Edition, Pearson, 2017.
2. Jan M. Rabaey, Anantha Chandrakasan, Borivoje. Nikolic, "Digital Integrated Circuits: A Design perspective", Second Edition, Pearson, 2016.

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, Moder,"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.

21EC1604 DATA COMMUNICATION NETWORKS

L	T	P	C
3	0	0	3

OBJECTIVES

- To familiarize with the architectures and the protocol stack in use.
- To impart knowledge in various switching techniques in Physical layer.
- To understand the division of network functionalities in data link layer.
- To have an in depth knowledge in addressing and Routing Protocols.
- To be exposed to the required functionality of flow control and congestion control in transport layer.
- To understand application layer protocols and security issues.

UNIT - I FUNDAMENTALS AND PHYSICAL LAYER 9

Overview of Data Communications- Networks - Types - Network models - Protocol Layering - TCP/IP protocol suite - OSI Model- Physical Layer- Transmission impairment - Performance-Switching- Circuit-Switched Networks- Packet Switching.

UNIT - II DATALINK LAYER 9

Introduction to Data Link Layer - Link layer Addressing- Error Detection and Correction (Cyclic Codes, Checksum) -Overview of Data link Control - DLC services- Data-Link Layer Protocols - HDLC-Media Access Control (MAC)- Random Access- Controlled Access- Channelization - Standard Ethernet (IEEE 802.3) - Wireless LANs (IEEE 802.11).

UNIT - III NETWORK LAYER 9

Network-Layer Performance- Ipv4 Addresses -Internet Protocol (IPV4)- ICMPv4- Unicast Routing- Routing Algorithms- Unicast Routing Protocols-Multicast Routing-Introduction- Multicasting Basics- Intradomain Multicast Protocols- Interdomain Multicast Protocols-Next Generation IP- IPv6 Addressing- IPv6 Protocol- Transition From IPv4 TO IPv6.

UNIT - IV TRANSPORT LAYER 9

Introduction to Transport Layer -Transport-Layer Protocols- Services - Port Numbers -User Datagram Protocol- Transmission Control Protocol-Data-Flow Characteristics- Flow Control To Improve QoS.

UNIT - V APPLICATION LAYER 9

Standard Client-Server Protocols- World Wide Web (WWW) - HyperText Transfer Protocol (HTTP) - File Transfer Protocol (FTP) - Electronic Mail - Domain Name System (DNS) - Firewalls.

TOTAL: 45 PERIODS

OUTCOMES:

On successful completion of the course student will be able to:

1. Illustrate the significance and role of Networks in the present contemporary world.
2. Identify the various switching techniques in Physical layer.
3. Employ the knowledge to identify appropriate physical and MAC layer protocols.
4. Apply the knowledge to identify the suitable routing algorithm based on the network and User requirement.
5. Examine the functionality of various flow control and congestion control mechanism in transport layer.
6. Develop application layer protocols to enable users to access files efficiently.

TEXT BOOKS:

1. Behrouz A. Forouzan, “Data communication and Networking”, Fifth Edition, Tata McGraw –Hill, 2013.

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.
4. Larry L. Peterson, Bruce S. Davie, “Computer Networks: A Systems Approach”, Fifth Edition, Morgan Kaufmann Publishers, 2011.

21EC1611	VLSI DESIGN LABORATORY	L	T	P	C
		0	0	4	2

OBJECTIVES:

- To learn Hardware Descriptive Language (Verilog/VHDL).
- To learn the fundamental principles of VLSI circuit design in analog domain.
- To learn the fundamental principles of VLSI circuit design in digital domain.
- To familiarize fusing of logical modules on FPGAs.
- To gain the knowledge to synthesize, Place and Route the digital IPs.
- To provide hands on design experience with professional design (EDA) platforms.

LIST OF EXPERIMENTS

Digital System Design using HDL & FPGA

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 an ALU using HDL. Simulate it using Xilinx/Altera Software and implement by Xilinx/Altera FPGA
4. Design a Universal Shift Register using HDL. Simulate it using Xilinx/Altera Software and implement by Xilinx/Altera FPGA
5. Design Finite State Machine (Moore/Mealy) using HDL. Simulate it using Xilinx/Altera Software and implement by Xilinx/Altera FPGA
6. Design Memories using HDL. Simulate it using Xilinx/Altera Software and implement by Xilinx/Altera FPGA.

Compare pre synthesis and post synthesis simulation for experiments 1 to 6.
Requirements: Xilinx ISE/Altera Quartus/ equivalent EDA Tools along with Xilinx/Altera/equivalent FPGA Boards

Digital Circuit Design

7. Design and simulate a CMOS inverter using digital flow
8. Design and simulate a CMOS Basic Gates & Flip-Flops
9. Design and simulate a 4-bit synchronous counter using a Flip-Flops Manual/Automatic Layout

Generation and Post Layout Extraction for experiments 7 to 9
Analyze the power, area and timing for experiments 7 to 9 by performing Pre-Layout and Post Layout Simulations.

Analog Circuit Design

1. Design and Simulate a CMOS Inverting Amplifier.
2. Design and Simulate basic Common Source, Common Gate and Common Drain Amplifiers. Analyze the input impedance, output impedance, gain and bandwidth for experiments 10 and 11 by performing Schematic Simulations.
3. Design and simulate simple 5 transistor differential amplifier. Analyze Gain, Bandwidth and CMRR by performing Schematic Simulations.

MINIPROJECT

TOTAL: 60 PERIODS

OUTCOMES:

On successful completion of the course student will be able to:

1. Write HDL code for basic as well as advanced digital integrated circuits.
2. Analyze and Import the logic modules into FPGA Boards.
3. Synthesize Place and Route the digital IPs.
4. Design, Simulate and Extract the layouts of Analog IC Blocks using EDA tools.
5. Design, Simulate and Extract the layouts of Digital IC Blocks using EDA tools.
6. Apply the knowledge of VLSI design to real time applications.

21EC1612	WIRELESS COMMUNICATION AND NETWORKS LABORATORY	L	T	P	C
		0	0	4	2

OBJECTIVES:

- To understand and capture an experimental approach to digital wireless communication.
- To give insight on the characteristics of various antennas.
- To Implement Error Control Coding Schemes.
- To implement and analyze different network protocols.
- To learn and use network commands.
- To be familiar with the various routing algorithms.

LIST OF WIRELESS COMMUNICATION EXPERIMENTS

1. Wireless Channel Simulation including fading and Doppler effects.
2. Simulation of Channel Estimation, Synchronization & Equalization techniques.
3. Analyzing Impact of Pulse Shaping and Matched Filtering using Software Defined Radios.
4. OFDM Signal Transmission and Reception using Software Defined Radios.
5. Radiation pattern of dipoles, Loop and patch antenna.
6. Directivity of end fire array and pyramidal horn antenna.

LIST OF NETWORKS EXPERIMENTS

1. Implementation of Error Detection / Error Correction Techniques.
2. Implementation of Stop and Wait and Sliding window Protocols.
3. Implementation of High Level Data Link Control.
4. Implementation of IP Commands such as ping, Trace route, nslookup and IP address configuration.
5. To create scenarios and study the performance of networks with CSMA / CA protocol and compare with CSMA/CD protocols.
6. Network Topology – Mesh, Star, Bus, Ring, Hybrid.
7. Implementation of Distance vector and Link state routing algorithms.
8. Study of Network simulator (NS) and simulation of Congestion Control Algorithms using NS.
9. Implementation of Encryption and Decryption Algorithms using any programming language.

TOTAL: 60 PERIODS

OUTCOMES:

On successful completion of the course student will be able to:

1. Estimate the Wireless channel characteristics and analyze the performance of Wireless communication system.
2. Obtain the radiation pattern and directivity of various antennas.
3. Use simulation tools to analyze the performance of various network protocols.
4. Simulate the network with different configurations to measure the performance parameters.
5. Analyze various routing algorithms.
6. Illustrate the operations of network protocols and algorithms.

VII SEMESTER

21EC1701	EMBEDDED SYSTEMS AND ROBOTICS	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To understand the basics of Embedded and Robotics system.
- To study the Architecture of ARM Processor.
- To understand interfacing concepts of ARM.
- To select appropriate hardware and microcontrollers based on need of application.
- To illustrate about robotic vision.
- To apply robot based concepts in AI.

UNIT - I INTRODUCTION TO EMBEDDED AND ROBOTICS 9

Introduction Embedded systems, Definition, Examples and components of embedded Systems, Embedded System Design Process, Various Embedded core controllers. Robotics -Definition and origin of robotics – degrees of freedom – Robot classifications and specifications – Asimov's laws of robotics.

UNIT - II ARM PROCESSOR 9

ARM design philosophy, data flow model and core architecture, registers, program status register, instruction pipeline, interrupts and vector table, operating modes and ARM processor families.

UNIT - III INTERFACING WITH ARM 9

Addressing modes, Instruction Sets: Data processing instructions, branch, load, store instructions, PSR instructions, and conditional instructions. Interfacings- LED blinking, simple I/O Switch, ADC, DAC, Stepper Motor and Sensor Interfacing.

UNIT - IV ROBOTIC VISION 9

Industrial application of vision controlled robotic system-process of imaging-architecture of robotics vision system-image acquisition-description of other components of vision systems-image representation - image processing.

UNIT - V AI ROBOTICS 9

Intelligent systems- elements of artificial intelligence- system architecture-applications of advanced robot-fuzzy logic control-advanced concept and procedures-future development-impact on employment.

TOTAL: 45 PERIODS

OUTCOMES:

On successful completion of the course student will be able to:

1. Gain knowledge of theory and practice related to Embedded and Robotic System.
2. Provide depth knowledge about ARM architecture and its interfacing.
3. Identify, formulate and solve engineering problems by using Embedded Systems.

4. Understand the vision controlled robotic system.
5. Realize the description of components of vision system.
6. Understand the applications of robotics in AI.

TEXT BOOKS:

1. K.V.K.K.Prasad, “Embedded Real Time Systems: Concepts, Design and Programming” 1st Edition, Dreamtech Publication,2014.
2. Rajkamal, “Embedded System: Architecture, Programming and Design”, TMH3.
3. R.K.Mittal and I.J.Nagrath, Robotics and Control, Tata McGraw Hill, New Delhi,4th Reprint, 2005.
4. James G. Keramas , Robot Technology Fundamendals India Edition.

REFERENCES:

1. Muhammad Ali Mazidi Shujen Chen, Sepehr Naimi Sarmad Naimi “Embedded Programming Using C Language”, 1st Edition, Freescale ARM Cortex-M.
2. Jonathan W Valvano,Embedded Microprocessor System:Real Time Interfacing, 3rd Edition, Thomson Engineering,2012.
3. John M. Holland, "Designing Autonomous Mobile Robots-Inside the mind of an Intelligent Machine", Newnes Publication, 2004.
4. Groover, M.P., Weiss, M., Nagel, R.N., & Odrey, N.G. Industrial robotics - technology, programming, and applications.
5. Shibu K.V, “Introduction to Embedded Systems”, McGraw Hill. 2014.

21EC1702 **MICROWAVE DEVICES AND CIRCUITS**

L	T	P	C
3	0	0	3

OBJECTIVES:

- To give insight of microwave passive and semiconductor devices.
- To give a thorough understanding of the working operation of Microwave tubes.
- To instill knowledge on microwave integrated circuits and measurement techniques of various microwave parameters.

UNIT - I **TWO PORT NETWORK** **9**

Microwave frequency bands, Applications of Microwaves, Review of Low frequency parameters: Impedance, Admittance, Hybrid and ABCD parameters, High Frequency parameters, Formulation of S parameters, Properties of S parameters, Reciprocal and lossless Network, Transmission matrix.

UNIT - II **MICROWAVE PASSIVE DEVICES** **9**

Theory and analysis: Microwave Junctions – E plane, H plane and Magic Tee, Waveguide Directional Coupler, T junction and Wilkinson Power Divider, Phase shifters, Attenuator, Circulator, Isolator, Matched termination.

UNIT - III **MICROWAVE SEMICONDUCTOR DEVICES** **9**

Crystal and Schottky diode, PIN diode, Gunn diode, Tunnel diode, IMPATT diode, Varactor diode, Microwave Bipolar and Field Effect Transistor, High Electron Mobility Transistor.

UNIT - IV **MICROWAVE TUBES** **9**

Theory and application of two cavity Klystron Amplifier, Reflex Klystron oscillator, Traveling wave tube amplifier, Cylindrical Magnetron oscillator, Carcinotron oscillator.

UNIT - V **MICROWAVE MEASUREMENTS AND INTEGRATED CIRCUITS** **9**

Measurement of Impedance, Frequency, Power, VSWR, Q-factor, Dielectric constant, Attenuation, S-parameters, and Microwave Integrated circuits - Materials, fabrication techniques, MIC components.

TOTAL: 45 PERIODS

OUTCOMES:

On successful completion of the course student will be able to:

1. Understand the concept of low and high frequency parameters.
2. Understand the concept of microwave passive devices.
3. Explain the working operation of various microwave semiconductor devices.
4. Understand the working operation of various microwave tubes.

5. Understand the various methods of measuring microwave parameters.
6. Explain the basics of microwave integrated circuits.

TEXT BOOKS:

1. Samuel Y Liao, “Microwave Devices & Circuits”, Prentice Hall of India, 2006.
2. Annapurna Das and Sisir K Das, “Microwave Engineering”, Tata Mc Graw Hill Publishing Company Ltd, New Delhi, 2005.

REFERENCES:

1. David M. Pozar, "Microwave Engineering", Fourth Edition, Wiley India, 2012.
2. Robert E Colin, “Foundations for Microwave Engineering”, John Wiley & Sons Inc, 2005.
3. Thomas H Lee, “Planar Microwave Engineering: A Practical Guide to Theory, Measurements and Circuits”, Cambridge University Press, 2004.

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21EC1703	OPTICAL COMMUNICATION AND NETWORKS	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To study about the various optical fiber modes, configuration and fabrication techniques.
- To understand the transmission characteristics of optical fibers.
- To learn about the various optical sources, detectors and transmission techniques.
- 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

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

UNIT - II TRANSMISSION CHARACTERISTIC OF OPTICAL FIBER 9

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

UNIT - III OPTICAL SOURCES AND DETECTORS 9

Sources: Intrinsic and extrinsic material-direct and indirect band gaps-LED-LED structures- surface emitting LED-Edge emitting LED-quantum efficiency and LED power-light source materials-modulation of LED-LASER diodes-modes and threshold conditions-Rate equations-external quantum efficiency-resonant frequencies-structures and radiation patterns-single mode laser-external modulation-temperature effort.

Detectors: PIN photo detector-Avalanche photo diodes-Photo detector noise-noise sources-SNR-detector response time-Avalanche multiplication noise-temperature effects- comparisons of photo detectors.

UNIT - IV OPTICAL RECEIVER, MEASUREMENTS AND COUPLING 9

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

UNIT - V OPTICAL COMMUNICATION SYSTEMS AND NETWORKS 9

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

TOTAL: 45 PERIODS

OUTCOMES:

On successful completion of the course student will 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. Explain optical sources and detectors with their use in optical communication system.
4. Discuss fiber optic receiver systems and measurement techniques.
5. Understand fiber joints and coupling.
6. Analyze optical communication systems and its networks.

TEXT BOOKS:

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

REFERENCES:

1. John M. Senior , “Optical Fiber Communication”, Second Edition, Pearson Education, 2007.
2. Rajiv Ramaswami,”Optical Networks” , Second Edition, Elsevier , 2004.
3. J.Gower, “Optical Communication System”, Prentice Hall of India, 2001.
4. Govind P. Agrawal, “Fiber-optic communication systems”, third edition, John Wiley & sons, 2004.

21EC1711	EMBEDDED SYSTEMS AND ROBOTICS LABORATORY	L	T	P	C
		0	0	4	2

OBJECTIVES:

- To learn the working of ARM processor.
- To understand the Building Blocks of Embedded Systems.
- To know the characteristics of Real Time Systems.
- To understand about Arduino microcontroller.
- To select appropriate hardware and microcontrollers based on need of application.
- To control motors using Arduino.

LIST OF EXPERIMENTS

1. Study of ARM microcontroller system
2. Interfacing ADC and DAC with ARM7.
3. Interfacing LED and to verify the output in ARM7.
4. Interfacing PWM and to verify the output in ARM7.
5. Interfacing real time clock and serial port in ARM7.
6. Interfacing keyboard and LCD with ARM7.
7. Interfacing stepper motor with ARM7
8. Interfacing temperature sensor with ARM7.
9. Control the dc motor on Arduino Robot in all directions.
10. Control the servo motor using Arduino board
11. Build a model with line following algorithm and run with Arduino Board.
12. Mini Projects using embedded system and Robotics.

TOTAL: 60 PERIODS

OUTCOMES:

On successful completion of the course student will be able to:

1. Design applications using ARM processor.
2. Write programs for interfacing keyboard, display, motor and sensor.
3. Develop programs for hardware interfacing with Arduino.
4. Formulate a mini project using embedded system and robotics.
5. Function effectively as an individual and in a team to accomplish the given task.
6. Gain knowledge to identify microcontroller and design a system for given application.

21EC1712 ADVANCED COMMUNICATION LABORATORY

L	T	P	C
0	0	4	2

OBJECTIVES:

- To understand the working principle of optical sources, detector, fibers
- To develop understanding of simple optical communication link
- To understand the measurement of BER, Pulse broadening
- To understand the characteristics of Microwave Devices
- To measure Various Microwave parameters
- To understand the characteristics of Microwave IC Filter

LIST OF OPTICAL EXPERIMENTS

1. Measurement of connector, bending and fiber attenuation losses.
2. Numerical Aperture and Mode Characteristics of Fibers.
3. DC Characteristics of LED and PIN Photo diode.
4. Fiber optic Analog and Digital Link Characterization - frequency response (analog), eye diagram and BER (digital)

LIST OF MICROWAVE EXPERIMENTS

1. VSWR and Impedance Measurement and Impedance Matching
2. Characterization of Directional Couplers, Isolators, Circulators
3. Gunn Diode Characteristics
4. Microwave IC – Filter Characteristics

TOTAL: 60 PERIODS

OUTCOMES:

On successful completion of the course student will be able to:

1. Analyze the performance of simple optical link by measurement of losses and analyzing the mode characteristics of fiber.
2. Develop simple Optical communication Link.
3. Analyze the Eye Pattern, Pulse broadening of optical fiber and the impact on BER.
4. Understand the intricacies in Microwave System design.
5. Measure the various Microwave parameters.
6. Analyze the characteristics of Microwave IC Filter.

SYLLABUS OF PROFESSIONAL ELECTIVE COURSES: VERTICALS

VERTICAL I VLSI CHIP DESIGN AND TESTING

21EC1901	ASIC DESIGN	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To learn the fundamentals of ASIC and its design methods.
- To gain knowledge on programmable architectures for ASICs.
- To learn advanced FPGA architectures.
- To understand the physical design of ASIC.
- To analyze algorithms of physical design of ASIC.
- To gain knowledge about ASIC System on Chip design.

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

Types of Asics - Design Flow - CMOS Transistors - Combinational Logic Cell – Sequential Logic Cell - Data Path Logic Cell - Transistors as Resistors - Transistor Parasitic Capacitance- Logical Effort.

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

Anti Fuse - Static RAM - EPROM and EEPROM Technology - ACTEL ACT- Xilinx LCA –ALTERA FLEX - ALTERA MAX DC & AC Inputs and Outputs - Clock & Power Inputs - Xilinx I/O Blocks.

UNIT - III PROGRAMMABLE ASIC ARCHITECTURE 9

Architecture and Configuration of ARTIX / Cyclone and KINTEX Ultra Scale / STRATIX FPGA – Micro-Blaze / NIOS Based Embedded Systems – Signal Probing Techniques.

UNIT - IV LOGIC SYNTHESIS, PLACEMENT AND ROUTING 9

Logic Synthesis - Floor Planning Goals and objectives, Measurement of Delay in Floor Planning, Floor Planning Tools, I/O and Power Planning, Clock Planning, Placement Algorithms. Routing: Global Routing, Detailed Routing, Special Routing.

UNIT - V SYSTEM-ON-CHIP DESIGN 9

SoC Design Flow, Platform-Based and IP Based SoC Designs, Basic Concepts of Bus Based Communication Architectures, High Performance Filters using Delta-Sigma Modulators, Applications: Digital Camera, SDRAM, High Speed Data standards.

TOTAL: 45 PERIODS

OUTCOMES:

On successful completion of the course student will be able to:

1. Apply Logical Effort Technique for predicting Delay, Delay Minimization and FPGA architectures.
2. Design Logic Cells and I/O Cells.
3. Analyze the various resources of recent FPGAs.
4. Understand the Algorithms for Floor Planning and Placement of Cells.
5. Apply Routing Algorithms for Optimization of Length and Speed.
6. Understand System on Chip Design of ASIC.

TEXT BOOKS:

1. M.J.S.Smith,“Application Specific Integrated Circuits, Pearson”, 2004
2. Steve Kilts,“Advanced FPGA Design”, Wiley Inter-Science,2006.

REFERENCES:

1. Wayne Wolf , ”FPGA-Based System Design”, Prentice Hall PTR, 2009.
2. Farzad Nekoogar and Faranak Nekoogar, “From ASICs to SOCs: A Practical Approach “, Prentice Hall PTR, 2003.
3. Roger Woods, John Mcallister, Dr. Ying Yi, Gaye Lightbod,“FPGA-Based Implementation of Signal Processing Systems”, Wiley, 2008.

21EC1902	CAD FOR VLSI DESIGN	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To introduce the VLSI design methodologies and design methods.
- To understand data structures and algorithms required for VLSI design.
- To study algorithms for partitioning and placement.
- To study algorithms for floor planning and routing.
- To study different modelling in VLSI design
- To gain knowledge about simulation and synthesis of VLSI design

UNIT – I INTRODUCTION 9

Introduction to VLSI Design Methodologies - VLSI Design Cycle - New Trends in VLSI Design Cycle - Physical Design Cycle - New Trends in Physical Design Cycle - Design Styles - Review of VLSI Design Automation Tools.

UNIT - II DATA STRUCTURES AND BASIC ALGORITHMS 9

Introduction to Data Structures and Algorithms - Algorithmic Graph Theory and Computational Complexity - Tractable and Intractable Problems - General Purpose Methods for Combinatorial Optimization.

UNIT - III PARTITIONING AND PLACEMENT 9

Layout Compaction - Problem Formulation -Algorithms for Constraint Graph Compaction - Partitioning - Placement - Placement Algorithms.

UNIT - IV FLOOR PLANNING AND ROUTING 9

Floor planning - Problem Formulation - Floorplanning Algorithms - Routing - Area Routing - Global Routing - Detailed Routing.

UNIT - V MODELLING, SIMULATION AND SYNTHESIS 9

Simulation - Gate Level Modeling and Simulation - Logic Synthesis and Verification Binary Decision Diagrams - High Level Synthesis.

TOTAL: 45 PERIODS

OUTCOMES:

On successful completion of the course student will be able to:

1. Apply various VLSI design methodologies.
2. Understand different data structures and algorithms required for VLSI design.
3. Apply algorithms for partitioning and placement.
4. Apply algorithms for floor planning and routing.
5. Analyze different modellings in VLSI design.
6. Understand simulation and synthesis of VLSI design.

TEXT BOOKS:

1. Sabih H. Gerez, “Algorithms for VLSI Design Automation”, Second Edition, Wiley-India, 2017.
2. Naveed a. Sherwani, “Algorithms for VLSI Physical Design Automation”, 3rd Edition,Springer, 2017.

REFERENCES:

1. Charles J. Alpert, Dinesh P. Mehta and Sachin S Sapatnekar,“Handbook of Algorithms for Physical Design Automation”, CRC Press, 1st Edition, 2009.
2. N.A. Sherwani, “Algorithms for VLSI Physical Design Automation”,Kluwer Academic Publishers, 2002.

21EC1903 **MIXED SIGNAL IC DESIGN**

L	T	P	C
3	0	0	3

OBJECTIVES:

- To study the mixed signal of submicron CMOS circuits
- To understand the various integrated based filters and topologies
- To learn architectures of various data converters
- To understand modeling of data converters
- To gain knowledge about improving SNR of various filters
- To 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 - MOSFET Switch, Delay Elements, 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, GmC integrators, Discrete time integrators, Filtering Topologies-Bilinear transfer function, 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** **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.

TOTAL: 45 PERIODS

OUTCOMES:

On successful completion of the course student will be able to:

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

TEXT BOOKS:

1. R.Jacob Baker, "CMOS Mixed Signal Circuit Design", Wiley India, IEEE Press, reprint 2008.
2. Floyd M. Gardner ,"Phase Lock Techniques" , John wiley & Sons, Inc 2005

REFERENCES:

1. Behzad Razavi , " Design of Analog CMOS Integrated Circuits ", McGraw Hill, 33rd Reprint, 2016.
2. R.Jacob Baker," CMOS Circuit Design, Layout and Simulation", Wiley India, IEEE Press, Second Edition, reprint 2009.

21EC1904 **LOW POWER IC DESIGN**

L	T	P	C
3	0	0	3

OBJECTIVES:

- To identify sources of power in an IC.
- To identify the power reduction techniques based on technology independent and technology dependent methods.
- To identify suitable techniques to reduce the power dissipation.
- To gain knowledge about advanced techniques for low power IC design.
- To estimate power dissipation at various levels in IC design.
- To develop algorithms for low power dissipation.

UNIT – I POWER DISSIPATION IN CMOS 9

Hierarchy of Limits of Power - Sources of Power Consumption - Physics of Power Dissipation in CMOS FET Devices - Basic Principle of Low Power Design.

UNIT - II POWER OPTIMIZATION 9

Logic Level Power Optimization - Circuit Level Low Power Design - Gate Level Low Power Design -Architecture Level Low Power Design - VLSI Subsystem Design of Adders, Multipliers, PLL, Low Power Design.

UNIT - III DESIGN OF LOW POWER CMOS CIRCUITS 9

Computer Arithmetic Techniques for Low Power System - Reducing Power Consumption in Combinational Logic, Sequential Logic, Memories - Low Power Clock - Advanced Techniques - Special Techniques, Adiabatic Techniques.

UNIT - IV POWER ESTIMATION 9

Power Estimation Techniques, Circuit Level, Gate Level, Architecture Level, Behavioral Level, Logic Power Estimation - Simulation Power Analysis -Probabilistic Power Analysis.

UNIT - V SYNTHESIS AND SOFTWARE DESIGN FOR LOW POWER CMOS CIRCUIT 9

Synthesis for Low Power - Behavioral Level Transform -Algorithms for Low Power - Software Design for Low Power.

TOTAL: 45 PERIODS

OUTCOMES:

On successful completion of the course student will be able to:

1. Understand power dissipation in MOS circuits.
2. Analyze power optimization at various abstraction levels.
3. Apply low power techniques for VLSI circuits.
4. Understand advanced techniques for low power IC design.
5. Analyze power estimation at various levels in IC design.
6. Develop algorithms to reduce power dissipation by software.

TEXT BOOKS:

1. J.Rabaey, “Low Power Design Essentials (Integrated Circuits and Systems)”, Springer, 2017.
2. Kaushik Roy and S.C.Prasad,”Low Power CMOS VLSI Circuit Design”, Wiley, 2009.

REFERENCES:

1. J.B.Kulo and J.H Lou,”Low Voltage CMOS VLSI Circuits”, Wiley 1999.
2. James B.Kulo, Shih-Chia Lin, “Low Voltage SOI CMOS VLSI Devices and Circuits”, John Wiley and Sons, Inc. 2001.

21EC1905 VLSI TESTING AND DESIGN FOR TESTABILITY

L	T	P	C
3	0	0	3

OBJECTIVES:

- To understand basics of testing and fault modeling.
- To learn test generation for combinational logic circuits.
- To learn test generation for sequential logic circuits.
- To study various approaches for testability.
- To gain knowledge about test pattern generation and algorithms.
- To study fault diagnosis in VLSI circuits.

UNIT – I TESTING AND FAULT MODELING 9

Introduction to testing - Faults in Digital Circuits - Modeling of faults - Logical Fault Models -Fault detection - Fault Location - Fault dominance - Logic simulation - Types of simulation -Delay models - Gate Level Event - driven simulation.

UNIT - II TEST GENERATION 9

Test generation for combinational logic circuits - Testable combinational logic circuit design - Test generation for sequential circuits - design of testable sequential circuits.

UNIT - III DESIGN FOR TESTABILITY 9

Design for Testability - Ad-hoc design - generic scan based design - classical scan based design- system level DFT approaches.

UNIT - IV SELF - TEST AND TEST ALGORITHMS 9

Built-In self-test - test pattern generation for BIST - Circular BIST - BIST Architectures - Testable Memory Design - Test Algorithms - Test generation for Embedded RAMs

UNIT - V FAULT DIAGNOSIS 9

Logical Level Diagnosis - Diagnosis by UUT reduction - Fault Diagnosis for Combinational Circuits - Self-checking design - System Level Diagnosis.

TOTAL: 45 PERIODS

OUTCOMES:

On successful completion of the course student will be able to:

1. Analyze the concept of testing and fault in VLSI digital circuits.
2. Apply test generation for combinational logic circuits.
3. Apply test generation for sequential logic circuits.
4. Realize various approaches for testability.
5. Understand test pattern generation and algorithms.
6. Analyze fault diagnosis in VLSI circuits.

TEXT BOOKS:

1. A.L.Crouch,“Design Test for Digital IC’s and Embedded Core Systems, Prentice Hall International, 2007.
2. M. Abramovici, M.A.Breuer and A.D. Friedman,“Digital systems and Testable Design”, Jaico Publishing House, 2001.

REFERENCES:

1. M.L.Bushnell and V.D.Agrawal,”Essentials of Electronic Testing for Digital, Memory and Mixed Signal VLSI Circuits”, Kluwer Academic Publishers, 2013.
2. P.K. Lala,”Digital Circuit Testing and Testability”, Academic Press, 2002.

21EC1906	SYSTEM ON CHIP	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To learn the fundamental system Processor architecture
- To gain knowledge on design concepts underlying system on chips
- To study processor selection for SoCs
- To introduce SOC memory design
- To learn basic interconnect architectures and SOC customization
- To familiarize the concepts of SOC to FPGA based embedded processor

UNIT – I SYSTEM ARCHITECTURE: OVERVIEW 9

Components of the system processor architectures-Memory and addressing system level - interconnection- SoC design requirements and specifications-design integration- design complexity cycle time, die area and cost, ideal and practical scaling, area-time-power trade off in processor design, Configurability.

UNIT - II PROCESSOR SELECTION FOR SOCs 9

Overview -soft processors, processor core selection. Basic concepts, instruction set, branches, interrupts and exceptions, Basic elements in instruction handling - Minimizing pipeline delays -reducing the cost of branches -Robust Processors-Vector processors, VLIW processors, Superscalar processors.

UNIT - III MEMORY DESIGN 9

SoC external memory, SoC internal memory, Scratch pads and cache-memory cache organization and write policies-strategies for line replacement at miss time - split I and D caches-multilevel caches-SoC memory systems-board based memory systems-simple processor/memory interaction.

UNIT - IV INTERCONNECT ARCHITECTURES AND SOC CUSTOMIZATION 9

Bus architectures - SoC standard buses AMBA, Core Connect-Processor customization approaches -Reconfigurable technologies-mapping designs onto reconfigurable devices - FPGA based design-Architecture of FPGA, FPGA interconnect technology, FPGA memory, Floor plan and routing.

UNIT - V FPGA BASED EMBEDDED PROCESSOR 9

Hardware software task partitioning-FPGA fabric Immersed Processors-Soft Processors and Hard Processors -Tool flow for Hardware/Software Co-design-Interfacing Processor with memory and peripherals -Types of On-chip interfaces - Wishbone interface, Avalon Switch Matrix, OPB Bus Interface, creating a Customized Microcontroller – FPGA based Signal Interfacing and Conditioning.

TOTAL: 45 PERIODS

OUTCOMES:

On successful completion of the course student will be able to:

1. Understand the fundamental system Processor architecture
2. Analyse design concepts underlying system on chips.
3. Apply knowledge of processor selection for SoCs.
4. Understand the design of SOC memory
5. Analyze interconnect architectures and SOC customization
6. Apply the concepts of SOC to FPGA based embedded processor

TEXT BOOKS:

1. Flynn, MJ, Luk, W, “Computer System Design: System-on-Chip”, Wiley India Pvt. Ltd, 2011.
2. Steve Furber, “Arm System-On-Chip Architecture”, 2/E. India, Pearson Education, 2001.

REFERENCES:

1. Wayne Wolf, “Modern VLSI Design -System- on-Chip Design”, Prentice Hall, 3rd Edition, 2008.
2. Wayne Wolf, “Modern VLSI Design – IP based Design”, Prentice Hall, 4th Edition, 2008 .

21EC1907	NETWORKS ON CHIP	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To understand the concept of Network - on - Chip
- To learn router architecture designs
- To gain knowledge about routing algorithms
- To perform testing of NOC
- To study about fault tolerance of NOC
- To understand about three dimensional integration of Network-on-Chip

UNIT - I INTRODUCTION TO NOC 9

Introduction to NOC - OSI layer rules in NOC - Interconnection Networks in Network-on-Chip -Network Topologies - Switching Techniques - Routing Strategies - Flow Control Protocol Quality-of-Service Support

UNIT - II ARCHITECTURE DESIGN 9

Switching Techniques and Packet Format - Asynchronous FIFO Design -GALS Style of Communication - Wormhole Router Architecture Design - VC Router Architecture Design - Adaptive Router Architecture Design

UNIT - III ROUTING ALGORITHM 9

Packet routing-QOS, Congestion control and Flow control - Router Design - Network Link Design - Efficient and Deadlock-Free Tree-Based Multicast Routing Methods - Path-Based Multicast Routing for 2D and 3D Mesh Networks- Fault-Tolerant Routing Algorithms - Reliable and Adaptive Routing Algorithms

UNIT - IV TEST AND FAULT TOLERANCE OF NOC 9

Design-Security in Networks-On-Chips-Formal Verification of Communications in Networks-on Chips-Test and Fault Tolerance for Networks-on-Chip Infrastructures-Monitoring Services for Networks-on-Chips.

UNIT - V THREE-DIMENSIONAL INTEGRATION OF NETWORK-ON-CHIP 9

Three-Dimensional Networks-on-Chips Architectures - A Novel Dimensionally-Decomposed Router for on-Chip Communication in 3D Architectures - Resource Allocation for QoS on-Chip Communication - on-Chip Protocols, Processor Traffic Modeling for Networks-on-Chip

TOTAL: 45 PERIODS

OUTCOMES:

On successful completion of the course student will be able to:

1. Understand the concept of Network - on – Chip.
2. Understand different router architecture design.
3. Apply different routing algorithms.
4. Perform testing of NOC.
5. Learn fault tolerance of NOC.
6. Understand about three dimensional integration of Network-on-chip.

TEXT BOOKS:

1. Fayez Gebali,Haytham Elmiligi, Mohamed Watheq E1-Kharashi, "Networks-On-Chips Theory and Practice CRC Press, 2009.
2. Konstantinos Tatas and Kostas Siozios "Designing 2D and 3D Network-On-Chip Architectures" 2013.

REFERENCES:

1. Palesi, Maurizio, Daneshtalab, Masoud "Routing Algorithms in Networks-On-Chip" 2014
2. Chrysostomos Nicopoulos, Vijaykrishnan Narayanan, Chita R.Das, "Networks-On – Chip Architectures Holistic Design Exploration", Springer, 2010

Vertical II - Signal Processing

21EC1908	DSP ARCHITECTURE AND PROGRAMMING	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To understand the Basics and Fundamentals of Digital Signal Processors
- To study TMS320C5x DSP's Architecture, On-chip Peripherals and Instruction set
- To study TMS320C6x DSP's Architecture, On-chip Peripherals and Instruction set
- To study the Advanced DSP Architecture and FFT Calculation
- To write a Program for signal processing applications
- To study 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 TMS320C5X PROCESSOR 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.

TOTAL: 45 PERIODS

OUTCOMES:
On successful completion of the course student will be able to:

1. Analyze the concepts of Digital Signal Processors.
2. Demonstrate their ability to program the TMS320C5x DSP processor for signal processing applications.
3. Demonstrate their ability to program the TMS320C6x DSP processor for signal processing applications.
4. Analyze Advanced DSP Architecture.
5. Compute Fast Fourier Transform.
6. Discuss, compare and select the suitable Advanced DSP Processors for real-time signal processing applications.

TEXT BOOKS:

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.

REFERENCES:

1. Rulph Chassaing and Donald Reay, "Digital Signal Processing and Applications with the C6713 and C6416 DSK", John Wiley & Sons, Inc., Publication, 2012 (Reprint).
2. User guides Texas Instruments, Analog Devices and NXP.

21EC1909 ADVANCED DIGITAL SIGNAL PROCESSING

L	T	P	C
3	0	0	3

OBJECTIVES:

- To learn and understand the concepts of stationary and non-stationary random signals and analysis & characterization of discrete-time random processes.
- To enunciate the significance of estimation of power spectral density of random processes.
- To introduce the principles of optimum filters such as Wiener and Kalman filters
- To introduce the principles of adaptive filters and its processes.
- To learn the applications of adaptive filters relates to communication Engineering.
- To introduce the concepts of multi-resolution analysis.

UNIT - I DISCRETE-TIME RANDOM PROCESSES 9

Random variables - ensemble averages a review, random processes - ensemble averages,autocorrelation and autocovariance matrices, ergodic random process, white noise, filteringrandom processes, spectral factorization, special types of random processes - AR, MA, ARMA

UNIT - II SPECTRUM ESTIMATION 9

Bias and consistency, Non-parametric methods - Periodogram, modified-Periodogram–performance analysis, Bartlett's method, Welch's method, Blackman-Tukey method, Performance comparison, Parametric methods - autoregressive (AR) spectrum estimation-autocorrelation method, Prony's method, solution using Levinson Durbin recursion.

UNIT - III OPTIMUM FILTERS 9

Wiener filters - FIR Wiener filter - discrete Wiener Hopf equation, Applications - filtering, linear prediction, IIR Wiener filter - causal and non-causal filters, Recursive estimators - discrete Kalman filter.

UNIT - IV ADAPTIVE FILTERS 9

Principles and properties of adaptive filters - FIR adaptive filters. Adaptive algorithms – steepest descent algorithm, the LMS algorithm – convergence, Applications of adaptive filtering – noise cancellation, channel equalization.

UNIT - V MULTIRESOLUTION ANALYSIS 9

Short-time Fourier Transform - Heisenberg uncertainty principle, Principles of multi-resolution analysis - sub-band coding, the continuous and discrete wavelet transform – properties, Applications of wavelet transform - noise reduction, image compression

TOTAL: 45 PERIODS

OUTCOMES:

On successful completion of the course student will be able to:

1. Articulate and apply the concepts of special random processes in practical applications.
2. Choose appropriate spectrum estimation techniques for a given random process.
3. Articulate and apply the principles of optimum filters such as Wiener and Kalman filters.
4. Apply optimum filters appropriately for a given communication application.
5. Apply appropriate adaptive algorithm for processing non-stationary signals.
6. Apply and analyze wavelet transforms for signal and image processing based applications

TEXT BOOKS:

1. Monson H. Hayes, "Statistical digital signal processing and modeling", John Wiley and Sons Inc.New York, Indian reprint 2008.
2. P. P. Vaidyanathan, "Multirate systems and filter banks", Prentice Hall Inc. 1993.

REFERENCES:

1. John G. Proakis & Dimitris G.Manolakis, “Digital Signal Processing – Principles, Algorithms & Applications”, Fourth Edition, Pearson Education / Prentice Hall, 2007.
2. Sophoncles J. Orfanidis, "Optimum signal processing", McGraw Hill, 2000.

21EC1910	DIGITAL IMAGE AND VIDEO PROCESSING	L	T	P	C
		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.
- To understand the basics of video processing.

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.

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 AND SEGMENTATION 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, Segmentation-Edge detection, Edge linking via Hough transform - Thresholding - Region based segmentation -Region growing - Region splitting and merging -Segmentation by morphological watersheds.

UNIT - IV 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.

UNIT - V BASICS OF VIDEO PROCESSING 9

Analog video, Digital Video, Time varying Image Formation models- 3D motion models, Geometric Image formation, Photometric Image formation, sampling of video signals, filtering operations.

TOTAL: 45 PERIODS

OUTCOMES:

On successful completion of the course student will be able to:

1. Understand the basics and fundamentals of digital image processing, such as digitization, sampling, quantization, and 2D-transforms.
2. Operate on images using the techniques of smoothing, sharpening and enhancement.
3. Apply the restoration concepts and filtering techniques.
4. Apply segmentation and features extraction concepts on digital images.
5. Understand various compression standards and recognition techniques.
6. Understand the basics of video processing.

TEXT BOOKS:

1. Rafael C. Gonzalez, Richard E. Woods, 'Digital Image Processing', Pearson, Third Edition, 2010.
2. Anil K. Jain, 'Fundamentals of Digital Image Processing', Pearson, 2002.
3. Yao wang, Joem Ostarmann and Ya – quin Zhang, "Video processing and communication",1st edition, PHI.

REFERENCES:

1. Kenneth R. Castleman, 'Digital Image Processing', Pearson, 2006.
2. Rafael C. Gonzalez, Richard E. Woods, Steven Eddins, 'Digital Image Processing using MATLAB', Pearson Education, Inc., 2011.
3. D,E. Dudgeon and RM. Mersereau, 'Multidimensional Digital Signal Processing', Prentice Hall Professional Technical Reference, 1990.
4. William K. Pratt, 'Digital Image Processing', John Wiley, New York, 2002.
5. Milan Sonka et al 'Image processing, analysis and machine vision', Brookes/Cole, Vikas Publishing House, 2nd edition, 1999.
6. M. Tekalp ,"Digital video Processing", Prentice Hall International, 2015.

21EC1911 **VLSI SIGNAL PROCESSING**

L	T	P	C
3	0	0	3

OBJECTIVES:

- To introduce techniques for pipelining and parallel processing of digital filters.
- To learn the DSP structures to suit VLSI implementations.
- To introduce techniques for altering the existing DSP structures to suit VLSI implementation.
- To introduce efficient design of bit-level arithmetic DSP architectures.
- To understand numerical strength reduction, wave analysis suitable for VLSI.
- To study some applications of asynchronous pipelining.

UNIT – I PIPELINING AND PARALLEL PROCESSING OF DIGITAL FILTERS 9

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

UNIT - II ALGORITHMIC STRENGTH REDUCTION TECHNIQUE I 9

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

UNIT - III ALGORITHIMIC STRENGTH REDUCTION TECHNIQUE II 9

Fast convolution - Cook-Toom algorithm, modified Cook-Toom algorithm, Pipelined and parallel recursive filters - Look-Ahead pipelining in first-order IIR filters, Look-Ahead pipelining with powerof-2 decomposition, Clustered look-ahead pipelining, Parallel processing of IIR filters, combined pipelining and parallel processing of IIR filters.

UNIT - IV BIT-LEVEL ARITHMETIC ARCHITECTURES 9

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

UNIT - V NUMERICAL STRENGTH REDUCTION, WAVE AND ASYNCHRONOUS PIPELINING 9

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

TOTAL: 45 PERIODS

OUTCOMES:

On successful completion of the course student will be able to:

1. Implement techniques for pipelining and parallel processing of digital filters,.
2. Apply the suitable DSP structures for VLSI implementations.
3. Apply techniques for altering the existing DSP structures.
4. Design of bit-level arithmetic DSP architectures.
5. Apply numerical strength reduction, wave analysis suitable for VLSI.
6. Develop applications using asynchronous pipelining.

TEXT BOOKS:

1. Keshab K. Parhi, "VLSI Digital Signal Processing Systems, Design and implementation", Wiley, Interscience, 2007.

REFERENCES:

1. U. Meyer – Baese, " Digital Signal Processing with Field Programmable Gate Arrays", Springer, Second Edition, 2004

21EC1912 **SPEECH PROCESSING**

L	T	P	C
3	0	0	3

OBJECTIVES:

- To understand the speech production mechanism.
- To understand the various speech analysis techniques and speech models.
- To understand the speech compression coding techniques.
- To understand the speech recognition techniques.
- To know the speaker recognition techniques.
- To understand speech synthesis techniques.

UNIT – I SPEECH SIGNAL CHARACTERISTICS & ANALYSIS 9

Speech production process - speech sounds and features- Phonetic Representation of Speech- representing speech in time and frequency domains - Short-Time Analysis of Speech - Short- Time Energy and Zero-Crossing Rate - Short-Time Autocorrelation Function - Short-Time Fourier Transform (STFT) - Speech Spectrum - Cepstrum - Mel-Frequency Cepstrum Coefficients - Hearing and Auditory Perception - Perception of Loudness - Critical Bands - Pitch Perception

UNIT - II SPEECH COMPRESSION CODING TECHNIQUES 9

Need for speech coding, Waveform coding of speech – PCM, Adaptive PCM, DPCM, ADPCM, Delta Modulation, Adaptive Delta Modulation, G.726 Standard for ADPCM, Parametric Speech Coding – Channel Vocoders, Linear Prediction Based Vocoders, Code Excited Linear Prediction (CELP) based Vocoders, Sinusoidal speech coding techniques, Hybrid coder, Transform domain coding of speech

UNIT - III SPEECH RECOGNITION 9

LPC for speech recognition- Hidden Markov Model (HMM)- training procedure for HMM- subword unit model based on HMM- language models for large vocabulary speech recognition – Overall recognition system based on subword units - Context dependent subword units- Semantic post processor for speech recognition.

UNIT - IV SPEAKER RECOGNITION 9

Acoustic parameters for speaker verification- Feature space for speaker recognition-similarity measures- Text dependent speaker verification-Text independent speaker verification techniques.

UNIT - V TEXT TO SPEECH SYNTHESIS 9

Text to speech synthesis(TTS)-Concatenative-Unit selection synthesis , Diphone synthesis, Domain-specific synthesis- HMM-based synthesis and waveform synthesis methods, sub-word units for TTS, intelligibility and naturalness-role of prosody

TOTAL: 45 PERIODS

OUTCOMES:

On successful completion of the course student will be able to:

1. Analyze speech production mechanism.
2. Analyze and Design various speech techniques and speech models.
3. Design speech compression coding techniques.
4. Configure speech recognition techniques.
5. Design speaker recognition systems.
6. Design text to speech synthesis systems.

TEXT BOOKS:

1. L. R. Rabiner and R. W. Schafer, "Introduction to Digital Signal Processing, Foundations and Trends in Signal Processing", Vol. 1, Nos. 1–2 (2007) 1–194.
2. Ben Gold and Nelson Morgan "Speech and Audio signal processing- processing and perception of speech and music", John Wiley and sons 2006.

REFERENCES:

1. Lawrence Rabiner, Biiing - Hwang Juang and B.Yegnanarayana "Fundamentals of Speech Recognition", Pearson Education, 2009.
2. Claudio Becchetti and Lucio Prina Ricotti, "Speech Recognition", John Wiley and Sons, 1999.
3. Donglos O shanhnessy "Speech Communication: Human and Machine", 2nd Ed. University press 2001.

21EC1913 **COMPUTER VISION**

L	T	P	C
3	0	0	3

OBJECTIVES:

- To review image processing techniques for computer vision.
- To understand shape and region analysis.
- To understand Hough Transform and its applications to detect lines, circles, ellipses.
- To understand three-dimensional image analysis techniques.
- To understand motion analysis.
- To study some applications of computer vision algorithms.

UNIT – I **IMAGE PROCESSING FOUNDATIONS** **9**

Review of image processing techniques - classical filtering operations - Thresholding techniques - edge detection techniques - corner and interest point detection - mathematical morphology – texture.

UNIT - II **SHAPES AND REGIONS** **9**

Binary shape analysis - connectedness - object labeling and counting - size filtering - distance functions - skeletons and thinning - deformable shape analysis - boundary tracking procedures - active contours - shape models and shape recognition - centroidal profiles - handling occlusion - boundary length measures - boundary descriptors - chain codes - Fourier descriptors - region descriptors – moments.

UNIT - III **HOUGH TRANSFORM** **9**

Line detection - Hough Transform (HT) for line detection - foot-of-normal method - line localization - line fitting - RANSAC for straight line detection - HT based circular object detection - accurate center location - speed problem - ellipse detection - Case study: Human Iris location - hole detection - generalized Hough Transform (GHT) - spatial matched filtering - GHT for ellipse detection - object location - GHT for feature collation.

UNIT - IV **3D VISION AND MOTION** **9**

Methods for 3D vision - projection schemes - shape from shading - photometric stereo - shape from texture - shape from focus - active range finding - surface representations - point-based representation - volumetric representations - 3D object recognition - 3D reconstruction - introduction to motion - triangulation - bundle adjustment - translational alignment - parametric motion - spline-based motion - optical flow - layered motion.

UNIT - V APPLICATIONS 9

Application: Photo album - Face detection - Face recognition - Eigen faces - Active appearance and 3D shape models of faces Application- Surveillance - foreground-background separation - particle filters - Chamfer matching, tracking, and occlusion - combining views from multiple cameras - human gait analysis Application: In-vehicle vision system: locating roadway - road markings - identifying road signs - locating pedestrians.

TOTAL: 45 PERIODS

OUTCOMES:

On successful completion of the course student will be able to:

1. Implement fundamental image processing techniques required for computer vision.
2. Perform shape analysis.
3. Apply Hough Transform for line, circle, and ellipse detections.
4. Apply 3D vision techniques.
5. Implement motion related techniques.
6. Develop applications using computer vision techniques.

TEXT BOOKS:

1. D. L. Baggio et al., "Mastering OpenCV with Practical Computer Vision Projects", Packt Publishing, 2012.
2. E. R. Davies, "Computer & Machine Vision", Fourth Edition, Academic Press, 2012.
3. Jan Erik Solem, "Programming Computer Vision with Python: Tools and algorithms for analyzing images", O'Reilly Media, 2012.

REFERENCES:

1. Mark Nixon and Alberto S. Aquado, "Feature Extraction & Image Processing for Computer Vision", Third Edition, Academic Press, 2012.
2. R. Szeliski, "Computer Vision: Algorithms and Applications", Springer 2011.
3. Simon J. D. Prince, "Computer Vision: Models, Learning, and Inference", Cambridge University Press, 2012.

21EC1914	UNDERWATER IMAGING SYSTEMS AND IMAGE PROCESSING	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To learn the fundamental components of optical imaging
- To learn the fundamentals of optical image processing
- To understand the challenges involved in Underwater imaging
- To understand the fundamental of Ocean Acoustics
- To Understand the principle of image processing techniques
- To Learn the SONAR Systems and various applications

UNIT – I FUNDAMENTAL COMPONENTS OF OPTICAL IMAGE PROCESSING SYSTEM 9

Fundamentals and application of image processing, Human and Computer Vision, Introduction on Digital Camera-Focal length, Aperture, Shutter Speed, Spatial Resolution, Underwater lights and its importance, Halogen, LED, Colour Temperature, lumens, Beam angle, Image File format- JPEG, PNG, TIFF, BMP, GIF.

UNIT - II OPTICAL IMAGE PROCESSING 9

Image Formation, Digitization, Sampling and Quantization, Geometric Transformation, Interpolation, Image Reconstruction, Spatial Filtering, Histogram, Binary Image, Color Fundamentals, Color transformations, Color Interpolation, Morphology, Image segmentation, Pattern Recognition, Challenges involved in underwater optical imaging.

UNIT - III FUNDAMENTALS OF UNDERWATER ACOUSTICS 9

Acoustic waves, Acoustic pressure, Velocity and density, Frequency and wavelength, Intensity and power, Logarithmic notation- Decibels, absolute references and levels, Source Level, Basics of propagation losses, Target Strength, Back scattering, Acoustic noise, Multiple paths, Doppler effect, Time characteristics of echoes, Active and passive sonar equations, Underwater electro acoustic transducers- projectors and hydrophones, General Structure of SONAR systems.

UNIT - IV SONAR SIGNAL PROCESSING 9

Spatial signals-Signals in space and time, Co-ordinate systems, Propagating waves, Wave number- frequency space, Finite continuous apertures, Spatial sampling, Directivity, Beamforming, Time and frequency domain beamforming, Array gain, Angular resolution, Transmitting signalsNarrowband Vs Chirp, Matched filtering, Range resolution, Time Varying Gain (TVG), Signal intensity to image conversion.

UNIT - V DIFFERENT TYPES OF SONAR SYSTEMS 9

Passive and active sonars, Single beam echo sounder, Multi beam echo sounder, Sub-bottom profiler, Sediment profiler, Side scan sonar, Synthetic aperture sonar, Forward looking sonar.

TOTAL: 45 PERIODS

OUTCOMES:

On successful completion of the course student will be able to:

1. Understand the techniques for underwater imaging
2. Understand the fundamentals of optical image processing
3. Understand the fundamentals of underwater acoustics and ambient noise
4. Exposer for array processing techniques for underwater imaging applications
5. Design of Filter and impedance matching circuits
6. Know about SONAR system and its applications

TEXT BOOKS:

1. Bernd Jahne, "Digital Image processing, Sixth Edition, Springer,2005
2. Rafael C. Gonzalez, Richard E. Woods, Steven Eddins, "Digital Image Processing using MATLAB, Third Edition, Gatesmark Publishing,2020
3. P.K. Thiruvikraman,"A Course on Digital Image processing with MATLAB, First Edition, IOP Publishing,2020

REFERENCES:

1. Tinku & Ajoy K. Ray,"Image Processing principles & Applications, First Edition, WileyInterscience,2005
2. Xavier Lurton,"An Introduction to Underwater Acoustics (Principles andapplications), Second Edition, Springer,2010
3. Don H. Johnson and Dan E. Dudgeon,"Array Signal Processing: Concepts and Techniques, First Edition, Prentice Hall,1993
4. Harry L. Van Trees,"Optimum Array Processing, First Edition, Wiley Interscience,2002
5. Richard O. Nielsen,"Sonar Signal Processing, First Edition, Artech House,1991
6. A. D. Waite,"SONAR for Practicing Engineers, Third Edition, Wiley,2002

VERTICAL III - RF TECHNOLOGIES

21EC1915	ELECTROMAGNETIC INTERFERENCE AND COMPATABILITY	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To introduce the basic concepts of Electromagnetic Interference
- To explain 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.

TOTAL: 45 PERIODS

OUTCOMES:

On successful completion of the course student will be able to:

1. Understand the basic concepts of EMI/EMC.
2. Identify the various types and mechanisms of Electromagnetic Interference.
3. Understand various EMI coupling principles.
4. Understand EMC design for circuits and PCBs.
5. Propose a suitable EMI mitigation technique.
6. 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.
2. Henry W.Ott., “Noise Reduction Techniques in Electronic Systems”, A Wiley Inter Science Publications, John Wiley and Sons, Newyork, 1988.

REFERENCES:

1. C.R.Paul, “Introduction to Electromagnetic Compatibility” , John Wiley and Sons, Inc,1992.
2. Bemhard Keiser, “Principles of Electromagnetic Compatibility”, 3rd Ed, Artech house,Norwood,1986.
3. Don R. J.White Consultant Incorporate, “Handbook of EMI/EMC”, Vol I-V, 1988.

21EC1916 **RFID SYSTEMS AND APPLICATIONS**

L	T	P	C
3	0	0	3

OBJECTIVES:

- To understand the fundamentals of RFID systems and Sensors
- To know the design challenges needed for analysis of RFID Enabled Sensors
- To develop awareness to RFID Applications.

UNIT - I FUNDAMENTALS AND OPERATING PRINCIPLES OF RFID 9

Introduction - Barcode Systems, magnetic Strip Card, Smart cards, RFID systems- History of RFID - RFID Tag Components: Tag Antenna, Integrated Circuits, Substrate. RFID Tag Types: Passive Tags, Active Tags, 1-Bit Transponder and Chip less Tags.

UNIT - II COMMUNICATION IN RFID SYSTEMS 9

Coupling Mechanisms-Data Encoding- Multipath Effect-Tag Reader and Sensor Communication-Passive Systems-Active Systems, UWB, Zigbee and Wi-Fi Tags.

UNIT - III OPERATING PRINCIPLES OF SENSORS 9

Types of Sensors, Use of Sensors, Basic Considerations of Sensor Design, Requirements for Accuracy, Requirements for Resolution, Environment of the Sensor, Calibration, Wireless Sensors and Wireless Sensor Networks.

UNIT - IV DESIGN OF RFID-ENABLED SENSORS 9

RFID Antenna Design Challenges, Antenna Basics and the Dipole, Passive RFID Antennas Using Serial Stubs, Bowtie T-Match RFID Antenna, Passive RFID Antenna Using Inductively Coupled Feed Structure, Voltage Multiplier for RFID Integrated Circuits, Microcontroller for Active RFID-Enabled Sensor.

UNIT - V RFID APPLICATIONS 9

Access Control Transportation Ticketing-Personnel identification – Vehicle identification-Production line monitoring. Long range RFID applications: Supply chain management-Mail and shipping-Clothing Tags-Food production control.

TOTAL: 45 PERIODS

OUTCOMES:

On successful completion of the course student will be able to:

1. Describe the functions and operations of an RFID components and systems.
2. Outline the performance characteristics of different types of RFID systems.
3. Understand the basic consideration and requirement of RFID sensors.
4. Analyze the antenna design considerations for RFID-enabled sensors.
5. Explain the essential components of IC or microcontrollers and their potential use in RFID-enabled sensors.
6. Develop RFID for Social and Environmental Applications.

TEXT BOOKS:

1. Amin Rida, LiYang, Manos Tentzeris, “RFID-Enabled Sensor Design and Applications”, 2nd Edition, Artech house, 2010.
2. V. Daniel Hunt, Alber Puglia, Mike Puglia, “RFID: A guide for radio frequency identification”, Wiley & Sons, Inc., Publication, 2011.

REFERENCES:

1. Klaus Finkenzeller, “RFID Handbook – Fundamentals and applications in contact less smart cards, radio frequency identification and near-field communication”, 3rd edition,Wiley 2010.
2. Steven Shepard, “Radio Frequency Identification”, 1st Edition, McGraw Hill, 2011.

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21EC1917 **RF MEMS**

L	T	P	C
3	0	0	3

OBJECTIVES:

- To understand the basic principles of RF MEMS.
- To study and explore MEMS switches.
- To give a thorough understanding of MEMS Inductors and Capacitors.
- To give insight on micro-machined RF filters and phase shifters.

UNIT - I INTRODUCTION OF RF MEMS 9

MEMS, Micro-fabrications for MEMS, Electromechanical transducers, Micro-sensing for MEMS, Materials for MEMS.

UNIT - II RF MEMS SWITCHES AND MICRO RELAYS 9

Switch parameters, Basics of switching, Switches for RF and microwave applications, Actuation mechanisms for MEMS devices, Bistable micro relays and micro-actuators, Dynamics of the switch operation, MEMS switch design, modeling and evaluation, MEMS switch design considerations.

UNIT - III MEMS INDUCTORS AND CAPACITORS 9

MEMS inductors: Self-inductance and mutual inductance, Micro-machined inductors, Effect of inductor layout, Reduction of stray capacitance of planar inductors, Approaches for improving the quality factor, Types of Inductors.

MEMS capacitors: MEMS gap-tuning capacitors, MEMS area-tuning capacitors, Dielectric tunable capacitors.

UNIT - IV MICROMACHINED RF FILTERS 9

Modeling of mechanical filters, modeling of resonator- mechanical coupling components- general consideration for mechanical filters, Micro-mechanical filters, Surface acoustic wave filters, Bulk acoustic wave filters, Micro-machined filters for millimeter wave frequencies.

UNIT - V MICROMACHINED PHASE SHIFTERS 9

Types of phase shifters and their limitations, MEMS phase shifters, switched delay line phase shifters- distributed MEMS phase shifters-polymer, Ferroelectric phase shifters, Distributed parallel plate capacitor – Interdigital capacitor phase shifters, Applications

TOTAL: 45 PERIODS

OUTCOMES:

On successful completion of the course student will be able to:

1. Understand the basic principles of RF MEMS.
2. Explain the operation of RF MEMS switches and micro relays.
3. Explain the operation of MEMS Inductors and Capacitors.
4. Compare the properties of MEMS inductors and capacitors.
5. Understand the working operation of various micro-machined RF filters.
6. Explain the different types of micro-machined phase shifters.

TEXT BOOKS:

1. Vijay K.Varadan, Vinoy.K.J and Jose.K.A, “RF MEMS and Their Applications”, Reprint, John Wiley & Sons, 2003.
2. Gabriel M. Rebeiz, “RF MEMS: Theory, Design, and Technology”, Wiley, 2003.

REFERENCES:

1. Hector J. De Los Santos, “Introduction to Micro electromechanical Microwave Systems”, 2nd Edition, Artech House, 2004.
2. Jacopo Iannacci, “Practical Guide to RF-MEMS”, John Wiley & Sons, 2013.
3. NadimMaluf, Kirt Williams, "Introduction to Micro electromechanical Systems Engineering", Artech House, 2004.

21EC1918 **SMART ANTENNAS**

L	T	P	C
3	0	0	3

OBJECTIVES:

- To understand the basic principles of smart antennas.
- To study insight on various DOA estimation techniques.
- To explore the basics on beamforming.
- To gain knowledge on integration of smart antennas and its processing methods.

UNIT - I INTRODUCTION TO SMART ANTENNAS 9

Need for Smart Antennas, Overview, Smart Antenna Configurations, Space Division Multiple Access (SDMA), Architecture of a Smart Antenna System, Benefits and Drawbacks, Basic Principles, Mutual Coupling Effects.

UNIT - II DOA ESTIMATION FUNDAMENTALS 9

Array Response Vector, Received Signal Model, Subspace-Based Data Model, Signal Auto-covariance Matrices, Conventional DOA Estimation Methods - Conventional Beamforming Method - Capon's Minimum Variance Method, Subspace Approach to DOA Estimation - MUSIC Algorithm - ESPRIT Algorithm, Uniqueness of DOA Estimates.

UNIT - III BEAMFORMING ALGORITHMS 9

The Classical Beamformer, Statistically Optimum Beamforming Weight Vectors- The Maximum SNR Beamformer- The Multiple Sidelobe Canceller and the Maximum SINR Beamformer- Minimum Mean Square Error (MMSE)- Direct Matrix Inversion (DMI)- Linearly Constrained Minimum Variance (LCMV), Adaptive Algorithms for Beamforming- The Least Mean-Square (LMS) Algorithm- The Recursive Least-Squares (RLS) Algorithm

UNIT - IV SPACE–TIME PROCESSING 9

Discrete Space–Time Channel and Signal Models, Space–Time Beamforming, Intersymbol and Co-Channel Suppression, Space–Time Processing for DS-CDMA, Capacity and Data Rates in MIMO Systems.

UNIT - V ADAPTIVE ARRAYS 9

Spatial covariance matrix, multi-beam arrays, Scanning arrays, switched beam beamformers, Fully adaptive beamformers - Temporal reference beamforming, spatial reference beamforming, Blind beamforming algorithms – DILFAST and SCORE algorithm

TOTAL: 45 PERIODS

OUTCOMES:

On successful completion of the course student will be able to:

1. Understand the basic principles of smart antennas.
2. Explain various DOA estimation techniques.
3. Understand the fundamentals of Beamforming and its algorithm.
4. Explain the importance of integration of smart antennas using various algorithms.
5. Explain the concept of space time processing.
6. Explain the various factors for space time processing for DS-CDMA.

TEXT BOOKS:

1. Constantine A. Balanis & Panayiotis I. Ioannides, "Introduction to Smart Antennas", Morgan & Claypool Publishers' series
2. Joseph C. Liberti Jr., Theodore S Rappaport, "Smart Antennas for Wireless Communications IS

REFERENCES:

1. T.S Rappaport, "Smart Antennas Adaptive Arrays Algorithms and Wireless Position Location", IEEE press 1998, PTR – PH publishers 1999.
2. Lal Chand Godara, "Smart Antennas", CRC Press, LLC-20.
3. Ben Allen, M. Ghavami, "Adaptive Array Systems: Fundamentals and Applications', John Wiley & Sons, Ltd, 2005.

21EC1919 **RF SYSTEM DESIGN**

L	T	P	C
3	0	0	3

OBJECTIVES:

- To understand the fundamentals of RF design and Microwave integrated circuits.
- To understand the various components of RF system for Wireless Communications.
- To know the basic techniques needed for analysis of RF systems.

UNIT - I RF DEVICES & IMPEDANCE MATCHING 9

Active RF components: Semiconductor basics in RF, bipolar junction transistors, RF field effect transistors, High electron mobility transistors, Impedance matching networks- Matching using discrete components and stub tuning.

UNIT - II ACTIVE RF COMPONENT & MODELING 9

Diode Model - Linear and Non-linear Diode Model, Transistor models- Large-Signal BJT Models - Small-Signal BJT Models, Measurements of Active devices- DC Characterization of Bipolar Transistor - Measurements of AC Parameters of Bipolar Transistor- scattering parameter device characterization.

UNIT - III RF TRANSISTOR AMPLIFIERS 9

Characteristics of Amplifier, Amplifier power relations, Stability consideration, constant gain, Noise figure circles, constant VSWR circles, Broadband high power and multistage amplifiers.

UNIT - IV RF FILTER 9

Basic resonators and Filter configuration - Filter Types and Parameters- Low-Pass Filter- High-Pass Filter-Bandpass and Bandstop Filters - Insertion Loss, special filter realization- Butterworth-Type Filter- Chebyshev-Type Filters.

UNIT - V OSCILLATOR & MIXER 9

Basic oscillator model, Negative Resistance Oscillator , Quartz Oscillators, High frequency oscillator configuration- Dielectric Resonator Oscillators - YIG-Tuned Oscillator - Gum Element Oscillator, Basic characteristics of mixers - Single-Ended Mixer Design - Single-Balanced Mixer - Double-Balanced Mixer.

TOTAL: 45 PERIODS

OUTCOMES:

On successful completion of the course student will be able to:

1. Understand the basic concepts of various RF devices.
2. Explain the design of various impedance matching networks.
3. Describe the characteristics of active RF components.
4. Explore the concepts of RF transistor amplifiers.
5. Understand the design and implementation of RF filters.
6. Explain the basic concepts of RF Oscillator and Mixer.

TEXT BOOKS:

1. Reinhold Ludwig and Pavel Bretshko, “RF Circuit design Theory and Applications”, Pearson Education, Inc., 2006
2. B.Razavi, “RF Microelectronics”, Pearson Education, 1997.

REFERENCES:

1. David. M. Pozar, “Microwave Engineering”, 4th Edition, John Wiley & Sons, Inc
2. Ingo Wolff, “Coplanar Microwave Integrated circuits”, John Wiley and sons, New Jersey, 2006.
3. T. Lee, “Design of CMOS RF Integrated Circuits”, Cambridge, 2004.

21EC1920 SIGNAL INTEGRITY FOR HIGH SPEED DESIGN

L	T	P	C
3	0	0	3

OBJECTIVES:

- To study the signal propagation on transmission lines.
- To explore multi-conductor transmission lines.
- To study the insights on non-ideal effects.
- To introduce methods to improve the signal transmission characteristics.

UNIT - I SIGNAL PROPAGATION ON TRANSMISSION LINES 9

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

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

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

UNIT - III NON-IDEAL EFFECTS 9

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

UNIT - IV POWER CONSIDERATIONS AND SYSTEM DESIGN 9

SSN/SSO, DC power bus design, layer stack up, SMT decoupling, Logic families, power consumption, and system power delivery, Logic families and speed Package types and parasitic 32, SPICE, IBIS models, Bit streams, PRBS and filtering functions of link-path components, Eye diagrams, jitter, inter-symbol interference Bit-error rate, Timing analysis.

UNIT - V CLOCK DISTRIBUTION AND CLOCK OSCILLATORS 9

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

TOTAL: 45 PERIODS

OUTCOMES:

On successful completion of the course student will be able to:

1. Identify sources affecting the speed of digital circuits.
2. Characterize and model multi-conductor transmission line.
3. Identify methods to improve the signal transmission characteristics.
4. Analyze non-ideal effects of transmission line.
5. Analyze clock distribution system.
6. Understand clock oscillators.

TEXT BOOKS:

1. H. W. Johnson and M. Graham, “High-Speed Digital Design: A Handbook of Black Magic”, Prentice Hall, 1993.
2. S. Hall, G. Hall, and J. McCall, “High-Speed Digital System Design: A Handbook of Interconnect Theory and Design Practices”, Wiley-Interscience, 2000.

REFERENCES:

1. Douglas Brooks, “Signal Integrity Issues and Printed Circuit Board Design”, Prentice Hall PTR, 2003.
2. Eric Bogatin, “Signal Integrity – Simplified”, Prentice Hall PTR, 2003.

21EC1921 **COMPUTATIONAL ELECTROMAGNETICS**

L	T	P	C
3	0	0	3

OBJECTIVES:

- To build the concepts on computational electromagnetic theory
- To compute various types of problems on electromagnetics
- To develop analytical and numerical skill on electromagnetics
- To introduce the concepts on applications of computational electromagnetic theory

UNIT - I **EM REVIEW** **9**

E-field - Permittivity – Coulomb’s Law - Flux of a vector field – Gauss’s Law for E fields (Integral) - Divergence – Gauss’s Law for E fields (Differential) B-field - Permeability - Biot-Savart law – Gauss’s law for B fields (integral and differential) - Divergence Theorem - Circulation of a vector field - Curl - Stokes Theorem. Gradient. Laplacian. Poisson and Laplace equations. Ampere-Maxwell Law - Faraday-Maxwell Law - Continuity equation - Constitutive equations.

UNIT - II **NUMERICAL DIFFERENTIATION** **9**

Forward difference - Backward difference - Central difference - Higher order derivatives - Partial derivatives - Solution of Linear Systems: Matrix equivalent. Solution sets - Direct vs Iterative methods - Sparse matrices – Libraries - Gaussian Elimination - Gauss-Seidel method - Numerical Integration Riemann Sums Left/right-point rules Midpoint -Trapezoid - Simpsons rules -Error bounds -Numerical Integration Examples

UNIT - III **METHOD OF MOMENTS** **9**

Greens Functions - Surface equivalence principle - Electrostatic formulation - Magnetostatic formulation - Electric Field Integral Equation - Magnetic Field Integral Equation - Direct and Iterative Solvers

UNIT - IV **FINITE DIFFERENCE TIME DOMAIN METHODS** **9**

1D wave propagation - Vee Algorithm - Numerical dispersion and stability - Perfectly matched absorbing boundary conditions - Dispersive materials.\xa0Antenna and scattering problems with FDTD - Non-uniform grids - Conformal grids – Periodic structures

UNIT - V **APPLICATIONS OF CEM** **9**

Antennas - Biological electromagnetic effects - Electronic packing and High speed circuits - Microwave devices and circuits - Environmental issues - Surveillance and intelligence gathering - Homeland security - Signal integrity.

TOTAL: 45 PERIODS

OUTCOMES:

On successful completion of the course student will be able to:

1. Understand the concepts on computational electromagnetic theory
2. Compute various types of problems on electromagnetics
3. Understand various types of analytical and numerical techniques to solve problems on electromagnetics
4. Understand the concepts and analysis approaches of MoM and FDTD methods.
5. Apply various types of analytical and numerical techniques to solve a boundary value problem related to electromagnetics.
6. Comprehend various applications of computational electromagnetic theory

TEXT BOOKS:

1. Walton C Gibson , "The Method of Moments in Electromagnetics", CRC Press, 2014.
2. Peterson, Scott L Ray and Raj Mittra , "Computational Methods for Electromagnetics", IEEE Press Series on Electromagnetic Wave Theory, 1998.

REFERENCES:

1. Roger F Harrington, "Field Computation by Moment Methods", IEEE Press, 1993.
2. Taflove A, Hagness SC , "Computational Electrodynamics: The Finite Difference Time Domain Method", Artech House, 2004.

VERTICAL IV BIOMEDICAL TECHNOLOGIES

21EC1922	MEDICAL ELECTRONICS	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To gain knowledge about the various physiological parameters both electrical and non-electrical
- To understand the methods of recording and also transmitting the physiological 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 AND IMAGING SYSTEM 9

Cardiac pacemakers, DC Defibrillator, Dialyser, Ventilators – Positive pressure ventilator, Magnetic Resonance Imaging Systems, Ultrasonic Imaging Systems – principles - Types -Applications.

UNIT - IV PHYSICAL MEDICINE AND BIOTELEMETRY 9

Diathermies - Shortwave, Ultrasonic and Microwave type and their applications, Surgical Diathermy, Biotelemetry - Single channel – Multichannel – Applications.

UNIT - V RECENT TRENDS IN MEDICAL INSTRUMENTATION 9

Telemedicine for healthcare , Insulin Pumps, Radio pill, Endomicroscope, Brain machine interface: Fundamentals of BMI – Structure of BMI system – Classification of BMI, Lab on a chip (LOC) - Challenges of LOC- Applications of LOC.

TOTAL: 45 PERIODS

OUTCOMES:

On successful completion of the course student will be able to:

1. Discuss the human body electro- physiological parameters and recording of bio-potentials.
2. Describe the measurement techniques for various non electrical parameters.
3. Interpret the various assist devices used in the hospitals viz. pacemakers, defibrillators, dialyzers and ventilators.
4. Comprehend physical medicine methods eg. Ultrasonic, shortwave, microwave surgical diathermies.
5. Describe the principles of Bio –Telemetry.
6. Explain the recent trends in medical instrumentation.

TEXT BOOKS:

1. Leslie Cromwell, "Biomedical Instrumentation and Measurement", Prentice Hall of India, New Delhi, 2017.

REFERENCES:

1. Khandpur, R.S., "Handbook of Biomedical Instrumentation", TATA Mc Graw-Hill, New Delhi, 2013.
2. John G.Webster, "Medical Instrumentation Application and Design", 3rd Edition, Wiley India, 2014.

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21EC1923	WEARABLE MEDICAL DEVICES	L T P C
		3 0 0 3

OBJECTIVES:

- To know the hardware requirement of wearable systems.
- To understand the communication and security aspects in the wearable devices.
- To know the applications of wearable devices in the field of medicine.

UNIT - I INTRODUCTION TO WEARABLE SYSTEMS AND SENSORS 9

Wearable Systems- Introduction, Need for Wearable Systems, Drawbacks of conventional Systems for Wearable Monitoring, Applications of Wearable Systems, Types of Wearable Systems, Components of wearable Systems. Sensors for wearable systems-Inertia movement sensors, Respiration activity sensor, Inductive plethysmography, Impedance plethysmography, pneumography, Wearable ground reaction force sensor.

UNIT - II SIGNAL PROCESSING AND ENERGY HARVESTING FOR WEARABLE DEVICES 9

Wearability issues -physical shape and placement of sensor, Technical challenges-sensor design, signal acquisition, sampling frequency for reduced energy consumption, Rejection of irrelevant information. Power Requirements- Solar cell, Vibration based, Thermal based, Human body as a heat source for power generation, Hybrid thermoelectric photovoltaic energy harvests, Thermopiles.

UNIT - III WIRELESS HEALTH SYSTEMS 9

Need for wireless monitoring, Definition of Body area network, BAN and Healthcare, Technical Challenges- System security and reliability, BAN Architecture – Introduction, Wireless communication Techniques.

UNIT - IV SMART TEXTILE 9

Introduction to smart textile- Passive smart textile, active smart textile. Fabrication Techniques- Conductive Fibres, Treated Conductive Fibres, Conductive Fabrics, Conductive Inks. Case study- smart fabric for monitoring biological parameters - ECG, respiration.

UNIT - V APPLICATIONS OF WEARABLE SYSTEMS 9

Medical Diagnostics, Medical Monitoring-Patients with chronic disease, Hospital patients, Elderly patients, neural recording, Gait analysis, Sports Medicine.

TOTAL: 45 PERIODS

OUTCOMES:

On successful completion of the course student will be able to:

1. Describe the concepts of wearable system.
2. Explain the energy harvestings in wearable device.
3. Analyze the signal from bio sensors.
4. Use the concepts of BAN in health care.
5. Illustrate the concept of smart textile.
6. Compare the various wearable devices in healthcare system.

TEXT BOOKS:

1. Annalisa Bonfiglo and Danilo De Rossi, “Wearable Monitoring Systems, Springer”, 2011.
2. Zhang and Yuan-Ting, “Wearable Medical Sensors and Systems,Springer”, 2013.
3. Edward Sazonov and Micheal R Neuman, “Wearable Sensors: Fundamentals, Implementation and Applications”, Elsevier, 2014.
4. Mehmet R.Yuce and Jamil Y.Khan, “Wireless Body Area Networks Technology, implementation applications”, Pan Stanford Publishing Pvt.Ltd, Singapore, 2012.

REFERENCES:

1. Sandeep K.S, Gupta, Tridib Mukherjee and Krishna Kumar Venkatasubramanian, Body Area Networks Safety, Security, and Sustainability, Cambridge University Press, 2013.
2. Guang-Zhong Yang, Body Sensor Networks, Springer, 2006.

21EC1924 **HUMAN ASSIST DEVICES**

L	T	P	C
3	0	0	3

OBJECTIVES:

- To study the role and importance of machines that takes over the functions of the heart and lungs.
- To study various mechanical techniques that helps a non-functioning heart.
- To learn the functioning of the artificial kidney.
- To understand the tests to assess the hearing loss and development of electronic devices to compensate for the loss.
- To study about recent techniques used in arm and legs replacement.

UNIT - I HEART LUNG MACHINE AND ARTIFICIAL HEART 9

Condition to be satisfied by the H/L System. Different types of Oxygenators, Pumps, Pulsatile and Continuous Types, Monitoring Process, Shunting, The Indication for Cardiac Transplant, Driving Mechanism, Blood Handling System, Functioning and different types of Artificial Heart, Schematic for temporary bypass of left ventricle.

UNIT - II CARDIAC ASSIST DEVICES 9

Assisted through Respiration, Right and left Ventricular Bypass Pump, Auxiliary ventricle, Open Chest and Closed Chest type, Intra Aortic Balloon Pumping, Prosthetic Cardiac valves, Principle of External Counter pulsation techniques.

UNIT - III ARTIFICIAL KIDNEY 9

Indication and Principle of Haemodialysis, Membrane, Dialysate, types of filter and membranes, Different types of hemodialyzers, Monitoring Systems, Wearable Artificial Kidney, Implanting Type.

UNIT - IV RESPIRATORY AND HEARING AIDS 9

Ventilator and its types-Intermittent positive pressure, Breathing Apparatus Operating Sequence, Electronic IPPB unit with monitoring for all respiratory parameters. Types of Deafness, Hearing Aids, wearable devices for hearing correction.

UNIT - V PROSTHETIC AND ORTHOTIC DEVICES 9

Hand and Arm Replacement - Different Types of Models Externally Powered Limb Prosthesis, Lower Limb and Upper limb orthotic devices, Functional Electrical Stimulation, Sensory Assist Devices, Materials for Prosthetic and orthotic devices.

TOTAL: 45 PERIODS

OUTCOMES:

On successful completion of the course student will be able to:

1. Explain the principles and construction of artificial heart.
2. Illustrate the function of Heart lung machine.
3. Understand various mechanical techniques that improve heart function
4. Explain the functioning of the membrane or filter that cleanses the blood.
5. Describe the tests to assess the hearing loss and development of wearable devices for the hearing loss.
6. Explore the different types of models for Prosthethic and orthotic purpose.

TEXT BOOKS:

1. John. G . Webster, “Bioinstrumentation”, John Wiley & Sons (Asia) Pvt Ltd , 2014.
2. Joseph D.Bronzino, “The Biomedical Engineering Handbook”, Third Edition: Three Volume Set, CRC Press, 2006.

REFERENCES:

1. Andreas.F. Von racum, “Hand book of bio material evaluation”, Mc-Millan publishers, 2000.
2. Gray E Wnek, Gray L Browlin, “Encyclopedia of Biomaterials and Biomedical Engineering” Marcel Dekker Inc New York 2004.
3. D.S. Sunder, “Rehabilitation Medicine”, 3rd Edition, Jaypee Medical Publication, 2010.
4. Albert M.Cook and Webster J.G., “Therapeutic Medical Devices”, Prentice Hall Inc., New Jersey,2013.

21EC1925	MEDICAL IMAGING SYSTEMS	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To understand the generation of X-ray and its uses in Medical imaging.
- To describe the principle of Computed Tomography.
- To know the techniques used for visualizing various sections of the body.
- To learn the principles of different radio diagnostic equipment in Imaging.
- To discuss the radiation therapy techniques and radiation safety.

UNIT - I X RAYS 9

Nature of X-rays- X-Ray absorption – Tissue contrast, X- Ray Equipment (Block Diagram) – X-Ray Tube, the collimator, Bucky Grid, power supply, Digital Radiography - discrete digital detectors, storage phosphor and film scanning, X-ray Image Intensifier tubes – Fluoroscopy – Digital Fluoroscopy, Angiography, cine Angiography, Digital subtraction Angiography, Mammography.

UNIT - II COMPUTED TOMOGRAPHY 9

Principles of tomography, CT Generations, X- Ray sources- collimation- X- Ray detectors – Viewing systems – spiral CT scanning – Ultra fast CT scanners, Image reconstruction techniques – back projection and iterative method.

UNIT - III MAGNETIC RESONANCE IMAGING 9

Fundamentals of magnetic resonance- properties of electromagnetic waves : speed , amplitude, phase, orientation and waves in matter - Interaction of Nuclei with static magnetic field and Radio frequency wave- rotation and precession – Induction of magnetic resonance signals – bulk magnetization – Relaxation processes T1 and T2, Block Diagram approach of MRI system – system magnet (Permanent, Electromagnet and Superconductors), generations of gradient magnetic fields, Radio Frequency coils (sending and receiving), shim coils, Electronic components, fMRI.

UNIT - IV NUCLEAR IMAGING 9

Radioisotopes- alpha, beta, and gamma radiations, Radio Pharmaceuticals. Radiation detectors – gas filled, ionization chambers, proportional counter, GM counter and scintillation Detectors, Gamma camera – Principle of operation, collimator, photomultiplier tube, X-Y positioning circuit, pulse height analyzer. Principles of SPECT and PET.

UNIT - V RADIATION THERAPY AND RADIATION SAFETY 9

Radiation therapy – linear accelerator, Telegamma Machine, SRS – SRT – Recent Techniques in radiation therapy – 3D CRT – IMRT – IGRT and Cyber knife – radiation measuring instruments Dosimeter, film badges, Thermo Luminescent dosimeters – electronic dosimeter – Radiation protection in medicine – radiation protection principles.

TOTAL: 45 PERIODS

OUTCOMES:

On successful completion of the course student will be able to:

1. Describe the working principle of the X-ray machine and its application.
2. Illustrate the principle computed tomography.
3. Interpret the technique used for visualizing various sections of the body using Magnetic Resonance Imaging.
4. Demonstrate the applications of radionuclide imaging.
5. Analyze different imaging techniques and choose appropriate imaging equipment for better diagnosis and outline the methods of radiation safety.
6. Outline the methods of radiation safety.

TEXT BOOKS:

1. Isaac Bankman, I. N. Bankman , "Handbook Of Medical Imaging: Processing and Analysis(Biomedical Engineering)",Academic Press,2000.
2. Jacob Beutel (Editor), M. Sonka (Editor), "Handbook of Medical Imaging", Volume 2. Medical Image Processing and Analysis, SPIE Press 2000.
3. Khin Wee Lai, Dyah Ekashanti Octorina Dewi "Medical Imaging Technology", Springer Singapore, 2015.

REFERENCES:

1. Khandpur R.S, "Handbook of Biomedical Instrumentation", Tata McGraw – Hill, New Delhi, 2003.
2. Dougherty, Geoff(Ed.), "Medical Image Processing- Techniques and Applications " , Springer -Verlag New York, 2011.

21EC1926	WIRELESS BODY AREA NETWORKS	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To know the hardware requirement of BAN.
- To understand the communication and security aspects in the BAN.
- To know the applications of BAN in the field of medicine.

UNIT - I INTRODUCTION TO BAN 9

Definition, BAN and Healthcare, Technical Challenges- Sensor design, biocompatibility, Energy Supply, optimal node placement, number of nodes, System security and reliability, BAN Architecture – Introduction.

UNIT - II HARDWARE FOR BAN 9

Processor-Low Power MCUs, Mobile Computing MCUs, Integrated processor with radio transceiver, Memory, Antenna-PCB antenna, Wire antenna, Ceramic antenna, External antenna, Antenna design and testing, Sensor Interface, Power sources-Batteries and fuel cells for sensor nodes.

UNIT - III TECHNOLOGIES FOR BAN 9

RF communication in Body, Propagation, Base Station-Network topology-Standalone BAN, Wireless personal Area Network Technologies-IEEE 802.15.1, IEEE P802.15.13, IEEE 802.15.14.

UNIT - IV COEXISTENCE ISSUES WITH BAN 9

Interferences – Intrinsic - Extrinsic, Effect on transmission, Counter measures- on physical layer and data link layer, Regulatory issues-Medical Device regulations, Security and Self-protection-Bacterial attacks, Virus infection, Secured protocols, Self-protection.

UNIT - V APPLICATIONS OF BAN 9

Monitoring patients with chronic disease, Hospital patients, Elderly patients, Cardiac arrhythmias monitoring, Multi patient monitoring systems, Multichannel Neural recording, Gait analysis, Sports Medicine, Electronic pill.

TOTAL: 45 PERIODS

OUTCOMES:

On successful completion of the course student will be able to:

1. Comprehend and appreciate the significance and role of this course in the present contemporary world.
2. Explain various processors used for BAN.
3. Design a BAN for appropriate application in medicine.
4. Assess the efficiency of communication and the security parameters.
5. Understand the need for medical device regulation and regulations followed in various Regions.
6. Extend the concepts of BAN for medical applications.

TEXT BOOKS:

1. Sandeep K.S. Gupta,Tridib Mukherjee, Krishna Kumar Venkata Subramanian, “Body Area Networks Safety, Security, and Sustainability’’, Cambridge University Press, 2013.
2. Mehmet R. Yuce, Jamil Y.Khan, “Wireless Body Area Networks Technology, Implementation, and Applications”, Pan Stanford Publishing Pte. Ltd., Singapore, 2012.

REFERENCES:

1. Zhang, Yuan-Ting, “Wearable Medical Sensors and Systems’’, Springer, 2013.
2. Guang-Zhong Yang(Ed.), “Body Sensor Networks’’, Springer, 2006.
3. Annalisa Bonfiglio, Danilo De Rossi, "Wearable Monitoring Systems", Springer, 2011.

21EC1927	BRAIN COMPUTER INTERFACE AND APPLICATIONS	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To understand the basic concepts of brain computer interface.
- To study the various signal acquisition methods.
- To study the signal processing methods used in BCI.

UNIT - I INTRODUCTION TO BCI 9

Fundamentals of BCI – Structure of BCI system – Classification of BCI – Invasive, Non-invasive and Partially invasive BCI – EEG signal acquisition - Signal Preprocessing – Artifacts removal.

UNIT - II ELECTROPHYSIOLOGICAL SOURCES 9

Sensorimotor activity – Mu rhythm, Movement Related Potentials – Slow Cortical Potentials-P300 - Visual Evoked Potential - Activity of Neural Cells - Multiple Neuromechanisms.

UNIT - III FEATURE EXTRACTION METHODS 9

Time/Space Methods – Fourier Transform, PSD – Wavelets – Parametric Methods – AR, MA, ARMA models – PCA – Linear and Non-Linear Features.

UNIT - IV FEATURE TRANSLATION METHODS 9

Linear Discriminant Analysis – Support Vector Machines - Regression – Vector Quantization– Gaussian Mixture Modeling – Hidden Markov Modeling – Neural Networks.

UNIT - V APPLICATIONS OF BCI 9

Functional restoration using Neuroprosthesis - Functional Electrical Stimulation, Visual Feedback and control - External device control, Case study: Brain actuated control of mobile Robot.

TOTAL: 45 PERIODS

OUTCOMES:

On successful completion of the course student will be able to:

1. Describe BCI system and its potential applications.
2. Analyze event related potentials.
3. Analyze sensory motor rhythms.
4. Compute features suitable for BCI.
5. Design classifier for a BCI system.
6. Implement BCI for various applications.

TEXT BOOKS:

1. Bernhard Graimann, Brendan Allison, Gert Pfurtscheller, “Brain-Computer Interfaces: Revolutionizing Human-Computer Interaction”, Springer, 2010.
2. Mehmet R. Yuce, Jamil Y.Khan, “Wireless Body Area Networks Technology, Implementation, and Applications”, Pan Stanford Publishing Pte. Ltd., Singapore, 2012.

REFERENCES:

1. R. Spehlmann, “EEG Primer”, Elsevier Biomedical Press, 2001.
2. Arnon Kohen, “Biomedical Signal Processing”, Vol I and II, CRC Press Inc, Boca Rato, Florida, 2006.
3. Bishop C.M., “Neural Networks for Pattern Recognition”, Oxford, Clarendon Press, 2005.

PANIMALAR ENGINEERING COLLEGE - CHENNAI.
JAISAKTHI EDUCATIONAL TRUST

21EC1928	THERAPEUTIC EQUIPMENT	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To learn the principles of cardiac assist devices.
- To understand the need and use of extracorporeal devices, and the use of lasers in medicine.
- To enable the students to gain knowledge on the working of therapeutic clinical equipment.

UNIT - I CARDIAC AND RESPIRATORY THERAPY EQUIPMENT 9

Cardiac Pacemaker: Internal and External Pacemaker– Programmable pacemakers, Cardiac Defibrillators: AC and DC Defibrillator- Internal and External Defibrillators - Protection Circuit, types of Ventilators – Pressure, Volume, and Time controlled. Basic principles of electromechanical, pneumatic and electronic ventilators.

UNIT - II BIOMECHANICAL THERAPEUTIC EQUIPMENT 9

Electrodiagnosis, Therapeutic radiation, Electrotherapy, Electrodes, Stimulators for Nerve and Muscle, Functional Electrical Stimulation, peripheral nerve stimulator, ultrasonic stimulators, Stimulators for pain and relief - Inferential Therapy Unit, TENS, GAIT Assessment and Therapy.

UNIT - III BODY CARE EQUIPMENT 9

Skin Treatment: Ultrasonic spot remove, vacuum therapy unit, Skin tightening, Wrinkle Reduction, Facial and Rejuvenation, Laser hair therapy machine, Body Slimmer/Shaper – Deep Heat Therapy, Massager, Fitness – Treadmill, Bike

UNIT - IV DENTAL CARE EQUIPMENT 9

Dental Chair - Dental Hand pieces and Accessories: Evolution of rotary equipment, Low-speed hand piece, High-speed hand piece, Hand piece maintenance, Vacuum and Pneumatic techniques: Vacuum techniques, Oral evacuation systems, Vacuum pump, Pneumatic techniques, Dental compressor, Decontamination Unit and constant fumigation unit, Dental Radiography: Dental X-ray Machine

UNIT - V HEAT & PHOTON THERAPY EQUIPMENT 9

High frequency heat therapy, Short wave diathermy, Microwave diathermy, Ultrasonic therapy, Lithotripsy. Therapeutic UV and IR Lamps, Basic principles of Biomedical LASERS, Applications of lasers in medicine, CO2 laser, He-Ne laser, Nd-YAG and Ruby laser.

TOTAL: 45 PERIODS

OUTCOMES:

On successful completion of the course student will be able to:

1. Suggest suitable therapeutic devices for ailments related to cardiology.
2. Suggest suitable therapeutic devices for ailments related to pulmonology, neurology.
3. Comprehend the principles of bodycare equipment
4. Understand the operation of dental care equipment.
5. Analyze the different types of therapies for suitable applications.
6. Appreciate the application of lasers in biomedical applications

TEXT BOOKS:

1. Khandpur. R.S.,“Handbook of Biomedical Instrumentation”. Second Edition. Tata McGrawHill Pub. Co., Ltd. 2013.
2. John.G.Webster. “Medical Instrumentation, Application and Design”. Fourth Edition.Wiley &s ons, Inc., NewYork. 2019.

REFERENCES:

1. Leslie Cromwell, Fred. J. Weibell & Erich. A. Pfeiffer. “Biomedical Instrumentation and Measurements”. Second Edition. Prentice Hall Inc.2020.
2. John Low & Ann Reed. “Electrotherapy Explained, Principles and Practice”. Second Edition. Butterworth Heinemann Ltd. 2019.
3. Joseph. J. Carr, John Michael Brown, “Introduction to Biomedical Equipment Technology”, Prentice Hall and Technology, 2018.

VERTICAL V WIRELESS NETWORKS AND IOT

21EC1929	WIRELESS NETWORKS	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To understand the concept about Wireless networks, protocol stack and standards.
- To understand and analyze 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 WLANS 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.

TOTAL: 45 PERIODS

OUTCOMES:

On successful completion of the course student will be able to:

1. Understand the key concepts of wireless networks, standards, technologies and their basic operations.
2. Analyze the network layer solutions for wireless networks.
3. Familiarize with the fundamentals of 3G Services, its protocols and applications.
4. Acquainted with in depth knowledge on internetworking of WLAN and WWAN.
5. Learn about evolution of 4G Networks, its architecture and applications.
6. Implement different type of applications for smart phones and mobile devices with latest network strategies.

TEXT BOOKS:

1. Jochen Schiller, “Mobile Communication”, Second Edition, Pearson Education 2012.
2. Vijay Garg, “Wireless Communications and networking”, First Edition, Elsevier 2007.

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, Joy kuri, “Wireless Networking”, First Edition, Elsevier 2011.
3. Simon Haykin, Michael Moher, David Koilpillai, ―Modern Wireless Communications‖, First Edition, Pearson Education 2013.

21EC1930 ADHOC AND WIRELESS SENSOR NETWORKS

L	T	P	C
3	0	0	3

OBJECTIVES:

- To learn Ad hoc network and Sensor Network fundamentals.
- To understand the different routing protocols.
- To have an in-depth knowledge on sensor network architecture and design issues.
- To understand the transport layer and security issues possible in Ad hoc networks.
- To understand the transport layer and security issues possible in Sensor networks.
- To 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 6r 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.

TOTAL: 45 PERIODS

OUTCOMES:

On successful completion of the course student will be 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.
6. Gain knowledge to 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.
2. HolgerKarl , Andreas willig, "Protocol and Architecture for Wireless Sensor Networks", John wiley publication, Jan 2006.

REFERENCES:

1. Feng Zhao, Leonidas Guibas, "Wireless Sensor Networks: an information processing approach", Elsevier publication, 2004.
2. Charles E. Perkins, "Ad Hoc Networking", Addison Wesley, 2000.
3. I.F. Akyildiz, W. Su, Sankarasubramaniam, E. Cayirci, "Wireless sensor networks: a survey", computer networks, Elsevier, 2002, 394 - 422.

21EC1931	COOPERATIVE COMMUNICATIONS AND NETWORKING	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To introduce the key concepts of Cooperative communications protocols.
- To learn about the concepts of multi node Cooperative communications.
- To understand the concepts of differential modulations for various cooperative communications.
- To bring out the concepts of cooperative networks.
- To present the application of cooperative networks in broadband communication.

UNIT - I COOPERATIVE COMMUNICATIONS WITH SINGLE RELAY 9

Cooperative communications, Cooperation protocols, System model, SER analysis for DF protocol, SER analysis for AF protocol, Comparison of DF and AF cooperation gains, Trans-modulation in relay communications

UNIT - II MULTI-NODE COOPERATIVE COMMUNICATIONS 9

Multi-node decode-and-forward protocol, Multi-node amplify-and-forward protocol, Distributed space–time coding (DSTC), Distributed space–frequency coding (DSFC)

UNIT - III DIFFERENTIAL MODULATION FOR COOPERATIVE COMMUNICATIONS 9

Differential modulation, Differential modulations for DF cooperative communications, Differential modulation for AF cooperative communications

UNIT - IV COOPERATIVE NETWORKING 9

Cognitive multiple access via cooperation - System model, CCMA protocols, Stability analysis, Throughput region, Delay analysis; Content-aware cooperative multiple access - System model, protocol, Dynamic state model, Performance analysis.

UNIT - V BROADBAND COOPERATIVE COMMUNICATIONS AND COVERAGE EXPANSION 9

System model, Cooperative protocol and relay-assignment scheme, Performance analysis, Performance lower bound and Optimum relay location.

TOTAL: 45 PERIODS

OUTCOMES:

On successful completion of the course student will be able to:

1. Understand the key concepts of Cooperative communications.
2. Learn about the concepts of multi node Cooperative communications.
3. Understand the concepts of differential modulations for cooperative communications.
4. Understand about cooperative networks.
5. Apply the Cooperative communication and networking concepts to broadband communications.
6. Able to develop various networks to expand coverage area.

TEXT BOOKS:

1. K.j.Ray liu, Ahmed k.Sadek, weifeng Su and Andres kwasinski "Cooperative Communications and Networking" Cambridge University Press, 2009.

REFERENCES:

1. Y.-W. Peter Hong , Wan-Jen Huang , C.-C. Jay Kuo., "Cooperative Communications and Networking: Technologies and System Design",Kindle Edition, 2010.
2. Gerhard kramer, Ivana maric and Roy D, "Cooperative Communications (Foundations and Trends in Networking)" , Ebook PDF, Kindle Edition, in 2006.

21EC1932	IoT AND ITS APPLICATIONS	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To know the fundamentals of IoT.
- To bring the IoT perspective in thinking and building solutions using Arduino and Raspberry pi.
- To provide overview of applications of IoT and relevant technologies.
- To explore various components of the Internet of things such as Sensors, internetworking and cyber space.
- To be able to design and implement IoT circuits and solutions.

UNIT - I INTRODUCTION TO IoT SYSTEMS 9

Introduction to IoT: Sensing, Actuation, Networking basics, Communication Protocols, Sensor Networks, Machine-to-Machine Communications, IoT Definition, Characteristics. IoT Functional Blocks, Physical design of IoT, Logical design of IoT, Communication models & APIs.

UNIT - II M2M FOR IoT 9

The Vision-Introduction, From M2M to IoT, M2M towards IoT-the global context, A use case example, Differing Characteristics. Definitions, M2M Value Chains, IoT Value Chains, An emerging industrial structure for IoT.

UNIT - III M2M VS IoT AN ARCHITECTURAL OVERVIEW 9

Building architecture, Main design principles and needed capabilities, An IoT architecture outline, standards considerations. Reference Architecture and Reference Model of IoT.

UNIT - IV IoT REFERENCE ARCHITECTURE 9

Getting Familiar with IoT Architecture, Various architectural views of IoT such as Functional, Information, Operational and Deployment. Constraints affecting design in IoT world-Introduction, Technical design Constraints.

UNIT - V DOMAIN SPECIFIC APPLICATIONS OF IoT 9

Home automation, Industry applications, Surveillance applications, Other IoT applications. Cisco IoT system – IBM Watson IoT platform – Manufacturing – Converged Plant wide Ethernet Model (CPwE) – Power Utility Industry – Grid Blocks Reference Model – Smart and Connected Cities: Layered architecture, Smart Lighting, Smart Parking Architecture and Smart Traffic Control.

TOTAL: 45 PERIODS

OUTCOMES:

On successful completion of the course student will be able to:

1. Articulate IoT sensing and actuation methods and physical design of IoT systems.
2. Interpret the M2M architecture for IoT.
3. Relate architecture overview of IoT systems.
4. Infer knowledge on IoT reference architecture.
5. Memorize various application of domain specific IoT system.
6. Able to develop various projects related to IoT.

TEXT BOOKS:

1. Jan Holler, Vlasios Tsiatsis, Catherine Mulligan, Stefan Avesand, Stamatis Karnouskos, David Boyle, “From Machine-to-Machine to the Internet of Things:Introduction to a New Age of Intelligence”, 1st Edition, Academic Press, 2014.
2. Vijay Madisetti and Arshdeep Bahga, “Internet of Things (A Hands-onApproach)”, 1st Edition, VPT, 2014.

REFERENCES:

1. Francis daCosta, “Rethinking the Internet of Things: A Scalable Approach to Connecting Everything”, 1st Edition, Apress Publications, 2013
2. Cuno Pfister, “Getting Started with the Internet of Things”, O‟Reilly Media, 2011, ISBN: 978-1-4493- 9357-1

21EC1933 **IoT BASED SYSTEM DESIGN**

L	T	P	C
3	0	0	3

OBJECTIVES:

- To understand Smart Objects and IoT Architectures.
- To learn about various IOT-related protocols.
- To build simple IoT Systems using Arduino and Raspberry Pi.
- To understand data analytics and cloud in the context of IoT.
- To develop IoT infrastructure for popular applications.

UNIT - I **FUNDAMENTALS OF IoT** **9**

Evolution of Internet of Things - Enabling Technologies - 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 - II **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 - Application Transport Methods: Supervisory Control and Data Acquisition - Application Layer Protocols: CoAP and MQTT

UNIT - III **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 - IV **DATA ANALYTICS AND SUPPORTING SERVICES** **9**

Structured Vs Unstructured Data and Data in Motion Vs Data in Rest - Role of Machine Learning - No SQL Databases - Hadoop Ecosystem - Apache Kafka, Apache Spark - Edge Streaming Analytics and Network Analytics - Xively Cloud for IoT, Python Web Application Framework - Django - AWS for IoT - System Management with NETCONF-YANG.

UNIT - V **CASE STUDIES/INDUSTRIAL APPLICATIONS** **9**

Cisco IoT system - IBM Watson IoT platform - Manufacturing - Converged Plantwide Ethernet Model (CPwE) - Power Utility Industry - GridBlocks Reference Model - Smart and Connected Cities: Layered architecture, Smart Lighting, Smart Parking Architecture and Smart Traffic Control.

TOTAL: 45PERIODS

OUTCOMES:

On successful completion of the course student will be able to:

1. Gain the Knowledge of IoT devices.
2. Analyze various protocols for IoT.
3. Design a PoC of an IoT system using Rasperry Pi/Arduino.
4. Apply data analytics and use cloud offerings related to IoT.
5. Analyze applications of IoT in real time scenario.
6. Gain knowledge to build basic smart devices.

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.
2. Arshdeep Bahga, Vijay Madisetti, “Internet of Things – A hands-on approach”, Universities Press, 2015.
3. Rajkamal, “Internet of Things: Architecture, Design Principles And Applications”, McGraw Hill Higher Education, 2016

REFERENCES:

1. Olivier Hersent, David Boswarthick, Omar Elloumi , “The Internet of Things – Key applications and Protocols”, Wiley, 2012.
2. Jan Ho¨ ller, Vlasios Tsiatsis , 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.
3. Dieter Uckelmann, Mark Harrison, Michahelles, Florian (Eds), “Architecting the Internet of Things”, Springer, 2011.
4. Michael Margolis,” Arduino Cookbook, Recipes to Begin, Expand, and Enhance Your Projects”, 2nd Edition, O'Reilly Media, 2011.

21EC1934 **INDUSTRIAL IOT 4.0**

L	T	P	C
3	0	0	3

OBJECTIVES:

- To learn and understand the Importance of IIoT in industrial applications.
- To uunderstand the architecture and protocols of IIOT.
- To apply the IIoT concepts in building solutions to Industrial problems.
- To uunderstand the need of Industry 4.0.
- To learn and understand the Industry 4.0 real-world applications.
- To design and develop various industrial projects.

UNIT - I INTRODUCTION ON INDUSTRIAL IOT (IIOT) 9

Introduction on IIoT, History of IIoT, IIoT System components: Sensors, Gateways, Routers, Modem, Cloud brokers, servers and its integration, sensors and interfacing: Introduction to sensors, Transducers, Classification, Roles of sensors in IIoT, Various types of sensors, Design of sensors, sensor architecture, special requirements for IIoT sensors, Role of actuators, types of actuators.

UNIT - II IIOT ARCHITECTURE AND PROTOCOLS 9

Industrial Internet of things -Reference Architecture,complete architecture of IIOT with interfacing, Need of protocols; Types of Protocols, Wi-Fi, Wi-Fi direct, Zigbee, Z wave, BACnet, BLE, Modbus, SPI, I2C, IIoT protocols - COAP, MQTT, 6LoWPAN, LWM2M, AMPQ IIoT cloud platforms: Overview of COTS cloud platforms, Predix, PTC Thing Worx, Microsoft Azure etc. Data analytics, cloud services, Business models: SaaS, PaaS, IaaS.

UNIT - III IIOT DATA MONITORING & CONTROL 9

IoT Gate way, IoT Edge Systems and It's Programming, Cloud computing, Real Time Dashboard for Data Monitoring, Data Analytics and Predictive Maintenance with IIoT technology.

UNIT - IV INDUSTRY 4.0 9

The revolution on Industry 4.o, Sustainability assessment of Manufacturing Industries, Lean Production system, Smart factories, Cyber-physical systems, Collaboration platform and Product lifecycle management, Role of Industry 4.0 in Artificial Intelligence, Big Data and Advanced Technologies.

UNIT - V CASE STUDIES ON IIOT AND INDUSTRY 4.0 9

IIOT Applications: Healthcare, Power Plants, Inventory Management & Quality Control, Plant Safety and Security (Including AR and VR safety applications), Facility Management, Milk Processing and Packaging Industries, Food Industry.

TOTAL: 45 PERIODS

OUTCOMES:

On successful completion of the course student will be able to:

1. Apply M2M protocols for development of IIoT Applications.
2. Understand the elements of IIoT to build a total control plane in an Industrial application.
3. Learn and understand the concept of IIOT architecture and protocols.
4. Build smart factory based on the concepts.
5. Build Industrial Applications.
6. Able to develop various industrial projects.

TEXT BOOKS:

1. Sudip Misra, Chandana Roy, Anandarup Mukherjee, " Introduction to Industrial Internet of Things and Industry 4.0", 1st edition, CRC Publisher, December 2020.
2. Industry 4.0: The Industrial Internet of Things Alasdair Gilchrist Publications: Apress, 2016.

REFERENCES:

1. HakimaChaouchi, " The Internet of Things Connecting Objects to the Web",Willy Publications, 2010.
2. Olivier Hersent, David Boswarthick, Omar Elloumi, "The Internet of Things: Key Applications and Protocols", ,2ndEdition, Willy Publications, 2010
3. Inside the Internet of Things (IoT), Deloitte University Press, 2016.
4. Ovidiu, Peter, " Internet of Things-From Research and Innovation to Market Deployment" River Publishers Series, 2014.

21EC1935 WIRELESS SENSOR NETWORK DESIGN

L	T	P	C
3	0	0	3

OBJECTIVES:

- To understand the fundamentals of wireless sensor network
- To gain knowledge on the MAC and Routing Protocols of WSN
- To get exposed to 6LOWPAN technology
- To acquire knowledge on the protocols required for developing real time applications using WSN and 6LOWPAN
- To gain knowledge about operating system related to WSN and 6LOWPAN

UNIT - I INTRODUCTION 9

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

UNIT - II MAC AND ROUTING PROTOCOLS 9

MAC protocols - fundamentals, low duty cycle protocols and wakeup concepts, contention and Schedule-based protocols - SMAC, BMAC,TRAMA, Routing protocols - Requirements, Classification -SPIN, Directed Diffusion, COUGAR, ACQUIRE, LEACH, PEGASIS.

UNIT - III 6LOWPAN 9

6LoWPAN Architecture - protocol stack, Adaptation Layer, Link layers - Addressing, Routing – Mesh - Under - Route-Over, Header Compression - Stateless header compression - Context- based header compression, Fragmentation and Reassembly, Mobility - types, Mobile IPv6, Proxy Home Agent, Proxy MIPv6, NEMO - Routing - MANET, ROLL, Border routing.

UNIT - IV APPLICATIONS 9

Design Issues, Protocol Paradigms - end-to-end, Real time streaming and sessions, Publish/subscribe, Web service paradigms, Common Protocols -Web service protocols, MQ telemetry transport for sensor networks (MQTT-S), ZigBee compact application protocol (CAP),Service discovery, Simple network management protocol (SNMP), Real-time transport and sessions, Industry- Specific protocols.

UNIT - V TOOLS 9

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

TOTAL: 45 PERIODS

OUTCOMES:

On successful completion of the course student will be able to:

1. Design solutions for WSNs applications.
2. Develop efficient MAC and Routing Protocols.
3. Design solutions for 6LOWPAN applications.
4. Develop efficient layered protocols in 6LOWPAN.
5. Use Tiny OS and Contiki OS in WSNs applications.
6. Use 6LOWPAN applications.

REFERENCES:

1. Holger Karl , Andreas willig, “Protocol and Architecture for Wireless Sensor Networks”, John Wiley Publication, 2006.
2. Anna Forster, “Introduction to Wireless Sensor Networks”, Wiley, 2017.
3. Zach Shelby Sensinode and Carsten Bormann, “6LoWPAN: The Wireless Embedded Internet” John Wiley and Sons, Ltd, Publication, 2009.
4. Philip Levis, “TinyOS Programming”, 2006 –www.tinyos.net.
5. The Contiki Operating System.http://www.sics.se/contiki.

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VERTICAL VI SPACE TECHNOLOGIES

21EC1936	RADAR TECHNOLOGIES	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To explore the concepts of radar and its frequency bands.
- To understand Doppler Effect and get acquainted with the working principles of CW radar, FM- CW radar.
- To impart the knowledge of functioning of MTI and Pulse Doppler Radar.
- To learn the functioning of tracking radars and compare various trackers.
- To study the significance of radar components and its applications.

UNIT - I BASICS OF RADAR 9

Maximum Unambiguous Range, Simple form of Radar Equation, Radar Block Diagram and Operation, Radar Frequencies and Applications. Prediction of Range Performance, Minimum Detectable Signal, Receiver Noise, Integration of Radar Pulses, Radar Cross Section of Targets, Transmitter Power.

UNIT - II CW AND FREQUENCY MODULATED RADAR 9

Doppler Effect, CW Radar – Block Diagram, Isolation between Transmitter and Receiver, Non-zero IF Receiver, Receiver Bandwidth Requirements, Applications of CW radar. FM-CW Radar: Range and Doppler Measurement, Block Diagram and Characteristics, FM-CW altimeter.

UNIT - III MTI AND PULSE DOPPLER RADAR 9

MTI and Pulse Doppler Radar: Principle, MTI Radar – Power Amplifier Transmitter and Power Oscillator Transmitter, Delay Line Cancellers – Filter Characteristics, Blind Speeds, Double Cancellation, Staggered PRFs. Range Gated Doppler Filters. MTI Radar Parameters, Limitations to MTI Performance**,** MTI versus Pulse Doppler Radar.

UNIT - IV TRACKING RADAR 9

Tracking with Radar, Sequential Lobing, Conical Scan, Mono pulse Tracking Radar Amplitude Comparison Mono pulse (one- and two- coordinates), Phase Comparison Mono pulse, Tracking in Range, Acquisition and Scanning Patterns, Comparison of Trackers.

UNIT - V RADAR COMPONENTS 9

Radar Displays – types. Duplexers – Branch type and Balanced type, Circulators as Duplexers. Steered Phased Array Antennas- Basic Concepts Introduction to Phased Array Antennas – Basic Concepts, Phase Shifters, Frequency Scan Arrays, Array Elements, and Feeds for Arrays.

TOTAL: 45PERIODS

OUTCOMES:

On successful completion of the course student will be able to:

1. Gain knowledge about the fundamentals of radar operation and radar range equation.
2. Understand the functioning and applications of CW and FM-CW Radar.
3. Study the principle, performance and limitations of MTI and PULSE DOPPLER radar.
4. Describe the basic operation of tracking radar to detect the location and trajectory path of target.
5. Illustrate the classification of Phased Array Antennas used in radar communication.
6. Identify the different types of display devices & duplexers.

TEXT BOOKS:

1. Merrill I. Skolnik, “Introduction to Radar Systems”, Tata Mc Graw Hill Edition, 3rd Ed., 2001.
2. Byron Edde, “Radar: Principles, Technology, Applications”, Pearson Education, 2004.

REFERENCES:

1. Peyton Z. Peebles, “Radar Principles”, Jr., Wiley India Pvt. Ltd., 2009.
2. Mark A. Richards, James A. Scheer, William A. Holm Yesdee, “Principles of Modern Radar: Basic Principles”, 2013.
3. Merrill I. Skolnik, “Radar Handbook”, 3rd Ed., McGraw Hill Education, 2008.

PANIMALAR ENGINEERING COLLEGE, CHENNAI. JAISAKTHI EDUCATIONAL TRUST PROSPERITY ENDURANCE CHARACTER

21EC1937 **PLANETARY SCIENCE**

L	T	P	C
3	0	0	3

OBJECTIVES:

- To understand the formation of solar systems and the planetary properties.
- To study the composition and formation of planetary atmosphere.
- To impart the knowledge of satellites of different planets and the structure of rings.
- To learn about the formation of various planets.
- To understand the biological thermodynamics for the existence of life in the planets.

UNIT - I INTRODUCTION TO PLANETARY SCIENCE 9

A Brief History of the Planetary Sciences, Inventory of the Solar System, Planetary Properties, Formation of the Solar System, The Two-Body Problem, The Three-Body Problem, Perturbations and Resonances, Stability of the Solar System, Dynamics of Spherical Bodies, Orbits about an Oblate Planet.

UNIT - II PLANETARY ATMOSPHERE 9

Thermal Structure- Sources and Transport of Energy- Observed Thermal Profiles, Atmospheric Composition, Clouds, Meteorology- Coriolis Effect-Winds Forced by Solar Heating, Photochemistry-Photolysis and Recombination-Photoionization: Ionospheres, Molecular and Eddy Diffusion, Atmospheric Escape, Secondary Atmospheres-Formation, Climate Evolution.

UNIT - III PLANETARY SATELLITES AND RINGS 9

Moons of Mars: Phobos and Deimos, Satellites of Jupiter, Satellites of Saturn, Satellites of Uranus, Satellites of Neptune, Tidal Forces and Roche's Limit, Flattening and Spreading of Rings- Jupiter's Rings-Saturn's Rings-Uranus's Rings-Neptune's Rings, Ring–Moon Interactions.

UNIT - IV PLANETARY FORMATION 9

Solar System Constraints, Star Formation: A Brief Overview, Evolution of the Protoplanetary Disk, Growth of Solid Bodies, Formation of the Terrestrial Planets, Formation of the Giant Planets, Planetary Migration, Small Bodies Orbiting the Sun, Planetary Rotation, Satellites of Planets and of Minor Planets.

UNIT - V PLANETS AND LIFE 9

Drake Equation, Biological Thermodynamics, Circumstellar Habitable Zones, Planetary Requirements for Life- Biogeochemical Cycles-Gravitational and Magnetic Fields-Giant Planets and Life, Impacts and Other Natural Disasters- K–T Event-Frequency of Impacts-Volcanos and Earthquakes, Life Affects of Planets, Origin of Life, Detecting Extraterrestrial Life.

TOTAL: 45 PERIODS

OUTCOMES:

On successful completion of the course student will be able to:

1. Describe the properties of planets gravitational interactions between bodies.
2. Gain knowledge on structure, dynamics and escape of planetary atmospheres.
3. Learn about the satellites of various planets and formation of rings.
4. Acquire in depth knowledge of development of various stages of planets.
5. Explain the affects of planet on the evolution of life.
6. Obtain deeper understanding on thermodynamics and other basic physics for planetary sciences.

TEXT BOOKS:

1. Jack J. Lissauer, Imke de Pater, “Fundamental Planetary Science: Physics, Chemistry and Habitability”, Cambridge University Press, 2019.

REFERENCES:

1. Colette Salyk, Kevin Lewis, “Introductory Notes on Planetary Science The solar system, exoplanets and planet formation”, IOP Publishing, 2020.

21EC1938	REMOTE SENSING	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To know the concepts of Remote Sensing and energy resources.
- To know the types of remote sensing and sensor characteristics.
- To understand the Digital Imaging concepts.
- To understand the Data integration and analysis of remote sensing.
- To learn the Applications of remote sensing.

UNIT - I BASICS OF REMOTE SENSING 9

Concepts of Remote Sensing - elements involved in remote sensing, remote sensing terminology & units, energy resources, energy interactions with earth surface features & atmosphere, atmospheric effects, Recording of Energy by Sensor, Transmission, Reception, and Processing.

UNIT - II TYPES OF REMOTE SENSING AND SENSOR CHARACTERISTICS 9

Types of Remote Sensing: Classification Based on Platform, Energy source, Imaging media, Electromagnetic spectrum, Number of Bands, Characteristics of Images, Orbital Characteristics of Satellite, Remote sensing satellites, Sensor Resolutions, Image Referencing System, Unmanned Aerial Vehicle-based Remote Sensing.

UNIT - III DIGITAL IMAGING 9

Digital Image, Sensor: Dispersing Element, Filter, Spectrometer and Spectroradiometer, Detectors, Imaging by Scanning Technique, Hyper-Spectral Imaging, Imaging by Non-Scanning Technique, Thermal Remote Sensing.

UNIT - IV DATA INTEGRATION AND ANALYSIS 9

Multi-Approach of Remote Sensing, Integration with Ground Truth and Other Ancillary Data, Integration of Transformed Data, Integration with GIS, Process of Remote Sensing Data Analysis, Limitations of Remote Sensing Data Analysis..

UNIT - V APPLICATIONS OF REMOTE SENSING 9

Introduction, Land-Cover and Land-Use, Agriculture: Crop Type Mapping, Crop Monitoring, and Crop Damage Assessment, Forestry: Clear-cut Mapping and Deforestation, Species Identification and Typing, Burn Mapping, Geology: Structural Mapping and Terrain Analysis, Geologic Unit Mapping, Oceans, and Coastal Monitoring, Monitoring of Atmospheric Constituents.

TOTAL: 45PERIODS

OUTCOMES:

On successful completion of the course student will be able to:

1. Describe different concepts and terms used in Remote Sensing and its data.
2. Understand the types of remote sensing and sensor characteristics.
3. Understand the functions of Digital Imaging techniques.
4. Evaluate the accuracy of Data and integration with GIS.
5. Understand the process of remote sensing data analysis.
6. Understand the applications of remote sensing.

TEXT BOOKS:

1. Basudeb Bhatta, "Remote Sensing and GIS", Oxford University Press, 2^{nd} Edition, 2011.
2. Paul Jude Gibson, "Introductory Remote Sensing: Principles and Concepts", Routledge, 11 New Fetter Lane, Landon, UK. 2000. ISBN: 0-415-17024-9.
3. Kang-tsung Chang, "Introduction to Geographic Information systems", McGraw Hill Education (Indian Edition), 7^{th} Edition, 2015.
4. Michael N. Demers, "Fundamentals of Geographic Information systems", 4^{th} Edition, Wiley Publishers, 2012.

REFERENCES:

1. Thomas M. Lillesand and Ralph W. Kiefer, "Remote Sensing and Image Interpretation", Wiley Publishers, 7^{th} Edition, 2015.
2. Tor Bernhardsen, "Geographic Information systems – An Introduction", Wiley India Publication, 3^{rd} Edition, 2010.
3. Satheesh Gopi, R. SathiKumar, N. Madhu, "Advanced Surveying: Total Station, GIS and Remote Sensing" Pearson Education, 1^{st} Edition, 2007.
4. M. Anji Reddy, "Textbook of Remote Sensing and Geographical Information systems".

21EC1939 **NAVIGATION SYSTEMS**

L	T	P	C
3	0	0	3

OBJECTIVES:

- To understand the Principles of geodesy with reference to GPS.
- To know the concept of positioning and different techniques.
- To understand the satellite system configurations.
- To processing of GPS data to help for satellite survey.
- To understand the applications of satellite geodesy.

UNIT - I BASICS OF GEO POSITIONING 9

Definition – Fundamental goals of Geodesy – Definitions – basic concepts – Historical perspective – development applications in Satellite Geodesy – Geoid and Ellipsoid satellite orbital motion – Keplerian motion – Kepler's Law – Perturbing forces – Geodetic satellite.

UNIT - II OBSERVATION TECHNIQUES 9

Determination of direction by photography – SECOR – Electronic observation techniques – Doppler Effect – Positioning concept – Development of TRANSIT satellites.

UNIT - III SATELLITE SYSTEM 9

GPS – Different segments – space control and user segments – satellite configuration – GPS signal structure – Orbit determination and Orbit representation Anti Spoofing and Selective Availability – Task of control segment – GPS receivers – main receiver components – Example of GPS receivers.

UNIT - IV GPS DATA PROCESSING 9

GPS observables – code and carrier phase observation – linear combination and derived observables – concept of parameter estimation – data processing – software modules – solutions of cycle slips ambiguities RINEX format. Concepts of rapid static methods with GPS semi kinematic and pure kinematic methods – basic constellation of satellite geometry & accuracy measures.

UNIT - V SATELLITE GEODESY APPLICATIONS 9

Geodetic control surveys, Cadastral surveying, Photogrammetry & Remote Sensing, Engineering applications, and Monitoring – GIS. GLONASS, GALILEO, COMPASS and IRNSS satellite configuration comparison – Satellite Laser Ranging & Applications – Concepts of satellite altimetry.

TOTAL: 45 PERIODS

OUTCOMES:

On successful completion of the course student will be able to:

1. Learn to identify Geodesy and their functions, orbital motion.
2. Understand the concept of positioning and different techniques.
3. Identify the satellite system configurations.
4. Understand the Processing of GPS data to help for satellite survey.
5. Identify error sources in GPS observations.
6. Understand the applications of satellite geodesy.

TEXT BOOKS:

1. Gunter Seeber, "Satellite Geodesy", Copy Right 2003 By Walter De Gruyter 1993, ISBN: 3- 11-017549-5.
2. Hofmann W. B, Lichtenegger. H, Collins. J, "Global Positioning System – Theory and Practice", Springer Verlag Wein, New York.-2008.
3. Alfred Leick , "GPS Satellite Surveying", 3rd Edition, John Wiley and Sons 2004.

REFERENCES:

1. G. S. Rao, "Global Navigation Satellite Systems", 2010 Tata McGraw Hill Education Pvt. Ltd.
2. Guocheng Xu , "GPS Theory, Algorithms and Applications", Springer-Verlag, 2003.

21EC1940	SATELLITE COMMUNICATION	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To enable the student to become familiar with the basics of satellite orbits and launching.
- To understand the subsystems of satellite segment and earth segment.
- To analyze the basic link design for satellite.
- To study the various methods of satellite access.
- To familiarize with the applications of satellites.

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).

TOTAL: 45 PERIODS

OUTCOMES:

On successful completion of the course student will be able to:

1. Explain the basics of satellite orbits and launching procedures.
2. Describe the various subsystems of earth segment and space segment.
3. Analyze the satellite Link design for transmission and reception of signals.
4. Choose appropriate multiple access technique for a given satellite communication application.
5. Impart knowledge about the applications of Satellite Communications.
6. Analyze the effects of various parameters on Satellite System performance.

TEXT BOOKS:

1. Dennis Roddy, “Satellite Communication”, 4^{th} Edition, Mc Graw Hill International, 2006.
2. Timothy, Pratt, Charles, W.Bostain, JeremyE.Allnutt,"Satellite Communication”,2^{nd} Edition, Wiley Publications,2002

REFERENCES:

1. Wilbur L.Pritchard, Hendri G. Suyderhoud, Robert A. Nelson, “Satellite Communication Systems Engineering”, Prentice Hall/Pearson, 2007.
2. K. N Raja Rao,” Fundamental of Satellite Communications”, PHI, 2004.
3. Richharia, “Satellite Communication Systems-Design Principles”, Macmillan 2003.
4. Anil K. Maini, Varsha Agrawal, “Satellite Communications”, Wiley India Pvt. Ltd., 2015.

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21EC1941 **AVIONICS SYSTEMS**

L	T	P	C
3	0	0	3

OBJECTIVES:

- To study the need for avionics system and its subsystems.
- To understand the trends in display technology.
- To impart knowledge on the architecture of the avionic systems and its features.
- To learn about the integrated avionics and weapon system and its maintenance.
- To know modular avionics packaging and EMI/EMC requirements in avionics.

UNIT - I OVERVIEW 9

Need for Avionics in civil and military aircraft and space systems – Integrated Avionics system – Typical avionics sub systems – Design approaches and recent advances - Application Technologies.

UNIT - II DISPLAYS AND I/O DEVICES 9

Control and display technologies CRT, LED, LCD, EL and plasma panel - Touch screen - Direct voice input (DVI) - Civil cockpit and military cockpit: MFDS, HUD, MFK, HOTAS, HMD.

UNIT - III DIGITAL AVIONICS ARCHITECTURE 9

Avionics system architecture– Features and applications of Data buses MIL–STD 1553 B – ARINC 429 -ARINC 629 - SAFEbus /FlexRay - Time triggered communication protocol/controller Area network - AFDX - CSDB.

UNIT - IV ELECTRONIC FLIGHT CONTROL SYSTEM 9

Types of modern control system, Integrated avionics and weapon system, Fault tolerant systems, Utility systems reliability and maintainability: maintenance - Built in test equipment, certification. Case Study: Air Traffic Control Logic.

UNIT - V PACKAGING AND EMI/EMC 9

Modular Avionics Packaging, Trade-off studies, ARINC and DOD types, system cooling, EMI/EMC requirements BIT and CFDS, Automatic Test Equipment, Speeds maintenance, ATLAS, Remote diagnostics and maintenance support-Life Cycle Costs for Military and Civil Avionics.

TOTAL: 45 PERIODS

OUTCOMES:

On successful completion of the course student will be able to:

1. Conceptualize systems and subsystems of avionics.
2. Get familiarize with the control and display technologies.
3. Explain the features and application of the digital avionics system.
4. Develop knowledge on the fault system and maintenance of flight control system
5. Identify the packaging techniques and standards of avionics systems.
6. Understand the maintenance and cost aspects of avionics systems.

TEXT BOOKS:

1. Collinson R.P.G. “Introduction to Avionics”, Chapman and Hall, 3rd edition, 2011.
2. Cary R .Spitzer, “The Avionics Handbook”, CRC Press, 2000.

REFERENCES:

1. Spitzer, C.R. “Digital Avionics Systems”, CRC Press, Taylor & Francis Group, Boca Raton,2015.
2. Brain Kendal, “Manual of Avionics”, Wiley India Pvt Ltd, 3rd edition, 2011.
3. Middleton, D.H. “Avionics Systems”, Longman Scientific and Technical, Longman Group UK Ltd., England, 1989.

21EC1942 ROCKETRY AND SPACE MECHANICS

	L	T	P	C
	3	0	0	3

OBJECTIVES:

- To introduce solar system and solar time.
- To introduce the basic concepts of orbital mechanics with particular emphasis on interplanetary trajectories.
- To know rocketry and missile systems.
- To understand the rocket motion through atmosphere.
- To know the stages and control methods of rocket vehicle.

UNIT - I SOLAR SYSTEM 9

The Solar System – References Frames and Coordinate Systems-The Celestial Sphere– The Ecliptic – Motion of Vernal Equinox-Sidereal Time – Solar Time – Standard Time –The Earth's Atmosphere-Galilean transformation Keplers Law, Newton Law of gravitation.

UNIT - II SATELLITE ORBITS 9

Estimation of orbital and escape velocity - The many body Problem – Lagrange Jacobian Identity-The Circular Restricted Three Body Problem-Liberation Points-Relative Motion in the N-body Problem Two – Body Problem-Satellite Orbits – Relations between Position and Time – Orbital Elements.

UNIT - III ROCKET MOTOR 9

Principle of operation of rocket motor - thrust equation- one dimensional and two dimensional rocket motions in free space and homogeneous gravitational fields-Description of vertical, inclined and gravity turn trajectories determinations of range and altitude- simple approximations to burnout velocity.

UNIT - IV ROCKET MOTION 9

Description of various loads experienced by a rocket passing through atmosphere-drag estimation – wave drag, skin friction drag, form drag and base pressure drag-Boat-tailing in missiles –performance at various altitudes.

UNIT - V ROCKET STAGES 9

Need for multi staging of rocket vehicle- multistage vehicle optimization- Stage separation dynamics and separation techniques- Aerodynamic and jet control methods of rocket vehicles – SITVC- Basics of rocket nozzles – principle- Conical and bell shaped nozzles- Adapted nozzles- Rocket dispersion – launching problems.

TOTAL: 45 PERIODS

OUTCOMES:

On successful completion of the course student will be able to:

1. Know about solar system and solar time
2. Understand the orbital mechanics with particular emphasis on interplanetary trajectories.
3. Awareness about the rocketry and missile systems
4. Know about rocket motion through atmosphere.
5. Understand the stages of rocket vehicle.
6. Understand the control methods used in rocket vehicle.

TEXT BOOKS:

1. G.P. Sutton, "Rocket Propulsion Elements", John Wiley & Sons Inc., New York, 5th Edition, 1986.
2. J.W. Cornelisse, "Rocket Propulsion and Space Dynamics", J.W. Freeman & Co., Ltd., London, 1982.

REFERENCES:

1. Van de Kamp, "Elements of astromechanics", Pitman Publishing Co., Ltd., London, 1980.
2. E.R. Parker, "Materials for Missiles and Spacecraft", McGraw-Hill Book Co., Inc., 1982.

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VERTICAL VII RADIO COMMUNICATION AND BROADBAND NETWORKS

21EC1943	BROADBAND ACCESS TECHNOLOGIES	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To understand the various Access Technologies.
- To understand the functions of Digital Subscriber Lines.
- To comprehend operation of Cable Modem.
- To explore various Fiber Access Technologies.
- To comprehend the concepts of Broad Band Access.

UNIT - I REVIEW OF ACCESS TECHNOLOGIES 9

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

UNIT - II DIGITAL SUBSCRIBER LINES 9

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

UNIT - III CABLE MODEM 9

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

UNIT - IV FIBER ACCESS TECHNOLOGIES 9

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

UNIT - V BROAD BAND WIRELESS 9

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

TOTAL: 45 PERIODS

OUTCOMES:

On successful completion of the course student will be able to:

1. Describe the various Access Technologies.
2. Identify the functions of Digital Subscriber Lines.

3. Apply operation of Cable Modem.
4. Analyze various Fiber Access Technologies.
5. Explain the concepts of Broad Band Access.

TEXT BOOKS:

1. Niel Ransom and Albert A. Azzam, “Broadband Access Technologies: ADSL, VDSL Cable Modem, Fiber and LMDS”, McGraw Hill 1999.
2. Gilbert Held, “Next Generation Modems: A Professional Guide to DSL and cable modems”, John Wiley & sons.

REFERENCES:

1. Walter J Woralski, “ADSL and DSL Technologies”, McGraw Hill computer Communication series, 1998.
2. William Webb, “Introduction to Wireless Local Loop broadband and narrow band system”, Artech House, 2000.
3. Martin P. Clarke, “Wireless Access Network: Fixed Wireless Access and WLL network Design and operation”, John Wiley & Sons 2000.

21EC1944	SOFTWARE DEFINED NETWORKS	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To understand the need for SDN and its data plane operations.
- To understand the functions of control plane.
- To comprehend the migration of networking functions to SDN environment.
- To explore various techniques of network function virtualization.
- To comprehend the concepts behind network virtualization.

UNIT - I SDN: BACKGROUND AND DATA PLANE 9

Evolving Network Requirements – The SDN Approach – SDN and NFV-Related Standards – SDN Data Plane – Open Flow Logical Network Device – Open Flow Protocol.

UNIT - II SDN CONTROL PLANE 9

SDN Control Plane Architecture: Southbound Interface, Northbound Interface – Control Plane Functions – ITU-T Model – Open Daylight – REST – Cooperation and Coordination among Controllers.

UNIT - III SDN APPLICATION PLANE 9

SDN Application Plane Architecture – Network Services Abstraction Layer – Traffic Engineering – Measurement and Monitoring – Security – Data Center Networking - Mobility and Wireless – Information-centric Networking.

UNIT - IV NETWORK FUNCTION VIRTUALIZATION 9

NFV Concepts – Benefits and Requirements – Reference Architecture – NFV Infrastructure – Virtualized Network Functions – NFV Management and Orchestration – NFV Use cases – SDN and NFV.

UNIT - V NETWORK VIRTUALIZATION 9

Virtual LANs – Open Flow VLAN Support – Virtual Private Networks – Network Virtualization – Open Daylight's Virtual Tenant Network – Co Software-Defined Infrastructure.

TOTAL: 45 PERIODS

OUTCOMES:

On successful completion of the course student will be able to:

1. Describe the motivation behind SDN and its data plane (K2).
2. Identify the functions of control plane (K3).
3. Apply SDN to networking applications (K3).
4. Apply various operations of network function virtualization.
5. Explain various use cases of SDN.

TEXT BOOKS:

1. William Stallings, “Foundations of Modern Networking: SDN, NFV, QoE, IoT and Cloud”, Pearson Education, 1st Edition, 2015.

2. Thomas D Nadeau, Ken Gray, “SDN: Software Defined Networks”, O’Reilly Media, 2013.

REFERENCES:

1. Fei Hu, “Network Innovation through OpenFlow and SDN: Principles and Design”, 1st Edition, CRC Press, 2014.

2. Paul Goransson, Chuck Black Timothy Culver, “Software Defined Networks: A Comprehensive Approach”, 2nd Edition, Morgan Kaufmann Press, 2016.
3. Oswald Coker, SiamakAzodolmolky, “Software-Defined Networking with OpenFlow”, 2nd Edition, O’Reilly Media, 2017.

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21EC1945	COGNITIVE RADIO NETWORKS	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To understand the concepts of cognitive radio.
- To familiarize with Architecture of Cognitive Radio.
- To learn spectrum sensing and dynamic spectrum access.
- To acquaint the fundamentals of MAC & Network Layer Design in Cognitive Radio.
- To introduce the Advancement in 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

Cognitive Radio – functions, components and design rules, Cognition cycle – orient, plan, decide and act phases, Inference Hierarchy, Architecture maps, Building the Cognitive Radio Architecture on Software defined Radio Architecture, 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 , Bayesian Approach, Neyman Pearson fusion rule for spectrum sensing, Optimum spectrum sensing – Kullback Leibler Divergence 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 – Multichannel MAC - slotted ALOHA – CSMA, Network layer design – routing in cognitive radios, flow control and error control techniques.

UNIT - V ADVANCED TOPICS IN COGNITIVE RADIO 9

Cognitive radio for Internet of Things - Features and applications – Enabling technologies and protocols – M2M technologies - Data storage and analysis techniques - Requirement and challenges of IoT – Energy efficiency– MIMO Cognitive Radio – Power allocation algorithms.

TOTAL: 45 PERIODS

OUTCOMES:

On successful completion of the course student will be able to:

1. Understand the concepts of cognitive radio.
2. Familiarize with Architecture of Cognitive Radio.
3. Learn spectrum sensing and dynamic spectrum access.
4. Compare MAC and network layer design for cognitive radio.
5. Discuss cognitive radio for Internet of Things and M2M technologies.

TEXT BOOKS:

1. Alexander M. Wyglinski, MaziarNekovee, Thomas Hou, “Cognitive Radio Communications and Networks”, Academic Press, Elsevier, 2010.
2. Bruce Fette, “Cognitive Radio Technology”, Newnes, 2006.

REFERENCES:

1. Kwang-Cheng Chen, Ramjee Prasad, “Cognitive Radio Networks”, John Wiley and Sons, 2009.
2. HuseyinArslan (Ed.), “Cognitive Radio, Software Defined Radio, and Adaptive Wireless Systems, Springer, 2007.
3. S.Shanmugavel, M.A.Bhagyaveni, R.Kalidoss, “Cognitive Radio-An Enabler for Internet of things”, River Publishers, 2017.

21EC1946 WIRELESS BROADBAND NETWORKS

L	T	P	C
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OBJECTIVES:

- To study the various network layer and transport layer protocols for wireless networks.
- To study the architecture and interference mitigation techniques in 3G standards.
- To learn about 4G technologies and LTE-A in mobile cellular networks.
- To learn about the layer level functionalities in interconnecting networks.
- To study the emerging techniques in 5G network

UNIT - I WIRELESS PROTOCOLS 9

Mobile network layer- Fundamentals of Mobile IP, data forwarding procedures in mobile IP, IPv4, IPv6, IP mobility management, IP addressing - DHCP, Mobile transport layer-Traditional TCP, congestion control, slow start, fast recovery/fast retransmission, classical TCP improvements- Indirect TCP, snooping TCP, Mobile TCP.

UNIT - II 3G EVOLUTION 9

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

UNIT - III 4G EVOLUTION 9

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

UNIT - IV BROAD BAND LAYER-LEVEL FUNCTIONS 9

Characteristics of wireless channels - downlink physical layer, uplink physical layer, MAC scheme -frame structure, resource structure, mapping, synchronization, reference signals and channel estimation, SC-FDMA, interference cancellation – CoMP, Carrier aggregation, Services - multimedia broadcast/multicast, location-based services.

UNIT - V **5G EVOLUTION** **9**

5G Roadmap - Pillars of 5G - 5G Architecture, The 5G internet - IoT and context awareness - Networking reconfiguration and virtualization support - Mobility QoS control - emerging approach for resource over provisioning, Small cells for 5G mobile networks- capacity limits and achievable gains with densification - Mobile data demand, Demand Vs Capacity, Small cell challenges, conclusion and future directions.

TOTAL: 45 PERIODS

OUTCOMES:

On successful completion of the course student will be able to:

1. Design and implement the various protocols in wireless networks.
2. Analyze the architecture of 3G network standards.
3. Analyze the difference of LTE-A network design from 4G standard.
4. Design the interconnecting network functionalities by layer level functions.
5. Explore the current generation (5G) network architecture.

TEXT BOOKS:

1. Kaveh Pahlavan, “Principles of wireless networks”, Prentice-Hall of India, 2008.
2. Jonathan Rodriguez, "Fundamentals of 5G Mobile networks", John Wiley, 2015.

REFERENCES:

1. Vijay K.Garg, “Wireless Network Evolution - 2G & 3G”. Prentice Hall, 2008.
2. Clint Smith,P.E, Dannel Collins, “3G Wireless Networks” Tata McGraw- Hill, 2nd Edition, 2011.
3. SassanAhmadi, “LTE-Advanced – A practical systems approach to understanding the 3GPP LTE Releases 10 and 11 radio access technologies”, Elsevier, 2014.

21EC1947 MASSIVE MIMO NETWORKS

	L	T	P	C
	3	0	0	3

OBJECTIVES:

- To gain knowledge about massive MIMO networks.
- To understand the massive MIMO propagation channels.
- To learn about channel estimation in single cell massive MIMO systems.
- To comprehend the channel estimation in and multicell massive MIMO systems.
- To comprehend the concepts of massive MIMO deployment in the context of single cell and multicell deployment.

UNIT - I MASSIVE MIMO NETWORKS 9

Definition of Massive MIMO, Correlated Rayleigh Fading, System Model for Uplink and Downlink, Basic Impact of Spatial Channel Correlation, Channel Hardening and Favourable Propagation, Local Scattering Spatial Correlation Model.

UNIT - II MASSIVE MIMO PROPAGATION CHANNEL 9

Favorable Propagation and Deterministic Channels-Capacity Upper Bound-Distance from Favorable Propagation-Favorable Propagation and Linear Processing-Singular Values and Favorable Propagation, Favorable Propagation and Random Channels-Independent Rayleigh Fading-Uniformly Random Line-of-Sight (UR-LoS)-Independent Rayleigh Fading versus UR-LoS - Finite-Dimensional Channels.

UNIT - III SINGLE-CELL SYSTEMS 9

Uplink Pilots and Channel Estimation - Orthogonal Pilots- De-Spreading of the Received Pilot Signal-MMSE Channel Estimation, Uplink Data Transmission - Zero-Forcing -Maximum-Ratio, Downlink Data Transmission-Linear Precoding-Zero-Forcing-Maximum-Ratio, Discussion-Interpretation of the Effective SINR Expressions-Implications for Power Control-Scaling Laws and Upper Bounds on the SINR - Near-Optimality of Linear Processing when M >> K - Net Spectral Efficiency - Limiting Factors: Number of Antennas and Mobility.

UNIT - IV MULTI-CELL SYSTEMS 9

Uplink Pilots and Channel Estimation, Uplink Data Transmission - Zero-Forcing - Maximum-Ratio, Downlink Data Transmission -Zero-Forcing - Maximum-Ratio, Discussion -Asymptotic Limits with Infinite Numbers of Base Station Antennas - The Effects of Pilot Contamination - Non-Synchronous Pilot Interference.

UNIT - V CELL DEPLOYMENT IN MIMO 9

Single-Cell Deployment Example: Fixed Broadband Access in Rural Area, Multi-Cell Deployment: Preliminaries and Algorithms, Multi-Cell Deployment Examples: Mobile Access - Dense Urban.

TOTAL: 45 PERIODS

OUTCOMES:

On successful completion of the course student will be able to:

1. Understand and explain massive MIMO networks.
2. Analyze massive MIMO propagation channels and their capacity bounds.
3. Examine channel estimation techniques for single cell system.
4. Analyze channel estimation techniques for multi cell system.
5. Explain the concepts underlying the deployment of single and multicell massive MIMO systems.

TEXT BOOKS:

1. Thomas L. Marzetta, Erik G. Larsson, Hong Yang, Hien Quoc Ngo, “Fundamentals of Massive MIMO”, Cambridge University Press 2016.

2. Emil Björnson, Jakob Hoydis and Luca Sanguinetti (2017), “Massive MIMO Networks: Spectral, Energy, and Hardware Efficiency”, Foundations and Trends, Now, 2017.

REFERENCES:

1. Long Zhao, Hui Zhao, Kan Zheng, “Wei Xiang Massive MIMO in 5G Networks: Selected Applications”, Springer 2018.

2. Leibo Liu, Guiqiang Peng, Shaojun Wei, “Massive MIMO Detection Algorithm and VLSI Architecture”, Springer 2019.
3. Shahid Mumtaz, Jonathan Rodriguez, Linglong Dai, “mmWave Massive MIMO A Paradigm for 5G”, Elsevier, 2017.

21EC1948 5G AND BEYOND COMMUNICATION NETWORKS

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OBJECTIVES:

- To get acquainted with the fundamentals of 5G networks.
- To study the processes associated with 5G architecture.
- To study spectrum sharing and spectrum trading.
- To learn the security features in 5G networks.
- To study the introduction of 6G system.

UNIT - I 5G CONCEPTS AND CHALLENGES 9

Fundamentals of 5G technologies, overview of 5G core network architecture,5G new radio and cloud technologies, Radio Access Technologies (RATs), EPC for 5G.

UNIT - II NETWORK ARCHITECTURE 9

5G architecture and core, network slicing, multi access edge computing(MEC)visualization of 5G components, end-to-end system architecture, service continuity, relation to EPC, and edge computing. 5G protocols: 5G NAS,NGAP, GTP-U, IPSec and GRE.

UNIT - III DYNAMIC SPECTRUM MANAGEMENT 9

Mobility management, Command and control, spectrum sharing and spectrum trading, cognitive radio based on 5G, millimeter waves.

UNIT - IV SECURITY IN 5G NETWORKS 9

Security features in 5G networks, network domain security, user domain security, flow based QoS framework, mitigating the threats in 5G.

UNIT - V 6G WIRELESS NETWORKS 9

6G Vision, Usage Scenarios, and Requirements, Architecture -Large-Dimensional and Autonomous 6G Networks, AI-Enabled Innovative Wireless Network Design, Promising Technologies for 6G Networks.

TOTAL: 45 PERIODS

OUTCOMES:

On successful completion of the course student will be able to:

1. Explore the concepts of 5G networks.
2. Comprehend the 5G architecture and protocols.
3. Understand dynamic spectrum management.
4. Familiarize the security aspects in 5G networks.
5. Understand the concepts of 6G networks.

TEXT BOOKS:

1. Stephen Rommer, “5G Core networks: Powering Digitalization”, Academic Press, 2019.

2. SaroVelrajan, “An Introduction to 5G Wireless Networks : Technology, Concepts and Use cases”, First Edition, 2020.

REFERENCES:

1. Jyrki.Penttinen,“5G Simplified: ABCs of Advanced Mobile Communications”, Copyrighted Material.

2. Wan Lee Anthony,” 5G system Design: An end to end Perspective”, Springer Publications, 2019.
3. Z. Zhang, Y. Xiao, Z. Ma, M. Xiao, Z. Ding, X. Lei, G. K. Karagiannidis, and P. Fan, “6G wireless networks: Vision, requirements, architecture, and key technologies,” IEEE Vehicular Technology Magazine, vol. 14, pp. 28–41, March 2019.

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JAISAKTHI EDUCATIONAL TRUST

21EC1949 **PHOTONIC NETWORKS**

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OBJECTIVES:

- To introduce the relevance of Photonic Networks to the existing technology.
- To enable the student to understand the importance of the infrastructure in photonic networks.
- To familiarize with the architectures and the protocol stack.
- To expose the student to the advances in networking and switching domains.
- To enable the student to understand the network design and management.

UNIT - I PHOTONIC SYSTEM COMPONENTS 9

Light Propagation in optical fibers – Loss & bandwidth, System limitations, NonLinear effects; Solitons; Optical Network Components – Couplers, Isolators & Circulators, Multiplexers & Filters, Optical Amplifiers, Switches, Wavelength Converters.

UNIT - II PHOTONIC NETWORK ARCHITECTURE 9

Introduction to Optical Networks; SONET / SDH, Metropoliton - Area Networks, Layered Architecture ; Broadcast and Select Networks – Topologies for Broadcast Networks, Media-Access Control Protocols, Testbeds for Broadcast & Select WDM; Wavelength Routing Architecture.

UNIT - III WAVELENGTH ROUTING NETWORKS 9

The optical layer, Node Designs, Optical layer cost tradeoff, Routing and wavelength assignment, Virtual topology design, Wavelength Routing Testbeds, Architectural variations.

UNIT - IV PACKET SWITCHING AND ACCESS NETWORKS 9

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

UNIT - V NETWORK DESIGN AND MANAGEMENT 9

Transmission System Engineering – System model, Power penalty - transmitter, receiver, Optical amplifiers, crosstalk, dispersion; Wavelength stabilization ; Overall design considerations; Control and Management – Network management functions, Configuration management, Performance management, Fault management, Optical safety, Service interface.

TOTAL: 45 PERIODS

OUTCOMES:

On successful completion of the course student will be able to:

1. Comprehend and appreciate the significance and role of Photonic Networks in the present contemporary world.
2. Use the backbone infrastructure of photonic networks for our present and future communication needs.
3. Discuss the architectures and the protocol stack in use.
4. Describe the advances and recent trends in the networking and switching approaches.
5. Compare the differences in the design of data plane, control plane, routing, switching, resource allocation methods, Network management and protection methods in vogue.

TEXT BOOKS:

1. Rajiv Ramaswami and Kumar N. Sivarajan,"Optical Networks: A Practical Perspective", Harcourt Asia Pvt Ltd., 3rd Edition, 2004.
2. C. Siva Ram Moorthy and Mohan Gurusamy, "WDM Optical Networks: Concept, Design and Algorithms", Prentice Hall of India, Ist Edition, 2002.

REFERENCES:

1. P.E. Green, Jr., "Fiber Optic Networks", Prentice Hall, NJ, 1993.

Biswanath Mukherjee, "Optical WDM Networks", Springer Series, 2006.

2. Martin P. Clarke, "Wireless Access Network: Fixed Wireless Access and WLL network Design and operation", John Wiley & Sons 2000.

VERTICAL VIII EMERGING TECHNOLOGIES

21EC1950	CRYPTOGRAPHY AND SECURITY PRACTICES	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To learn the fundamentals of networks security, security architecture, threats and vulnerabilities.
- To know the fundamental mathematical concepts related to Symmetric Key Cryptography.
- To know the fundamental mathematical concepts related to Asymmetric Key Cryptography.
- To comprehend the various types of data integrity and authentication schemes.
- To understand various Security Practices and System Security.

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 KEY 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.

TOTAL: 45 PERIODS

OUTCOMES:

On successful completion of the course student will be able to:

1. Understand the concept of security needed in computers and networks along with various possible attacks.
2. Analyze 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.
6. Understand types of System security.

TEXT BOOKS:

1. William Stallings, “Cryptography and Network Security - Principles and Practice”, Seventh Edition, Pearson Education, 2017.

REFERENCES:

1. C K Shyamala, N Harini and Dr. T R Padmanabhan, “Cryptography and Network Security”, Wiley India Pvt.Ltd.
2. Behrouz A. 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

21EC1951	BLOCKCHAIN TECHNOLOGIES AND APPLICATIONS	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To learn the fundamentals of Block chain.
- To explain the details of Bitcoin and its different components.
- To incorporate the consensus of Block chain.
- To understand the Ethereum development environment.
- To learn the applications of Block chain.

UNIT - I INTRODUCTION 9

Block chain history, basics, architectures, Types of block chain, Basic Cryptographic primitives used in Block chain –Secure- Collision Resistant hash functions - Digital signature - Public key cryptosystems – Zero knowledge proof systems - Need for Distributed Record Keeping - Modelling faults and adversaries- Byzantine Generals problem - Consensus algorithms and their scalability problems - Why Nakamoto Came up with Block chain based crypto currency.

UNIT - II BITCOIN 9

Fundamentals, aspects of bitcoins, properties of bitcoins, Digital Keys and Addresses – Transactions, life cycle, data structure, types – Structure of the block chain – Mining – Bitcoin Networks and Payments – Wallets – Alternative coins – Smart Contracts – Definition – Recardian contracts.

UNIT - III BITCOIN CONSENSUS 9

Bitcoin Consensus, Proof of Work (PoW)- Hashcash PoW , Bitcoin PoW, Attacks on PoW ,monopoly problem- Proof of Stake- Proof of Burn - Proof of Elapsed Time - Bitcoin Miner, Mining Difficulty, Mining Pool-Permissioned model and use cases, Design issues for Permissioned Blockchains, Execute contracts- Consensus models for permissioned blockchain-Distributed consensus in closed environment Paxos.

UNIT - IV ETHEREUM 9

Setting up Ethereum development tools – Solidity language – Ethereum accounts, key pairs, working with Externally Owned Accounts (EOA), contract accounts – Smart contracts, structure, setting up and interaction, examples – Decentralised applications, implementation, case studies – Whisper protocol – Swarm architecture and concepts.

UNIT - V APPLICATIONS 9

Applications of block chain in cyber security- integrity of information- E-Governance, Finance, Internet of things, Health and other contract enforcement mechanisms.

TOTAL: 45 PERIODS

OUTCOMES:

On successful completion of the course student will be able to:

1. Define the fundamentals of Blockchain.
2. Explain the different steps in the use of Bitcoins.
3. Understand the basics of Bitcoin consensus.
4. Describe the Consensus of Blockchain.
5. Analyze the Ethereum.
6. Inspect various applications of Block chain.

TEXT BOOKS:

1. S.Shukla,n M.Dhawan, S.Sharma, S. Venkatesan, "Blockchain Technology: Cryptocurrency and Applications", Oxford University Press 2019.
2. Arvind Narayanan, Joseph Bonneau, Edward Felten, Andrew Miller and Steven Goldfeder, "Bitcoin and cryptocurrency technologies: a comprehensive introduction", Princeton University Press,2016.

REFERENCES:

1. Imran Bashir, "Mastering Blockchain: Distributed Ledger Technology, Decentralization, and Smart Contracts Explained", Second Edition, Packt Publishing, 2018.
2. Alex Leverington, "Ethereum Programming", Packt Publishing Limited, 2017.
3. Arshdeep Bahga and Vijay Madisetti, "Blockchain Applications : A Hands-On Approach", 2017.

21EC1952	DATA SCIENCE AND ANALYTICS	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To understand the techniques and processes of data science.
- To apply descriptive data analytics.
- To visualize data for various applications.
- To understand inferential data analytics.
- To analyze and build predictive models from data

UNIT - I INTRODUCTION TO DATA SCIENCE 9

Need for data science – benefits and uses – facets of data – data science process – setting the research goal – retrieving data – cleansing, integrating, and transforming data – exploratory data analysis – build the models– presenting and building applications.

UNIT - II DESCRIPTIVE ANALYTICS 9

Frequency distributions–Outliers–interpreting distributions–graphs–averages-describing variability – interquartile range – variability for qualitative and ranked data - Normal distributions – z-scores –correlation – scatter plots – regression – regression line – least squares regression line –standard error of estimate – interpretation of r2 – multiple regression equations – regression toward the mean.

UNIT - III INFERENTIAL STATISTICS 9

Populations – samples – random sampling – Sampling distribution-standard error of the mean –Hypothesis testing– z-test procedure–decision rule–calculations– decisions–interpretations – one-tailed and two-tailed tests – Estimation – point estimate – confidence interval –level of confidence– effect of sample size.

UNIT - IV ANALYSIS OF VARIANCE 9

t-test for one sample – sampling distribution of t – t-test procedure – t-test for two independent samples – p-value – statistical significance – t-test for two related samples. F-test – ANOVA – Two-factor experiments–three tests –two-factor ANOVA – Introduction to chi-square tests.

UNIT - V PREDICTIVE ANALYTICS 9

Linear least squares–implementation–goodness of fit–testing a linear model–weighted resampling. Regression using Stats Models – multiple regression – nonlinear relationships – logistic regression – estimating parameters – Time series analysis – moving averages – missing values –serial correlation– autocorrelation. Introduction to survival analysis.

TOTAL: 45 PERIODS

OUTCOMES:

On successful completion of the course student will be able to:

1. Explain the data analytics pipeline.
2. Analyze the techniques of data science.
3. Describe and visualize data.
4. Perform statistical inferences from data.
5. Analyze the variance in the data.
6. Propose models for predictive analytics.

TEXT BOOKS:

1. David Cielen, ArnoD.B.Meysman, and MohamedAli,“Introducing Data Science”,Manning Publications,2016.
2. Robert S.Witte and JohnS.Witte,“Statistics”,Eleventh Edition, Wiley Publications, 2017.
3. JakeVander Plas,“Python DataScience Handbook”,O’Reilly,2016.

REFERENCES:

1. Allen B.Downey,“ThinkStats: Exploratory Data Analysis in Python”, Green Tea Press,2014.
2. Sanjeev J.Wagh, Manisha S.Bhende, Anuradha D.Thakare, “Fundamentals of Data Science”, CRC Press,2022.
3. Chirag Shah,“A Hands-on Introduction to Data Science”, Cambridge University Press, 2020.
4. Vineet Raina, Srinath Krishnamurthy, “Building an Effective Data Science Practice: A Framework to Bootstrap and Manage a Successful Data Science Practice”, A press, 2021.

21EC1953 **MACHINE LEARNING ALGORITHMS**

L	T	P	C
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OBJECTIVES:

- To grasp the fundamental concepts of Machine Learning.
- To understand supervised learning and their applications.
- To realize the concepts and algorithms of unsupervised learning.
- To study advanced learning techniques in Machine Learning.
- To study applications of machine learning in real world domains.

UNIT - I INTRODUCTION TO ML ALGORITHMS 9

Machine Learning–Types of Machine Learning –Machine Learning process-preliminaries, testing Machine Learning algorithms, turning data into Probabilities, and Statistics for Machine Learning- Probability theory – Probability Distributions – Decision Theory.

UNIT - II SUPERVISED LEARNING ALGORITHMS 9

Linear Models for Regression – Linear Models for Classification- Discriminant Functions, Probabilistic Generative Models, Probabilistic Discriminative Models – Decision Tree Learning – Bayesian Learning, Naïve Bayes – Ensemble Methods, Bagging, Boosting, Neural Networks, Multi- layer Perceptron, Feed- forward Network, Error Back propagation - Support Vector Machines.

UNIT - III UNSUPERVISED LEARNING ALGORITHMS 9

Clustering- K-means – EM Algorithm- Mixtures of Gaussians –Dimensionality Reduction, Linear Discriminant Analysis, Factor Analysis, Principal Components Analysis, Independent Components Analysis.

UNIT - IV COMPUTATIONAL LEARNING THEORY 9

Sampling-Basic Sampling methods, Monte Carlo, Gibbs Sampling – Computational Learning Theory – Mistake Bound Analysis – Reinforcement learning – Markov Decision processes, Deterministic and Non-deterministic Rewards and Actions, Temporal Difference Learning Exploration.

UNIT - V IMPLEMENTATION OF ML ALGORITHMS 9

Image fusion-object recognition-speech analysis-text document clustering-handwritten digit recognition-image segmentation-spam email classification.

TOTAL: 45 PERIODS

OUTCOMES:

On successful completion of the course student will be able to:

1. Analyze Classification and Regression in Supervised learning
2. Familiar with Unsupervised Learning.
3. Design a learning model appropriate to the application.
4. Design a Neural Network for an application.
5. Use a tool to implement typical Clustering algorithms for different types of applications.
6. Identify applications suitable for different types of Machine Learning with suitable justification.

TEXT BOOKS:

1. Stephen Marsland, "Machine Learning – An Algorithmic Perspective", Chapman and Hall, CRC Press, Second Edition, 2014.
2. Kevin P. Murphy, " Machine Learning: A Probabilistic Perspective", MIT Press, 2012.

REFERENCES:

1. Christopher Bishop" Pattern Recognition and Machine Learning", Springer, 2007.
2. Ethem Alpaydin,, "Introduction to Machine Learning", MIT Press, Third Edition, 2014.
3. Tom Mitchell, "Machine Learning", McGraw-Hill, 1997.

21EC1954 **DEEP LEARNING**

L	T	P	C
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OBJECTIVES:

- To understand the basic ideas and principles of Neural Networks.
- To learn the basic concepts of Deep Learning algorithms.
- To familiarize the student with convolutional neural networks.
- To understand Deep Learning Architectures.
- To familiarize about Deep Learning Applications.

UNIT - I BASICS OF NEURAL NETWORKS 9

Basic concept of Neurons – Activation functions - Perceptron - components - Algorithm – Perceptron models -Feed Forward and Back Propagation Networks.

UNIT - II INTRODUCTION TO DEEP LEARNING 9

Feed Forward Neural Networks – Gradient Descent – Back Propagation Algorithm – Vanishing Gradient problem – Mitigation – RelU Heuristics for Avoiding Bad Local Minima – Heuristics for Faster Training – Nestors Accelerated Gradient Descent – Regularization – Dropout.

UNIT - III CONVOLUTIONAL NEURAL NETWORKS 9

CNN Architectures – Operation - Convolution – Pooling Layers – Transfer Learning – Categories - Strategies - Applications - Transfer Learning for Image Classification.

UNIT - IV DEEP LEARNING ARCHITECTURES 9

LSTM, GRU, Encoder/Decoder Architectures – Autoencoders – Standard - Sparse – Denoising – Contractive - Variational Autoencoders – Adversarial Generative Networks – Autoencoder and DBM.

UNIT - V APPLICATIONS OF DEEP LEARNING 9

Image Segmentation – Object Detection – Image generation with Generative Adversarial Networks – Video to Text with LSTM Models – Case Study: Named Entity Recognition – Parsing and Sentiment Analysis using Recursive Neural Networks – Sentence Classification using Convolutional Neural Networks – Dialogue Generation with LSTMs.

TOTAL: 45 PERIODS

OUTCOMES:

On successful completion of the course student will be able to:

1. Understand the basic concepts of Neural networks.
2. Familiarize with Deep Learning Algorithms.
3. Understand Convolutional Neural Networks.
4. Organize Transfer Learning categories and strategies.
5. Discuss more Deep Learning Architectures.
6. Learn about applications of Deep Learning in Image Processing.

TEXT BOOKS:

1. Ian Good Fellow, Yoshua Bengio, Aaron Courville, “Deep Learning”, MIT Press, 2017.
2. Francois Chollet, “Deep Learning with Python”, Manning Publications, 2018.
3. Phil Kim, “Matlab Deep Learning: With Machine Learning, Neural Networks and Artificial Intelligence”, Apress , 2017.

REFERENCES:

1. Ragav Venkatesan, Baoxin Li,”Convolutional Neural Networks in Visual Computing”, CRCPress, 2018.
2. Navin Kumar Manaswi, “Deep Learning with Applications Using Python”, Apress, 2018.
3. Joshua F. Wiley, “R Deep Learning Essentials”, Packt Publications, 2016.

21EC1955 HUMAN COMPUTER INTERACTION

L	T	P	C
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OBJECTIVES:

- To determine the necessity of user interaction by understanding usability engineering and user modeling.
- To learn the methodologies for designing interactive systems.
- To examine the evaluation methodologies of design.
- To understand design issues for web platforms.
- To understand design issues for mobile platforms and interaction with machines.

UNIT - I HCI AND USABILITY 9

Context of Interaction – Ergonomics - Designing Interactive systems – Understanding Users – cognition and cognitive frameworks, User Centered approaches, Usability, Universal Usability, Understanding and conceptualizing interaction, Guidelines, Principles and Theories.

UNIT - II INTERACTION STYLES 9

HCI patterns, design frameworks, design methods, prototyping. Understanding interaction styles, Direct Navigation and Immersive environments, Fluid navigation, Expressive Human and Command Languages, Communication and Collaboration.

UNIT - III USER EXPERIENCE DESIGN 9

Frameworks for User Centric Computing, Computational models of users, Advancing the user experience, Timely user Experience, Information search, Data Visualization.

UNIT - IV COGNITIVE SYSTEMS AND EVALUATION OF HCI 9

Communication and collaboration models Task analysis, dialog notations and design, Evaluation Techniques- assessing user experience- usability testing – Heuristic evaluation and walkthroughs, analytics predictive models.

UNIT - V INTERACTION TECHNIQUES FOR WEB, MOBILE & MACHINES 9

Designing websites, social media, Collaborative environments, Agents and Avatars, Ubiquitous computing, Mobile Computing, Wearable Computing, Introduction to M2M, drone and autonomous vehicle interaction.

TOTAL: 45 PERIODS

OUTCOMES:

On successful completion of the course student will be able to:

1. Design for usability based on a variety of classic Universal user-centric models.
2. Use complex interaction styles and techniques for contextual design.
3. Evaluate interaction designs and implementations.
4. Understand the models and theories for user interaction.
5. Suggest suitable designs for web applications.
6. Understand the basics of interaction with mobiles and machines.

TEXT BOOKS:

1. Ben Shneiderman, Catherine Plaisant, Maxine Cohen, Steven Jacobs, Niklas Elmqvist "Designing the User Interface: Strategies for Effective Human-Computer Interaction", Sixth Edition, Pearson Education, 2017.

2. Jenny Preece, Helen Sharp, Yvonne Rogers, "Interaction Design: Beyond Human Computer Interaction", Wiley, 5th Edition, 2019.

REFERENCES:

1. Alan Dix, Janet Finlay, Gregory Abowd, Russell Beale, "Human Computer Interaction", Third Edition, Pearson Education, 2004.

2. David Benyon, "Designing User Experience: A guide to HCI, UX and interaction design", 4th Edition, Pearson, 2018.
3. Samit Bhattacharya, "Human-Computer Interaction: User-Centric Computing for Design", McGraw-Hill India, 1st Edition, 2019.
4. Alan Dix, Steve Gill, Devina Ramduny-Ellis, Jo Hare, "TouchIT: Understanding Design in a Physical-Digital World", Oxford University Press, 1st Edition, 2022.
5. Alan Cooper, Robert Reimann, David Cronin, Christopher Noessel, "About Face: The Essentials of Interaction Design", 4th Edition, Wiley, 2014.
6. Giles Colborne, Simple and Usable Web, Mobile, and Interaction Design, New Riders Press, 2nd Edition, 2018.
7. Donald A. Norman, "Design of Everyday Things", MIT Press, 2013.
8. Steven Hoober, Eric Berkman, "Designing Mobile Interfaces Patterns for Interaction Design", O'Reilly, 2011.
9. Bill Scott and Theresa Neil, "Designing Web Interfaces", First Edition, O"Reilly, 2009.
10. Cameron Banga, Josh Weinhold, "Essential Mobile Interaction Design: Perfecting Interface Design in Mobile Apps", Addison-Wesley Professional, 1st edition, 2014.

21EC1956 AUGMENTED REALITY AND VIRTUAL REALITY

L	T	P	C
3	0	0	3

OBJECTIVES:

- To impart the fundamental aspects and principles of AR/VR Technologies.
- To know the internals of the hardware and software components involved in the development of AR/VR enabled applications.
- To learn about the graphical processing units and their architectures.
- To gain knowledge about AR/VR application development.
- To know the technologies involved in the development of AR/VR based applications

UNIT - I INTRODUCTION TO VIRTUAL REALITY AND AUGMENTED REALITY 9

Introduction to Virtual Reality and Augmented Reality – Definition – Introduction to Trajectories and Hybrid Space-Three I's of Virtual Reality – Virtual Reality Vs 3D Computer Graphics – Benefits of Virtual Reality – Components of VR System – Introduction to AR-AR Technologies-Input Devices – 3D Position Trackers – Types of Trackers – Navigation and Manipulation Interfaces – Gesture Interfaces – Types of Gesture Input Devices – Output Devices – Graphics Display – Human Visual System – Personal Graphics Displays – Large Volume Displays – Sound Displays – Human Auditory System.

UNIT - II VR MODELING 9

Modeling – Geometric Modeling – Virtual Object Shape – Object Visual Appearance – Kinematics Modeling – Transformation Matrices – Object Position – Transformation Invariants –Object Hierarchies – Viewing the 3D World – Physical Modeling – Collision Detection – Surface Deformation – Force Computation – Force Smoothing and Mapping – Behavior Modeling – Model Management.

UNIT - III VR PROGRAMMING 9

VR Programming – Toolkits and Scene Graphs – World ToolKit – Java 3D – Comparison of World ToolKit and Java 3Dman Factors in VR.

UNIT - IV APPLICATIONS 9

Hu – Methodology and Terminology – VR Health and Safety Issues – VR and Society-Medical Applications of VR – Education, Arts and Entertainment – Military VR Applications – Emerging Applications of VR – VR Applications in Manufacturing – Applications of VR in Robotics – Information Visualization – VR in Business – VR in Entertainment – VR in Education.

UNIT - V **AUGMENTED REALITY** **9**

Introduction to Augmented Reality-Computer vision for AR-Interaction-Modelling and Annotation Navigation-Wearable devices.

TOTAL: 45 PERIODS

OUTCOMES:

On successful completion of the course student will be able to:

1. Understand the basic concepts of AR and VR.
2. Understand the tools related to AR/VR.
3. Understand the technologies related to AR/VR.
4. Know the working principle of AR/VR related Sensor devices.
5. Design of various models using modeling techniques.
6. Develop AR/VR applications in different domains.

TEXT BOOKS:

1. Charles Palmer, John Williamson, "Virtual Reality Blueprints: Create compelling VR experiences for mobile", Packt Publisher, 2018.
2. Dieter Schmalstieg, Tobias Hollerer, "Augmented Reality: Principles & Practice", Addison Wesley, 2016.

REFERENCES:

1. John Vince, "Introduction to Virtual Reality", Springer-Verlag, 2004.
2. William R. Sherman, Alan B. Craig: Understanding Virtual Reality – Interface, Application, Design", Morgan Kaufmann, 2003.

List of Open Electives I (V SEMESTER)

21EE1005	**ENERGY CONSERVATION AND MANAGEMENT**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

OBJECTIVES:

- Understand and analyse the energy data of industries
- Carryout energy accounting and balancing
- Conduct energy audit and suggest methodologies for energy savings
- Utilise 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

Pumps, 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.

TOTAL: 45 PERIODS

OUTCOMES:

On successful completion of the course student will be able to:

1. Remember the knowledge for Basic combustion and furnace design and selection of thermal and mechanical energy equipment.
2. Study the Importance of Stoichiometry relations, Theoretical air required for complete combustion.
3. Skills on combustion thermodynamics and kinetics
4. Apply calculation and design tube still heaters.
5. Studied different heat treatment furnace.
6. Practical and theoretical knowledge burner design.

TEXT BOOKS:

1. Energy Manager Training Manual (4 Volumes) available at www.energymanagertraining.com. a website administered by Bureau of Energy Efficiency (BEE), a statutory body under Ministry of Power, Government of India, 2004.

REFERENCES:

1. Witte. L.C., P.S. Schmidt, D.R. Brown, "Industrial Energy Management and Utilisation" Hemisphere Publ, Washington, 1988.
2. Callaghn, P.W. "Design and Management for Energy Conservation", Pergamon Press, Oxford, 1981
3. Dryden. I.G.C., "The Efficient Use of Energy" Butterworths, London, 1982
4. Turner. W.C., "Energy Management Hand book", Wiley, New York, 1982
5. Murphy. W.R. and G. Mc KAY, "Energy Management", Butterworths, London 1987

21CS1001	FUNDAMENTALS OF DATABASE MANAGEMENT SYSTEMS	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To understand the basic concepts and the applications of database systems.
- To understand the various data models
- To learn the relational database design principles.
- To know the basics of SQL and construct queries using SQL.
- To familiar with the basic issues of transaction processing and concurrency control.

UNIT - I DATABASE FUNDAMENTALS 9

Introduction: Database System Applications, Purpose of Database Systems, View of Data, components and structure, Database Users and Administrator, History of Database Systems.

UNIT - II DATA MODELS 9

ER model, Entities, Attributes and Entity sets, Relationships and Relationship sets, Additional features of ER Model, Conceptual Design with the ER Model, Enhanced E-R Model.

UNIT - III RELATIONAL DATABASE 9

Relational Data Model - Concept of relations, schema-instance distinction, keys, referential integrity and foreign keys, relational algebra operators, Normalization (1NF, 2NF, 3NF, BCNF).

UNIT - IV STRUCTURED QUERY LANGUAGE 9

Introduction, data definition in SQL, table, key and foreign key definitions, update behaviours. Querying in SQL, notion of aggregation, aggregation functions group by and having clauses, embedded SQL

UNIT - V TRANSACTION MANAGEMENT AND CONCURRENCY 9

Control Transaction management: ACID properties, serializability and concurrency control, Lock based concurrency control (2PL, Deadlocks), Time stamping methods, optimistic methods, database recovery management.

TOTAL: 45 PERIODS

OUTCOMES:

On successful completion of the course student will be able to:

1. Remember the Structure of a Database
2. Understand an Entity Relational Model for a database.
3. Apply Relational database concepts to design a database.
4. Analyze the importance of normalization and functional dependencies in database design
5. Understand transaction processing and concurrency control
6. Create a database design using Relational models

TEXT BOOKS:

1. Data base System Concepts, A. Silberschatz, Henry. F. Korth, S.Sudarshan, McGraw Hill India Private Limited, 7th edition.

REFERENCES:

1. Data base Management Systems, Raghu Ramakrishnan, Johannes Gehrke, McGraw Hill Education (India) Private Limited, 3rd Edition.

PANIMALAR ENGINEERING COLLEGE, CHENNAI.
JAISAKTHI EDUCATIONAL TRUST

21CS1003 **CLOUD COMPUTING**

L	T	P	C
3	0	0	3

OBJECTIVES:

- To learn about the concept of cloud and utility computing.
- 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 TO CLOUD COMPUTING 9

Introduction to Cloud Computing – Roots of Cloud Computing – Desired Features of Cloud Computing – Challenges and Risks – Benefits and Disadvantages of Cloud Computing.

UNIT - II VIRTUALIZATION 9

Introduction to Virtualization Technology – Load Balancing and Virtualization – Understanding Hypervisor – Types of Virtualization – Server, Desktop, Application Virtualization.

UNIT - III CLOUD ARCHITECTURE, SERVICES AND STORAGE 9

NIST Cloud Computing Reference Architecture – Public, Private and Hybrid Clouds - IaaS – PaaS – SaaS – Architectural Design Challenges.

UNIT - IV RESOURCE MANAGEMENT AND SECURITY IN CLOUD 9

Inter Cloud Resource Management – Resource Provisioning Methods – Security Overview – Cloud Security Challenges – Data Security –Application Security – Virtual Machine Security.

UNIT - V CASE STUDIES 9

Google App Engine(GAE) – GAE Architecture – Functional Modules of GAE – Amazon Web Services(AWS) – GAE-Open Stack .

TOTAL: 45 PERIODS

OUTCOMES:

On successful completion of the course student will be able to:

1. Articulate the main concepts, key technologies, strengths and limitations of cloud computing.
2. Learn the key and enabling technologies that help in the development of cloud.
3. Develop the ability to understand and use the architecture of compute and storage cloud, service and delivery models.
4. Explain the core issues of cloud computing such as resource management and security.
5. Be able to install and use current cloud technologies.
6. Choose the appropriate technologies, algorithms and approaches for implementation and use of cloud.

TEXT BOOKS:

1. Buyya R., Broberg J., Goscinski A., Cloud Computing: Principles and Paradigm, First Edition, John Wiley and Sons, 2011.
2. Kai Hwang, Geoffrey C. Fox, Jack G. Dongarra, “Distributed and Cloud Computing, From Parallel Processing to the Internet of Things”, Morgan Kaufmann Publishers, 2012.
3. Rittinghouse, John W., and James F. Ransome, Cloud Computing: Implementation, Management, And Security, CRC Press, 2017.

REFERENCES:

1. RajkumarBuyya, 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.
3. George Reese, “Cloud Application Architectures: Building Applications and Infrastructure in the Cloud: Transactional Systems for EC2 and Beyond (Theory in Practice), OReilly, 2009.

21EC1003 BASIC OF BIOMEDICAL INSTRUMENTATION

L	T	P	C
3	0	0	3

OBJECTIVES:

- To study about the different biopotential and its propagation
- To understand the different types of electrodes and its placement for various recording
- To study the design of bioamplifier for various physiological recording
- To learn the different measurement techniques for non-physiological parameters.
- To familiarize the different biochemical measurements.

UNIT - I BIOPOTENTIAL GENERATION AND ELECTRODES TYPES 9

Origin of bio potential and its propagation.Types of electrodes -surface, needle and micro electrodes and their equivalent circuits. Recording problems - measurement with two electrodes.

UNIT - II BIOSIGNAL CHARACTERISTICS AND ELECTRODE CONFIGURATIONS 9

Biosignals characteristics frequency and amplitude ranges. ECG Einthoven's Triangle , standard 12 lead system. EEG –10-20 electrode system, unipolar, bipolar and average mode. EMG– unipolar and bipolar mode.

UNIT - III SIGNAL CONDITIONING CIRCUITS 9

Need for bio-amplifier - differential bio-amplifier, Impedance matching circuit, isolation amplifiers, Power line interference, Right leg driven ECG amplifier, Band pass filtering.

UNIT - IV MEASUREMENT OF NON-ELECTRICAL PARAMETERS 9

Temperature, respiration rate and pulse rate measurements. Blood Pressure: indirect methods - Auscultatory method, direct methods: electronic manometer, Systolic, diastolic pressure, Blood flow and cardiac output measurement: Indicator dilution, and dye dilution method, ultrasound blood flow measurement.

UNIT - V BIO-CHEMICAL MEASUREMENT 9

Blood gas analyzers and Non-Invasive monitoring, colorimeter, Sodium Potassium Analyser, spectrophotometer, blood cell counter, auto analyzer (simplified schematic description).

TOTAL: 45 PERIODS

OUTCOMES:

On successful completion of the course student will be able to:

1. Learn the different bio-potential and its propagation.
2. Get familiarize the different electrode placement for various physiological recording
3. Students will be able to design bio-amplifier for various physiological recording
4. Students will understand various technique on electrical physiogical measurements
5. Understand the different biochemical measurements

TEXT BOOKS:

1. Leslie Cromwell,"Biomedical Instrumentation and measurement", Prentice hall of India, New Delhi, 2012.
2. John G. Webster,"Medical Instrumentation Application and Design", John Wiley and sons, New York, 2014.

REFERENCES:

1. Myer Kutz, "Standard Handbook of Biomedical Engineering and Design", McGraw Hill Publisher, 2013.
2. Khandpur R.S, "Handbook of Biomedical Instrumentation", Tata McGraw-Hill, New Delhi, 2013.
3. Joseph J. Carr and John M. Brown, "Introduction to Biomedical Equipment Technology", Pearson Education, 2014.

21EE1006	**INTELLIGENT AUTOMATION**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

OBJECTIVES:

- To identify potential areas for automation and justify need for automation.
- Study the concepts of Artificial Intelligence.
- Learn the methods of solving problems using Artificial Intelligence.
- Apply the concept of AI to attain industrial automation.

UNIT - I INTRODUCTION TO AUTOMATION (7+2 skill)9

Introduction to Industrial Automation - Automation in Production System- Principles and Strategies of Automation - Basic Elements of an Automated System- Advanced Automation Functions- Levels of Automations- Production Economics - Methods of Evaluating Investment Alternatives- Costs in Manufacturing- Break Even Analysis- Unit cost of production- Cost of Manufacturing Lead time and Work-in-process.

UNIT - II INTRODUCTION TO ARTIFICAL INTELLIGENCE (7+2 skill)9

Introduction to Artificial Intelligence -Introduction-Foundations of AI- History of AI- Intelligent agents: Agents and Environment- Reactive agent- deliberative- goal driven- utility driven and learning agents -Artificial Intelligence programming techniques. Introduction to ML and DL Concepts

UNIT - III KNOWLEDGE AND REASONING (7+2 skill)9

Knowledge Representation and Reasoning - Ontologies-foundations of knowledge representation and reasoning-representing and reasoning about objects- relations- events-actions- time- and space- predicate logic-situation calculus- description logics-reasoning with defaults-reasoning about knowledge-sample applications- Representing Knowledge and reasoning in an Uncertain Domain- Bayes rule- Bayesian networks-probabilistic inference sample applications- Planning: planning as search- partial order planning- construction and use of planning graphs.

UNIT - IV EXPERT SYSTEMS (7+2 skill)9

Expert systems -Expert systems – Architecture of expert systems, Roles of expert systems – Knowledge Acquisition – Meta knowledge- Heuristics. Typical expert systems – MYCIN – ART-XOON.

UNIT - V AI IN CONTROL SYSTEMS (7+2 skill)9

Industrial AI applications and Case studies - Applications of Industrial AI in Monitoring-optimization and control- AI applications in Industry Automation using - natural language processing-computer vision-speech recognition-computer vision.

TOTAL: 45 PERIODS

OUTCOMES:

On successful completion of the course student will be able to:

1. Understand the basics AI algorithms (L2).
2. Identify appropriate AI methods to solve a given problem (L1).
3. Illustrate about AI/ML/DL techniques in Industrial Automation (L3).
4. Summarize the levels of automation (L2).
5. Ability to apply AI concepts for industrial optimization and control. (L4).
6. Design the AI for various applications

TEXT BOOKS:

1. Rich and Knight, "Artificial Intelligence", 3rd Edition, Tata McGraw Hill, 2014.
2. M.P.Groover, "Automation, Production Systems and Computer Integrated Manufacturing", 5th edition, Pearson Education, 2009.

REFERENCES:

1. Anuradha Srinivasaraghavan, Vincy Joseph "Machine Learning", Wiley, 2019.
2. Stuart Russell and Peter Norvig, "Artificial Intelligence: A Modern Approach", 2nd Edition, Prentice Hall, 2003.
3. Rajiv Chopra, "Deep Learning", 1st Edition, Khanna Publishing House, 2018.

21CB1001 INTRODUCTION TO C PROGRAMMING

L	T	P	C
3	0	0	3

OBJECTIVES:

- To acquire knowledge to write an algorithm and flowchart for problems.
- To study and develop C programs using operators, expressions and control flow.
- To learn the concept for functions and pointers.
- To gather knowledge about structure and I/O.
- To learn about processing of files.

UNIT - I BASICS OF C PROGRAMMING 9

Introduction to programming paradigms, Art of Programming through Algorithms and Flowcharts.History and importance of C - Applications of C Language - Structure of C program – Basics: Data Types – Constants –Variables - Keywords – Operators: Precedence and Associativity - Expressions – Input / Output statements, Assignment statements – Decision-making statements - Switch statement - Looping statements – Pre-processor directives - Compilation process – Exercise Programs: Check whether the required amount can be withdrawn based on the available amount – Menu-driven program to find the area of different shapes – Find the sum of even numbers.

SUGGESTED ACTIVITIES:

Understanding the constructs of C Language.
Control the sequence of the program and give logical outputs.
Understanding the uses of pre-processors and various memory models.

SUGGESTED EVALUATION METHODS

Tutorial on conditionals and loops.
Assignments.

UNIT - II ARRAYS 9

Introduction to Arrays – One dimensional array: Declaration – Initialization - Accessing elements – Operations: Traversal, Insertion, Deletion, Searching - Two dimensional arrays: Declaration – Initialization - Accessing elements – Operations: Read – Print – Sum – Transpose – Multiplication- Exercise Programs: Print the number of positive and negative values present in the array – Sort the numbers using bubble sort - Find whether the given is matrix is diagonal or not.

SUGGESTED ACTIVITIES:

Understanding the purpose of array
Design and implement applications using arrays
Develop an application to perform matrix operations using multi-dimensional arrays

SUGGESTED EVALUATION METHODS

Pedagogical tools
Assignments.

UNIT - III STRINGS & POINTERS 9

Introduction to Strings - Reading and writing a string - String operations (without using built-in string functions): Length – Compare – Concatenate – Copy – Reverse – Substring – Insertion – Indexing – Deletion – Replacement – Array of strings – Pointers: Pointer operators – Pointer arithmetic - Exercise programs: To find the frequency of a character in a string - To find the number of vowels, consonants and white spaces in a given text - Sorting the names.

SUGGESTED ACTIVITIES:

Understanding the purpose of strings

Developing C programs using strings

SUGGESTED EVALUATION METHODS

Quizzes

Tabulate the different strings functions and its purpose

UNIT - IV FUNCTIONS 9

Introduction to Functions – Types: User-defined and built-in functions - Function prototype - Function definition - Function call - Parameter passing: Pass by value - Pass by reference - Built-in functions (string functions) – Recursive functions – Exercise programs: Calculate the total amount of power consumed by ‘n’ devices (passing an array to a function) – Menu-driven program to count the numbers which are divisible by 3, 5 and by both (passing an array to a function) – Replace the punctuations from a given sentence by the space character (passing an array to a function)

SUGGESTED ACTIVITIES:

Apply code reusability with functions and pointers

Develop and implement modular applications in C using functions.

SUGGESTED EVALUATION METHODS

Assignments

Pedagogical Techniques

UNIT - V STRUCTURES, UNIONS AND FILE MANAGEMENT 9

Introduction to structures – Declaration – Initialization – Accessing the members – Nested Structures – Array of Structures – Structures and functions – Passing an entire structure – typedef – Union - Storage classes and Visibility. Exercise programs: Compute the age of a person using structure and functions (passing a structure to a function) – Compute the number of days an employee came late to the office by considering his arrival time for 30 days (Use array of structures and functions) - Defining and opening a file, closing a file, Input/output and Error Handling on Files

SUGGESTED ACTIVITIES:

Demonstration of real-world applications using file operations.

Implementing applications using Unions, Enumerations and typedef.

Understanding the basics of file handling mechanisms

SUGGESTED EVALUATION METHODS

Quizzes

Assignment

TOTAL: 45 PERIODS

OUTCOMES:

On successful completion of the course student will be able to:

1. Ability to implement the algorithms and flow chart for solving mathematical and engineering problems
2. Develop C programs for real world/technical application using basic constructs
3. Implement C programs using control structures
4. Explore the usage of arrays, pointers and functions in C.
5. Implement Programs with structures and union in C.
6. Design applications using sequential and random access file processing

TEXT BOOKS:

1. ReemaThareja, "Programming in C", Oxford University Press, Second Edition, 2016.
2. Kernighan, B.W and Ritchie,D.M, "The C Programming language", Second Edition, Pearson Education, 2015.

REFERENCES:

1. Paul Deitel and Harvey Deitel, "C How to Program with an Introduction to C++", Eighth edition, Pearson Education, 2018.
2. Yashwant Kanetkar, Let us C, 17th Edition, BPB Publications, 2020.
3. Byron S. Gottfried, "Schaum's Outline of Theory and Problems of Programming with C", McGraw-Hill Education, 1996.
4. Pradip Dey, Manas Ghosh, "Computer Fundamentals and Programming in C", Second Edition, Oxford University Press, 2013.
5. Anita Goel and Ajay Mittal, "Computer Fundamentals and Programming in C", 1st Edition, Pearson Education, 2013.

21ML1001 DATA STRUCTURES AND ALGORITHMS

	L	T	P	C
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OBJECTIVES:

- To understand the concepts of ADTs
- To design linear data structures–lists, stacks, and queues
- To understand sorting algorithms
- To understand the concept of searching and hashing algorithms
- To apply Tree and Graph structures

UNIT - I LINEAR DATA STRUCTURES – LIST 9

Abstract Data Types (ADTs) – List ADT – array-based implementation – linked list implementation ––singly linked lists- circularly linked lists- doubly-linked lists – applications of lists –Polynomial Manipulation – All operations (Insertion, Deletion, Merge, Traversal).

SUGGESTED ACTIVITES:

Developing and application(student's choice using all the linear data structure

SUGGESTED EVALUATION METHODS:

Programs and Demonstration on applications of linear data structures.
Checking output of programs implemented.
Assignments.

UNIT - II LINEAR DATA STRUCTURES – STACKS, QUEUES 9

Stack ADT – Operations - Applications - Evaluating arithmetic expressions- Conversion of Infix to postfix expression - Queue ADT – Operations - Circular Queue Priority Queue – deQueue – applications of queues- Job Scheduling- Josephus problem.

SUGGESTED ACTIVITES:

Demonstrating stack for Towers of Hanoi application.

SUGGESTED EVALUATION METHODS:

Programs on applications of Stacks and Queues
Quiz on various topics of the unit
Assignments

UNIT - III NON LINEAR DATA STRUCTURES – TREES 9

Tree ADT - Representation of Trees- Binary Tree -Tree traversal- expression trees - applications of trees - binary search tree ADT -Threaded Binary Trees- AVL Trees - B-Tree B+ Tree -Trie - Heap - Applications of heap.

SUGGESTED ACTIVITES:

Solving expressions using expression trees by determining infix, prefix and postfix expressions.
Developing any application using trees

SUGGESTED EVALUATION METHODS:

Programs using tree traversal and binary tree

Programs on binary search trees.

Programs and Demonstration using AVL tree applications.

Assignments

UNIT - IV NON LINEAR DATA STRUCTURES - GRAPHS 9

Definition - Representation of Graph - Types of graph - Breadth-first traversal - Depth- first traversal - Topological Sort - Bi-connectivity - Cut vertex - Euler circuits - Applications of graphs- Shortest path algorithms- Minimum spanning trees- Prims and Kruskal Algorithms Applications of BFS: Graph Coloring.

SUGGESTED ACTIVITES:

External learning- Applications of graphs.

Practical- To choose and apply a suitable graph algorithm for solving a real time problem /scenario such as Network Routing.

SUGGESTED EVALUATION METHODS:

Assignments on representation of graphs for a given problem

Quizzes on basics of graphs.

Programs and Demonstration using application of graph and topological sort

UNIT - V SEARCHING, SORTING AND HASHING TECHNIQUES 9

Searching- Linear Search - Binary Search. Sorting -Quick Sort - Bubble sort - Selection sort - Heap Sort -Merge Sort - Insertion sort - Bucket sort - Shell sort - Radix sort. Hashing- Hash Functions – Separate Chaining - Open Addressing - Rehashing - Extendible Hashing

SUGGESTED ACTIVITES:

External learning- Applications of graphs.

Practical-To choose and apply a suitable graph algorithm for solving a real time problem/scenario such as Network Routing.

SUGGESTED EVALUATION METHODS:

Tutorials on external sorting.

Tutorials on hashing.

Check output of programs implemented

TOTAL: 45 PERIODS

OUTCOMES:

On successful completion of the course student will be able to:

1. Implement abstract datatypes for linear data structures.
2. Apply the different linear data structures to problem solutions.
3. Model problems as Tree problems and implement efficient Tree algorithms to solve them.

4. Model problems as graph problems and implement efficient graph algorithms to solve them.
5. Critically analyze the various sorting algorithms.
6. Analyze the various searching and hashing algorithms

TEXT BOOKS:

1. Mark Allen Weiss, Data Structures and Algorithm Analysis in C, 2nd Edition, Pearson education, 2011.
2. Reema Thareja, ‘Data Structures Using C’, Second Edition , Oxford University Press, 2011.

REFERENCES:

1. Thomas H.Cormen, Charles E. Leiserson, Ronald L.Rivest, Clifford Stein, “Introduction to Algorithms”,Second Edition, McGraw Hill,2002.
2. Aho,HopcroftandUllman,“DataStructuresandAlgorithms”,PearsonEducation, 1983.
3. StephenG.Kochan,”ProgramminginC”,3rd edition, Pearson Education.
4. Ellis Horowitz, Sartaj Sahni, Susan Anderson-Freed, “Fundamentals of Data Structures in C”,Second Edition,University Press,2008.

21IT1003	ETHICAL HACKING	L T P C
		3 0 0 3

OBJECTIVES: To impart Knowledge on the following topics:

- To explore the concepts of security testing and the knowledge required to protect against hackers and attackers.
- To understand reconnaissance and the publicly available tools used to gather information on potential targets.
- To discover the scanning techniques used to identify network system open ports.
- To identify network system vulnerabilities and confirm their exploitability.
- To explore techniques for identifying web application vulnerabilities and attacks.

UNIT - I INTRODUCTION TO HACKING 9

Introduction to Hacking – Important Terminologies – Penetration Test – Vulnerability Assessments versus Penetration Test – Pre-Engagement – Rules of Engagement - Penetration Testing Methodologies – OSSTMM – NIST – OWASP – Categories of Penetration Test – Types of Penetration Tests – Vulnerability Assessment Summary -Reports.

SUGGESTEDACTIVITIES:

In-class activity to understand the penetration testing methodologies.
Practical – Use security tools in Kali Linux to assess the vulnerabilities.
Prepare Vulnerability Assessment summary reports.

SUGGESTEDEVALUATIONMETHODS:

Assignment on categories of penetration testing and vulnerability summary reports.
Quiz on penetration testing methodologies, OSSTMM and OWASP.

UNIT - II INFORMATION GATHERING AND SCANNING 9

Information Gathering Techniques – Active Information Gathering – Passive Information Gathering – Sources of Information Gathering – Tracing the Location – Traceroute – ICMP raceroute – TCP Traceroute – Usage – UDP Traceroute – Enumerating and Finger printing the Webservers – Google Hacking – DNS Enumeration – Enumerating SNMP – SMTP Enumeration
– Target Enumeration and Port Scanning Techniques – Advanced Firewall/IDS Evading Techniques.

SUGGESTED ACTIVITIES:

Explain different ways to gather information about a system in the network.
Demonstrate the network command tools to identify the system.
Understand the network protocols and port scanning techniques using Kali linux.

SUGGESTED EVALUATION METHODS:

Assignment problems on information gathering and traceroute of ICMP, DNS and SNMP.
Quizzes on enumeration, port scanning techniques and firewall/IDS evading techniques.

UNIT - III NETWORK ATTACKS 9

Vulnerability Data Resources – Exploit Databases – Network Sniffing – Types of Sniffing – Promiscuous versus Nonpromiscuous Mode – MITM Attacks – ARP Attacks – Denial of Service Attacks –Hijacking Session with MITM Attack – SSL Strip: Stripping HTTPS Traffic – DNS Spoofing – ARP Spoofing Attack Manipulating the DNS Records – DHCP Spoofing – Remote Exploitation – Attacking Network Remote Services – Overview of Brute Force Attacks – Traditional Brute Force – Attacking SMTP – Attacking SQL Servers – Testing for
Weak Authentication.

SUGGESTED ACTIVITIES:

Familiarizing with different types of attacks such as sniffing, spoofing etc.
Demonstrating the MITM attack using ARP Poisoning using Kali Linux.
Teaching with case studies: SSL Stripping, SQL Injection, Brute Force attacks.

SUGGESTEDEVALUATIONMETHODS:

Assignment on denial of service (DoS) attack and hijacking session with MITMattack.
Quizzes on SSL stripping, ARP spoofing and weak authentication

UNIT - IV EXPLOITATION 9

Introduction to Metasploit – Reconnaissance with Metasploit – Port Scanning with Metasploit – Compromising a Windows Host with Metasploit – Client Side Exploitation Methods – E-Mails with Malicious Attachments – Creating a Custom Executable – Creating a Backdoor with SET – PDF Hacking – Social Engineering Toolkit – Browser Exploitation – Post–Exploitation – Acquiring Situation Awareness – Hashing Algorithms – Windows Hashing Methods – Cracking the Hashes – Brute force Dictionary Attacks – Password Salts –Rainbow Tables – John the Ripper – Gathering OS Information – Harvesting Stored Credentials.

SUGGESTED ACTIVITIES:

Case studies: Understand the Metasploit and Exploitations.

Demonstrating email with malicious attachment and cracking the hashes.

Practical - Implementing hashing algorithms and cracking the hashes

SUGGESTED EVALUATION METHODS:

Assignments on social engineering toolkit and browser exploitation.

Quizzes on reconnaissance with Metasploit and client–side exploitation methods.

UNIT - V WIRELESS AND WEB HACKING 9

Wireless Hacking – Introducing Aircrack– Cracking the WEP – Cracking a WPA/WPA2 Wireless Network Using Aircrack-ng – Evil Twin Attack – Causing Denial of Service on the Original AP – Web Hacking – Attacking the Authentication – Brute Force and Dictionary Attacks – Types of Authentications – Log-In Protection Mechanisms – Captcha Validation Flaw

– Captcha RESET Flaw – Manipulating User-Agents to Bypass Captcha and Other Protection – Authentication Bypass Attacks – Testing for the Vulnerability – Automating Itwith Burp Suite – Session Attacks – SQL Injection Attacks – XSS (Cross-Site Scripting) –Types of Cross-Site Scripting – Cross-Site Request Forgery (CSRF) – SSRF Attacks - penetration testing

SUGGESTED ACTIVITIES:

Cracking the WEP and WPA/WPA2 passphrase using Cracking tool in Kali Linux.

Design a web application with different authentication mechanism.

Understand the protection mechanism to prevent against various server attacks.

SUGGESTED EVALUATION METHODS:

Assignment on evil twin attack and denial of service attack on access point in WLAN.

Quizzes on types of authentication and vulnerabilities in a web application.

TOTAL: 45 PERIODS

OUTCOMES:

On successful completion of the course student will be able to:

1. Use various security tools to assess the computing system.
2. Predict the vulnerabilities across any computing system using penetration testing.
3. Identify prediction mechanism to prevent any kind of attacks.
4. Protect the system from malicious software and worms.
5. Evaluate the wireless network flaws and able to apply security patches
6. Analyze the risk and support the organization for effective security measures.

TEXT BOOKS:

1. Rafay Baloch, “Ethical Hacking and Penetration Testing Guide”, CRC Press, 2014.

REFERENCES:

1. Kevin Beaver, “Ethical Hacking for Dummies”, Sixth Edition, Wiley, 2018.
2. Jon Erickson , “Hacking: The Art of Exploitation”, Second Edition, Rogunix, 2007.

21EC1005 PRODUCT DESIGN AND DEVELOPMENT

L	T	P	C
3	0	0	3

OBJECTIVES:

- To facilitate the knowledge about product design.
- To know about engineering and functions in product design.
- To explore the tools and product manufacturing using case studies.

UNIT - I INTRODUCTION 9

Introduction to course, Product life-cycle, Product policy of an organization. Selection of a profitable product, Product design process, Product analysis.

UNIT - II ENGINEERING IN PRODUCT DESIGN 9

Value engineering in product design; Advantages, Applications in product design, Problem identification and selection.

UNIT - III FUNCTIONS IN PRODUCT DESIGN 9

Analysis of functions, Anatomy of function. Primary versus secondary versus tertiary/unnecessary functions, Functional analysis: Functional Analysis System Technique (FAST), Case studies.

UNIT - IV PRODUCT DESIGN TOOLS 9

Introduction to product design tools, QFD, Computer Aided Design, Robust design, DFX, DFM, DFA,Ergonomics in product design.

UNIT - V PRODUCT MANUFACTURING AND PROTOTYPE 9

DFMA guidelines, Product design for manual assembly, Design guidelines for metallic and nonmetallic products to be manufactured by different processes such as casting, machining, injection molding etc., Rapid prototyping, needs, advantages, working principle of SLA, LOM and SLS.

TOTAL: 45 PERIODS

OUTCOMES:

On successful completion of the course student will be able to:

1. Discuss the need for product life cycle.
2. Discuss the engineering and functions in the design of product.
3. Learn the significance of Engineering in product design
4. Explain the various tools used for design of a product.
5. Analyze the guidelines for manufacturing and prototype of a product.
6. Apply knowledge about various products in the present day scenario.

TEXT BOOKS:

1. Karl T. Ulrich, "Product Design and Development” Mc Graw -Hill International, 6th Edition.

REFERENCES:

1. Ulrich, Karl T., Eppinger, Steve D., and Yang, Maria C., Product Design and Development. 7th ed., McGraw-Hill Education, 2020.
2. Regalla, Srinivasa Prakash, "Product design and manufacturing", New Age International (P) Ltd.

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21ME1004 INDUSTRIAL POLLUTION AND PREVENTION

L	T	P	C
3	0	0	3

OBJECTIVES: To impart Knowledge on the following topics:

- This course is designed to learn a variety of chemical, physical, biological treatment processes related to industrial pollution control.
- This course is to make pollution profiles of the industries, categorization, control methodologies and technologies, system design, ethic concepts and solving of the engineering problems on industrial systems.

UNIT - I TYPES OF POLLUTION 9

Types of emissions from chemical industries and effects of environment, environment legislation, Type of pollution, sources of wastewater, Effluent guidelines and standards

UNIT - II CHARACTERISTICS OF POLLUTANTS 9

Characterization of effluent streams, oxygen demands and their determination (BOD, COD, and TOC), Oxygen sag curve, BOD curve mathematical, controlling of BOD curve, self purification of running streams, sources and characteristics of pollutants in fertilizer, paper and pulp industry. General methods of control and removal of sulfur dioxide, oxides of nitrogen and organic vapors from gaseous effluent, treatment of liquid and gaseous effluent in fertilizer industry.

UNIT - III CONTROL OF POLLUTION 9

General methods of control and removal of sulfur dioxide, oxides of nitrogen and organic vapors from gaseous effluent, treatment of liquid and gaseous effluent in fertilizer industry.

UNIT - IV POLLUTION MEASUREMENTS 9

Air pollution sampling and measurement: Types of pollutant and sampling and measurement, ambient air sampling: collection of gaseous air pollutants, collection of particulate air pollutants. Stack sampling: sampling system, particulate sampling, and gaseous sampling. Analysis of air pollutants: Sulphur dioxide, nitrogen oxides, carbon monoxide, oxidants and Ozone, hydrocarbons, particulate matter.

UNIT - V EMISSION CONTROL TECHNIQUES 9

Air pollution control methods and equipments: Source collection methods: raw material changes, process changes, and equipment modification. Cleaning of gaseous equipments particulate emission control: collection efficiency, control equipment like gravitational settling chambers, Cyclone separators, fabric filters, scrubbers, packed beds and plate columns, venturi scrubbers, their design aspects. Control of gaseous emissions: absorption by liquids, absorption equipments, adsorption by solids.

TOTAL: 45 PERIODS

OUTCOMES:

On successful completion of the course student will be able to:

1. Understanding of air/water pollution regulations and their scientific basis.
2. Apply knowledge for the protection and improvement of the environment.
3. Understanding the sources and characteristics of the pollutants.
4. Ability to monitor and design the air and water pollution control systems.
5. Ability to select and use suitable waste treatment technique

TEXT BOOKS:

1. Environmental pollution and control engineering, Rao C. S. - Wiley Eastern Limited, India, 1993.
2. Pollution control in process industries by S.P. Mahajan TMH.,1985.

REFERENCES:

1. Waste water treatment by M.Narayana Rao and A.K.Datta,Oxford and IHB publ. New Delhi.
2. Air pollution control by P.Prathap mouli and N.Venkata subbayya. Divya Jyothi Prakashan, Jodhpur
3. "Industrial Pollution Control and Engineering." Swamy AVN, Galgotia publications, 2005.Hyderabad

List of Open Electives II (VI SEMESTER)

21ME1917	**RENEWABLE ENERGY RESOURCES**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

OBJECTIVES:

- To get exposure on solar radiation and its environmental impact to power.
- To know about the various collectors used for storing solar energy.
- To know about the various applications in solar energy.
- To learn about the wind energy and biomass and its economic aspects.
- To know about geothermal energy with other energy sources.

UNIT - I PRINCIPLES OF SOLAR RADIATION 10

Role and potential of new and renewable source, the solar energy option, Environmental impact of solar power, physics of the sun, the solar constant, extraterrestrial and terrestrial solar radiation, solar radiation on titled surface, instruments for measuring solar radiation and sun shine, solar radiation data.

UNIT - II SOLAR ENERGY COLLECTION 8

Flat plate and concentrating collectors, classification of concentrating collectors, orientation and thermal analysis, advanced collectors.

UNIT - III SOLAR ENERGY STORAGE AND APPLICATIONS 7

Different methods, Sensible, latent heat and stratified storage, solar ponds. Solar Applications - solar heating/cooling technique, solar distillation and drying, photovoltaic energy conversion.

UNIT - IV WIND ENERGY AND BIO GAS 10

Sources and potentials, horizontal and vertical axis windmills, performance characteristics, Betz criteria BIO-MASS: Principles of Bio-Conversion, Anaerobic/aerobic digestion, types of Bio-gas digesters, gas yield, combustion characteristics of bio-gas, utilization for cooking, I.C-Engine operation and economic aspects.

UNIT - V GEOTHERMAL ENERGY 9

Resources, types of wells, methods of harnessing the energy, potential in India. OCEAN ENERGY: OTEC, Principles utilization, setting of OTEC plants, thermodynamic cycles. Tidal and wave energy: Potential and conversion techniques, mini-hydel power plants, and their economics. DIRECT ENERGY CONVERSION: Need for DEC, Carnot cycle, limitations, principles of DEC.

TOTAL: 45 PERIODS

OUTCOMES:

On successful completion of the course student will be able to:

1. Understand the renewable source, the solar energy option, Environmental impact of solar power physics of the sun the solar constant.
2. Apply the knowledge of Flat plate and concentrating collectors, classification of concentrating collectors.
3. Determine Sensible, latent heat and stratified storage, solar ponds photovoltaic energy conversion.
4. Determine horizontal and vertical axis windmills, performance characteristics combustion characteristics of bio-gas.
5. Methods of harnessing the energy, potential in India Principles utilization, setting of OTEC plants.
6. Determine the mini-Hydel power plants and their economics Carnot cycle limitations principles of DEC.

TEXT BOOKS:

1. Rai G.D. , “Non-Conventional Energy Sources”, Khanna Publishers, 2011.
2. Ramesh R & Kumar K.U , “Renewable Energy Technologies”,Narosa Publishing House, 2004.

REFERENCES:

1. Tiwari and Ghosal, “Renewable energy resources”, Narosa Publishing House, 2007.
2. Twidell&Wier, “Renewable Energy Resources”, CRC Press (Taylor & Francis), 2011.
3. Mittal K M, “Non-Conventional Energy Systems”, Wheeler Publishing Co. Ltd, New Delhi, 2003.
4. Kothari D.P, Singhal., K.C., “Renewable energy sources and emerging technologies”, P.H.I, New Delhi.

21ME1937	INDUSTRIAL SAFETY AND MAINTENANCE	L	T	P	C
		3	0	0	3

OBJECTIVES:

- Identify unsafe conditions and recognize unsafe alerts.
- Interpret the rules and regulations for safety operations.
- Capable of solving problem of accidents.
- Capable of solving the present for criticizing the present for improved safety.
- Collaborate and modify processes / procedures for safety.

UNIT - I **INTRODUCTION** **9**

Evolution of modern safety concepts – Fire prevention – Mechanical hazards – Boilers, Pressure vessels, Electrical Exposure.

UNIT - II **CHEMICAL HAZARDS** **9**

Chemical exposure – Toxic materials – Radiation Ionizing and Non-ionizing Radiation - Industrial Hygiene – Industrial Toxicology.

UNIT - III **ENVIRONMENTAL CONTROL** **9**

Industrial Health Hazards – Environmental Control – Industrial Noise - Noise measuring instruments, Control of Noise, Vibration, - Personal Protection.

UNIT - IV **HAZARD ANALYSIS** **9**

System Safety Analysis –Techniques – Fault Tree Analysis (FTA), Failure Modes and Effects Analysis (FMEA), HAZOP analysis and Risk Assessment.

UNIT - V **SAFETY REGULATIONS** **9**

Explosions – Disaster management – catastrophe control, hazard control , Factories Act, Safety regulations Product safety – case studies.

TOTAL: 45 PERIODS

OUTCOMES:

On successful completion of the course student will be able to:

1. Identify and prevent chemical, environmental mechanical, fire hazard.
2. Collect, analyze and interpret the accidents data based on various safety techniques.
3. Apply proper safety techniques on safety engineering and management.
4. Able to perform hazard analysis.
5. Aid to design the system with environmental consciousness by implementing safety regulation.

TEXT BOOKS:

1. John V.Grimaldi, “Safety Management”, AITB S Publishers, 2003.

REFERENCES:

1. David L.Goetsch, “Occupational Safety and Health for Technologists”, Engineers and Managers, Pearson Education Ltd. 5th Edition, 2005.
2. Deshmukh L M, “Industrial Safety Management”, Tata McGraw-Hill Publishing Company Ltd.,2005.
3. Safety Manual, “EDEL Engineering Consultancy”, 2000.

21EC1011 TELEHEALTH TECHNOLOGY

L	T	P	C
3	0	0	3

OBJECTIVES:

- Learn the key principles for telemedicine and health.
- Understand telemedical technology.
- Know telemedical standards, mobile telemedicine and it applications

UNIT - I TELEMEDICINE AND HEALTH 9

History and Evolution of telemedicine, Organs of telemedicine, Global and Indian scenario, Ethicaland legal aspects of Telemedicine - Confidentiality, Social and legal issues, Safety and regulatory issues, Advances in Telemedicine.

UNIT - II TELEMEDICALTECHNOLOGY 9

Principles of Multimedia - Text, Audio, Video, data, Data communications and networks, PSTN,POTS, ANT, ISDN, Internet, Air/ wireless communications Communication infrastructure for telemedicine – LAN and WAN technology. Satellite communication, Mobile communication.

UNIT - III TELEMEDICAL STANDARDS 9

Data Security and Standards: Encryption, Cryptography, Mechanisms of encryption, phases of Encryption. Protocols: TCP/IP, ISO-OSI, Standards to followed DICOM, HL7, H. 320 series Video Conferencing, Security and confidentiality of medical records, Cyber laws related to telemedicine

UNIT - IV MOBILE TELEMEDICINE 9

Tele radiology: Image Acquisition system Display system, Tele pathology, Medical information storage and management for telemedicine- patient information, medical history, test reports, medical images, Hospital information system.

UNIT - V TELE MEDICAL APPLICATIONS 9

Telemedicine – health education and self care. · Introduction to robotics surgery, Telesurger, Telecardiology, Teleoncology, Telemedicine in neurosciences, Business aspects-Project planning and costing, Usage of telemedicine.

TOTAL: 45 PERIODS

OUTCOMES:

On successful completion of the course student will be able to:

1. Describe principles used for telemedicine and telehealth
2. Apply multimedia technologies in telemedicine.
3. Explain Protocols behind encryption techniques for secure transmission of data.
4. Explain various telemedical standards
5. Analyse patient information in hospital
6. Apply telehealth in healthcare.

TEXT BOOKS:

1. Norris, A.C. “Essentials of Telemedicine and Telecare”,Wiley,2012.

REFERENCES:

1. Wootton,R.,Craig,J.,Patterson,V.(Eds.),“IntroductiontoTelemedicine.RoyalSociety of Medicine” Press Ltd, Taylor & Francis 2016
2. O'Carroll, P.W., Yasnoff, W.A.,Ward,E., Ripp,L.H., Martin, E.L.(Eds), “Public Health Informatics and Information Systems”, Springer, 2013.
3. Simpson, W. Video over IP. A practical guide to technology and applications. Focal Press Elsevier, 2006
4. Bemmel, J.H. van, Musen, M.A. (Eds.) Handbook of Medical Informatics. Heidelberg, Germany: Springer, 1997 MohanBansa l, “MedicalInformatics”, TataMcGraw-Hill,2014.

21CS1002	SOFTWARE ENGINEERING	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To understand the phases in a software project
- To understand fundamental concepts of requirements engineering and Analysis Modeling.
- To understand the various software design methodologies, software testing, software process models
- To learn various testing and maintenance measures
- To understand the working knowledge of the techniques for estimation, design, testing and quality management of large software development projects

UNIT - I SOFTWARE PROCESS MODELS 9

Introduction to Software Engineering, Software Process, Perspective and Specialized Process Models – Waterfall model – Spiral Model – V shaped model – RAD model – Iterative Model – Prototype model. Introduction to Agility : Extreme programming.

UNIT - II REQUIREMENTS ANALYSIS AND SPECIFICATION 9

Software Requirements: Functional and Non-Functional, User requirements, System requirements, Software Requirements Document – Requirement Engineering Process: Feasibility Studies, Requirements elicitation and analysis, requirements validation, requirements management-Classical analysis: Structured system Analysis.

UNIT - III SOFTWARE DESIGN 9

Design process – Design Concepts-Design Model– Design Heuristic – Architectural Design - Architectural styles, Architectural Design, Architectural Mapping using Data Flow- User Interface Design: Interface analysis, Interface Design –Component level Design: Designing Class based components, traditional Components.

UNIT - IV TESTING AND MAINTENANCE 9

Software testing fundamentals-Internal and external views of Testing-white box testing - basis path testing-control structure testing-black box testing- Regression Testing – Unit Testing – Integration Testing – Validation Testing – System Testing And Debugging – Software Implementation Techniques: Coding practices-Refactoring-Maintenance and Reengineering-BPR model-Reengineering process model-Reverse and Forward Engineering.

UNIT - V PROJECT MANAGEMENT 9

Software Project Management: Estimation – LOC, FP Based Estimation, Make/Buy Decision COCOMO I & II Model – Project Scheduling – Scheduling, Earned Value Analysis Planning– Project Plan, Planning Process, RFP Risk Management – Identification, Projection - Risk Management-Risk Identification-RMMM Plan-CASE TOOLS.

TOTAL: 45 PERIODS

OUTCOMES:

On successful completion of the course student will be able to:

1. Decompose the given project in various phases of a lifecycle.
2. Choose appropriate process model depending on the user requirements.
3. Perform various life cycle activities like Analysis, Design, Implementation, Testing and Maintenance.
4. Know various processes used in all the phases of the product.
5. Apply the knowledge, techniques, and skills in the development of a software product.
6. Estimate the size of the software product.

TEXT BOOKS:

1. Roger S. Pressman, Bruce R.Maxim-Software Engineering - A Practitioner's Approach, Eight Edition, McGraw-Hill International Edition, 2015.
2. IanSommerville,-Software Engineering, 9th Edition, Pearson Education Asia, 2011.

REFERENCES:

1. Rajib Mall,Fundamentals of Software Engineering, Third Edition, PHI Learning PrivateLimited,2009.
2. PankajJalote, Software Engineering, A Precise Approach, Wiley India, 2010.
3. Kelkar S.A., Software Engineering, Prentice Hall of India Pvt Ltd, 2007.
4. Stephen R.Schach, Software Engineering, Tata McGraw-Hill Publishing Company Limited,2007.
5. http://nptel.ac.in

21EE1003 LOGIC AND DISTRIBUTED CONTROL SYSTEM

L	T	P	C
3	0	0	3

OBJECTIVES:

- To give an overview of the automation technologies such as PLCs, SCADA and DCS used in industries
- To provide a fundamental understanding of the different languages used for PLC Programming
- To provide insight into some of the advanced principles those are evolving for present and future automation.

UNIT - I PLC & SCADA 9

PLC: Evolutions of PLCs – Programmable Controllers – Architecture, I/O modules – Comparative study of Industrial PLCs. SCADA: Remote terminal units- Master station - Communication architectures.

UNIT - II BASICS OF PLC PROGRAMMING(LADDER) 9

Basics of PLC programming – Ladder Logic – Relay type instructions – Timer/Counter instructions – Program control instructions – Data manipulation and math instructions – Programming Examples

UNIT - III PLC PROGRAMMING (OTHER LANGUAGES) 9

Functional block programming - Sequential function chart – Instruction list – Structured text programming – PLC controlled sequential Process Examples.

UNIT - IV DISTRIBUTED CONTROL SYSTEM 9

DCS: Evolution & types – Hardware architecture – Field control station – Interfacing of conventional and smart field devices (HART and FF enabled) with DCS Controller – Communication modules – Operator and Engineering Human interface stations – Study of any one DCS available in market.

UNIT - V ADVANCED TOPICS IN AUTOMATION 9

Introduction to Networked Control systems – Plant wide control – Internet of things – Cloud based Automation – OLE for Process Control – Safety PLC – Case studies: PLC - SCADA - DCS.

TOTAL: 45 PERIODS

OUTCOMES:

On successful completion of the course student will be able to:

1. Ability to understand all the important components such as PLC, SCADA, DCS,I/O modules and field devices of an industrial automation system
2. Ability to develop PLC program in different languages for industrial sequential applications.
3. Able to select and use most appropriate automation technologies for a given application.
4. Ability to gain knowledge on the recent developments in industrial automation.

TEXT BOOKS:

1. F.D. Petruzella, Programmable Logic Controllers, Tata Mc-Graw Hill, Third edition, 2010
2. Michael P. Lukas, Distributed Control Systems: Their Evaluation and Design, Van Nostrand Reinhold Co., 1986
3. D. Popovic and V.P.Bhatkar,' Distributed computer control for industrial Automation' Marcel Dekker, Inc., Newyork ,1990.

REFERENCES:

1. Clarke, G., Reynders, D. and Wright, E., "Practical Modern SCADA Protocols: DNP3,4. 60870.5 and Related Systems", Newnes, 1st Edition, 2004.
2. Hughes, T.A., "Programmable Logic Controllers: Resources for Measurements and Control Series", 3rd Edition, ISA Press, 2004.
3. McMillan, G.K., "Process/Industrial Instrument and Controls Handbook", 5th Edition, McGraw- Hill handbook, New York, 1999.
4. NPTEL Notes on, "Programmable Logic Control System" by Department of Electrical Engg., IIT Kharagpur.

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21EC1008 ROBOTICS AND AUTOMATION

L	T	P	C
3	0	0	3

OBJECTIVES:

- To introduce basic robotic terminologies.
- To study about the sensors of robot.
- To understand the kinematics of robot.
- To illustrate about robotic vision.
- To apply robot based concepts in AI

UNIT - I INTRODUCTION TO ROBOTS 9

Introduction – Robotics -Definition and origin of robotics –components and structure of robots- different types of robot – various generations of robots – degrees of freedom – Robot classifications and specifications – Asimov's laws of robotics.

UNIT - II POWER SOURCES, SENSORS AND ACTUATORS 9

Hydraulic, pneumatic and electric drives: Design and control issues – determination of HP of motor and gearing ratio – variable speed arrangements – path determination – micro machines in robotics- machine vision – ranging – laser – acoustic – magnetic, fiber optic and tactile sensors.

UNIT - III KINEMATICS OF ROBOTS 9

Link Description - Link-Connection Description - Convention for Affixing Frames to Links - Manipulator Kinematics- Actuator Space-Joint Space and Cartesian Space Case Studies: Kinematics Of Two Industrial Robots - frames with standard names- computational considerations.

UNIT - IV ROBOTIC VISION 9

Industrial application of vision controlled robotic system-process of imaging- architecture of robotics vision system-image acquisition-description of other components of vision systems-image representation - image processing.

UNIT - V AI ROBOTICS 9

Intelligent systems- elements of artificial intelligence- system architecture- applications of advanced robot-fuzzy logic control-advanced concept and procedures-future development-impact on employment.

TOTAL: 45 PERIODS

OUTCOMES:

On successful completion of the course student will be able to:

1. Understand the evolution of robot technology and mathematically represent different types of robot.
2. Familiarize various electrical drive systems and sensors used in robotics for various applications.
3. Understand the kinematics of robotic device.
4. Understand the vision controlled robotic system.
5. Realize the description of components of vision systems.
6. Understand the applications of robotics in AI.

TEXT BOOKS:

1. Introduction to Robotics: Mechanics and control : J. Craig , Pearson,2008.
2. R.K.Mittal and I.J.Nagrath, Robotics and Control, Tata McGraw Hill, New Delhi, 4th Reprint, 2005.
3. James G. Keramas , Robot Technology Fundamendals India Edition.

REFERENCES:

1. Robotics Engineering : R. Klafter, PHI learning, 2009.
2. John M. Holland, "Designing Autonomous Mobile Robots-Inside the mind of an Intelligent Machine", Newnes Publication, 2004.
3. Robot : Dynamics and Control, Spong&Vidyasagar, McGraw Hill 2008.
4. Matthew T. Mason , Mechanics of Robotic Manipulation (Intelligent Robotics and Autonomous Agents) , MIT press 2022.
5. Groover, M.P., Weiss, M., Nagel, R.N., & Odrey, N.G. Industrial robotics - technology, programming, and applications.
6. Robotics and Control , Mittal R K & Nagrath I J , TMH.

21IT1001	**WEB DESIGN AND MANAGEMENT**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

OBJECTIVES:

- To Learn the basic concepts in HTML, CSS, JavaScript.
- To Understand the responsive design and development.
- To highlight the web frameworks in Web 2.0.
- To Design a Website with HTML, JS, CSS / CMS - Word press.
- To implement the project using CSS and open source.

UNIT - I WEB DESIGN - HTML MARKUP FORSTRUCTURE AND CSS 9

Working of Web - HTML Markup for Structure - Creating simple page - Marking up text - Addi Links -Adding Images - Table Markup - Forms - HTML5, CSS - Formatting text - Colours a Background - Padding, Borders and Margins - Floating andpositioning - Page Layout with CSS Transition, Transforms and Animation – Javascript - Using JavaScript

SUGGESTED ACTIVITIES:

Create HTML web page using CSS and JS
Create colorful web page design using CSS box model

SUGGESTED EVALUATION METHODS:

Quiz on HTML basic tags and CSS layout
Assignment submission on creating web page for different application.

UNIT - II RESPONSIVE WEB DESIGN 9

Sass for Responsive Web Design - Marking Content with HTML5 - Mobile-First or Desktop- First –CSSGrids, CSS Frameworks, UI Kits, and Flexbox for RWD - Designing small UIs by Large Finger -Images and Videos in Responsive Web Design - Meaningful Typography for Responsive Web Design.

SUGGESTED ACTIVITIES:

Create a simple web design using /Java /any language
Design small UI

SUGGESTED EVALUATION METHODS:

Build a responsive SaaS web page design
Create a Code for responsive web design videos.

UNIT - III WEB FRAMEWORK 9

Django Template System - Interacting with a Database (Modules) - Django Administration Site, Form Processing, Advanced Views and Urlconfs, Generic Views - Extending the Template Engine - Generating Non-HTML Content, Sessions, Users, Registration, Caching, Other Contributed Sub Frameworks, Middleware, Integrating with Legacy Databases and Applications, Extending Django's Admin Interface, Internationalization, Security and Deploying Django. The Model Definition Reference, The Data Base API Reference, Generic Views Reference, Settings, Built-In Template Tags and Filters, The Django - Admin Utility and Request and Response Objects. – Web App - Ruby Language – Ruby on Rails – Framework – Action Controller and Action View - RDF, Rdfa, OWL and Jena.

SUGGESTED ACTIVITIES:

Use web application framework software like Django, Flask to design and support the web application. Build web application using Ruby language.

SUGGESTED EVALUATION METHODS:

Assignment on web framework tool.

UNIT - IV WEB PROJECT MANAGEMENT 9

Project Life Cycle - Project Definition - Discovery and Requirements - Project Schedule and Budgeting- Running the project - Technical Documentation - Development , Communication, Documentation – QAand testing -Deployment - Support and operations.

SUGGESTED ACTIVITIES:

Case studies on Technical documentation

Real world domain specific problems involving project life cycle.

SUGGESTED EVALUATION METHODS:

Student assignment on case studies related to healthcare, climate change, ecommerce, retail business, manufacturing etc.

UNIT - V PRODUCTION, MAINTENANCE AND EVALUATION 9

Design and Construction – Testing, Launch and Handover – Maintenance – Review and Evaluation – Case Study: Using the Skills and Concepts Learn with the ADOBE IMAGE READY,DREAM WEAVER, FLASH, and Scripts, Develop Portfolios in the Form of Web Pages which have to be uploaded in Free Public Domains.

SUGGESTED ACTIVITIES:

Case studies on applications involving concept of adobe image ready.

Demonstration of develop portfolio in form of web page.

SUGGESTED EVALUATION METHODS:

Quiz on Testing and develop portfolio.

TOTAL: 45 PERIODS

OUTCOMES:

On successful completion of the course student will be able to:

1. Design Website using HTML CSS and JS.
2. Design Responsive Sites.
3. Identify the suitable web framework to support the development of web applications.
4. Manage, Maintain and Support Web Apps.
5. Write and demonstrate simple web applications involving CSS.
6. Create and maintain responsive websites and employ strategies with user-centered design methodologies.

TEXT BOOKS:

1. Jennifer Niederst Robbins, "Learning Web Design", O'REILLY 4th Edition.
2. Ricardo Zea, "Mastering Responsive Web Design", PACKT Publishing, 2015.
3. Justin Emond, Chris Steins, "Pro Web Project Management", Apress,2011.

REFERENCES:

1. Jon Duckett, "HTML and CSS: Design and Build Websites", John Wiley and Sons, edition 2014.
2. Jon Duckett, Jack Moore,"JavaScript & JQuery: Interactive Front-End Web Development".
3. John Wiley and Sons, edition 2014.

21CB1002 MOBILE APPLICATION DEVELOPMENT

L	T	P	C
3	0	0	3

OBJECTIVES:

- To demonstrate their understanding of the fundamentals of Android operating systems.
- To learn how to utilize rapid prototyping techniques to design and develop sophisticatedAndroid application.
- To understand the platform for developing mobile application.
- To show their ability to deploy software to mobile devices.
- To exhibit their ability to debug programs running on mobile devices.

UNIT - I INTRODUCTION TO ANDROID OPERATING SYSTEM 9

Introduction to Android Operating System: Android OS design and Features – Android development framework, SDK features, Installing and running applications on Android Studio, Creating AVDs, Types of Android applications, Best practices in Android programming, Android tools Android application components – Android Manifest file, Resources for different devices and languages, Runtime Configuration Changes Android Application Lifecycle – Activities, Activity lifecycle, activity states, monitoring state changes.

SUGGESTED ACTIVITIES:

- Understanding the Android OS
- Acquire knowledge on basic building blocks of Android programming required for Appdevelopment.

SUGGESTED EVALUATION METHODS

- Quizzes
- Assignments

UNIT - II CONTROLS AND USER INTERFACE 9

Measurements – Device and pixel density independent measuring units - Layouts – Linear, Relative, Grid and Table Layouts - User Interface (UI) Components – Editable and non-editable Text Views, Buttons, Radio and Toggle Buttons, Checkboxes, Spinners, Dialog and pickers -Event Handling – Handling clicks or changes of various UI components Fragments – Creating fragments, Lifecycle of fragments, Fragment states, Adding fragments to Activity, adding, removing and replacing fragments with fragment transactions, interfacing between fragments and Activities, Multi-screen Activities.

SUGGESTED ACTIVITIES:

- Acquire the knowledge on Android devices and Platform
- Understanding the UI components.

SUGGESTED EVALUATION METHODS

- Pedagogical tools

Assignments

UNIT - III INTENTS AND BROADCASTS 9

Intent – Using intents to launch Activities, Explicitly starting new Activity, Implicit Intents, Passing data to Intents, Getting results from Activities, Native Actions, using Intent to dial a number or to send SMS -Broadcast Receivers –Using Intent filters to service implicit Intents, Resolving Intent filters, finding and using Intents received within an Activity Notifications – Creating and Displaying notifications, Displaying Toasts- Accessing Databases.

SUGGESTED ACTIVITIES:

- Understanding the working principle of Android for app development.
- Develop and publish Android applications in to Android Market

SUGGESTED EVALUATION METHODS

- Quizzes
- Crossword puzzles

UNIT - IV INTRODUCTION TO iOS 9

Introduction to iPhone, MVC Architecture, View Controller - Building the UI and Event handling, Application life cycle, Tab Bars, Story Boards and Navigation Controllers, Table View, Push Notification, Database handling, Introduction to icloud, Webkit framework in iOS8, Deploying and publishing application.

SUGGESTED ACTIVITIES:

- Understand the concepts of iOs.
- Develop and publish applications using iOS

SUGGESTED EVALUATION METHODS

- Assignments
- Crossword puzzles

UNIT - V WINDOWS MOBILE APP DEVELOPMENT 9

Introduction to Windows Phone 8, Application Life cycle, UI Designing and events, Building, Files and Storage, Network Communication, Push Notification, Background Agents, Maps and Locations, Data Access and storage, Introduction to Silverlight and XAML, Data Binding, Deploying and Publishing.

SUGGESTED ACTIVITIES:

- Understand the windows phone concepts.
- To learn the concepts of data binding, deploying and publishing

SUGGESTED EVALUATION METHODS

- Assignments
- Quizzes

TOTAL: 45 PERIODS

OUTCOMES:

On successful completion of the course student will be able to:

1. Learn and understand the technology and business trends impacting mobile application.
2. Understand and remember the components of android, iOS, and windows mobile application.
3. Learning the techniques for developing mobile applications.
4. Create the mobile applications with compelling user interface and database connectivity forreal time applications.
5. Apply and develop mobile application with iOS platform.
6. Develop and deploy mobile applications using Silverlight.

TEXT BOOKS:

1. Reto Meier, “Professional Android Application Development”, Wrox, 2010.
2. David Mark, Jack Nutting and Jeff LaMarche, “Beginning iOS 6 Development Exploring theiOS SDK”, Apress, 2013.

REFERENCES:

1. Beginning Android 4 Application Development, Wei-Meng Lee, Wiley India (Wrox), 2013.
2. Baijian Yang, Pei Zheng, Lionel M. Ni, “Professional Microsoft Smartphone Programming”,Wrox Edition.

21EE1007	INTELLIGENT CONTROL OF ELECTRIC VEHICLES	L	T	P	C
		2	0	2	3

OBJECTIVES: To impart Knowledge on the following topics:

- To design and drive the mathematical model of a BLDC motor and its characteristics.
- To learn the different control schemes for BLDC motor.
- To study the basics of fuzzy logic.
- To study the FPGA & VHDL basics.
- To implement fuzzy logic control of BLDC motor in real time.

UNIT - I MATHEMATICAL MODEL AND CHARACTERISTICS ANALYSIS OF THE BLDC MOTOR 6

Structure and Drive Modes - Basic Structure, General Design Method, Drive Modes. Mathematical Model, Differential Equations, Transfer Functions, State-Space Equations. Characteristics Analysis, Starting Characteristics, Steady-State Operation, Dynamic Characteristics, Load Matching Commutation Transients

UNIT - II SPEED CONTROL FOR ELECTRIC DRIVES 6

Introduction -PID Control Principle, Anti windup Controller, Intelligent Controller. Vector Control. Control applied to BLDC motor.

UNIT - III FUZZY LOGIC 6

Membership functions: features, fuzzification, methods of membership value assignments Defuzzification: lambda cuts - methods - fuzzy arithmetic and fuzzy measures: fuzzy arithmetic - extension principle - fuzzy measures - measures of fuzziness -fuzzy integrals - fuzzy rule base and approximate reasoning : truth values and tables, fuzzy propositions, formation of rules decomposition of rules, aggregation of fuzzy rules, fuzzy reasoning-fuzzy inference systems, overview of fuzzy expert system-fuzzy decision making.

UNIT - IV FPGA AND VHDL BASICS 6

Introduction – FPGA Architecture-Advantages-Review of FPGA family processors-Spartan 3, Spartan 6 and Spartan 7. VHDL Basics- Fundamentals-Instruction set-data type-conditional statements- programs like arithmetic, sorting, PWM generation, Speed detection.

UNIT - V REAL TIME IMPLEMENTATION 6

Inverter design, identifying rotor position via hall effect sensors, open loop and fuzzy logic control of 48 V BLDC motor using FPGA.

TOTAL: 30 PERIODS

OUTCOMES:

On successful completion of the course student will be able to:

1. To design the mathematical model of a BLDC motor and to discuss about its characteristics.
2. To demonstrate the PID control, ant windup controller, Intelligent Controller and Vector Control. Control applied to BLDC motor.
3. To illustrate the basics of fuzzy logic system.
4. To describe the basics of VHDL & FPGA applied to control of EVs.
5. To design and implement of fuzzy logic control scheme for BLDC motor using FPGA in real time.
6. Design and simulate controllers for induction motors in EV for steady sate and transient conditions.

TEXT BOOKS:

1. Electric Powertrain Energy Systems, Power Electronics and Drives for Hybrid, Electric and Fuel Cell Vehicles, John G. Hayes, G. Abas Goodarzi, Wiley 1st Edition, 2018.
2. VHDL Primer, A (3rd Edition), Jayaram Bhasker, Prentice Hall, 1st Edition, 2015.

REFERENCES:

1. Iqbal Hussain, "Electric and Hybrid Vehicles: Design Fundamentals, Third Edition" CRC Press, Taylor & Francis Group, 2021, 1st Edition.
2. Chang-liang, Permanent Magnet Brushless DC Motor Drives and Controls, Xia Wiley, 2012, 1st Edition.
3. M.N. Cirstea, A. Dinu, J.G. Khor,M. McCormick, Neural and Fuzzy Logic Control of Drives and Power Systems, Newnes publications, 1st Edition, 2002.
4. Wei Liu, Hybrid Electric Vehicle System Modeling and Control, Wiley, 2017, 2nd Edition.
5. Electric and Plug-in Hybrid Vehicle Networks Optimization and Control, Emanuele
Crisostomi • Robert Shorten, Sonja Stüdli • Fabian Wirth, CRC Press, 1st Edition, 2018.

21ME1934	INDUSTRIAL ENGINEERING	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To understand the various components and functions of production planning and control such as product planning, process planning, production scheduling.
- To know the recent trends like manufacturing requirement Planning (MRP II) and Enterprise Resource Planning (ERP).
- To make cost estimation for various products after process planning and product planning along with manufacturing time calculations.

UNIT - I INTRODUCTION TO PRODUCTION AND OPERATIONS MANAGEMENT 9

Objectives and benefits of planning and control-Functions of production control-Types of production- job- batch and continuous-Product development and design-Marketing aspect-Functional aspects-Operational aspect-Durability and dependability aspect aesthetic aspect. Profit consideration- Standardization, Simplification & specialization- Break even analysis-Economics of a new design.

UNIT - II PRODUCT PLANNING AND PROCESS PLANNING 9

Product planning-Extending the original product information-Value Analysis-Problems in lack of product planning-Process planning and routing-Prerequisite information needed for process planning- Steps in process planning-Quantity determination in batch production-Machine capacity, balancing- Analysis of process capabilities in a multi-product system.

UNIT - III PRODUCTION SCHEDULING 9

Production Control Systems-Loading and scheduling-Master Scheduling-Scheduling rules-Gantt charts-Perpetual Loading-Basic scheduling problems - Line of balance – Flow production scheduling- Batch production scheduling-Product sequencing – Production Control systems- Periodic batch control-Material requirement planning, KANBAN – Dispatching-Progress reporting and expediting. Manufacturing lead time-Techniques for aligning completion times and due dates.

UNIT - IV COST ESTIMATION 9

Importance of costing and estimation- Types of estimates – Estimating procedure-Methods of costing-elements of cost estimation, Estimation labor cost, material cost-allocation of overhead charges- Calculation of depreciation cost, Estimation of Different Types of Jobs - Estimation of Sheet metal Shop, Forging Shop, Welding Shop and Foundry Shop.

UNIT - V MACHINING TIME CALCULATION & RECENT TRENDS IN INDUSTRIAL ENGINEERING 9

Estimation of Machining Time - Importance of Machine Time Calculation- Calculation of Machining Time for Different Lathe Operations, Drilling and Boring - Machining Time Calculation for Milling, Shaping and Planning -Machining Time Calculation for Grinding. Introduction to computer integrated production planning systems- elements of JUST IN TIME SYSTEMS-Fundamentals of MRP II and ERP.

TOTAL: 45 PERIODS

OUTCOMES:

On successful completion of the course student will be able to:

1. Understand the basic concepts of production and operations management with cost considerations.
2. Understand the concepts of value analysis, process capabilities, balancing for product and process planning.
3. Understand fundamental concepts of scheduling theory by determining an optimal schedule for a flow shop and also to solve complex job shop problems, design and evaluate various feasible job shop schedules.
4. Enable both the costing and estimating procedures for all type of industry with overheads.
5. Understand the importance of machining time along with recent trends like JIT, MRP - II and ERP.

TEXT BOOKS:

1. Martand T Telsang, “Industrial Engineering and Production Management”, Third Revised edition, S. Chand and Company, 2018.
2. Narang GBS and Kumar V, Production and Costing, Khanna Publishers, 2014.

REFERENCES:

1. Panneerselvam. R, Production and operations Management, PHI, 3rd Edition, 2012.
2. James. B. Dilworth,” Operations management – Design, Planning and Control for manufacturing and services” McGraw Hill International edition 1992.
3. William J Stevenson, Operations Management, McGraw Hill,13th Edition,2018.
4. Chary. S.N., “Production and Operations Management”, Tata McGraw Hill, 6^{th}Edition, 2019.
5. Banga T R and Sharma S C, Estimating and Costing, Khanna Publishers, 2001.

21ME1005 **HOSPITAL MANAGEMENT**

L	T	P	C
3	0	0	3

OBJECTIVES:

- To understand the fundamentals of hospital administration and management.
- To know the market related research process.
- To explore various information management systems and relative supportive services.
- To learn the quality and safety aspects in hospital.

UNIT - I OVERVIEW OF HOSPITAL ADMINISTRATION 9

Distinction between Hospital and Industry, Challenges in Hospital Administration – Hospital Planning- Equipment Planning – Functional Planning.

UNIT - II HUMAN RESOURCE MANAGEMENT IN HOSPITAL 9

Principles of HRM – Functions of HRM – Profile of HRD Manager –Human Resource Inventory – Manpower Planning.

UNIT - III RECRUITMENT AND TRAINING 9

Different Departments of Hospital, Recruitment, Selection, Training Guidelines – Methods of Training – Evaluation of Training – Leadership grooming and Training, Promotion – Transfer.

UNIT - IV SUPPORTIVE SERVICES 9

Medical Records Department – Central Sterilization and Supply Department – Pharmacy – Food Services - Laundry Services.

UNIT - V COMMUNICATION AND SAFETY ASPECTS IN HOSPITAL 9

Purposes – Planning of Communication, Modes of Communication – Telephone, ISDN, Public Address and Piped Music – CCTV. Security – Loss Prevention – Fire Safety – Alarm System – Safety Rules.

TOTAL: 45 PERIODS

OUTCOMES:

On successful completion of the course student will be able to:

1. Able to understand fundamentals of hospital administration and management and their importance in the globalized competitive world.
2. Able to understand the market related research process.
3. Able to explore various information management systems and relative supportive services.
4. Apply the quality and safety aspects in hospital.
5. Able to understand the communication and safety aspects in hospital.

TEXT BOOKS:

1. R.C.Goyal, “Hospital Administration and Human Resource Management”, PHI – Fourth Edition, 2006.
2. G.D.Kunders, “Hospitals – Facilities Planning and Management – TMH, New Delhi – Fifth Reprint 2007.

REFERENCES:

1. Cesar A.Caceres and Albert Zara, “The Practice of Clinical Engineering, Academic Press, New York, 1977.
2. Norman Metzger, “Handbook of Health Care Human Resources Management”, 2nd edition, Aspen Publication Inc. Rockville, Maryland, USA, 1990.
3. Peter Berman “Health Sector Reform in Developing Countries” - Harvard University Press, 1995.
4. William A. Reinke “Health Planning For Effective Management” - Oxford University Press.1988.
5. Blane, David, Brunner, “Health and SOCIAL Organization: Towards a Health Policy for the 21st Century”, Eric Calrendon Press 2002.
6. Arnold D. Kalcizony& Stephen M. Shortell, “Health Care Management”, 6th Edition Cengage Learning, 2011.

PANIMALAR ENGINEERING COLLEGE

(An Autonomous Institution, Affiliated to Anna University, Chennai)

Bangalore Trunk Road, Varadharajapuram,

Poonamallee, Chennai – 600 123.

Department of Electronics and Communication Engineering

B.E- Electronics and Communication Engineering

Curriculum and SyllabusRegulation 2021

PROGRAMME EDUCATIONAL OBJECTIVES: (PEOs):

- To prepare students to analyze, design and implement electronic circuits and systems using the knowledge acquired from basic science and mathematics.
- To train students with good scientific and engineering knowledge so as to comprehend, analyze, design and create novel products and solutions for real life problems.
- To introduce the research world to the graduates not only in their own domain but also in multidisciplinary domain, so that they feel motivated for higher studies.
- To prepare graduates to exhibit professionalism, ethical attitude, communication skills, team work and leadership qualities in their profession and adapt to current trends by engaging in lifelong learning.
- To practice professionalism in a collaborative, team-oriented manner that embraces the multicultural environment of today's business world.

PROGRAMME OUTCOMES (POs):

1. **Engineering knowledge**
   Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
2. **Problem Analysis**
   Identify, formulate, research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
3. **Design/development of solutions**
   Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
4. **Conduct investigations of complex problems**
   Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information

5. **Modern tool usage**

   Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.

6. **The engineer and society**

   Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal, and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

7. **Environment and Sustainability**

   Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of need for sustainable development.

8. **Ethics**

   Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

9. **Individual and Team Work**

   Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

10. **Communication**

    Communicate effectively on complex engineering activities with the engineering community and with society at large. Some of them are, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

11. **Project Management and Finance**

    Demonstrate knowledge and understanding of the engineering and management principles and apply these to one’s own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

12. **Lifelong 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 (PSOs):

PSO1: Graduates should demonstrate an understanding of the basic concepts in the primary area of Electronics and Communication Engineering, including: analysis of circuits containing both active and passive components, electronic systems, control systems, electromagnetic systems, digital systems, computer applications and communications.

PSO2: Graduates should demonstrate the ability to utilize the mathematics and the fundamental knowledge of Electronics and Communication Engineering to design complex systems which may contain both software and hardware components to meet the desired needs.

PSO3: The graduates are capable of excelling in Electronics and Communication Engineering industry/Academic /Software companies through professional careers.

PANIMALAR ENGINEERING COLLEGE

(An Autonomous Institution, Affiliated to Anna University, Chennai)

ELECTRONICS AND COMMUNICATION ENGINEERING

CHOICE BASED CREDIT SYSTEM

CURRICULA AND SYLLABI – R2021

SEMESTER I

Sl. No	Course Code	Course Title	Category	Contact Periods	L	T	P	C
THEORY								
1.	21HS1101	Communicative English and Language Skills Lab I Integrated	HS	5	3	0	2	4
2.	21MA1101	Engineering Mathematics –I	BS	4	3	1	0	4
3.	21PH1101	Engineering Physics	BS	3	3	0	0	3
4.	21CY1101	Engineering Chemistry	BS	3	3	0	0	3
5.	21ES1101	Problem Solving and Python Programming	ES	3	3	0	0	3
6.	21ES1102	Engineering Graphics	ES	5	3	0	2	4
PRACTICALS								
7.	21ES1111	Problem Solving and Python Programming Laboratory	ES	4	0	0	4	2
8.	21BS1111	Physics and Chemistry Laboratory	BS	4	0	0	4	2
		TOTAL		**31**	**18**	**1**	**12**	**25**

SEMESTER II

Sl. No	Course Code	Course Title	Category	Contact Periods	L	T	P	C
THEORY								
1.	21HS1201	Communicative English and Language Skills Lab II Integrated	HS	5	3	0	2	4
2.	21MA1201	Engineering Mathematics-II	BS	4	3	1	0	4
3.	21PH1201	Physics for Electronics Engineering	BS	3	3	0	0	3
4.	21BE1201	Basics of Electrical and Measurement Engineering	ES	3	3	0	0	3
5.	21EC1201	Circuit Analysis	PC	3	2	1	0	3
6.	21EC1202	Electronic Devices	PC	3	3	0	0	3
PRACTICALS								
7.	21EC1211	Circuits and Devices Laboratory	PC	4	0	0	4	2
8.	21ES1211	Engineering Practices Laboratory	ES	4	0	0	4	2
		TOTAL		**29**	**17**	**2**	**10**	**24**

SEMESTER III

Sl. No	Course Code	Course Title	Category	Contact Periods	L	T	P	C
THEORY								
1.	21MA1302	Linear Algebra and Numerical Analysis	BS	4	4	0	0	4
2.	21EC1301	Electromagnetic Fields	PC	3	3	0	0	3
3.	21EC1302	Electronic Circuits	PC	3	3	0	0	3
4.	21EC1303	Digital Electronics	PC	3	3	0	0	3
5.	21EC1304	Signals and Systems	PC	3	3	1	0	4
6.		Mandatory Course I	MC	2	2	0	0	0
PRACTICALS								
7.	21EC1311	Circuits and Simulation Laboratory	PC	4	0	0	4	2
8.	21EC1312	Digital Electronics Laboratory	PC	4	0	0	4	2
TOTAL				**26**	**18**	**1**	**8**	**21**

SEMESTER IV

Sl. No	Course Code	Course Title	Category	Contact Periods	L	T	P	C
THEORY								
1.	21MA1403	Probability and Random Processes	BS	4	3	1	0	4
2.	21EC1401	Artificial Intelligence and Machine Learning (Lab Integrated)	PC	4	3	0	2	4
3.	21EC1402	Control Systems Engineering	PC	4	3	1	0	4
4.	21EC1403	Fundamentals of Data structures in C	PC	3	3	0	0	3
5.	21EC1404	Analog Integrated Circuits	PC	3	3	0	0	3
6.		Mandatory Course II	MC	2	2	0	0	0
PRACTICALS								
7.	21EC1412	Analog Integrated Circuits Laboratory	PC	4	0	0	4	2
8.	21EC1413	Fundamentals of Data structures in C Laboratory	PC	4	0	0	4	2
TOTAL				**28**	**17**	**2**	**10**	**22**

SEMESTER V

Sl. No	Course Code	Course Title	Category	Contact Periods	L	T	P	C
THEORY								
1.	21EC1501	Analog and Digital Communication	PC	3	3	0	0	3
2.	21EC1502	Digital Signal Processing	PC	3	3	0	0	3
3.	21EC1503	Microcontrollers and Computer Architecture	PC	3	3	0	0	3
4.	21EC1504	Transmission Lines and Waveguides	PC	3	3	0	0	3
5.		Professional Elective – I	PE	3	3	0	0	3
6.		Open Elective 1	OE	3	3	0	0	3
PRACTICALS								
7.	21EC1511	Microcontrollers and Interfacing Laboratory	PC	4	0	0	4	2
8.	21EC1512	Digital Signal Processing Laboratory	PC	4	0	0	4	2
9.	21EC1513	Analog and Digital Communication Laboratory	PC	4	0	0	4	2
		TOTAL		**30**	**18**	**0**	**12**	**24**

SEMESTER VI

Sl. No	Course Code	Course Title	Category	Contact Periods	L	T	P	C
THEORY								
1.	21EC1601	Wireless Communication	PC	3	3	0	0	3
2.	21EC1602	Antenna Theory and Design	PC	3	3	0	0	3
3.	21EC1603	VLSI and Chip Design	PC	3	3	0	0	3
4.	21EC1604	Data Communication Networks	PC	3	3	0	0	3
5.		Professional Elective II	PE	3	3	0	0	3
6.		Open Elective II	OE	3	3	0	0	3
PRACTICALS								
7.	21EC1611	VLSI Design Laboratory	PC	4	0	0	4	2
8.	21EC1612	Wireless Communication and Networks Laboratory	PC	4	0	0	4	2
		TOTAL		**26**	**18**	**0**	**8**	**22**

SEMESTER VII

Sl. No	Course Code	Course Title	Category	Contact Periods	L	T	P	C
THEORY								
1.	21EC1701	Embedded Systems and Robotics	PC	3	3	0	0	3
2.	21EC1702	Microwave Devices and Circuits	PC	3	3	0	0	3
3.	21EC1703	Optical Communication and Networks	PC	3	3	0	0	3
4.		Professional Elective – III	PE	3	3	0	0	3
5.		Professional Elective – IV	PE	3	3	0	0	3
PRACTICALS								
6.	21EC1711	Embedded Systems and Robotics Laboratory	PC	4	0	0	4	2
7.	21EC1712	Advanced Communication Laboratory	PC	4	0	0	4	2
8.	21EC1713	Mini Project	EEC	2	0	0	2	1
TOTAL				**25**	**15**	**0**	**10**	**20**

SEMESTER VIII

Sl. No	Course Code	Course Title	Category	Contact Periods	L	T	P	C
THEORY								
1.		Professional Elective – V	PE	3	3	0	0	3
2.		Professional Elective – VI	PE	3	3	0	0	3
PRACTICALS								
1.	21EC1811	Project Work	EEC	20	0	0	20	10
TOTAL				**26**	**6**	**0**	**20**	**16**

Total No. of Credits: 174

PROFESSIONAL ELECTIVE COURSES: VERTICALS

Sl. No	Vertical I	Vertical II	Vertical III	Vertical IV	Vertical V	Vertical VI	Vertical VII	Vertical VIII
	VLSI Chip Design and Testing	**Signal Processing**	**RF Technologies**	**Biomedical Technologies**	**Wireless Networks and IoT**	**Space Technologies**	**Radio Communication and Broadband Networks**	**Emerging Technologies**
1.	21EC1901 ASIC Design	21EC1908 DSP Architecture and Programming	21EC1915 Electromagnetic Interference and Compatability	21EC1922 Medical Electronics	21EC1929 Wireless Networks	21EC1936 Radar Technologies	21EC1943 Broadband Access Technologies	21EC1950 Cryptography and Security Practices
2.	21EC1902 CAD for VLSI Design	21EC1909 Advanced Digital Signal Processing	21EC1916 RFID systems and Applications	21EC1923 Wearable Medical Devices	21EC1930 Adhoc and Wireless Sensor Networks	21EC1937 Planetary Science	21EC1944 Software Defined Networks	21EC1951 Blockchain Technologies and Applications
3.	21EC1903 Mixed Signal IC Design	21EC1910 Digital Image and Video Processing	21EC1917 RF MEMS	21EC1924 Human Assist Devices	21EC1931 Cooperative Communications and Networking	21EC1938 Remote Sensing	21EC1945 Cognitive Radio Networks	21EC1952 Data Science and Analytics
4.	21EC1904 Low Power IC Design	21EC1911 VLSI Signal Processing	21EC1918 Smart Antennas	21EC1925 Medical Imaging Systems	21EC1932 IoT and its Applications	21EC1939 Navigation Systems	21EC1946 Wireless Broadband Networks	21EC1953 Machine Learning Algorithms
5.	21EC1905 VLSI Testing and Design for Testability	21EC1912 Speech Processing	21EC1919 RF System Design	21EC1926 Wireless Body Area Networks	21EC1933 IoT Based System Design	21EC1940 Satellite Communication	21EC1947 Massive MIMO Networks	21EC1954 Deep learning
6.	21EC1906 System on Chip	21EC1913 Computer Vision	21EC1920 Signal Integrity for High Speed Design	21EC1927 Brain Computer Interface and Applications	21EC1934 Industrial IoT 4.0	21EC1941 Avionics Systems	21EC1948 5G and beyond communication Networks	21EC1955 Human Computer Interaction
7.	21EC1907 Networks on Chip	21EC1914 Underwater Imaging Systems And Image Processing	21EC1921 Computational Electro magnetics	21EC1928 Therapeutic Equipment	21EC1935 Wireless Sensor Network Design	21EC1942 Rocketry and Space Mechanics	21EC1949 Photonic Networks	21EC1956 Augmented Reality/Virtual Reality

Registration of Professional Elective Courses from Verticals:

Professional Elective Courses will be registered in Semesters V to VIII. These courses are listed in groups called verticals that represent a particular area of specialization / diversified group. Students are permitted to choose all the Professional Electives from a particular vertical or from different verticals. Further, only one Professional Elective course shall be chosen in a semester horizontally (row-wise). However, two courses are permitted from the same row, provided one course is enrolled in Semester V and another in semester VI.

The registration of courses for B.E./B.Tech (Honours) or Minor degree shall be done from Semester V to VIII. The procedure for registration of courses explained above shall be followed for the courses of B.E/B.Tech (Honours) or Minor degree also. For more details on B.E./B.Tech (Honours) or Minor degree refer to the Regulations 2021.

List of Open Electives I (V SEMESTER)

Sl. No	Course Code	Course Title	Category	Contact Periods	L	T	P	C
1.	21EE1005	Energy Conservation and Management	OE	3	3	0	0	3
2.	21CS1001	Fundamentals of Database Management Systems	OE	3	3	0	0	3
3.	21CS1003	Cloud Computing	OE	3	3	0	0	3
4.	21EC1003	Basic of Biomedical Instrumentation	OE	3	3	0	0	3
5.	21EE1006	Intelligent Automation	OE	3	3	0	0	3
6.	21CB1001	Introduction to C Programming	OE	3	3	0	0	3
7.	21AM1001	Data Structures and Algorithms	OE	3	3	0	0	3
8.	21IT1003	Ethical Hacking	OE	3	3	0	0	3
9.	21EC1005	Product Design and Development	OE	3	3	0	0	3
10.	21ME1004	Industrial Pollution and Prevention	OE	3	3	0	0	3

List of Open Electives II (VI SEMESTER)

Sl. No	Course Code	Course Title	Category	Contact Periods	L	T	P	C
1.	21ME1917	Renewable Energy Resources	OE	3	3	0	0	3
2.	21ME1937	Industrial Safety and Maintenance	OE	3	3	0	0	3
3.	21EC1011	Telehealth Technology	OE	3	3	0	0	3
4.	21CS1002	Software Engineering	OE	3	3	0	0	3
5.	21EE1003	Logic and Distributed Control System	OE	3	3	0	0	3
6.	21EC1008	Robotics and Automation	OE	3	3	0	0	3
7.	21IT1001	Web Design and Management	OE	3	3	0	0	3
8.	21CB1002	Mobile Application Development	OE	3	3	0	0	3
9.	21EE1007	Intelligent Control of Electric Vehicles	OE	3	3	0	0	3
10.	21ME1934	Industrial Engineering	OE	3	3	0	0	3
11.	21ME1005	Hospital Management	OE	3	3	0	0	3

MANDATORY COURSES

Sl. No	Course Code	Course Title	Category	Contact Periods	L	T	P	C
1.	21MC1001	Environmental Science	MC	2	2	0	0	0
2.	21MC1002	Constitution of India	MC	2	2	0	0	0
3.	21MC1003	Human Values	MC	2	2	0	0	0
4.	21MC1004	Energy Studies	MC	2	2	0	0	0
5.	21MC1005	Essence of Indian Traditional Knowledge	MC	2	2	0	0	0
6.	21MC1006	Soft Skills and Personality Development	MC	2	2	0	0	0
7.	21MC1007	Value Education, Human Rights and Legislature Procedure	MC	2	2	0	0	0

Credit Distribution

Sl.No	Subject Area	CREDITS PER SEM								Total	Percentage
	Semester	I	II	III	IV	V	VI	VII	VIII		
1.	**HS**	4	4							8	4.60
2.	**BS**	12	7	4	4					27	15.52
3.	**ES**	9	5							14	8.05
4.	**PC**		8	17	18	18	16	13		90	51.72
5.	**PE**					3	3	6	6	18	10.34
6.	**OE**					3	3			6	3.45
7.	**EEC**							1	10	11	6.32
8.	**MC**			0	0					0	0
TOTAL		**25**	**24**	**21**	**22**	**24**	**22**	**20**	**16**	**174**	**100**

21HS1101	COMMUNICATIVE ENGLISH AND LANGUAGE SKILLS LAB I INTEGRATED	L	T	P	C
		3	0	2	4

OBJECTIVES:

- To induce the basic reading and writing skills among the first year engineering and technology students.
- To assist the learners to develop their listening skills, which will enable them listening to lectures and comprehend them by asking questions and seeking clarifications
- To succor the learners to develop their speaking skills and speak fluently in real contexts.
- To motivate the learners to develop vocabulary of a general kind by developing their reading skills for meeting the competitive exams like GATE, TOFEL, GRE, IELTS, and other exams conducted by Central and State governments

UNIT - I INTRODUCING ONESELF 9

Listening: Listening and filling details, Listening to Speeches by Specialists and Completing Activities such as Answering Questions, Identifying the Main Ideas, Style, etc. Speaking: Introducing Oneself – Introducing Friend/ Family. Reading: Descriptive Passages (From Newspapers / Magazines).Writing: Writing a Paragraph (Native Place, School Life), Developing Hints. Grammar: Noun, Pronoun & Adjective. Vocabulary Development: One Word Substitution.

UNIT - II DIALOGUE WRITING 9

Listening: Listening to Conversations (Asking for and Giving Directions).Speaking: Making Conversation Using (Asking for Directions, Making an Enquiry), Role Plays, and Dialogues. Reading: Reading a Print Interview and Answering Comprehension Questions. Writing: Writing a Checklist, Dialogue Writing Grammar: Tenses and Voices. Vocabulary Development: Prefix &Suffix, Word formation.

UNIT - III DRAFTING OFFICIAL COMMUNICATIONS 9

Listening: Listening for specific information. Speaking: Giving Short Talks on a given Topic. Reading: Reading Motivational Essays on Famous Engineers and Technologists (Answering Open – Ended and Closed Questions).Writing: Writing Formal Letters / Emails. Grammar: Adverb, Prepositions & Conjunctions. Vocabulary Development: Collocations – Fixed Expressions.

UNIT - IV WRITTEN COMMUNICATION 9

Listening: Listening to Short Talks (5 Minutes Duration and Fill a Table, Gap-Filling Exercise) Note Taking/Note Making .Speaking: Small Group Discussion, Giving Recommendations .Reading: Reading Problem – Solution Articles/Essays Drawn From Various Sources .Writing: Making Recommendations Note Making – Complaint Letters. Grammar: Subject-Verb Agreement, Framing Questions. Vocabulary Development: Connectives, Reference Words, Technical Vocabulary.

UNIT - V WRITING DEFINITIONS AND PRODUCT DESCRIPTION 9

Listening: Listening to a Product Description (Labeling and Gap Filling) Exercises. Speaking: Describing a Product and Comparing and Contrasting it with Other Products. Reading: Reading Graphical Material for Comparison (Advertisements).Writing: Writing Definitions (Short and Long)– Compare and Contrast Paragraphs, Essay writing. Grammar:– Phrasal Verbs – Cause and Effect Sentences –Compound Nouns Vocabulary Development: Use of Discourse Markers.

TOTAL: 45 PERIODS

OUTCOMES:

On successful completion of the course student will be able to:

1. Comprehend conversations and short talks delivered in English
2. Participate effectively in informal conversations; introduce themselves and their friends and express opinions English
3. Read articles of a general kind in magazines and newspapers
4. Write short essays of a general kind and personal letters and emails in English
5. Recognize the use of grammar in speech and writing

TEXT BOOKS:

1. N P Sudharshana & C Savitha. English for Technical Communication Delhi: CUP, 2019. Board of Editors. English for Engineers and Technologists Volume 1 Orient Black Swan Limited, 2020.

REFERENCES:

1. Board of Editors. “Using English-A course book for Undergraduate engineers and Technologists”, Orient Black Swan Limited, 2017
2. Bailey, Stephen. “Academic Writing: A Practical Guide for Students”. New York: Rutledge,2011.
3. Comfort, Jeremy, et al. Speaking Effectively: Developing Speaking Skills for Business English. Cambridge University Press, Cambridge: Reprint 2011
4. Means,L. Thomas and Elaine Langlois. “English & Communication For Colleges. Cengage Learning” ,USA:2007
5. Redston, Chris & Gillies Cunningham, “Face2Face (Pre-intermediate Student’s Book & Workbook)”, Cambridge University Press, New Delhi: 2005.

LANGUAGE SKILLS LAB

List of exercises
Minimum of exercises to be conducted 15

1. Reading: Different text type
2. Reading: Predicting content using pictures and title.
3. Reading: Use of graphic organizers to review
4. Reading: Aid comprehension.
5. Reading: Understanding reference words
6. Reading: Use of connectors in a passage-
7. Reading: Speed reading Techniques.
8. Reading and Comprehending the passages in the competitive exams like GATE, TOFEL, GRE,IELTS, and other exams conducted by Central and State governments.
9. Reading: Sentence Completion: Exercises used in competitive exams.
10. Writing: Error Detection:
11. Writing: Spotting and reasoning the errors found from the passages in competitive exams.
12. Writing: Email writing
13. Writing: Job Application: Resume
14. Writing: Elements of a good essay-
15. Writing: Types of essays- Descriptive-Narrative- issue based.
16. Writing: Statement of Purpose
17. Writing: Letter of recommendation
18. Writing: Vision statement
19. Writing: Verbal Analogy,
20. Writing: Phrases, and Idioms associated with competitive exams.

TOTAL: 30 PERIODS

REFERENCES:

1. Suresh Kumar.E and et al. Enriching Speaking and Writing Skills. Second Edition. Orient Black swan: Hyderabad, 2012
2. Davis, Jason and Rhonda Liss. Effective Academic Writing (Level 3) Oxford University Press: Oxford, 2006
3. Withrow, Jeans and et al. Inspired to Write. Readings and Tasks to develop writing skills. Cambridge University Press: Cambridge, 2004
4. Goatly, Andrew. Critical Reading and Writing. Routledge: United States of America, 2000

21MA1101	ENGINEERING MATHEMATICS- I	L	T	P	C
		3	1	0	4

OBJECTIVES:

- Matrix transforms are very useful within the world of computer graphics. A matrix algebra can be readily applied to the structural properties of graphs from an algebraic point of view.
- The aim of this course to get depth knowledge about calculus.
- Familiarize the functions of two variables and finding its extreme points.
- To make the students understand various techniques of integration.
- Apply multiple integral ideas in solving areas, volumes and other practical problems

UNIT - I **MATRICES** **9+3**

Eigen values and Eigen vectors of a real matrix —Rank of the matrix – Characteristic equation — Properties of Eigenvalues and Eigen vectors — Cayley Hamilton theorem — Diagonalization of matrices— Reduction of a quadratic form to canonical form by orthogonal transformation and similarity transformation —Nature of quadratic forms.

UNIT - II **DIFFERENTIAL CALCULUS** **9+3**

Representation of functions – Limit of a function – Continuity – Derivatives – Differentiation rules (Sum, Product & Quotient rule, Chain rule, logarithmic and implicit differentiation) – Maxima and Minima of functions of one variable-Rolle's theorem- Mean value theorem.

UNIT - III **FUNCTIONS OF SEVERAL VARIABLES** **9+3**

Partial differentiation – Homogeneous functions and Euler's theorem – Total derivative – Change of variables – Jacobians – Partial differentiation of implicit functions – Taylor's series for functions of two variables – Maxima and minima of functions of two variables –Lagrange's method of undetermined multipliers.

UNIT - IV **INTEGRAL CALCULUS** **9+3**

Definite and Indefinite integrals – Substitution rule – Techniques of Integration – Integration by parts – Bernoulli's formula- Trigonometric integrals – Trigonometric substitutions – Integration of rational functions by partial fraction – Integration of irrational functions – Improper integrals.

UNIT - V **MULTIPLE INTEGRALS** **9+3**

Double integrals in modelling and polar coordinates – Change of order of integration in modelling coordinates– Area enclosed by plane curves – Change of variables in double integrals – Triple integrals –Volume of Solids.

TOTAL: 60 PERIODS

OUTCOMES:

On successful completion of the course student will be able to:

1. Find eigenvalues and eigen vectors, diagonalization of a matrix, symmetric matrices, positive definite matrices and similar matrices.
2. Apply limit definition and rules of differentiation to differentiate functions.
3. Understand familiarity in the knowledge of Maxima and Minima, Jacobian, Taylor series and apply the problems involving Science and Engineering
4. Understand the knowledge of Integration by parts, Trigonometric integrals, Trigonometric substitutions, Integration of rational functions by partial fraction.
5. Understand the knowledge of Area enclosed by plane curves, Change of variables in double integrals, Triple integrals, Volume of Solids.

TEXT BOOKS:

1. Grewal B.S., ―Higher Engineering Mathematics‖, Khanna Publishers, NewDelhi,43rd Edition, 2014.
2. James Stewart, ―Calculus: Early Transcendentals‖, Cengage Learning,7th Edition, NewDelhi, 2015.
3. Bali N., Goyal M. and Walkins C., ―Advanced Engineering Mathematics‖, Firewall Media (An imprint of Lakshmi Publications Pvt. Ltd.,), New Delhi, 7th Edition, 2009

REFERENCES:

1. Anton, H, Bivens, I and Davis, S, ―Calculus‖, Wiley, 10th Edition, 2016.
2. Jain R.K. and Iyengar S.R.K., ―Advanced Engineering Mathematics‖, Narosa Publications,NewDelhi, 3rd Edition, 2007.
3. Narayanan, S. and Manicavachagom Pillai, T. K., ―Calculus‖ Volume I and II, S. Viswanathan Publishers Pvt. Ltd., Chennai, 2007
4. Srimantha Pal and Bhunia, S.C, ―Engineering Mathematics‖ Oxford University Press, 2015.
5. Weir, M.D and Joel Hass, ―Thomas Calculus‖, 12th Edition, Pearson India, 2016.
6. B.V. Ramana, ― Higher Engineering Mathematics‖, McGraw Hill Education, India.
7. Erwin Kreyzig, Advanced Engineering Mathematics, John Wiley sons,10thedition,2015

21PH1101	ENGINEERING PHYSICS	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To enhance the fundamental knowledge in Physics and its applications relevant to various streams of Engineering and Technology.

UNIT - I MECHANICS 9

System of particles: centre of mass in one and two dimensions – rotational motion of continues system– torque – moment of inertia – conservation of angular momentum – Newton's laws for rotation – equations of rotational motion – work energy theorem for rotational motion. Stress, strain, Hooke's law and elastic moduli – twisting couple per unit twist for solid and hollow cylinders – torsional pendulum theory – bending moment of beam – cantilever and non-uniform bending theory – uniform bending theory – I shape girder.

UNIT - II ELECTROMAGNETIC THEORY 9

Divergence – curl – integral calculus – Gauss divergence theorem – Stoke's theorem – equation of continuity – displacement current – Maxwell's equations – Gauss's laws – Faraday's law –Ampere- Maxwell law – mechanism of electromagnetic wave propagation – Hertz observation – production and detection of electromagnetic wave – electromagnetic waves in free space and matter – energy carried by electromagnetic wave – momentum and radiation pressure – properties of electromagnetic waves.

UNIT - III THERMAL PHYSICS 9

Mode of heat transfer: conduction, convection and radiation – thermal expansion of solids – bimetallic strips – thermal conductivity – heat conduction through compound media (series & parallel) – Forbe's and Lee's disc method; theory and experiment – thermal insulation – applications – heat exchangers – refrigerators, solar water heater.

UNIT - IV OSCILLATORY MOTION, LASERS AND FIBER OPTICS 9

Spring mass system – differential equation-simple harmonic motion-damped oscillation-forced oscillation –analogy with LCR circuits and mechanical oscillation – plane wave equation – equations of wave motion in a rope and velocity of wave. Population of energy levels, Einstein's A and B coefficients derivation – optical amplification (qualitative) – Semiconductor lasers: homojunction and heterojunction –components and principle of fiber optics – numerical aperture and acceptance angle derivation – types of optical fibers (material, refractive index, mode) – losses associated with optical fibers – fiber as pressure and displacement sensors.

UNIT - V QUANTUM MECHANICS 9

Blackbody radiation – Planck's hypothesis and derivation – wave particle duality of light: concepts of photon – Compton effect: theory and experiment – de Broglie hypotheses - concept of wave function and its physical significance – Schrödinger's wave equation – time independent and time dependent equations – particle in a one-dimensional box – tunnelling (qualitative) – scanning tunnelling microscope.

TOTAL: 45 PERIODS

OUTCOMES:

On successful completion of the course student will be able to:

1. Understand the basics of mechanics and especially elastic properties of materials.
2. Gain knowledge on the basic concepts of electromagnetic waves and its properties.
3. Acquire knowledge on the concepts of thermal properties of materials and their applications in heat exchangers.
4. Acquire knowledge on the concepts of oscillations, lasers and fiber optics and their technological applications
5. Get knowledge on advanced physics concepts of quantum theory and its applications in modelling microscopes.

TEXT BOOKS:

1. Gaur, R.K. & Gupta, S.L. ―Engineering Physics‖. Dhanpat Rai Publishers, 2012.
2. Santhosam, K. Russel Raj, K. & Maheswaran, A. ―Engineering Physics, KRAM Publications, 2021
3. Pandey, B.K. & Chaturvedi, S. ―Engineering Physics‖. Cengage Learning India, 2012.

REFERENCES:

1. Halliday, D., Resnick, R. & Walker, J. ―Principles of Physics‖. Wiley, 2015.
2. Tipler, P.A. & Mosca, G. ―Physics for Scientists and Engineers with Modern Physics'. W.H.Freeman, 2007.
3. Arthur Beiser, ―Concepts of Modern Physics‖, Mc Graw Hill, Sixth edition, 1994.
4. Douglas. C., Giancoli. ―Physics: Principles with applications‖, Pearson, 2014.

21CY1101	ENGINEERING CHEMISTRY	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To know about the importance of Chemistry in Engineering domain
- To understand the Chemistry background of industrial process.
- To apply Chemistry knowledge for Engineering disciplines.

UNIT - I WATER TECHNOLOGY 9

Hardness –Types of hardness – Estimation by EDTA method – Boiler troubles-scale, sludge, priming, foaming, caustic embrittlement, Boiler corrosion – Internal Conditioning – Carbonate, phosphate, Calgon conditioning – External Conditioning – Zeolite and Demineralization process – Desalination, Reverse Osmosis Method – Domestic water treatment.

UNIT - II HIGH POLYMERS AND NANOCHEMISTRY 9

Polymers – Introduction – Classification of Polymers (Origin/Source, Structure, Monomers, Inter- molecular Forces, Synthesis) – Commercial Polymers (Poly Vinyl Chloride (PVC), Polytetrafluoroethylene (PTFE), Nylon-6 6, Nylon-6, Polyethylene Terephthalate (PET) – Conducting Polymers – Polyaniline, Polythiophene, Trans-Polyacetylene – Basic definition – FRP – General Engineering applications of FRP (Civil Engineering Structures).**Nanomaterials** – Introduction, size dependent properties (Surface area, Electrical, Optical, Catalytic and Thermal properties). Synthesis of nanomaterials: Top-down and bottom-up approaches, Chemical Synthesis – Co precipitation, Sol-Gel process and Chemical vapor deposition, Nanoscale materials: Fullerenes, Carbon nanotubes and 8odellin – Characterization, properties and applications. Green synthesis of Nanoparticles.

UNIT - III INSTRUMENTAL METHODS AND ANALYSIS 9

Introduction to Spectroscopy – Types of spectroscopy – Absorption spectra – Emission spectra – Wave length and Wave number- Electromagnetic radiation – Flame Photometry, Atomic Absorption Spectroscopy, UV-Visible spectrum. Introduction – basic principles – Instrumentation& Applications – Infrared Spectroscopy. Chromatographic methods – Types (column, Thin layer, paper, Gas, High Performance Liquid Chromatographic methods) – principle- Separation and quantification of Organic compounds by GC and HPLC. Conductometric Titrations: Instrumentation – Advantages – Applications Potentiometric Titrations: Instrumentation –Advantages-Applications. Measurement of pH: pH metry – Instrumentation – Applications.

UNIT - IV ELECTROCHEMISTRY AND CORROSION 9

Introduction- Electrode potentials-Electrochemical series-Electrochemical cell-redox reaction – measurement and applications – Nernst Equation Derivation-Electrochemical extraction of metals – Electrolytic refining of metals –Nano electrochemical Sensors. Corrosion – causes, factors, types, Chemical and Electrochemical Corrosion (Galvanic, Differential aeration) – Corrosion Control, Electrochemical protection – Sacrificial Anodic method – Impressed Current Cathodic Protection – Corrosion Inhibitors – Biocorrosion. Protective Coatings – Paints, Constituents, Functions- Surface preparation for metallic coatings, Electroplating and Electroless Plating.

UNIT - V ENERGY SOURCES AND STORAGE DEVICES 9

Introduction – Nuclear energy – Nuclear fission – Controlled Nuclear fission – Nuclear Fusion – Differences – Nuclear chain reactions –Nuclear Reactor – Classification of Nuclear Reactor – Light WaterNuclear Reactor, Breeder Reactor – Solar Energy, Conversion, Solar Cells – Wind Energy.Batteries and Fuel Cells – Types of batteries –– Zinc – carbon dry cell –Lead Storage battery– Nickel-Cadmium Battery – Lithium battery – Battery Engineering – Battery hazards – Biological Batteries.Fuel Cells – Hydrogen-Oxygen Fuel Cell – Hondas cell-Supercapacitors (elementary idea).

TOTAL: 45 PERIODS

OUTCOMES:

On successful completion of the course student will be able to:

1. Analyze the water quality parameters in purification and significance in industries, daily life.
2. Explain the types, fabrication and engineering applications of polymers. Develop economically ne methods of synthesizing nanomaterial and their applications.
3. Demonstrate the knowledge of analytical techniques using spectroscopy.
4. Relate the electrode potential for its feasibility inelectrochemical reaction. Illustrate the causes, co corrosion and to achieve its protection.
5. Compare the economic and efficient usage of non-conventional and conventional energy source and various storage devices.

TEXT BOOKS:

1. P.C.Jain and Monika Jain, ―Engineering Chemistry‖, Dhanpat Rai Publishing Company(P) LTD., New Delhi.
2. S. S. Dara and S.S. Umare, ―A Textbook of Engineering Chemistry‖ S. Chand and Company Ltd, New Delhi.
3. V.R.Gowariker, N.V.Viswanathan and JayadevSreedhar, ―Polymer Science‖, New Age International P (Ltd.,), Chennai, 2006
4. P. Kannan and A. Ravikrishnan, ―Engineering Chemistry‖, Sri Krishna Hitech Publishing Company Pvt. Ltd. Chennai, 2009. 16
5. S. Vairam, P. Kalyani and Suba Ramesh, ―Engineering Chemistry‖, Wiley India, 2011

REFERENCES:

1. Friedrich Emich, —Engineering Chemistry‖, Scientific International Pvt. Ltd., New Delhi.
2. PrasanthaRath, —Engineering Chemistry‖, Cengage Learning India Pvt., Ltd., Delhi.
3. P.W. Atkins and de Paula Julio, —Physical Chemistry‖, Oxford University Press, 8th Ed.,(Indian Student Edition) (2009).
4. K. K. Rohatgi-Mukherjee, —Fundamental of Photochemistry‖ New Age International (P) Ltd., New Delhi, 1986.
5. G.A. Ozin and A.C. Arsenault, —Nanochemistry: A Chemical Approach to Nanomaterials‖, RSC Publishing, 2005
6. Nanomaterials, B.Viswanathan, Alpha Science , ISBN: 9781842654941.

PANIMALAR ENGINEERING COLLEGE . CHENNAI.
JAISAKTHI EDUCATIONAL TRUST

21ES1101	PROBLEM SOLVING AND PYTHON PROGRAMMING	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To know the basic programming constructs –data types, decision structures, and control structures in python
- To know how to use libraries for string manipulation
- To Use python data structures – Lists, Tuples and Dictionary
- To know the basic concepts of Object-Oriented Programming
- To learn about 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); Python: Data types, variables, expressions, precedence of operators, 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, and guess an integer number in a range, Towers of Hanoi.

SUGGESTED ACTIVITIES:

- Developing Pseudo codes and flowcharts for real life activities such as railway ticket Booking using IRCTC, admission process to undergraduate course, academic schedules during a semester etc.
- Developing algorithms for basic mathematical expressions using arithmetic Operations
- Installing Python.
- Simple programs on print statements, arithmetic operations.

SUGGESTED EVALUATION METHODS:

- Quizzes on algorithm and basic python.
- Assignments on illustrative problems.
- Quizzes on simple python programs.

UNIT - II CONTROL FLOW, STRINGS & FUNCTIONS 9

Conditionals: Boolean values and operators, conditional (if), alternative (if-else), chained conditional (if-elif-else); Iteration: state, while, for, break, continue, pass; functions, function definition and use; Fruitful functions: return values, parameters and arguments, local and global scope, function composition, recursion; Strings: string slices, immutability, string functions and methods, string module. Illustrative programs: exchange the values of two variables, circulate the values of n variables, distance between two points.

SUGGESTED ACTIVITIES:

- Simple Python program implementation using Operators, Conditionals, Iterative Constructs and Functions.
- Developing simple applications like calculator, calendar, phone directory, to-do lists etc.
- Flow charts for GCD, Exponent Functions, Fibonacci Series using conditionals and Recursion vs. Iteration.

SUGGESTED EVALUATION METHODS:

- Quizzes on strings.
- Assignments on illustrative problems.
- Quizzes on control flow and functions.

UNIT - III 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; Lists as arrays. Illustrative programs: selection sort, insertion sort, merge sort, histogram.

SUGGESTED ACTIVITIES:

- Implementing python program using lists, tuples, sets for the following scenario:
- Simple sorting techniques
- Student Examination Report
- Billing Scheme during shopping.
- Implementing any application using List and Tuple data structures.

SUGGESTED EVALUATION METHODS:

- Quizzes on list slices.
- Assignments on illustrative problems.
- Quizzes on tuples and dictionaries.

UNIT - IV OBJECT ORIENTED PROGRAMMING WITH PYTHON 9

Classes and OOP: classes, objects, attributes and methods; defining classes; design with classes, data 11odelling; persistent storage of objects – inheritance, polymorphism, operator overloading; abstract classes; exception handling, try block. Illustrative programs: demonstrate the concept of class and objects.

SUGGESTED ACTIVITIES:

- Features of OOP.
- Persistent storage of objects
- Operators and its usage.
- Simple programs using OOP concepts.

SUGGESTED EVALUATION METHODS:

- Quizzes on basic OOP concepts.
- Assignments on illustrative problems.
- Quizzes on inheritance and exception handling.

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.

SUGGESTED ACTIVITIES:

- Developing modules using Python to handle files and apply various operations onfiles
- Usage of exceptions, multiple except blocks – for applications that use delimiters likeage,range of numerals etc.
- Implementing Python program to open a non-existent file using exceptions.

SUGGESTED EVALUATION METHODS:

- Quizzes on basic file operations.
- Assignments on illustrative problems.
- Quizzes on packages and modules

TOTAL: 45 PERIODS

OUTCOMES:

On successful completion of the course student will be able to:

1. Develop algorithmic solutions to simple computational problems.
2. Write and execute simple Python programs.
3. Familiarize with python string handling techniques and user defined functions.
4. Represent compound data using Python lists, tuples and dictionaries.
5. Understand the concept of object oriented programming techniques.
6. Read and write data from/to files in Python Programs.

TEXT BOOKS:

1. Reema Thareja, ``Problem Solving and Programming with Python'', 2nd edition, OXFORD University Press, New Delhi, 2019.(UNIT 1,2,3,4(Exception Handling) and 5).
2. Bill Lubanovic, ―Introducing Python-Modern Computing in Simple Package‖, 2nd edition, O'REILLY, 2019.(UNIT 4(Object Oriented Programming)).

REFERENCES:

1. Steven F. Lott, ―Modern Python Cookbook'', 2nd Edition, O'REILLY, 2020.
2. Ryan Marvin, Mark Ng'ang'a, Amos Omondi, ―Python Fundamentals, Packt Publishing., 2018.
3. Paul J. Deitel, Python for Programmers, Pearson India Education Services Pvt. Ltd,2020.
4. Martin C. Brown, Python: The Complete Reference, McGraw Hill Education; Forthedition, 2018.

21ES1102	ENGINEERING GRAPHICS	L	T	P	C
		3	0	2	4

OBJECTIVES:

- Drawing free hand sketches of basic geometrical shapes and multiple views of objects.
- Drawing orthographic projections of lines and planes.
- Drawing orthographic projections of solids.
- Drawing development of the surfaces of objects.
- Drawing isometric and perspective views of simple solids.

CONCEPTS AND CONVENTIONS (Not for Examination): 2

Importance of graphics in engineering applications – Use of drafting instruments.BIS conventions and specifications. Size, layout and folding of drawing sheets – Lettering and dimensioning. Introduction to drafting packages like CAD and demonstration of their use in engineering fields.

UNIT - I PLANE CURVES AND FREEHAND SKETCHING 14

Basic Geometrical constructions, Curves used in engineering practices-Conics: Construction of Ellipse, Parabola and Hyperbola by eccentricity method – Construction of cycloid, Involutes of square, pentagon and circle – Drawing of tangents and normal to the above curves. Free Hand sketching-Orthographic projection – Orthographic views of simple three-Dimensional objects.

UNIT - II PROJECTION OF POINTS, LINES AND PLANE SURFACES 15

Orthographic projection- principles-Principle planes-First angle projection-Projection of points. Projection of straight lines (only First angle projections) inclined to both the principal planes- Determination of true lengths eg and true inclinations by rotating line method and traces. Projection of planes (polygonal and circular surfaces) inclined to both the principal planes by rotating object method.

UNIT - III PROJECTION OF SOLIDS 15

Projection of simple solids like prisms, pyramids, cylinder, and cone when the axis is inclined to one principle planes by rotating object method and auxiliary plane method.

UNIT - IV PROJECTION OF SECTIONED SOLIDS AND DEVELOPMENT OF SURFACES 15

Sectioning of solids in simple vertical position when the cutting plane is inclined to the one of the principal planes and perpendicular to the other – obtaining true shape of section. Development of lateral surfaces of simple solids and frustum and truncated solids – Prisms, pyramids cylinders and cones.

UNIT - V ISOMETRIC AND PERSPECTIVE PROJECTIONS 14

Principles of isometric projection – isometric scale –Isometric projections of simple solids and frustum and truncated solids – Prisms, pyramids, cylinders, cones-combination of two solid objects in simple vertical positions.Perspective projection of simple solids-Prisms, pyramids and cylinders by visual ray method.

TOTAL: 75 PERIODS

OUTCOMES:

On successful completion of the course student will be able to:

1. Draw free hand sketching of basic geometrical shapes and multiple views of objects.
2. Draw orthographic projections of lines and planes
3. Draw orthographic projections of solids
4. Draw development of the surfaces of objects
5. Draw isometric and perspective views of simple solids.

TEXT BOOKS:

1. Natarajan, K. V., ―A text book of Engineering Graphics‖, 28th Ed., Dhanalakshmi Publishers, Chennai, 2015.
2. Venugopal, K. and Prabhu Raja, V., ―Engineering Graphics‖, New Age, 2008.

REFERENCES:

1. Bhatt, N.D.,Panchal V M and Pramod R. Ingle, ―Engineering Drawing‖, Charotar Publishing House, 53rd Edition, 2014.
2. Parthasarathy, N. S. and Vela Murali, ―Engineering Drawing‖, Oxford University Press, 2015
3. Agrawal, B. and Agrawal C.M., ―Engineering Drawing‖, Tata McGraw, N.Delhi, 2008.

21ES1111	PROBLEM SOLVING AND PYTHON PROGRAMMING LABORATORY	L	T	P	C
		0	0	4	2

OBJECTIVES:

- To write, test, and debug simple Python programs.
- To implement Python programs with conditions and loops.
- To use functions for structuring Python programs.
- To represent compound data using Python lists, tuples, dictionaries.
- To use OOPS concepts in Python.
- To read and write data from/to files in Python

LIST OF EXPERIMENTS

1. Basic Python Programs.
2. Write programs to demonstrate different number data types in python.
3. Develop python programs to demonstrate various conditional statements.
4. Implement user defined functions using python.
5. Develop python scripts to demonstrate functions.
6. Develop python programs to perform various string operations like slicing, indexing& formatting.
7. Develop python programs to perform operations on List & Tuple.
8. Demonstrate the concept of Dictionary with python programs.
9. Develop python codes to demonstrate concept of class and objects.
10. Demonstrate OOPS concepts like inheritance and polymorphism with python programs.
11. Demonstrate python codes to print try, except and finally block statements.
12. Implement python programs to perform file operations.
13. Implement python programs using modules and packages.
14. Simulate bouncing ball using Pygame.

Mini Project :Suggested Topics(but not limited to)

1. Dice roll simulator.
2. Guess the number game.
3. Sending emails using python.
4. Random password generator.
5. Alarm clock.
6. URL shortener.

TOTAL: 60 PERIODS

OUTCOMES:

On successful completion of the course student will be able to:

1. Write, test, and debug simple Python programs.
2. Implement Python programs with conditions and loops.
3. Use functions for structuring Python programs.
4. Represent compound data using Python lists, tuples, dictionaries.
5. Use OOPS concepts in Python.
6. Read and write data from/to files in Python

21BS1111	PHYSICS AND CHEMISTRY LABORATORY	L	T	P	C
		0	0	4	2

PHYSICS LABORATORY

OBJECTIVES:

- To introduce different experiments to test basic understanding of physics concepts applied in optics, thermal physics, properties of matter and liquids.

LIST OF EXPERIMENTS
(Minimum of experiments to be conducted: 5 Experiments)

1. Determination of rigidity modulus – Torsion pendulum
2. Determination of Young's modulus by non-uniform bending method
   (a)Determination of wavelength, and particle size using Laser
   (b)Determination of acceptance angle in an optical fiber
3. Determination of thermal conductivity of a bad conductor – Lee's Disc method
4. Determination of velocity of sound and compressibility of liquid – Ultrasonic interferometer
5. Determination of wavelength of mercury spectrum – spectrometer grating
6. Determination of band gap of a semiconductor

TOTAL: 30 PERIODS

OUTCOMES:

On successful completion of the course student will be able to:

1. Apply principles of elasticity, optics and thermal properties for engineering applications.

TEXT BOOKS:

1. Ruby Das, C.S. Robinson, Rajesh Kumar, Prashant Kumar Sahu, A Textbook of Engineering Physics Practical, University Science Press, Delhi, II Edition (2016), ISBN 978-93-80386-86-7
2. Harnam Singh, Dr.P.S. Hemne, B.Sc., Practical Physics, S.Chand & Company Ltd, New Delhi, Edition 2011, ISBN 81-219-0469-2

CHEMISTRY LABORATORY

OBJECTIVES:

- To inculcate experimental skills to test basic understanding of water quality parameters such as, alkalinity, hardness, DO and chloride.
- To induce the students to familiarize with electroanalytical techniques such as,pH metry,potentiometry and conductometry in the determination of aqueous solutions.

LIST OF EXPERIMENTS
(Minimum of experiments to be conducted: 5 Experiments)

1. Estimation of HCl using Na2CO3 as primary standard and Determination of alkalinity in Water sample.
2. Determination of total, temporary & permanent hardness of water by EDTA method.
3. Determination of DO content of water sample by Winkler"s method.
4. Determination of chloride content of water sample by argentometric method.
5. Estimation of copper content of the given solution by Iodometry.
6. Determination of strength of given hydrochloric acid using pH meter. Determination of strength of acids in a mixture of acids using conductivity meter
7. Estimation of iron content of the given solution using potentiometer.
8. Determination of total, temporary & permanent hardness of water by EDTA method.
9. Estimation of iron content of the water sample using spectrophotometer (1, 10- 26, Phenanthroline / thiocyanate method).
10. Estimation of sodium and potassium present in water using flame photometer.
11. Determination of molecular weight of polyvinyl alcohol using Ostwald viscometer.
12. Pseudo first order kinetics-ester hydrolysis.
13. Corrosion experiment-weight loss method.
14. Phase change in a solid.

TOTAL: 30 PERIODS

OUTCOMES:

On successful completion of the course student will be able to:

1. Analyse the quality of water samples with respect to their acidity, alkalinity, hardness and DO
2. Quantitatively analyse the aqueous solution by electroanalytical techniques

TEXT BOOKS:

1. Laboratory Manual-Department of Chemistry CEGC, Anna University (2014).
2. Vogel’s Textbook of Quantitative Chemical Analysis (8th edition, 2014).

		L	T	P	C
21HS1201	**COMMUNICATIVE ENGLISH AND LANGUAGE SKILLS LAB II INTEGRATED**	**3**	**0**	**2**	**4**

OBJECTIVES:

- To develop linguistic and strategic competence in workplace context and to enhance language proficiency and thereby the employability of budding engineers and technologists.
- To improve the relevant language skills necessary for professional communication.
- To help learners to develop their listening skills, which will, enable them to listen to lectures and comprehend them by asking questions; seeking clarification and developing their speaking skills and to speak fluently in real contexts
- To Introduce them to life skills, their importance in leading Personal & professional life, key concepts of business communication and Communicative skills.

UNIT - I — INTERPERSONAL COMMUNICATION — 9

Listening: Listening to Telephone Conversations Speaking: Role Play Exercises Based on Workplace Contexts, Introducing Oneself - PEP Talks. Reading: Reading the Interview of an Achiever and Completing Exercises (Skimming, Scanning and Predicting).Writing: Writing a Short Biography of an Achiever Based on Given Hints, Grammar: Adjective, Sentence pattern. Vocabulary Development: Idioms and Phrases.

UNIT - II — TECHNICAL COMMUNICATION — 9

Listening: Listening to Talks/Lectures Both General and Technical and Summarizing the Main Points. **Speaking:** Participating in Debates, TED Talks. **Reading:** Reading Technical Essays/ Articles and Answering Comprehension Questions. **Writing:** Summary Writing ,Minutes of the meeting. **Grammar:** Participle Forms, Relative Clauses. **Vocabulary Development:** Compound Words, Abbreviations and Acronyms.

UNIT - III — PROCESS DESCRIPTION — 9

Listening: Listening to a Process Description and Drawing a Flowchart **Speaking:** Participating in Group Discussions, Giving Instructions, Presentation **Reading:** Reading Instruction Manuals. **Writing:** Process Descriptions – Writing Instructions. **Grammar:** Use of Imperatives, Active and Passive Voice, Sequence Words. **Vocabulary Development:** Misspelt words, Homophones and Homonyms.

UNIT - IV — REPORT WRITING — 9

Listening: Listening to a Presentation and Completing Gap-Filling Exercises. **Speaking:** Making Formal Presentations. **Reading:** Reading and Interpreting Charts/Tables and Diagrams **Writing:** Interpreting Charts/Tables and Diagrams, Writing a Report **Grammar:** Direct into Indirect Speech, Use of Phrases. **Vocabulary Development:** Reporting Words, Technical Jargon.

UNIT - V **APPLYING FOR JOBS** **9**

Listening: Listening to a Job Interview and Completing Gap-Filling Exercises. **Speaking:** Mock Interview, Telephone Interviews, GD. **Reading:** Reading a Job Interview, SOP, Company Profile and Completing Comprehension Exercises. **Writing:** Job Applications and Resumes. **Grammar:** Conditional Clauses, Modal verbs. **Vocabulary Development:** Technical Vocabulary, Purpose Statement.

TOTAL: 45 PERIODS

OUTCOMES:

On successful completion of the course student will be able to:

1. Read and comprehend technical texts effortlessly.
2. Write thoughts and insights of their own.
3. Recognize the need for life skills, apply them to different situations, the basic communication practices in different types of communication.
4. Gain confidence to communicate effectively in various situations to acquire employability skills.
5. Become an active listener of professional contexts.

TEXT BOOKS:

1. Richards, C. Jack. Interchange, New Delhi: CUP, 2017
2. Board of Editors. English for Engineers and Technologists Volume 2 Orient Black Swan Limited, 2020.

REFERENCES:

1. Kumar, Suresh. E. Engineering English. Orient Blackswan: Hyderabad,2015
2. Raman, Meenakshi and Sharma, Sangeetha- Technical Communication Principles and Practice. Oxford University Press: New Delhi, 2014.
3. Grussendorf, Marion, English for Presentations, Oxford University Press, Oxford: 2007
4. Means, L. Thomas and Elaine Langlois, English & Communication For Colleges. Cengage Learning, USA: 2007
5. Kumar, Suresh. E. Engineering English. Orient Blackswan: Hyderabad,2015 Students can be asked to read Tagore, Chetan Bhagat and for supplementary reading

LANGUAGE SKILLS LAB

List of exercises
Minimum of exercises to be conducted 15

1. Listen to lectures - articulate a complete idea as opposed to producing fragmented utterances – Tedtalks, Science Fiction – My fair lady
2. Listening to a process information – General Competitive Examinations, GRE
3. Listening for specific information: accuracy and fluency – BEC
4. Listening - following, responding to explanations, giving directions and instructions in academic and business contexts – IELTS, TOEFL.
5. Listening to transcripts and answer to the questions.
6. Listening: Read aloud in class and gap - filling.
7. Listening: Recognizing and interpreting non - verbal cues.
8. Listen first, speak second - Having the mindset of a listener.
9. Speaking – sharing personal information - Self introduction
10. Speaking – Small talk or Pep Talk
11. Speaking – Group discussion, Visume –visual presentation of resume
12. Speaking – Presentation – Formal and Informal
13. Speaking – Mock interview
14. Speaking – FAQ"S on Job interview
15. Speaking : Simulations - (show and tell)
16. Speaking: News brief - Ripped from today's headlines.
17. Speaking: Who's telling the truth?
18. Speaking: JAM
19. Speaking: Debate
20. Speaking: Story Narration

TOTAL: 15 PERIODS

TEXT BOOKS:

1. Brooks, Margret. Skills for Success. Listening and Speaking. Level 4 Oxford University Press,
2. Richards, C. Jack. & David Bholke. Speak Now Level 3. Oxford University Press, Oxford: 2010

REFERENCES:

1. Bhatnagar, Nitin and Mamta Bhatnagar. Communicative English for Engineers and Professionals. Pearson: New Delhi, 2010.
2. Ladousse, Gillian Porter. Role Play. Oxford University Press: Oxford, 2014.
3. Richards C. Jack. Person to Person (Starter). Oxford University Press: Oxford, 2006.
4. Vargo, Mari. Speak Now Level 4. Oxford University Press: Oxford, 2013.
5. E. Suresh Kumar et al. Communication for Professional Success. Orient Blackswan: Hyderabad, 2015.
6. Raman, Meenakshi and Sangeeta Sharma. Professional Communication. Oxford University Press: Oxford, 2014.

21MA1201	ENGINEERING MATHEMATICS II	L	T	P	C
		3	1	0	4

OBJECTIVES: To impart Knowledge on the following topics:

- Vectors are very helpful for the engineering students as it will give the insight into how to trace along the different types of curves.
- To develop an understanding of the standard technique of a complex variable theory in particular of analytic functions and its mapping property.
- Complex integration is an intuitive extension of real integration. Complex variable techniques have been used in a wide variety of areas of engineering. This has been particularly true in areas such as electromagnetic field theory, fluid dynamics, aerodynamics and elasticity.
- To solve the linear differential equations with constant coefficients.
- Laplace Transform is very useful for the electronics students, this gives the basics of how to solve the problems in electronic circuits.

UNIT - I VECTOR CALCULUS 12

Gradient, divergence and curl – Directional derivative – Irrotational and solenoidal vector fields – Vector integration – Green's theorem in a plane - Gauss divergence theorem and Stoke's theorem (excluding proofs) – Simple applications involving cubes, rectangular parallelopiped, sphere and cylinder.

UNIT - II ANALYTIC FUNCTIONS 12

Functions of a complex variable – Analytic functions - Cauchy-Riemann equations - Necessary and sufficient conditions– Harmonic and orthogonal properties of analytic function – Harmonic conjugate, Construction of analytic functions by Milne Thomson method– Conformal mapping: w =z+c, cz, 1/z, z2 and bilinear transformation.

UNIT - III COMPLEX INTEGRATIONS 12

Line integrals- Cauchy's integral theorem-Cauchy's integral formula - Singularities - Residues– Cauchy's residue theorem - Taylor's and Laurent's series expansions – Application of residue theorem for evaluation of real definite integrals – Use of circular contour and semi- circular contour (excluding poles on the real axis).

UNIT - IV ORDINARY DIFFERENTIAL EQUATIONS 12

Higher order linear differential equations with constant coefficients -Method of variation of parameters – Homogenous equation of Euler's and Legendre's type – System of simultaneous linear differential equations with constant coefficients - Method of undetermined coefficients.

UNIT - V **LAPLACE TRANSFORMS** **12**

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

TOTAL: 60 PERIODS

OUTCOMES:

On successful completion of the course student will be able to:

1. Identify the Gradient, divergence and curl of a vector point function and related identities. Evaluation of line, surface and volume integrals using Gauss, Stokes and Green‟s theorems and their verification.
2. Understand analytic functions, harmonic functions, conformal mapping.
3. Determine the types of singularities, residues, contour integration.
4. Apply various techniques in solving differential equations.
5. solve differential equations using laplace transforms.
6. Identify the Gradient, divergence and curl of a vector point function and related identities. Evaluation of line, surface and volume integrals using Gauss, Stokes and Green‟s theorems and their verification.
7. Understanding analytic functions, harmonic functions, conformal mapping.

TEXT BOOKS:

1. Grewel. B.S, "Higher Engineering Mathematics", 43rd Edition, Khanna Publications, Delhi, 2014.
2. B.V. Ramana, " Higher Engineering Mathematics", McGraw Hill Education, India.
3. Bali N., Goyal M. and Walkins C., "Advanced Engineering Mathematics", Firewall Media (An imprint of Lakshmi Publications Pvt. Ltd.,), New Delhi, 7th Edition, 2009.

REFERENCES:

1. Kreyszig Erwin, Advanced Engineering Mathematics", John wiley and Sons, 10th Edition, New Delhi.
2. Jain R.K. and Iyengar S.R.K., "Advanced Engineering Mathematics", Narosa Publications, New Delhi, 3rd Edition, 2007.
3. O‟Neil, P.V. "Advanced Engineering Mathematics", Cengage Learning India Pvt. Ltd, New Delhi, 2007.
4. Sastry, S.S, "Engineering Mathematics", Vol.I & II, PHI Learnig Pvt. Ltd, 4th Edition, New Delhi, 2014.
5. Wyile, R.C. and Barrett, L.C., "Advanced Engineering Mathematics "Tata McGraw Hill Education Pvt Ltd, 6th Edition, New Delhi, 2012.

21PH1201	PHYSICS FOR ELECTRONICS ENGINEERING	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To understand the essential principles of Physics of semiconductor device and Electron transport properties. Become proficient in magnetic, dielectric and optical properties of materials and Nano devices.

UNIT - I ELECTRICAL PROPERTIES OF MATERIALS 9

Classical free electron theory – postulates – expression for electrical conductivity – expression for thermal conductivity – Wiedemann–Franz law – success and failures – quantum free electron theory – postulates – Fermi-Dirac statistics – density of energy states – band theory of solids – postulates – Bloch theorem – energy bands from electron wave reflections – metals, semiconductors and insulators – electron effective mass (qualitative) – concept of hole.

UNIT - II SEMICONDUCTOR PHYSICS 9

Crystal structure of Si – Czochralski method - Intrinsic Semiconductors – energy band diagram – carrier concentration in intrinsic semiconductors - extrinsic semiconductors – carrier concentration in N-type & P-type semiconductors – variation of carrier concentration with temperature - variation of Fermi level with temperature and impurity concentration - drift and diffusion transport of carriers – Einstein‟s relation – Hall effect and applications – Zener and avalanche breakdown in p-n junctions – Ohmic contacts –– Schottky diode – degenerate and non-degenerate semiconductors – tunnel diode

UNIT - III MAGNETIC AND SUPERCONDUCTING PROPERTIES OF MATERIALS 9

Magnetism in materials – magnetic field and induction – magnetic permeability and susceptibility – classifications of magnetic materials – ferromagnetic domain theory – M versus H behaviour - hard and soft magnetic materials - examples and uses magnetic principle in computer data storage magnetic hard disc. Superconductivity – zero resistance and Meissner effect – critical field and critical current density – BCS theory (qualitative) – Type I and Type II superconductors – maglev train – Josephson junction.

UNIT - IV DIELECTRIC AND OPTICAL PROPERTIES OF MATERIALS 9

Relative permittivity – polarization processes – internal field and Clausius-Mosotti relation – dielectric loss – dielectric breakdown (definition only) – high-k dielectrics.Classification of optical materials – carrier generation and recombination processes – Absorption and emission of light in metals, insulators and semiconductors (concepts only) – photocurrent in a P-N diode – photo detectors – pin diode – solar cell – LED.

UNIT - V **NANODEVICES** **9**

Introduction – electron density in bulk material – size dependence of Fermi energy – quantum confinement – quantum structures – density of states in quantum well, quantum wire and quantum dot structures – excitons – quantum confined Stark effect - resonant tunneling – quantum interference effects – ballistic transport quantum resistance and conductance Coulomb blockade effects – single electron phenomena and single electron transistor – carbon nanotubes: properties and applications.

TOTAL: 45 PERIODS

OUTCOMES:

On successful completion of the course student will be able to:

1. gain knowledge on classical and quantum electron theories, and energy band structures.
2. acquire knowledge on basics of semiconductor crystalline materials and its applications in various devices.
3. get knowledge on magnetic and dielectric properties of materials.
4. have the necessary understanding on the functioning of optical materials for optoelectronics.
5. understand the basics of quantum structures and their applications in spintronics and carbon electronics.

TEXT BOOKS:

1. Kasap, S.O., Principles of Electronic Materials and Devices, 4^{th} Edition, McGraw-Hill Education, 2018.
2. Donald A. Neamen, Semiconductor Physics and Devices: Basic Principles, 4^{th} edition, McGrawHill, 2012.
3. K. Santhosam, K. Russel Raj and A, Maheswaran, “Electrical Engineering Materials”, Chess Educational Publishers, 2021.

REFERENCES:

1. Hanson, G.W. —Fundamentals of Nanoelectronics. Pearson Education, 2009.
2. Rolf E. Hummel, “Electronic Properties of Materials”, Springer, 2011.
3. Charles Kittel, “Introduction to Solid State Physics”, Wiley, 2012.
4. A.J.Dekker, “Solid State Physics”, Prentice – Hall, Inc., 1969.
5. Rogers, B., Adams, J. & Pennathur, S. “Nanotechnology: Understanding Small Systems”, CRC Press, 2014.

21BE1201	BASICS OF ELECTRICAL AND MEASUREMENT ENGINEERING	L	T	P	C
		3	0	0	3

OBJECTIVES: To impart Knowledge on the following topics:

- To understand the basic concepts of electric energy utilization.
- To understand the operation of AC and DC machines.
- To understand the operation and applications of special electrical components
- To understand the working principle of electrical and mechanical measurements.

UNIT - I UTILIZATION OF ENERGY 9

Principle of wind and solar energy systems. Electrical wiring - Domestic and Industrial Illumination - Fluorescent and LED lamps. Protection- Need for Earthing, fuses and circuit breakers -Energy tariff.

UNIT - II ELECTRICAL MACHINES 9

Principle of operation DC machines- Characteristics of DC motor - Single phase transformers, three phase and single-phase induction motors – Speed Control.

UNIT - III SPECIAL ELECTRICAL COMPONENTS 9

Permanent magnet synchronous motor – Brushless DC Motor - Stepper motor – Switched reluctance motor, Electromechanical Relays.

UNIT - IV ELECTRICAL MEASUREMENTS 9

Classification of instruments – moving coil and moving iron meters -- Induction type, dynamometer type wattmeter – Energy meter – Instrument transformers (CT & PT) – Wheatstone bridge for measurement of unknown resistance, Maxwell bridge for unknown inductance and Schering Bridge for unknown capacitance –Instrumentation Amplifiers.

UNIT - V MECHANICAL MEASUREMENTS 9

Classification of transducers, strain, RTD, thermocouples, Piezo-electric transducer, LVDT, Turbine and electromagnetic flow meters, level transducers ultrasonic and fiber optic transducers, type of sensors, elastic sensors, viscosity, moisture and pH sensors, Digital transducers, vibrating wire instruments like load cells, stress meter, etc.

TOTAL: 45 PERIODS

OUTCOMES:

On successful completion of the course student will be able to:

1. Understand the basics of utilization of energy
2. Understand the operation of electrical machines
3. Develop and understand the special electrical components
4. Develop the capacity in measuring electrical parameters
5. Develop the capacity in measuring mechanical parameters

TEXT BOOKS:

1. Del Toro, "Electrical Engineering Fundamentals‟ Pearson Education, New Delhi, 2007
2. Alan S. Moris, Principles of Measurements and Instruments, Prentice-Hall of India Pvt. Ltd., New Delhi, 1999.
3. SmarjitGhosh, "Fundamentals of Electrical and Electronics Engineering", 2nd Edition 2007
4. Rajendra Prasad,"Fundamentals of Electrical engineering‟ Prentice Hall of India, 2006

REFERENCES:

1. Sanjeev Sharma, "Basics of Electrical Engineering‟ S.K International Publishers, New Delhi 2007.
2. John Bird, Electrical Circuits theory and Technology, Elsevier, First India Edition, 2006.
3. Doebelin, E.O., Measurements Systems – Application and Design‟, McGraw Hill Publishing Co, 1990.

21EC1201	CIRCUIT ANALYSIS	L	T	P	C
		2	1	0	3

OBJECTIVES:

- To introduce electric circuits and its analysis
- To develop the ability to solve the DC circuits.
- To impart knowledge on solving circuit equations using network theorems
- To study the transient and steady state response of the circuits subjected to step and sinusoidal excitations
- To educate on obtaining the transient response and resonance of circuits.
- To introduce coupled circuits and topology

UNIT - I DC CIRCUIT ANALYSIS 9+3

Basic Components of electric Circuits, Charge, current, Voltage and Power, Voltage and Current Sources, Ohms Law, Kirchoff„s Current Law, Kirchoff„s voltage law, The single Node – Pair Circuit, series and Parallel Connected Independent Sources, Resistors in Series and Parallel, voltage and current division, Nodal analysis, Mesh analysis.

UNIT - II NETWORK THEOREM AND DUALITY 9+3

Useful Circuit Analysis techniques - Linearity and superposition, Thevenin and Norton Equivalent Circuits, Maximum Power Transfer, Delta-Wye Conversion. Duals, Dual circuits.

UNIT - III SINUSOIDAL STEADY STATE ANALYSIS 9+3

Sinusoidal Steady – State analysis , Characteristics of Sinusoids, The Complex Forcing Function, The Phasor, Phasor relationship for R, L, and C, impedance and Admittance, Nodal and Mesh Analysis, Phasor Diagrams, AC Circuit Power Analysis, Instantaneous Power, Average Power, apparent Power and Power Factor, Complex Power.

UNIT - IV TRANSIENTS AND RESONANCE IN RLC CIRCUITS 9+3

Basic RL and RC Circuits, The Source- Free RL Circuit, The Source-Free RC Circuit, The Unit-Step Function, Driven RL Circuits, Driven RC Circuits, RLC Circuits, Frequency Response, Parallel Resonance, Series Resonance, Quality Factor.

UNIT - V COUPLED CIRCUITS AND TOPOLOGY 9+3

Magnetically Coupled Circuits, mutual Inductance, the Linear Transformer, the Ideal Transformer, An introduction to Network Topology, Trees and General Nodal analysis, Links and Loop analysis.

TOTAL: 60 PERIODS

OUTCOMES:

On successful completion of the course student will be able to:

1. Comprehend the basics of circuit analysis
2. Solve electrical circuits using theorems
3. Analyse the sinusoidal steady state response
4. Analyse the transient and resonance in RLC circuits
5. Understand coupled circuits and topology

TEXT BOOKS:

1. William H. Hayt Jr, Jack E. Kemmerly and Steven M. Durbin, “Engineering Circuits Analysis”, McGraw Hill publishers, edition, New Delhi, 2013.
2. Charles K. Alexander, Mathew N.O. Sadiku, “Fundamentals of Electric Circuits”, Second Edition, McGraw Hill, 2013. 36
3. Allan H. Robbins, Wilhelm C. Miller, “Circuit Analysis Theory and Practice”, Cengage Learning India, 2013
4. Sudhakar A and Shyam Mohan SP, “Circuits and Network Analysis and Synthesis”, McGraw Hill, 2015.

REFERENCES:

1. Chakrabarti A, “Circuits Theory (Analysis and synthesis), Dhanpath Rai & Sons, New Delhi, 1999.
2. Jegatheesan, R., “Analysis of Electric Circuits,” McGraw Hill, 2015.
3. Joseph A. Edminister, Mahmood Nahri, “Electric circuits”, Schaum‟s series, McGrawHill, New Delhi, 2010.
4. M E Van Valkenburg, “Network Analysis”,Prentice-Hall of India Pvt Ltd, New Delhi, 2015.
5. Mahadevan, K., Chitra, C., “Electric Circuits Analysis,” Prentice-Hall of India Pvt Ltd., New Delhi, 2015.
6. Richard C. Dorf and James A. Svoboda, “Introduction to Electric Circuits”, 7th Edition, John Wiley & Sons, Inc. 2015.

21EC1202	ELECTRONIC DEVICES	L T P C 3 0 0 3

OBJECTIVES:

- To acquaint the students with the construction, theory and operation of the basic electronic devices such as PN junction diode, Bipolar and Field effect Transistors, Power control devices, LCD and other Opto-electronic devices.

UNIT - I SEMICONDUCTOR DIODE 9

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

UNIT - II BIPOLAR JUNCTION TRANSISTORS 9

NPN -PNP - Operations-Early effect-Current equations – Input and Output characteristics of CE, CB, CC - h-parameter model, Ebers Moll 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, FINFET, PINFET, CNTFET, DUAL GATE MOSFET, Zener diode-Varactor diode - Gallium Arsenide device, LDR.

UNIT - V POWER DEVICES AND DISPLAY DEVICES 9

UJT, SCR, Diac, Triac, Power BJT- Power MOSFET- DMOS-VMOS, LCD, Photo transistor, Opto Coupler, CCD.

TOTAL: 45 PERIODS

OUTCOMES:

On successful completion of the course student will be able to:

1. Explain the V − I characteristics of semiconductor diode.
2. Classify the configurations of BJT and understand its equivalence circuits.
3. Understand the drain – transfer characteristics of FET.
4. Illustrate the characteristics of special semiconductor devices.
5. Outline the concepts of power devices.
6. Outline the concepts of display devices.

TEXT BOOKS:

1. Donald A Neaman, —Semiconductor Physics and Devices‖, Fourth Edition, Tata Mc GrawHill Inc. 2012.
2. Salivahanan. S, Suresh Kumar. N, Vallavaraj.A, —Electronic Devices and circuits, Third Edition, Tata McGraw- Hill, 2008.

REFERENCES:

1. Robert Boylestad and Louis Nashelsky, —Electron Devices and Circuit Theory Pearson Prentice Hall, 10th edition, July 2008.
2. R.S.Sedha, — A Text Book of Applied Electronics Chand Publications, 2006.
3. Yang, —Fundamentals of Semiconductor devices, McGraw Hill International Edition.

21EC1211 CIRCUITS AND DEVICES LABORATORY

L	T	P	C
0	0	4	2

OBJECTIVES:

- To learn the characteristics of basic electronic devices
- To learn the characteristics of transistors and SCR
- To design RL, RC and RLC circuits
- To understand Thevinin & Norton theorem KVL & KCL, and Super Position Theorems.

LIST OF EXPERIMENTS

Minimum of experiments to be conducted: 12

1. Characteristics of PN Junction Diode
2. Zener diode Characteristics & Regulator using Zener diode
3. Common Emitter input-output Characteristics
4. Common Base input-output Characteristics
5. FET Characteristics
6. SCR Characteristics
7. Verifications of Thevenin & Norton theorem
8. Verifications of KVL & KCL
9. Verifications of Super Position Theorem
10. verifications of maximum power transfer & reciprocity theorem
11. Determination of Resonance Frequency of Series & Parallel RLC Circuits
12. Transient analysis of RL and RC circuits

TOTAL: 60 PERIODS

OUTCOMES:

On successful completion of the course student will be able to:

1. understand the characteristics of Electronic devices
2. understand the behaviour of the transistors and SCR
3. design RL, RC and RLC circuits
4. verify Thevenin & Norton theorem, KVL & KCL, and Super Position Theorems

TEXT BOOKS:

1. Donald A Neaman, "Semiconductor Physics and Devices", Tata McGrawHill Inc. 2012.
2. Robert Boylestad and Louis Nashelsky, -Electron Devices and Circuit Theory Pearson prentice Hall,10th edition, July 2008.
3. William H. HAyt, Jr. Jack E. Kemmerly and steven M. Durbin, "Engineering Circuit Analysis", McGraw Hill Science Engineering, Eighth Edition, 11th Reprint 2016.

21ES1211	ENGINEERING PRACTICES LABORATORY	L	T	P	C
		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 & ELECTRICAL

I CIVIL ENGINEERING PRACTICES **15**

Plumbing Work:

a. Connecting various basic pipe fittings like valves, taps, coupling, unions, reducers, elbows and
b. Other components which are commonly used in household.
c. Preparing plumbing line sketches.
d. Laying pipe connection to the suction side of a pump
e. Laying pipe connection to the delivery side of a pump.
f. Connecting pipes of different materials: Metal, plastic and flexible pipes used in household

Wood Work:

a. Introduction to Tools and Equipments
b. Simple Planning and sawing practice
c. Making Half Lap, Dovetail, Mortise and Tenon joints

Wood Work Study:

a. Studying joints in door panels and wooden furniture
b. Studying common industrial trusses using models.

II ELECTRICAL ENGINEERING PRACTICES: **15**

a. Residential house wiring using switches, fuse, indicator, lamp and energy meter.
b. Fluorescent lamp wiring.
c. Stair case wiring
d. Measurement of electrical quantities – voltage, current, power & power factor in RLC circuit.
e. Measurement of energy using single phase energy meter.
f. Measurement of resistance to earth of electrical equipment.

GROUP- B

MECHANICAL AND ELECTRONICS

I MECHANICAL ENGINEERING PRACTICES **15**

Basic Machining Work

a. Introduction to Lathe machine, Tools and Equipments
b. Simple Turning and facing
c. Step turning
d. Simple Drilling and Tapping of flat plate

Welding Work:

a. Introduction to Arc welding
b. Welding of Butt Joints

Assembly Work:

a. Assembling a centrifugal pump.
b. Assembling an air conditioner.

Sheet Metal Work:

a. Demonstrating basic sheet metal operations

Foundry Work:

a. Demonstrating basic foundry operations.

II ELECTRONICS ENGINEERING PRACTICES: **15**

a. Study of Electronic components and equipments – Resistor, color coding
b. Measurement of AC signal parameter (peak-peak, rms period, frequency) using CRO.
c. Study of logic gates AND, OR, EX-OR and NOT.
d. Generation of Clock Signal.
e. Soldering practice – Components Devices and Circuits – Using general purpose PCB.
f. Measurement of ripple factor of HWR and FWR.

TOTAL: 60 PERIODS

OUTCOMES:

On successful completion of the course student will be able to:

1. Connect various basic pipe fittings and other components which are commonly used in household and to know about the various tools, Equipment and making different joints
2. Know the Lathe machine, Tools and Equipment with machining experiments and have knowledge about Arc welding, Tools and Equipments with making different joints
3. Carry out basic home electrical works and appliances and measure the electrical quantities
4. Analyze the basic electronic circuits and to solder simple components on PCB and test simple electronic circuits

TEXT BOOKS:

1. Jeyapoovan T., Saravanapandian M. & Pranitha S., “Engineering Practices Lab Manual”, Vikas Publishing House Pvt.Ltd, (2006)
2. Kannaiah P. & Narayana K.L., “Manual on Workshop Practice”, Scitech Publications, (1999).
3. Jeyachandran K., Natarajan S. & Balasubramanian S., “A Primer on Engineering Practices Laboratory”, Anuradha Publications, (2007).
4. S. Gowri & T. Jeyapoovan, “Enginering Practices Lab Manual 5/E”, S. Chand Publishing, 2019

REFERENCES:

1. K.C. John, "Mechanical workshop practice", Second edition, PHI learning Pvt Ltd, New Delhi
2. Bawa H.S., “Workshop Practice”, Tata McGraw – Hill Publishing Company Limited, (2007)

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III SEMESTER

21MA1302	LINEAR ALGEBRA AND NUMERICAL ANALYSIS	L	T	P	C
		4	0	0	4

OBJECTIVES:

- To understand the concepts of vector space and Sub space.
- To understand the concepts of linear Transformations and diagonalization.
- To apply the concept of inner product spaces in orthogonalization.
- To introduce the basic concepts of solving algebraic and transcendental equations.
- To introduce the numerical techniques of interpolation in various intervals in real life situations.

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 SOLUTION OF EQUATIONS AND EIGENVALUE PROBLEMS 12

Solution of algebraic and transcendental equations : Fixed point theorem (without proof)– Newton Raphson method - Solution of linear system of equations : Gauss elimination method – Gauss Jordan method - Iterative methods of Gauss Jacobi and Gauss Seidel – Eigenvalues of a matrix by Power method.

UNIT - V INTERPOLATION AND APPROXIMATION 12

Interpolation with unequal intervals: Lagrange's interpolation – Newton's divided difference interpolation - Interpolation with equal intervals: Newton's forward and backward difference formulae.

TOTAL: 60 PERIODS

OUTCOMES:

On successful completion of the course student will be able to:

1. Understand the concepts of vector space.
2. Understand the concepts of linear transformations.
3. Understand the concepts of diagonalization
4. Apply the concept of inner product spaces in orthogonalization
5. Understand the basic concepts and techniques of solving algebraic and transcendental equations.
6. Apply the numerical techniques of interpolation and error approximations in various intervals in real life situations.

TEXT BOOKS:

1. Friedberg, A.H., Insel, A.J. and Spence, L., ―Linear Algebra‖, Prentice Hall of India, New Delhi, 2004.
2. Grewal, B.S., and Grewal, J.S., "Numerical Methods in Engineering and Science", Khanna Publishers, 10th Edition, New Delhi, 2015.
3. Kumaresan, S., ―Linear Algebra – A Geometric Approach, Prentice – Hall of India, New Delhi, Reprint, 2010.
4. Kandasamy, P., Thilagavathy, K.,andGunavathy,S., 'Numerical Methods', Chand and Co.,2013.

REFERENCES:

1. Kolman, B. Hill, D.R., ―Introductory Linear Algebra‖, Pearson Education, New Delhi, First Reprint, 2009.
2. Lay, D.C., ―Linear Algebra and its Applications‖, 5th Edition, Pearson Education, 2015.
3. Burden, R.L. and Faires, J.D, "Numerical Analysis", 9th Edition, Cengage Learning, 2016.
4. Sundarapandian, V. ―Numerical Linear Algebra‖, Prentice Hall of India, New Delhi, 2008.

21EC1301	**ELECTROMAGNETIC FIELDS**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

OBJECTIVES:

- To impart knowledge on the basics of static electric field and the associated laws
- To impart knowledge on the basics of static magnetic field and the associated laws
- To give insight into coupling between electric and magnetic fields through Faraday's law, displacement current and Maxwell's equations
- To gain the behavior of the propagation of EM waves

UNIT - I INTRODUCTION 9

Electromagnetic model, Units and constants, Review of vector algebra, Rectangular, cylindrical and spherical coordinate systems, Line, surface and volume integrals, Gradient of a scalar field, Divergence of a vector field, Divergence theorem, Curl of a vector field, Stoke's theorem, Null identities, Helmholtz's theorem , Verify theorems for different path, surface and volume.

UNIT - II ELECTROSTATICS 9

Electric field, Coulomb's law, Gauss's law and applications, Electric potential, Conductors in static electric field, Dielectrics in static electric field, Electric flux density and dielectric constant, Boundary conditions, Electrostatics boundary value problems Capacitance, Parallel, cylindrical and spherical capacitors, Electrostatic energy, Poisson's and Laplace's equations, Uniqueness of electrostatic solutions, Current density and Ohm's law, Electromotive force and Kirchhoff's voltage law, Equation of continuity and Kirchhoff's current law.

UNIT - III MAGNETOSTATICS 9

Lorentz force equation, Law of no magnetic monopoles, Ampere's law, Vector magnetic potential, Biot-Savart law and applications, Magnetic field intensity and idea of relative permeability, Calculation of magnetic field intensity for various current distributions Magnetic circuits, Behaviour of magnetic materials, Boundary conditions, Inductance and inductors, Magnetic energy, Magnetic forces and torques.

UNIT - IV TIME-VARYING FIELDS AND MAXWELL's EQUATIONS 9

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 9

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 ata plane conducting boundary, Normal incidence at a plane dielectric boundary.

TOTAL: 45 PERIODS

OUTCOMES:

On successful completion of the course student will be able to:

1. Relate the fundamentals of vector, coordinate system to electromagnetic concepts.
2. Analyze the characteristics of Electrostatic field.
3. Interpret the concepts of Electric field in material space and solve the boundary conditions.
4. Explain the concepts and characteristics of Magneto Static field in material space and solve boundary conditions.
5. Determine the significance of time varying fields.
6. Evaluate the electromagnetic wave propagation in lossy and lossless medium.

TEXT BOOKS:

1. Edward C. Jordan & Keith G. Balmain,Electromagnetic waves and Radiating Systems, Second Edition, Prentice-Hall Electrical Engineering Series.
2. M.N.O.Sadiku and S.V. Kulkarni, Principles of electromagnetics, 6th ed., Oxford(Asian Edition), 2015

REFERENCES:

1. D.K. Cheng, Field and wave electromagnetics, 2nd ed., Pearson (India), 1989
2. W.H. Hayt and J.A. Buck, Engineering electromagnetics, 7th ed., McGraw-Hill (India), 2006
3. B.M. Notaros, Electromagnetics, Pearson: New Jersey, 2011

21EC1302	ELECTRONIC CIRCUITS	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To understand the methods of biasing transistors.
- To design and analyse BJT, FET amplifier circuits.
- To analyse the frequency response of amplifiers.
- To study about feedback amplifiers and oscillators principles.
- To analyse tuned amplifiers.
- To acquaint the students about Power Amplifiers.

UNIT - I BIASING OF DISCRETE BJT, JFET 9

Need for Biasing-DC Load line-Operating point- Methods of BJT Biasing -Bias compensation- Thermal stability - Biasing of JFET

UNIT - II BJT & FET AMPLIFIERS 9

Small signal Analysis of Common Emitter, Common Collector and Common Base amplifiers - Introduction to Multi stage Amplifiers - Darlington Amplifier - Small signal Analysis of FET amplifiers.

UNIT - III FREQUENCY ANALYSIS OF AMPLIFIERS 9

Low and High frequency Response of BJT Amplifiers-Short circuit current gain- cut off frequency- Unity Gain Bandwidth - Frequency Response of CS amplifier - Bandwidth of Multi stage amplifiers.

UNIT - IV FEEDBACK AMPLIFIERS AND OSCILLATORS 9

Feedback topologies-Voltage Series, Current Series, Voltage Shunt, Current Shunt-General characteristics of negative feedback amplifiers-Effect of negative feedback on Input and output Resistance- Oscillators- Barkhausen Criterion- Analysis of RC phase shift, Wien-bridge oscillators- Hartley, Colpitts oscillators-Crystal oscillators

UNIT - V TUNED AMPLIFIERS AND POWER AMPLIFIERS 9

Introduction-Analysis of single tuned amplifier - effect of cascading single tuned tuned amplifiers on bandwidth -Stagger tuned amplifier-Hazeltine neutralization – Power amplifiers-Class A, Class B.

TOTAL: 45 PERIODS

OUTCOMES:

On successful completion of the course student will be able to:

1. Choose appropriate Biasing circuits of BJT,JFET
2. Design and analysis of BJT, FET amplifiers.
3. Study about frequency response of amplifiers.
4. Analyze the Feedback Amplifier and Oscillator circuits.
5. Study about Tuned amplifiers.
6. Summarize the operation of Power Amplifiers.

TEXT BOOKS:

1. S Salivahanan and N Suresh Kumar, Electronic Devices and Circuits, 4th Edition, Mc Graw Hill Education (India) Private Ltd., 2017.
2. Jacob Millman, Christos C Halkias, Satyabrata JIT ,Electronic Devices and circuits , 4th Edition, Mc Graw Hill Education (India) Private Ltd., 2015.

REFERENCES:

1. Robert L. Boylestad and Louis Nasheresky, Electronic Devices and Circuit Theory, 11th Edition, Pearson Education
2. David A. Bell,Electronic Devices and Circuits, Fifth Edition, Oxford University Press,2008.
3. Floyd, Electronic Devices, Ninth Edition, Pearson Education, 2012.
4. Donald .A. Neamen, Electronic Circuit Analysis and Design, 3rd Edition, Tata McGraw Hill, 2010.

21EC1303	DIGITAL ELECTRONICS	L	T	P	C
		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 sequential circuits.
- To introduce the analysis and design procedures for asynchronous sequential circuits.
- To explain the various semiconductor memories and related technology.
- To introduce the electronic circuits involved in the making of logic gates

UNIT - I DIGITAL FUNDAMENTALS 9

Number Systems – Decimal, Binary, Octal, Hexadecimal, 1's and 2's complements, Codes – Binary, BCD, Excess 3, Gray, Alphanumeric codes, Boolean theorems, Logic gates, Universal gates, Sum of products and product of sums, Minterms and Maxterms, Karnaugh map Minimization and Quine- McCluskey method of minimization.

UNIT - II COMBINATIONAL CIRCUIT DESIGN 9

Design of Half and Full Adders, Half and Full Subtractors, Binary Parallel Adder – Carry look ahead Adder, BCD Adder, Multiplexer, Demultiplexer, Magnitude Comparator, Decoder, Encoder, Priority Encoder.

UNIT - III SYNCHRONOUS SEQUENTIAL CIRCUITS 9

Flip flops – SR, JK, T, D, Master/Slave FF – operation and excitation tables, Triggering of FF, Analysis and design of clocked sequential circuits – Design - Moore/Mealy models, state minimization, state assignment, circuit implementation – Design of Counters- Ripple Counters, Ring Counters, Shift registers, Universal Shift Register.

UNIT - IV ASYNCHRONOUS SEQUENTIAL CIRCUITS 9

Stable and Unstable states, output specifications, cycles and races, state reduction, race free assignments, Hazards, Essential Hazards, Pulse mode sequential circuits, Design of Hazard free circuits.

UNIT - V PROGRAMMABLE LOGIC DEVICES AND DIGITAL INTEGRATED CIRCUITS 9

Programmable Logic Devices: Programmable Logic Array (PLA) - Programmable Array Logic (PAL)Field Programmable Gate Arrays (FPGA) - Implementation of combinational logic circuits using PLA, PAL.
Digital integrated circuits: Logic levels, propagation delay, power dissipation, fan-out and fan-in, noise margin, logic families and their characteristics-TTL, CMOS.

TOTAL: 45 PERIODS

OUTCOMES:

On successful completion of the course student will be able to:

1. Use digital concepts and its applications in Digital systems.
2. Design various combinational digital circuits using logic gates.
3. Design and Analyze synchronous sequential circuits.
4. Design and Analyze asynchronous sequential circuits.
5. Use the semiconductor memories and related technology.
6. Use electronic circuits involved in the design of logic gates.

TEXT BOOKS:

1. M. Morris Mano and Michael D. Ciletti, "Digital Design", 5th Edition, Pearson, 2014.
2. Ronald J. Tocci , Neal S. Widmer and Gregory L. Moss,"Digital Systems: Principles and Applications" , Tenth Edition, Pearson Education, 2009.

REFERENCES:

1. Charles H.Roth. "Fundamentals of Logic Design", 6th Edition, Thomson Learning, 2013.
2. Thomas L. Floyd, "Digital Fundamentals", 10th Edition, Pearson Education Inc, 2011.
3. Leach, Malvino and Saha "Digital Principles and Applications", McGraw Hill Education, 8th Edition, 2014.
4. Anil K.Maini "Digital Electronics", Wiley, 2014.
5. Soumitra Kumar Mandal " Digital Electronics", McGraw Hill Education Private Limited, 2016.
6. Dr.P.Kannan, M.Saraswathi, "Digital Electronics", Sree Kamalamani Publication, Second Edition, 2017.

21EC1304	SIGNALS AND SYSTEMS	L	T	P	C
		3	1	0	4

OBJECTIVES:

- To understand the basic properties of signals.
- To analyze the basic systems using properties.
- To analyze the characteristics of continuous time signals in the Fourier and Laplace domain
- To analyze LTI – Continuous time systems in Time domain and Frequency domain
- To analyze the characteristics of Discrete time signals in the Fourier and Z transform domain
- To analyze LTI - Discrete time systems in Time domain

UNIT - I CLASSIFICATION OF SIGNALS AND SYSTEMS 12

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, Time-variant & Time-invariant, Causal & Non-causal, Stable & Unstable.

UNIT - II ANALYSIS OF CONTINUOUS TIME SIGNALS 12

Fourier Series for periodic signals -Analysis of Continuous Time Signals using Fourier Transform –Inverse FT -Properties of FT, CT Signal analysis using Laplace Transform-Unilateral LT and Bilateral LT-Inverse LT- Properties of Unilateral LT.

UNIT - III LINEAR TIME INVARIANT CONTINUOUS TIME SYSTEMS 12

Impulse response - convolution integral – Graphical method - Properties of convolution integral- Overall impulse response for interconnected systems - Fourier and Laplace transforms in Analysisof CT systems - Solving of Differential Equation.

UNIT - IV ANALYSIS OF DISCRETE TIME SIGNALS 12

Baseband signal sampling -Analysis of Discrete Time Signals using Discrete Time Fourier Transform (DTFT)- Inverse DTFT–Properties of DTFT- Analysis of Discrete Time Signals using Z-Transform – Inverse Z-Transform - Properties of Z-Transform.

UNIT - V LINEAR TIME INVARIANT-DISCRETE TIME SYSTEMS 12

Impulse response – Convolution sum –Graphical method - Properties of Discrete Convolution- Overall impulse response for interconnected systems -Solving of Difference equations- Solution of Difference equation using DTFT- solution of difference equation using Z-transform.

TOTAL: 60 PERIODS

OUTCOMES:

On successful completion of the course student will be able to:

1. Understand the basics of signals and its classifications
2. Analyze the basic systems and its classifications
3. Determine the frequency Response for Deterministic signal and also analyze in S-domain.
4. Apply the Fourier and Laplace Transform for the analysis of LTI -Continuous Time systems.
5. Analyze the Characteristics of DT signals by using DTFT and Z-transform.
6. Apply the Fourier and Z- Transform for the analysis of LTI –Discrete Time systems.

TEXT BOOKS:

1. Allan V.Oppenheim, S.Wilsky and S.H.Nawab, “Signals and Systems”,Pearson,2015.
2. S. Haykin and B. Van Veen, "Signals and Systems", 2nd Edition, Wiley, 2007.

REFERENCES:

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

21MC1006	SOFT SKILLS AND PERSONALITY DEVELOPMENT	L	T	P	C
		2	0	0	0

OBJECTIVES:

- To inform the students about the importance of projecting a positive social image.
- To insist on the aspects of effective planning and goal-setting.
- To provide an in-depth view to the students about building self esteem and confidence.
- To motivate the students to become winning personalities.
- To enable the students understand the importance of employing perfect body language in communication.
- To inculcate leadership qualities in the young minds.

UNIT - I INTRODUCTION TO SOFT SKILLS 6

Importance of Soft skills - Attributes regarded as soft skills - Indentifying major soft skills - Introduction to personality - Dimensions of personality - Determinants of personality.

UNIT - II SELF DISCOVERY/KNOW THYSELF 6

SWOT Analysis - Developing positive attitude - Career Panning – Goal Setting and prioritization- Importance of self-motivation- Building self-esteem and confidence.

UNIT - III ART OF SPEAKING/ INTERPERSONAL COMMUNICATION 6

Tips for powerful presentation - Public speaking - Developing confidence-Interpersonal Relationships - Planning and Preparation - Successful and effective delivery of speech.

UNIT - IV PROJECTING A POSITIVE SOCIAL IMAGE 6

Grooming - Body language - Eye contact - Social etiquette - Manners in conversations - Team Building.

UNIT - V EMPLOYABILITY SKILLS 6

Leadership - Emotional Intelligence - Interpersonal Skills - Negotiation skills - Stress Management - Time Management.

TOTAL: 30 PERIODS

OUTCOMES:

On successful completion of the course student will be able to:

1. Speak confidently with any speakers of English, including native speakers in day today activity at working culture.
2. Speak effortlessly in different contexts – informal and formal.
3. Learn employability skills.
4. Introspect the role of an employable engineer in LSRW skills.
5. Groom his or herself as a successful human being.

TEXT BOOKS:

1. Soft Skills by Dr.K.Alex- S.Chand
2. Soft skills by MJP Publishers

REFERENCES:

1. Basic Managerial Skills for All by E.H. McGrath S.J

21EC1311 CIRCUITS AND SIMULATION LABORATORY

L	T	P	C
0	0	4	2

OBJECTIVES:

- Study the Frequency response of BJT Amplifiers
- Learn the frequency response of CS Amplifiers
- Design feedback amplifiers
- Design oscillator circuits
- To study about Tuned Amplifiers
- Perform SPICE simulation of Electronic circuits

LIST OF EXPERIMENTS

1. Fixed bias common emitter amplifier circuit
2. Common base amplifier
3. Common collector amplifier with voltage divider bias
4. Common source amplifier
5. Series and Shunt feedback amplifiers-Frequency response, Input and output impedance calculation
6. RC Phase shift oscillator and Wien Bridge Oscillator
7. Hartley Oscillator and Colpitts Oscillator
8. Single Tuned Amplifier

SIMULATION USING SPICE (Using Transistor):

1. Common emitter amplifier
2. Common source amplifier
3. Class A power amplifier

TOTAL: 60 PERIODS

OUTCOMES:

On successful completion of the course student will be able to:

1. Design and analyse BJT amplifiers
2. Design and analyse FET amplifiers
3. Design feedback amplifiers.
4. Design oscillator circuits
5. Study Tuned Amplifiers
6. Simulate and analyse Electronic circuits using PSpice.

REFERENCES:

1. Donald. A. Neamen, Electronic Circuits Analysis and Design, 3rd Edition, Mc Graw Hill Education (India) Private Ltd., 2010.
2. Robert L. Boylestad and Louis Nasheresky, “Electronic Devices and Circuit Theory”, 11th Edition, Pearson Education, 2013.

21EC1312 **DIGITAL ELECTRONICS LABORATORY**

L	T	P	C
0	0	4	2

OBJECTIVES:

- Learn the basic operation of gates.
- Understand the basic digital circuits and to verify their operation.
- Know the concepts of Combinational circuits and sequential circuits.
- Understand the concepts of flip-flops, registers.
- Understand the concept of counters.

LIST OF EXPERIMENTS

1. Study of Logic gates and verify its truth table.
2. 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
3. Design and implementation of 4 bit binary Adder/ Subtractor and BCD adder using IC 7483.
4. Design and implementation of Multiplexer and De-multiplexer using logic gates
5. Design and implementation of encoder and decoder using logic gates.
6. Design and implementation of 2-bit magnitude comparator using logic gates, 8-bit magnitude comparator using IC 7485.
7. Design and implementation of 16 bit odd/even parity checker /generator using IC74180.
8. Construction and verification of 4 bit ripple counter and Mod-10 / Mod-12 Ripple counters
9. Design and implementation of 3-bit synchronous up/down counter.
10. Implementation of SISO, SIPO, PISO and PIPO shift registers using flip-flops.

TOTAL: 60 PERIODS

OUTCOMES:

On successful completion of the course student will be able to:

1. Implement and Verify basic function of digital circuits.
2. Construct basic combinational circuits and verify their functionalities.
3. Apply the design procedures to design basic sequential circuits.
4. Design different types of counters.
5. Implement and analyze the working of Shift registers.
6. Design and Test the digital logic circuits.

REFERENCES:

1. M. Morris Mano and Michael D. Ciletti, “Digital Design”, 5th Edition, Pearson, 2014.
2. Ronald J. Tocci , Neal S. Widmer and Gregory L. Moss,“Digital Systems: Principles and Applications” , Tenth Edition, Pearson Education, 2009.

IV SEMESTER

21MA1403	PROBABILITY AND RANDOM PROCESSES	L	T	P	C
		3	1	0	4

OBJECTIVES:

- To provide necessary basic concepts in probability and random processes for applications such as random signals, linear systems in communication engineering.
- To understand the basic concepts of probability, one and two dimensional random variables and to introduce some standard distributions applicable to engineering which can describe real life phenomenon.
- To understand the basic concepts of random processes which are widely used in IT fields.
- To understand the concept of correlation and spectral densities.
- To understand the significance of linear systems with random inputs.

UNIT - I RANDOM VARIABLES 12

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

UNIT - II TWO - DIMENSIONAL RANDOM VARIABLES 12

Joint distributions – Marginal and conditional distributions – Covariance – Correlation and linear regression – Transformation of random variables – Central limit theorem for Independent Identically Distributed random variable (Without Proof).

UNIT - III RANDOM PROCESSES 12

Classification – Stationary process – Markov process - Markov chain - Poisson process.

UNIT - IV CORRELATION AND SPECTRAL DENSITIES 12

Auto correlation functions – Cross correlation functions – Properties – Power spectral density – Cross spectral density – Properties.

UNIT - V LINEAR SYSTEMS WITH RANDOM INPUTS 12

Linear time invariant system – System transfer function – Linear systems with random inputs – Auto correlation and cross correlation functions of input and output.

TOTAL: 60 PERIODS

OUTCOMES:

On successful completion of the course student will be able to:

1. Understand the fundamental knowledge of the concepts of probability and have knowledge of standard distributions which can describe real life phenomenon.
2. Understand the basic concepts of one dimensional random variables and apply in engineering applications.
3. Understand the basic concepts of two dimensional random variables and apply in engineering applications.
4. Apply the concept random processes in engineering disciplines.
5. Understand and apply the concept of correlation and spectral densities.
6. Analyze the response of random inputs to linear time invariant systems.

TEXT BOOKS:

1. Ibe, O.C.," Fundamentals of Applied Probability and Random Processes ", 1st Indian Reprint, Elsevier, 2007.
2. Peebles, P.Z., "Probability, Random Variables and Random Signal Principles ", Tata McGraw Hill, 4th Edition, New Delhi, 2002.
3. Veerarajan T, "Probability, Statistics and Random Processes with Queueing Theory", Mc Graw Hill, 1st Edition, 2018.

REFERENCES:

1. Cooper. G.R., McGillem. C.D., "Probabilistic Methods of Signal and System Analysis", Oxford University Press, New Delhi, 3rd Indian Edition, 2012.
2. Hwei Hsu, "Schaum's Outline of Theory and Problems of Probability, Random Variables and Random Processes ", Tata McGraw Hill Edition, New Delhi, 2004.
3. Miller. S.L. and Childers. D.G., —Probability and Random Processes with Applications to Signal Processing and Communications ", Academic Press, 2004.
4. Stark. H. and Woods. J.W., —Probability and Random Processes with Applications to Signal Processing ", Pearson Education, Asia, 3rd Edition, 2002.
5. Yates. R.D. and Goodman. D.J., —Probability and Stochastic Processes", Wiley India Pvt. Ltd., Bangalore, 2nd Edition, 2012.

21EC1401	ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING (LAB INTEGRATED)	L	T	P	C
		3	0	2	4

OBJECTIVES:

- To study the fundamental knowledge about Artificial Intelligence
- To learn the prologs involved in Artificial Intelligence
- To discuss the details of Natural Language processing
- To learn about the details of Machine Learning
- To study the details of Machine Learning techniques
- To study the algorithms involved in Machine Learning

UNIT - I INTRODUCTION TO ARTIFICIAL INTELLIGENCE 9

Meaning and definition of artificial intelligence, Physical Symbol System Hypothesis, production systems, Characteristics of production systems; Breadth first search and depth first search techniques. Heuristic search Techniques: Hill Climbing, Iterative deepening DFS, bidirectional search. Analysis of search methods. A* algorithm, and their analysis. Introduction to Genetic Algorithm.

UNIT - II INTRODUCTION TO PROLOG 9

Knowledge Representation, Problems in representing knowledge, knowledge representation using propositional and predicate logic, logical consequences, syntax and semantics of an expression, semantic Tableau Forward and backward reasoning. Proof methods, substitution and unification, conversion to clausal form, normal forms, resolution, refutation, deduction, theorem proving, in ferencing, monotonic and non monotonic reasoning. Introduction to Prolog.

UNIT - III NATURAL LANGUAGE PROCESSING 9

Network-based representation and reasoning, Semantic networks, Conceptual Graphs, frames. Description logic (DL), concept language, reasoning using DL

UNIT - IV INTRODUCTION TO MACHINE LEARNING 9

Preliminaries, what is machine learning; varieties of machine learning, learning input/output functions, bia, sample application. Boolean functions and their classes, CNF, DNF, decision lists. Version spaces for learning, version graphs, learning search of a version space

UNIT - V MACHINE LEARNING TECHNIQUES 9

Statistical Learning, background and general method, learning belief networks, nearest neighbor. Decision-trees, supervised learning of uni-variance decision trees, network equivalent of decision trees

TOTAL: 45 PERIODS

OUTCOMES:

On successful completion of the course student will be able to:

1. Use appropriate search algorithms for any AI problem
2. Represent a problem using first order and predicate logic
3. Understand the NLP that use Artificial Intelligence
4. Understand the various approaches for Machine Learning techniques
5. Apply the Bayesian Belief concepts to machine learning
6. Discuss the decision tree algorithm and overcome the problem of overfitting

TEXT BOOKS:

1. Artificial Intelligence: Elaine Rich, Kevin Knight, Mc-GrawHill
2. Introduction to Machine learning, Nils J.Nilsson S Salivahanan and N Suresh.

REFERENCES:

1. Introduction to AI & Expert System: Dan W.Patterson, PHI.
2. Artificial Intelligence by Luger (Pearson Education)
3. Russel&Norvig, Artificial Intelligence: A Modern Approach, Pearson Education.
4. Machine learning for dummies, IBM Limited ed, by Judith Hurwitz and Daniel Kirsch
5. Introduction to Machine Learning with Python A guide for data scientists, Andreas, C. Muller & Sarah Guido, O'Reilly

Experiments of Artificial Intelligence and Machine Learning Laboratory

Artificial Intelligence

1. Installation of gnu-prolog, Study of Prolog (gnu-prolog), its facts, and rules.
2. Write simple facts for the statements and querying it.
3. Write a program for Family-tree.
4. Write Program for Monkey-banana Problem.
5. Write a program which behaves a small expert for medical Diagnosis.
6. Write programs for computation of recursive functions like factorial Fibonacci numbers, etc.

Machine Learning

1. Implement and demonstrate the FIND-S algorithm for finding the most specific hypothesis based on a given set of training data samples. Read the training data from a .CSV le
2. For a given set of training data examples stored in a .CSV file, implement and demonstrate the Candidate- Elimination algorithm. Output a description of the set of all hypotheses consistent with the training examples.
3. Write a program to demonstrate the working of the decision tree based ID3 algorithm. Use an appropriate data set for building the decision tree and apply this knowledge to classify a new sample.
4. Build an Artificial Neural Network by implementing the Back propagation algorithm and test the same using appropriate data sets.

21EC1402	CONTROL SYSTEMS ENGINEERING	L	T	P	C
		3	1	0	4

OBJECTIVES:

- To identify the various control system components and their representations.
- To analyze the various time domain parameters.
- To analyze the various frequency response plots and its system.
- To analyze the different compensation techniques required for the systems
- To apply the concepts of various system stability criterions.
- To Design various transfer functions of digital control system using state variable models.

UNIT - I SYSTEMS COMPONENTS AND THEIR REPRESENTATION 12

Control System: Terminology and Basic Structure-Feed forward and Feedback control theory- Electrical and Mechanical Transfer Function Models-Block diagram Models-Signal flow graphs models

Suggested Activities:

Solving of problems based on transfer function models, block diagram reduction and signal flow graph.

Suggested Evaluation Methods:

Assignment on application examples on open loop and closed loop control system
Quizzes on System component representations

UNIT - II TIME RESPONSE ANALYSIS 12

Transient response - steady state response - Measures of performance of the standard first order and second order system - effect on an additional zero and an additional pole - steady error constant and system - type number - PID control-Analytical design for PD, PI,PID control systems

Suggested Activities:

Solving of problems on steady error constant and system
Obtaining of time response using suitable software tools

Suggested Evaluation Methods:

Assignments based on problems in first order and second order systems
Quizzes on Time domain specifications.

UNIT - III FREQUENCY RESPONSE AND SYSTEM ANALYSIS 12

Closed loop frequency response - Performance specification in frequency domain - Frequency response of standard second order system - Bode Plot - Polar Plot - Nyquist plots - Design of compensators using Bode plots - Cascade lead compensation-Cascade lag compensation-Cascade lag-lead compensation

Suggested Activities:

Solving of problems in Bode plot and compensators
Frequency response analysis using suitable software tools

Suggested Evaluation Methods:

Assignments on Polar plot and Nyquist plot
Quizzes on frequency domain specifications

UNIT - IV STABILITY ANALYSIS 12

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

Suggested Activities:

Solving of Problem in RH criterion,

Analyzing system stability using suitable software tools

Suggested Evaluation Methods:

Assignments on Root Locus,

Quizzes on Stability criterions

UNIT - V ANALYSIS OF STATE VARIABLE METHODS 12

State variable representation - Conversion of state variable models to transfer functions - Conversion of transfer functions to state variable models - Solution of state equations - Concepts of Controllability and Observability - Stability of linear systems - Equivalence between transfer function and state variable representations - State variable analysis of digital control system - Digital control design using state feedback.

Suggested Activities:

Solving of problems in Observability and Controllability, State space models and equations

State Space analysis using suitable software tools

Suggested Evaluation Methods:

Assignment in conversion of state variable models to transfer functions

Quizzes on State space representation and analysis

TOTAL: 60 PERIODS

OUTCOMES:

On successful completion of the course student will be able to:

1. Able to acquire the knowledge of signals, systems and its classifications.
2. Able to analyze various system using time domain specifications.
3. Able to analyze various system using frequency domain specifications.
4. Able to analyze the different compensation techniques required for the systems.
5. Able to apply the concepts of stability of the system using RH and Nyquist methods.
6. Able to design transfer functions of digital control system using state variable models.

TEXT BOOKS:

1. M. Gopal, “Control System – Principles and Design”, Tata McGraw Hill, 4th Edition, 2012.
2. J. Nagrath and M. Gopal, “Control System Engineering”, New Age International Publishers, 5th Edition, 2007.

REFERENCES:

1. A. Nagoor Kani, “Control System Engineering”, CBS Publication and Distributors, 2020.
2. Richard C. Dorf, Robert H. Bishop, “Modern Control System”, Pearson, 13th Edition, 2016

21EC1403 FUNDAMENTALS OF DATA STRUCTURES IN C

L	T	P	C
3	0	0	3

OBJECTIVES:

- To understand the basic concepts of the C-programming language
- To learn the different data types, Understand searching and sorting algorithms
- To identify different types of data structures and its operations for real-time programming applications.
- To know stack and queues in processing data for real-time applications
- To understand tree data storage structure for real-time applications.
- To use algorithms to find shortest data search in graphs for real-time application development

UNIT - I FUNDAMENTAL OF C PROGRAMMING 9

Structure of a C program, Compilation and linking processes, Constants, Variables, Data Types, Types of operators in C, Managing Input and Output operations, Decision Making and Branching - Looping statements.

SUGGESTED ACTIVITIES:

Implementing programs using data types, arithmetic operators and basic input/output operations.

Developing programs using if-else, do-while, while, for, switch, break, continue, enum.

Create an application that performs operations like String manipulation.

Create an application that performs operations like String manipulation.

SUGGESTED EVALUATION METHODS:

Assignment on conditionals and loops.

Evaluation of the programs implemented.

UNIT - II ADVANCED - C PROGRAMMING 9

Functions - Pass by value - Pass by reference, Recursion, Pointers – Definition – Initialization - Pointer’s arithmetic. Structures and unions – definition - Programs using structures and Unions, Dynamic Memory Allocation, Pre-processor directives.

SUGGESTED ACTIVITIES:

Demonstration of Function programs using Call by Value and by reference.

Demonstration of C programs using Recursion and pointers

Programs using dynamic memory.

SUGGESTED EVALUATION METHODS:

Quizzes on structures & union.

Assignments on C programs to implement concepts of pointers and functions.

Quizzes on Dynamic Memory Allocation operations.

UNIT - III LINEAR DATA STRUCTURES 9

Array-Operations on Arrays–Insertion and Deletion-Applications on Arrays. Abstract Data Types (ADTs), List ADT, Array Based Implementation - Stacks and Queues, Linked List - Linked list-based implementation of Stacks and Queues– Applications of Stacks and Queues

SUGGESTED ACTIVITIES:

Converting an algorithm from recursive to non-recursive using stack.
Demonstrating stack for Towers of Hanoi application.
Developing any application using all the linear data structures.

SUGGESTED EVALUATION METHODS

Quizzes on abstract data types.
Assignments linked list and stack.
Quizzes on queue and applications.

UNIT - IV NON-LINEAR DATA STRUCTURE 9

Trees-General Trees-Tree Terminologies-Tree epresentation - Binary Trees, Tree Traversals, Expression Trees, Binary Search Tree, Applications of trees. Graphs - Representation of Graph – Types of graphs - Breadth-first traversal – Depth- first traversal – Applications

SUGGESTED ACTIVITIES:

Implementing binary tree and tree traversals.
Solving expressions using expression trees by determining infix, prefix and postfix expressions.
Implementing graph traversals.

SUGGESTED EVALUATION METHODS:

Quizzes on basic tree operations.
Assignments on tree traversals and some sample expressions.
Assignment on Graphs and applications.

UNIT - V SORTING AND SEARCHING TECHNIQUES 9

Algorithms – Sorting - Insertion Sort, Quick Sort, Merge Sort, Algorithms–rching Techniques-Linear and Binary Search.

SUGGESTED ACTIVITIES:

Implementation of all sorting techniques.
Demonstration of searching techniques under best- and worst-case inputs.

SUGGESTED EVALUATION METHODS:

Quizzes on sorting and searching.
Assignments on insertion sort and quick sort.
Seminar and Quiz on searching methods.

TOTAL: 45 PERIODS

OUTCOMES:

On successful completion of the course student will be able to:

1. Develops the use of the C programming language to implement various algorithms, and develops the basic concepts and terminology of programming in general.
2. Identify linear and non-linear data structures. Create algorithms for searching and sorting.
3. Create the different types of linked lists and evaluate its operations
4. Construct stack and queue data structures and evaluate its operations
5. Create tree data structures and evaluate its types and operations
6. Create graph data structure, evaluate its operations, implement algorithms to identify shortest path.

TEXT BOOKS:

1. ReemaThareja, ``Programming in C'', 2nd edition, OXFORD University Press, New Delhi, 2019. (Units 1 and 2)
2. ReemaThareja, ``Data Structures Using C'', 2nd edition, OXFORD University Press, New Delhi, 2016. (Units 3,4 5)

REFERENCES:

1. E.Balagurusam,"Programming in ANSI C",8thedition,McGraw Hill Education India,2019.
2. Paul Deitel and Harvey Deitel, "C How to Program", Seventh edition, Pearson Publication.
3. Aho, Hopcroft and Ullman,"Data Structures and Algorithms", Pearson Education,1983.
4. Stephen G. Kochan,"Programming in C", 3rd edition, Pearson Education.
5. Ellis Horowitz, SartajSahni, Susan Anderson-Freed, "Fundamentals of Data Structures in C", Second Edition, University Press, 2008

21EC1404	ANALOG INTEGRATED CIRCUITS	L	T	P	C
		3	0	0	3

OBJECTIVES:

- Introduce the basic building blocks of analog integrated circuits.
- To learn the linear and non-linear applications of operational amplifiers.
- To introduce the theory and applications of analog multipliers and PLL.
- To learn the theory of ADC and DAC.
- To introduce the concepts of waveform generation using op-amps.
- To introduce, study and analyze some special function ICs.

UNIT - I BUILDING BLOCKS OF ANALOG INTEGRATED CIRCUITS 9

Current mirror and current sources, Current sources as active loads, Voltage sources, Voltage References, BJT Differential amplifier with active loads, Basic information about op-amps – Ideal Operational Amplifier - General operational amplifier stages - and internal circuit diagrams of IC 741, DC and AC performance characteristics, slew rate, Open and closed loop configurations – JFET Operational Amplifiers – LF155 and TL082.

UNIT - II APPLICATIONS OF OPERATIONAL AMPLIFIERS 9

Sign Changer, Scale Changer, Phase Shift Circuits, Voltage Follower, V-to-I and I-to-V converters, adder, subtractor, Instrumentation amplifier, Integrator, Differentiator, Logarithmic amplifier, Antilogarithmic amplifier, Comparators, Schmitt trigger, Precision rectifier, peak detector, clipper and clamper, Low-pass, high-pass and band-pass Butterworth filters.

UNIT - III ANALOG MULTIPLIER AND PLL 9

Analog Multiplier using Emitter Coupled Transistor Pair - Gilbert Multiplier cell – Variable transconductance technique, analog multiplier ICs and their applications, Operation of the basic PLL, Closed loop analysis, Voltage controlled oscillator, Monolithic PLL IC 565, application of PLL for AM detection, FM detection, FSK modulation and demodulation and Frequency synthesizing and clock synchronisation.

UNIT - IV ANALOG TO DIGITAL AND DIGITAL TO ANALOG CONVERTERS 9

Analog and Digital Data Conversions, D/A converter – specifications - weighted resistor type, R-2R Ladder type, Voltage Mode and Current-Mode R - 2R Ladder types - switches for D/A converters, high speed sample-and-hold circuits, A/D Converters – specifications - Flash type - Successive Approximation type - Single Slope type – Dual Slope type - A/D Converter using Voltage-to-Time Conversion - Over-sampling A/D Converters, Sigma – Delta converters.

UNIT - V WAVEFORM GENERATORS AND SPECIAL FUNCTION ICS 9

Sine-wave generators, Multivibrators and Triangular wave generator, Saw-tooth wave generator, ICL8038 function generator, Timer IC 555, IC Voltage regulators – Three terminal fixed and adjustable voltage regulators - IC 723 general purpose regulator - Monolithic switching regulator, Low Drop – Out(LDO) Regulators - Switched capacitor filter IC MF10, Frequency to Voltage and Voltage to Frequency converters, Audio Power amplifier, Video Amplifier, Isolation Amplifier, Optocouplers and fibre optic IC.

TOTAL: 45 PERIODS

OUTCOMES:

On successful completion of the course student will be able to:

1. Infer basic building blocks of Analog ICs.
2. Demonstrate linear and nonlinear applications of op-amps.
3. Illustrate the functions of analog multiplier and Phase Locked Loop (PLL).
4. Compare the working principles of data conversion methods (ADCs & DACs).
5. Explain waveform generators using op-amps.
6. Analyze special function ICs.

TEXT BOOKS:

1. Michael Jacob, "Applications and Design with Analog Integrated Circuits", Prentice Hall of India, 1996.
2. Sergio Franco, "Design with Operational Amplifiers and Analog Integrated circuits" 4th Edition, Tata Mc Graw-Hill, 2016.

REFERENCES:

1. D.Roy Choudhry, ShailJain,"Linear Integrated Circuits", New Age International Pvt. Ltd., 2000. Circuits", 3rd Edition, Tata McGraw-Hill, 2007.
2. Robert F.Coughlin, Frederick F.Driscoll, " Operational Amplifiers and Linear Integrated Circuits", Sixth Edition, PHI,2001.
3. B.S.Sonde, "System design using Integrated Circuits", 2nd Edition, New Age Pub, 2001
4. Gray and Meyer, "Analysis and Design of Analog Integrated Circuits", Wiley International, 2005.
5. Ramakant A.Gayakwad, "OP-AMP and Linear ICs",4th Edition, Prentice Hall /Pearson Education, 2001.
6. William D.Stanley, "Operational Amplifiers with Linear Integrated Circuits", Pearson Education, 2004.
7. S.Salivahanan & V.S. Kanchana Bhaskaran, "Linear Integrated Circuits", TMH, 2008.

21EC1412	ANALOG INTEGRATED CIRCUITS LABORATORY	L	T	P	C
		0	0	4	2

OBJECTIVES:

- To design oscillators and amplifiers using op-amps.
- To design filters different types of filters using OPAMP and analyze its frequency response.
- To analyze the working of PLL and use PLL as frequency multiplier.
- To design DC power supply using Monolithic ICs.
- To test the performance of filters using PSPICE Programs.
- To Utilize PSPICE Software for circuit design using schematic entry for analog Multiplier, ADC and 555 IC Timer circuits.

LIST OF EXPERIMENTS

Design and Testing of the Following Circuits

1. Inverting, Non inverting and differential amplifiers.
2. Integrator and Differentiator.
3. Instrumentation amplifier
4. Active low-pass, High-pass and band-pass filters.
5. Astable and Monostable multivibrators using Op-amp
6. Schmitt Trigger using op-amp.
7. Phase shift and Wien bridge oscillators using Op-amp.
8. Astable and Monostable multivibrators using NE555 Timer.
9. PLL characteristics and its use as Frequency Multiplier, Clock synchronization
10. R-2R Ladder Type D- A Converter using Op-amp.
11. DC power supply using LM317 and LM723.
12. Study of SMPS

Simulation using Pspice

1. Active low-pass, High-pass and band-pass filters using Op-amp
2. Astable and Monostable multivibrators using NE555 Timer.
3. A/ D converter
4. Analog multiplier

TOTAL: 60 PERIODS

OUTCOMES:

On successful completion of the course student will be able to:

1. Design Oscillators and Amplifiers using operational amplifiers.
2. Design filters using OPAMP and perform experiment on frequency response.
3. Analyze the working of PLL and use PLL as frequency multiplier.
4. Design DC power supply using ICs.
5. Analyze the performance of filters using PSPICE. Utilize PSPICE Software for circuit design.

REFERENCES:

1. Michael Jacob, " Applications and Design with Analog Integrated Circuits ", Prentice Hall of India, 1996 .
2. D.Roy Choudhry, ShailJain,"Linear Integrated Circuits", New Age International Pvt. Ltd., 2000. Circuits", 3rd Edition, Tata McGraw-Hill, 2007.
3. S.Salivahanan & V.S. Kanchana Bhaskaran, "Linear Integrated Circuits", TMH, 2008.

21EC1413	FUNDAMENTALS OF DATA STRUCTURES IN C LABORATORY	L	T	P	C
		0	0	4	2

OBJECTIVES:

- To develop programs in C using basic constructs.
- To develop applications in C using arrays.
- To develop applications in C using strings, pointers, functions and structures
- To understand and implement basic data structures using C
- To apply linear and non-linear data structures in problem solving and searching and sorting algorithms

LIST OF EXPERIMENTS

1. Basic C Programs –control statement, looping, data manipulations.
2. Programs using Arrays – one and two dimensional.
3. Programs using strings – string function implementation
4. Programs using function – Call by value, call by reference.
5. Programs using pointer, Structure and Union.
6. Programs involving dynamic memory allocations
7. Array implementation of stacks and queues
8. Linked list implementation of stacks and queues
9. Application of Stacks and Queues
10. Implementation of Trees, Tree Traversals
11. Implementation of Binary Search trees
12. Implementation of Linear search and binary search
13. Implementation Insertion sort, Bubble sort, Quick sort and Merge Sort

TOTAL: 60 PERIODS

OUTCOMES:

On successful completion of the course student will be able to:

1. Write basic and advanced programs in C
2. Implement functions and recursive functions in C
3. Understand practical knowledge on the applications of data structures
4. Choose appropriate sorting algorithm for an application and implement it in a modularized way
5. Design and analyze the time and space efficiency of the data structure
6. Identity the appropriate data structure for given problem.

21MC1001	ENVIRONMENTAL SCIENCE	L	T	P	C
		2	0	0	0

OBJECTIVES:

- To introduce the basic concepts of environment, ecosystems and biodiversity and emphasize on the biodiversity of India and its conservation.
- To impart knowledge on the causes, effects and control or prevention measures of environmental pollution and natural disasters.
- To facilitate the understanding of global and Indian scenario of renewable and non- renewable resources, causes of their degradation and measures to preserve them.
- To familiarize the influence of societal use of resources on the environment and introduce the legal provisions, National and International laws and conventions for environmental protection.
- To inculcate the effect of population dynamics on human and environmental health and inform about human right, value education and role of technology in monitoring human and environmental issues.
- To introduce the basic concepts of environment, ecosystems and biodiversity and emphasize on the biodiversity of India and its conservation.

UNIT - I ENVIRONMENT, ECOSYSTEMS AND BIODIVERSITY 6

Definition, scope and importance of environment – need for public awareness - concept of an ecosystem – structure and function of an ecosystem – producers, consumers and decomposers energy flow in the ecosystem – ecological succession – food chains, food webs and ecological pyramids Introduction to biodiversity definition: genetic, species and ecosystem diversity – bio geographical classification of India – value of biodiversity: consumptive use, productive use, social, ethical, aesthetic and option values – Biodiversity at global, national and local levels – India as a mega-diversity nation – hot-spots of biodiversity – threats to biodiversity: habitat loss, poaching of wildlife, man-wildlife conflicts – endangered and endemic species of India – conservation of biodiversity: In-situ and ex-situ conservation of biodiversity.

UNIT - II ENVIRONMENTAL POLLUTION 6

Definition – causes, effects and control measures of: (a) Air pollution (b) Water pollution (c) Soil pollution (d) Marine pollution (e) Noise pollution (f) Thermal pollution (g) Nuclear hazards – solid waste management: causes, effects and control measures of municipal solid wastes, biomedical wastes and e-wastes – role of an individual in prevention of pollution – pollution case studies

UNIT - III NATURAL RESOURCES 6

Forest resources: Use and over-exploitation, deforestation, case studies- timber extraction, mining, dams and their effects on forests and tribal people – Water resources: Use and over- utilization of surface and ground water, floods, drought, conflicts over water, dams-benefits and problems – Mineral resources: Use and exploitation, environmental effects of extracting and using mineral resources, case studies – Food resources: World food problems, changes caused by agriculture and overgrazing, effects of modern agriculture, fertilizer-pesticide problems, water logging, salinity, case studies – Landresources.

UNIT - IV SOCIAL ISSUES AND THE ENVIRONMENT 6

From unsustainable to sustainable development – urban problems related to energy – water conservation, rain water harvesting, watershed management – resettlement and rehabilitation of people; its problems and concerns, case studies – role of non-governmental organization- environmental ethics: Issues and possible solutions – climate change, global warming, acid rain, ozone layer depletion. environment protection act – Air (Prevention and Control of Pollution) act – Water (Prevention and control of Pollution) act – Wildlife protection act – Forest conservation act – enforcement machinery involved in environmental legislation- central and state pollution control boards- Public awareness.

UNIT - V HUMAN POPULATION AND THE ENVIRONMENT 6

Population growth, variation among nations – population explosion – family welfare programme – environment and human health – human rights – value education – HIV / AIDS – women and child welfare – role of information technology in environment and human health – Case studies.

TOTAL: 30 PERIODS

OUTCOMES:

On successful completion of the course student will be able to:

1. Recognize and understand the functions of environment, ecosystems and biodiversity and their conservation.
2. Identify the causes, effects and environmental pollution and natural disasters and contribute to the preventive measures in the immediate society.
3. Identify and apply the understanding of renewable and non-renewable resources and contribute to the sustainable measures to preserve them for future generations.
4. Recognize different forms of energy and apply them for suitable applications in for technological advancement and societal development.
5. Demonstrate the knowledge of societal activities on the long and short term environmental issues and abide by the legal provisions, National and International laws and conventions in professional and personal activities and to identify and analyses effect of population dynamics on human value education, consumerism and role of technology in environmental issues.

TEXT BOOKS:

1. Anubha Kaushik and C. P. Kaushik's "Perspectives in Environmental Studies", 6th Edition, New Age International Publishers (2018).
2. Benny Joseph, 'Environmental Science and Engineering', Tata McGraw-Hill, New Delhi, (2016).
3. Gilbert M.Masters, 'Introduction to Environmental Engineering and Science', 2nd edition, Pearson Education (2004).

REFERENCES:

1. R.K. Trivedi, 'Handbook of Environmental Laws, Rules, Guidelines, Compliances and Standards', Vol. I and II, Enviro Media.
2. Cunningham, W.P. Cooper, T.H. Gorhani, 'Environmental Encyclopedia', Jaico Publ., House, Mumbai, 2001.
3. Dharmendra S. Sengar, 'Environmental law', Prentice hall of India PVT. LTD, New Delhi, 2007.

4. Rajagopalan, R, ‘Environmental Studies-From Crisis to Cure’, Oxford University Press (2005).
5. Erach Bharucha “Textbook of Environmental Studies for Undergraduate Courses” Orient Blackswan Pvt. Ltd. (2013).

V SEMESTER

21EC1501	ANALOG AND DIGITAL COMMUNICATION	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To familiarize with various Amplitude Modulation Schemes
- To understand Angle Modulation Techniques
- To analyze Noise in Continuous Wave Modulation Techniques
- To acquaint the fundamentals of Source coding Techniques
- To impart knowledge in various waveform coding
- To introduce the various band pass signaling schemes

UNIT - I AMPLITUDE MODULATION 9

Introduction to Communication systems- Amplitude Modulation- - Modulation index, Spectra, Power relations and Bandwidth – AM Generation – Square law and Switching modulator, AM Detection-Envelope Detector. DSBSC Generation – Balanced and Ring Modulator, DSBSC Detection-Coherent Detection and COSTAS loop detector. SSB Generation – Filter, Phase Shift and Third Methods, SSB Detection-Coherent detector. VSB Generation – Filter Method, Super heterodyne Receiver, Noise performance analysis in AM.

UNIT - II ANGLE 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. Noise performance analysis in FM.

UNIT - III INFORMATION THEORY 9

Discrete Memoryless source, Information, Entropy, Source coding theorem - Shannon – Fano & Huffman codes. Mutual Information.

UNIT - IV WAVEFORM CODING 9

Low pass sampling – Aliasing- Signal Reconstruction-Quantization - Uniform & non-uniform quantization - quantization noise - Logarithmic Companding, PCM, DPCM, ADPCM - Delta Modulation and ADM principles-Linear Predictive Coding.

UNIT - V DIGITAL MODULATION SCHEME 9

Geometric Representation of signals – Functional Block Diagram of Digital Communication system. Generation, detection and BER of Coherent BPSK, QPSK, DPSK, QAM and BFSK - Carrier Synchronization - Structure of Non-coherent Receivers

TOTAL: 45 PERIODS

OUTCOMES:

On successful completion of the course student will be able to:

1. Compare and contrast various amplitude modulation techniques
2. Analyze Noise in Continuous Wave Modulation Techniques
3. Understand the concepts Angle Modulation schemes
4. Apply the concepts of Source Coding to improve coding efficiency
5. Gain knowledge in sampling and quantization, Waveform Encoding schemes
6. Discuss the importance of Digital modulation techniques

TEXT BOOKS:

1. Simon Haykins," Communication Systems", Wiley, 5th Edition, 2009.
2. Simon Haykins "Digital Communication", Wiley, 2009.
3. B.P.Lathi, "Modern Digital and Analog Communication Systems", 4th Edition, Oxford University Press, 2011.

REFERENCES:

1. Wayner Tomasi, Electronic Communication System, 5th Edition, Pearson Education,2008.
2. D.Roody, J.Coolen, Electronic Communications, 4th edition PHI 2006.
3. B.Sklar, "Digital Communications Fundamentals and Applications", 2nd Edition Pearson Education 2007.
4. H P Hsu, Schaum Outline Series - "Analog and Digital communications" TMH 2006.
5. Couch.L., "Modern Communication Systems", Pearson, 2001.

21EC1502	DIGITAL SIGNAL PROCESSING	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To learn Discrete Fourier Transform (DFT), properties of DFT and its application to linear filtering.
- To understand the characteristics of digital filters, design digital IIR filters and apply these filters to filter undesirable signals in various frequency bands
- To understand the characteristics of digital filters, design digital 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 understand the fundamental concepts DSP processor and multi rate signal processing.
- To introduce the concepts of adaptive filters and its application to communication engineering.

UNIT - I DISCRETE FOURIER TRANSFORM 9

Analysis & synthesis equations for Discrete Fourier transform (DFT) - Properties of DFT - periodicity, symmetry, circular convolution, 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 9

Characteristics of practical frequency selective filters, characteristics of commonly used analog filters - Butterworth filters, Chebyshev filters, Design of IIR filters from analog filters (LPF, HPF, BPF, BRF) - Impulse invariance method, Bilinear transformation, Frequency transformation in the analog domain, Structure of IIR filter - direct form I, direct form II, Cascade, parallel realizations.

UNIT - III FINITE IMPULSE RESPONSE FILTERS 9

Introduction of FIR filters - Design of linear phase FIR filters using windows - Rectangular, Hamming and Hanning window, Frequency sampling method. FIR filter structures - linear phase structure, direct form realizations.

UNIT - IV FINITE WORD LENGTH EFFECTS 9

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 DSP ARCHITECTURE AND APPLICATIONS 9

DSP Fixed-Point Architecture- Blocks of DSP Processor-Addressing modes, Multirate signal processing - Decimation, Interpolation, Sampling rate conversion by a rational factor, Adaptive Filters – Introduction - Applications of adaptive filter - Equalization.

TOTAL: 45 PERIODS

OUTCOMES:

On successful completion of the course student will be able to:

1. Apply DFT for the analysis of digital signals and systems
2. Design IIR filters
3. Design FIR Filters.
4. Characterize the effects of finite precision representation on digital filter.
5. Design multirate filters with fixed point DSP Processor.
6. Apply adaptive filters appropriately in communication systems

TEXT BOOKS:

1. John G. Proakis, Dimitris G. Manolaxis,"Discrete-Time Signal Processing", 4th Edition, Pearson, 2007.
2. Emmanuel C. Ifeachor& Barrie. W. Jervis, "Digital Signal Processing", Second Edition, Pearson Education / Prentice Hall, 2002.
3. A. V. Oppenheim, R.W. Schafer and J.R. Buck, "Discrete-Time Signal Processing", 8th Indian Reprint, Pearson, 2004.

REFERENCES:

1. P. Ramesh Babu, "Digital Signal Processing", Scitech Publications in 2011.
2. B.P.Lathi, "Principles of Linear Systems and Signals", Second Edition,Oxford,2009.
3. Sanjit K. Mitra, "Digital Signal Processing – A Computer Based Approach", Tata Mc Graw Hill, 2007.
4. Andreas Antoniou,"Digital Signal Processing", Tata Mc Graw Hill, 2006.

21EC1503	MICROCONTROLLERS AND COMPUTER ARCHITECTURE	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To study the Architecture of 8051 microcontroller.
- To design a 8051 microcontroller based system.
- To understand about PIC microcontroller architecture
- To design a PIC microcontroller based system.
- To understand the concept of various memories and interfacing.
- To study the parallel processing technique of advanced processor.

UNIT - I　　8051 MICROCONTROLLER　　9

Architecture of 8051 – Special Function Registers(SFRs) - I/O Pins Ports and Circuits -Instruction set - Addressing modes - Assembly language programming.

UNIT - II　　INTERFACING WITH 8051 MICROCONTROLLER　　9

Programming 8051 Timers - Serial Port Programming - Interrupts Programming – LCD & Keyboard Interfacing - ADC, DAC & Sensor Interfacing - External Memory Interface- Stepper Motor and Waveform generation.

UNIT - III　　PIC MICROCONTROLLER　　9

Introduction to PIC 16C6X microcontrollers, architecture and memory organization, registers, I/O ports, interrupts, timer, instruction sets, Basic programming in PIC Microcontroller, Sensor interfacing, motor control.

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.

TOTAL: 45 PERIODS

OUTCOMES:

On successful completion of the course student will be able to:

1. Design and implement 8051 microcontroller based systems.
2. Interface various devices with 8051
3. Design and implement PIC microcontroller based systems.
4. Interface various devices with PIC microcontroller.
5. Explain the concept of various memories, interfacing and organization of multiprocessors.
6. Gain knowledge in parallel processing technique and unconventional architectures

TEXT BOOKS:

1. Mohamed Ali Mazidi, Janice Gillispie Mazidi, Rolin McKinlay, “The 8051 Microcontroller and Embedded Systems: Using Assembly and C”, Second Edition, Pearson education, 2011.
2. Muhammod Ali Mazidi, Rolin D. Mckinlay & Danny Sansey, “PIC Microcontroller and Embeded System SPI, UART using Assembly & C for PICI8,” Pearson International Edition, 2008.

REFERENCES:

1. Doughlas V.Hall,”Microprocessors and Interfacing, Programming and Hardware”,TMH,2012
2. Miles J. Murdocca and Vincent P. Heuring, “Computer Architecture and Organization: An Integrated approach”, Second edition, Wiley India Pvt Ltd, 2015
3. A.K.Ray,K.M.Bhurchandi, "Advanced Microprocessors and Peripherals" 3rd edition, Tata McGrawHill, 2012.
4. John .B.Peatman , “Design with PIC Microcontroller”, Prentice Hall, 1997.
5. David A. Patterson and John L. Hennessey, “Computer Organization and Design”, Fifth edition, Morgan Kauffman / Elsevier, 2014.

21EC1504	TRANSMISSION LINES AND WAVEGUIDES	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To give an insight on filters.
- To introduce the characteristics of transmission lines at low and high frequencies.
- To give thorough understanding about impedance transformation and matching.
- To use Smith chart in problem solving.
- To impart knowledge on waveguide theories.

UNIT - I FILTERS 9

Characteristic impedance of symmetrical networks, Constant K filters: Low Pass, High Pass, Band Pass, and Band Elimination, m-derived filters: Low pass and High pass, Composite filter.

UNIT - II TRANSMISSION LINE THEORY 9

General theory of Transmission lines, General solution, The infinite line, Wavelength, Velocity of propagation, Waveform distortion, Distortion-less line, Line not terminated in Z0, Reflection coefficient, Calculation of current, voltage, power delivered and efficiency of transmission, Input impedance, Open and short circuited lines.

UNIT - III HIGH FREQUENCY TRANSMISSION LINES 9

Transmission line equations at radio frequencies, Voltage and current on the dissipation-less line, Standing Waves, Standing Wave Ratio, Input impedance, Impedance matching - Quarter wave transformer, Single stub matching, Solutions of problems using Smith chart.

UNIT - IV GUIDED WAVES BETWEEN PARALLEL PLATES 9

Transmission of TM, TE and TEM waves between Parallel plates, Characteristics of TE, TM and TEM waves - Cut-off frequency, Phase velocity, Group velocity, Phase constant, Wavelength and Impedance.

UNIT - V RECTANGULAR AND CIRCULAR WAVEGUIDES 9

Rectangular waveguide and circular waveguide: Transmission of TM and TE waves, Characteristics of TE and TM waves - Cut-off frequency, Phase velocity, Group velocity, Phase constant, Wavelength and Impedance, Impossibility of TEM waves in waveguide, Excitation of modes.

TOTAL: 45 PERIODS

OUTCOMES:

On successful completion of the course student will be able to:

1. Understand the theory and design of filters.
2. Explain the theory of transmission lines and calculate its parameters.
3. Analyze signal propagation in transmission line at high frequency.
4. Design impedance matching devices for high frequency lines.
5. Solve transmission line related problems using Smith chart.
6. Explain the structure and operation of waveguides.

TEXT BOOKS:

1. John D Ryder, “Networks, lines and fields”, Second Edition, Prentice Hall India, 2009.
2. E.C.Jordan and K.G. Balmain, "Electromagnetic Waves and Radiating Systems", Prentice Hall of India, 2006.

REFERENCES:

1. G.S.N Raju "Electromagnetic Field Theory and Transmission Lines”, Pearson Education, First edition 2005
2. Magnusson, P., Weisshaar, A., Tripathi, V., Alexander, G., “Transmission Lines and Wave Propagation”, 4th edition, CRC Press. 2017.
3. Joseph Edminister, Schaum’s Series, Electromagnetics, TMH, 2007.

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21EC1511	MICROCONTROLLERS AND INTERFACING LABORATORY	L	T	P	C
		0	0	4	2

OBJECTIVES:

- To understand architecture and advanced features of microcontrollers.
- To understand PIC/ARM processor registers, instruction pipeline, interrupts and architecture.
- To learn about instructions, addressing modes, conditional instructions
- To learn programming of advanced microcontrollers.
- To write a assembly language program for microcontroller.
- To write a program for interfacing of external devices with microcontroller.

LIST OF EXPERIMENTS

Assembly language programming experiments using 8051 and PIC:

1. Addition/Subtraction/multiplication/division of 8/16 bit data.
2. Data transfer/exchange between specified memory locations.
3. Largest/smallest from a series.
4. Sorting (Ascending/Descending) of data.
5. Square/cube/square root of 8-bit data
6. Code conversion-(Hex to Decimal / ASCII to Decimal and vice versa.

Interfacing experiments using 8051

1. Display (LED/Seven segment/LCD) and keyboard interface
2. ADC interface.
3. DAC interface with wave form generation.
4. Stepper motor interface
5. DC motor interface
6. Traffic Light Controller.
7. Mini Projects using anyone microcontroller.

TOTAL: 60 PERIODS

OUTCOMES:

On successful completion of the course student will be able to:

1. Interpret assembly language Program for 8051 microcontrollers
2. Interpret assembly language Program for PIC microcontrollers
3. Interface various peripheral devices with 8051 microcontroller
4. Function effectively as an individual and in a team to accomplish the given task.
5. Gain knowledge to identify microcontroller and design a system for given application.
6. Provide Solutions to Real time Application

21EC1512 DIGITAL SIGNAL PROCESSING LABORATORY

L	T	P	C
0	0	4	2

OBJECTIVES:

- To implement generation of sequences.
- To realize Linear Convolution, Circular Convolution and Correlation.
- To analyze Frequency spectrum analysis (DFT).
- To design and realize IIR filters.
- To design and realize FIR filters.
- To implement signal processing algorithms using digital signal processor.

LIST OF EXPERIMENTS

MATLAB / EQUIVALENT SOFTWARE PACKAGE

1. Generation of elementary Discrete-Time sequences
2. Linear and Circular convolution
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

TOTAL: 60 PERIODS

OUTCOMES:

On successful completion of the course student will be able to:

1. Generation of basic signal sequences.
2. Design and implement the basic signal processing operations like convolution and correlation helps to resolve real time applications.
3. Frequency domain analysis using DFT.
4. Design of IIR Filters for performing filtering operations over real-time signals.
5. Design of FIR Filters for performing filtering operations over real-time signals.
6. Implementation of signal processing algorithms using digital signal processor.

TEXT BOOKS:

1. John G. Proakis, Dimitris G. Manolaxis, —Discrete-Time Signal Processing‖, 4th Edition, Pearson, 2007.

REFERENCES:

1. P. Ramesh Babu, —Digital Signal Processing‖, Scitech Publications in 2011.
2. Sanjit K. Mitra, —Digital Signal Processing – A Computer Based Approach, Tata Mc Graw Hill, 2007.

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21EC1513	ANALOG AND DIGITAL COMMUNICATION LABORATORY	L	T	P	C
		0	0	4	2

OBJECTIVES:

- To study the AM & FM Modulation and Demodulation.
- To learn and realize the effects of sampling and TDM.
- To understand the PCM and DM modulation and Demodulation
- To understand the Digital modulation and Demodulation
- To Simulate Waveform Coding Techniques & Digital Modulation Schemes.
- To Implement Error Control Coding Schemes.

LIST OF EXPERIMENTS

1. AM- Modulator and Demodulator
2. FM - Modulator and Demodulator
3. Signal sampling.
4. TDM.
5. Line Coding Techniques
6. Pulse Code Modulation and Demodulation.
7. Digital Modulation – ASK, PSK, FSK.
8. Delta Modulation and Demodulation.
9. Simulation of DM, Slope Overload Distortion & Granular Noise
10. Simulation of ADM
11. Simulation of ASK FSK, and BPSK Generation and Detection Schemes.
12. Simulation of DPSK, QPSK and QAM Generation and Detection Schemes.
13. Simulation of Linear Block and Convolutional Schemes.

TOTAL: 60 PERIODS

OUTCOMES:

On successful completion of the course student will be able to:

1. Design AM, FM & Digital Modulators for specific applications.
2. Compute the sampling frequency for digital modulation.
3. Demonstrate their knowledge in waveform coding signaling schemes
4. Demonstrate their knowledge in Digital Modulation schemes
5. Simulate & validate the various Digital Modulation Schemes.
6. Apply various channel coding schemes & demonstrate their capabilities towards the improvement of the noise performance of Communication system.

VI SEMESTER

21EC1601	WIRELESS COMMUNICATION	L	T	P	C
		3	0	0	3

OBJECTIVES: To impart Knowledge on the following topics:

- To understand the importance of Channel coding.
- To understand the design of a cellular system.
- To study the various digital signaling techniques.
- To study the multipath mitigation techniques.
- To understand the concepts of multiple antenna techniques.

UNIT - I WIRELESS CHANNEL CODING TECHNIQUES 9

Channel coding theorem - Linear Block codes –Cyclic Codes- Convolutional codes - Viterbi Decoder.

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, π/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

ISI, Equalization – Adaptive equalization, Linear and Non-Linear equalization, Zero forcing and LMS Algorithms. Diversity – Micro and Macro diversity, Diversity combining techniques, 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.

TOTAL: 45 PERIODS

OUTCOMES:

On successful completion of the course student will be able to:

1. Analyze problems &arrive at feasible solutions for error control using Channel Coding Methods
2. Design a cellular system based on resource availability and traffic demands
3. Identify suitable signaling techniques for the wireless channel and system under consideration.
4. Identify suitable multipath mitigation techniques for the wireless channel and system under consideration.
5. Understand The concepts of multiple antenna techniques

TEXT BOOKS:

1. Rappaport,T.S., “Wireless communications”, Pearson Education, Second Edition, 2010
2. Andreas.F. Molisch, “Wireless Communications”, John Wiley – India, 2006

REFERENCES:

1. Andrea Goldsmith ,“Wireless Communication”, Cambridge University Press, 2011
2. Van Nee, R. and Ramji Prasad,“OFDM for wireless multimedia communications”, Artech House, 2000
3. David Tse and PramodViswanath,,”Fundamentals of Wireless Communication”, Cambridge University Press, 2005.
4. Upena Dalal, “Wireless Communication”, Oxford University Press, 2009.

21EC1602	ANTENNA THEORY AND DESIGN	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To give insight of antenna radiation and its parameters.
- To give a thorough understanding of the radiation characteristics of different types of antennas and antenna arrays.
- To instill knowledge on antenna measurements

UNIT - I INTRODUCTION TO ANTENNAS 9

Physical concept of radiation, Near and far-field regions, Antenna Gain, Directivity and Efficiency, Radiation resistance, Radiation pattern, Beam width, Bandwidth, Aperture Efficiency and Effective Area, Polarization, Antenna Noise Temperature, Friis transmission equation, Link budget and link margin.

UNIT - II RADIATION MECHANISMS AND DESIGN ASPECTS 9

Radiation Mechanisms of Linear Wire and Loop antennas, Design considerations and applications - Yagi antenna, Slot antenna, Horn antenna, Parabolic reflector antennas, Microstrip antennas.

UNIT - III ANTENNA ARRAYS 9

Two-element array, n-element linear array – Broadside and End fire array, Array factor, Pattern multiplication, Uniformly spaced arrays with non-uniform excitation – Binomial and Dolph Chebyshev array.

UNIT - IV SPECIAL ANTENNAS 9

Rhombic antenna, Frequency independent antennas - Helical antenna, Spiral antenna, Log Periodic Dipole Array (LPDA), PIFA, Smart antenna, Reconfigurable antenna, Active antenna, Dielectric antennas.

UNIT - V ANTENNA MEASUREMENTS 9

Antenna Measurement range - Elevated Range, Reflection Range, Near Field Range, Far Field Range, Compact Range, Slant range, Indoor range, Measurement of Gain, Directivity, Polarization and Radiation pattern.

TOTAL: 45 PERIODS

OUTCOMES:

On successful completion of the course student will be able to:

1. Understand the physical concept of radiation and antenna parameters.
2. Explain the radiation mechanism of dipole, loop, aperture, microstrip and reflector antennas.
3. Understand the mathematical design and applications of linear wire and aperture antennas.
4. Apply the basic principles to analyze antenna arrays.
5. Explain the structure, operation and applications of various special antennas.
6. Understand the various methods of antenna measurements.

TEXT BOOKS:

1. John D Krauss, Ronald J Marhefka and Ahmad S. Khan, "Antennas and Wave Propagation": Fourth Edition, Tata McGraw-Hill, 2006.
2. Constantine A.Balanis – "Antenna Theory Analysis and Design", Third edition, John Wiley India Pvt Ltd., 2005.

REFERENCES:

1. Rajeswari Chatterjee, "Antenna Theory and Practice" Revised Second Edition New Age International Publishers, 2006.
2. A.R.Harish, M.Sachidanada, "Antennas and Wave propagation, Oxford University Press, 2007.
3. S. Drabowitch, "Modern Antennas" Second Edition, Springer Publications, 2007.
4. Robert S.Elliott "Antenna Theory and Design" Wiley Student Edition, 2006.

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21EC1603	VLSI AND CHIP DESIGN	L	T	P	C
		3	0	0	3

OBJECTIVES:

- Study the fundamentals of CMOS circuits and its characteristics.
- Gain the knowledge about IC fabrication process.
- Learn the design and realization of combinational circuits.
- Learn the design and realization of sequential digital circuits.
- To familiarize with the Data Path Architectural choices and memory subsystems.
- Learn the different FPGA architectures and testability of VLSI circuits.

UNIT - I INTRODUCTION TO CHIP DESIGN 9

MOS Transistor, Long-Channel I-V Characteristics, C-V Characteristics, Non ideal I-V Effects, Linear Delay model, Logical effort, Scaling, Stick Diagrams, Layout design rules.

Fabrication process of pMOS, nMOS, CMOS and BiCMOS technologies, Comparison of different technologies.

UNIT - II COMBINATIONAL CIRCUIT DESIGN 9

Circuit Families - Static CMOS, Pass Transistor, Transmission Gates, Ratioed Circuits, Dynamic Circuits, Domino, Cascode Voltage Switch Logic, Adiabatic Logic.

Power Consumption in CMOS - Dynamic Power, Static Power, Various power optimization techniques-MTCMOS, Power Gating.

UNIT - III SEQUENTIAL CIRCUIT DESIGN 9

Static latches and Registers-MUX based, Transmission Gate based, Pass Transistor based (SR, Master Slave, D latch), Dynamic latches and Registers - C2MOS, TSPC, TSPCR, Pulse Registers, Sense Amplifier Based Register, Pipelining, Monostable and Astable Sequential Circuits.

Timing Issues - Synchronous Design, Clock Distribution Techniques.

UNIT - IV DESIGN OF ARITHMETIC BUILDING BLOCKS AND SUBSYSTEM 9

Arithmetic Building Blocks - Data Paths, Adders- Static CMOS Full Adder, Ripple Carry Adder, Carry Bypass Adder, Carry Look Ahead Adder, Koggestone Adder, Carry Save Adder, Multipliers-Array Multiplier, Wallace tree Multiplier, Booth Multiplier, Dadda Multiplier, Barrel Shift Register, ALU. Semiconductor Memories - SRAM and DRAM.

UNIT - V FPGA ARCHITECTURES AND TESTING 9

Types of ASIC - Full Custom and Semi-Custom, FPGA Architectures: SRAM and Flash type, Study of FPGA Development Boards-ZYNQ 7000 series and PYNQ boards

Design for Testability - BIST, IDDQ Testing, Boundary Scan.

TOTAL: 45 PERIODS

OUTCOMES:

On successful completion of the course student will be able to:

1. Realize the fundamental concepts of MOS transistor.
2. Understand the concept of IC fabrication process
3. Design combinational MOS circuits and power strategies.
4. Design and construct Sequential Circuits and Timing systems.
5. Design arithmetic building blocks and memory subsystems.
6. Apply and implement FPGA design flow and testing.

TEXT BOOKS:

1. Neil H.E. Weste, David Money Harris, “CMOS VLSI Design: A Circuits and Systems Perspective”, 4th Edition, Pearson, 2017.
2. Jan M. Rabaey, Anantha Chandrakasan, Borivoje. Nikolic, “Digital Integrated Circuits: A Design perspective”, Second Edition, Pearson, 2016.

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, Moder,”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.

21EC1604	DATA COMMUNICATION NETWORKS	L T P C 3 0 0 3

OBJECTIVES

- To familiarize with the architectures and the protocol stack in use.
- To impart knowledge in various switching techniques in Physical layer.
- To understand the division of network functionalities in data link layer.
- To have an in depth knowledge in addressing and Routing Protocols.
- To be exposed to the required functionality of flow control and congestion control in transport layer.
- To understand application layer protocols and security issues.

UNIT - I FUNDAMENTALS AND PHYSICAL LAYER 9

Overview of Data Communications- Networks - Types - Network models - Protocol Layering - TCP/IP protocol suite - OSI Model- Physical Layer- Transmission impairment - Performance-Switching- Circuit-Switched Networks- Packet Switching.

UNIT - II DATALINK LAYER 9

Introduction to Data Link Layer - Link layer Addressing- Error Detection and Correction (Cyclic Codes, Checksum) -Overview of Data link Control - DLC services-Data-Link Layer Protocols - HDLC-Media Access Control (MAC)- Random Access-Controlled Access- Channelization - Standard Ethernet (IEEE 802.3) - Wireless LANs (IEEE 802.11).

UNIT - III NETWORK LAYER 9

Network-Layer Performance- Ipv4 Addresses -Internet Protocol (IPV4)- ICMPv4-Unicast Routing- Routing Algorithms- Unicast Routing Protocols-Multicast Routing-Introduction- Multicasting Basics- Intradomain Multicast Protocols- Interdomain Multicast Protocols-Next Generation IP- IPv6 Addressing- IPv6 Protocol- Transition From IPv4 TO IPv6.

UNIT - IV TRANSPORT LAYER 9

Introduction to Transport Layer -Transport-Layer Protocols- Services - Port Numbers -User Datagram Protocol- Transmission Control Protocol-Data-Flow Characteristics-Flow Control To Improve QoS.

UNIT - V APPLICATION LAYER 9

Standard Client-Server Protocols- World Wide Web (WWW) - HyperText Transfer Protocol (HTTP) - File Transfer Protocol (FTP) - Electronic Mail - Domain Name System (DNS) - Firewalls.

TOTAL: 45 PERIODS

OUTCOMES:

On successful completion of the course student will be able to:

1. Illustrate the significance and role of Networks in the present contemporary world.
2. Identify the various switching techniques in Physical layer.
3. Employ the knowledge to identify appropriate physical and MAC layer protocols.
4. Apply the knowledge to identify the suitable routing algorithm based on the network and User requirement.
5. Examine the functionality of various flow control and congestion control mechanism in transport layer.
6. Develop application layer protocols to enable users to access files efficiently.

TEXT BOOKS:

1. Behrouz A. Forouzan, "Data communication and Networking", Fifth Edition, Tata McGraw –Hill, 2013.

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.
4. Larry L. Peterson, Bruce S. Davie, "Computer Networks: A Systems Approach", Fifth Edition, Morgan Kaufmann Publishers, 2011.

21EC1611	VLSI DESIGN LABORATORY	L	T	P	C
		0	0	4	2

OBJECTIVES:

- To learn Hardware Descriptive Language (Verilog/VHDL).
- To learn the fundamental principles of VLSI circuit design in analog domain.
- To learn the fundamental principles of VLSI circuit design in digital domain.
- To familiarize fusing of logical modules on FPGAs.
- To gain the knowledge to synthesize, Place and Route the digital IPs.
- To provide hands on design experience with professional design (EDA) platforms.

LIST OF EXPERIMENTS

Digital System Design using HDL & FPGA

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 an ALU using HDL. Simulate it using Xilinx/Altera Software and implement by Xilinx/Altera FPGA
4. Design a Universal Shift Register using HDL. Simulate it using Xilinx/Altera Software and implement by Xilinx/Altera FPGA
5. Design Finite State Machine (Moore/Mealy) using HDL. Simulate it using Xilinx/Altera Software and implement by Xilinx/Altera FPGA
6. Design Memories using HDL. Simulate it using Xilinx/Altera Software and implement by Xilinx/Altera FPGA.

Compare pre synthesis and post synthesis simulation for experiments 1 to 6.
Requirements: Xilinx ISE/Altera Quartus/ equivalent EDA Tools along with Xilinx/Altera/equivalent FPGA Boards

Digital Circuit Design

7. Design and simulate a CMOS inverter using digital flow
8. Design and simulate a CMOS Basic Gates & Flip-Flops
9. Design and simulate a 4-bit synchronous counter using a Flip-Flops Manual/Automatic Layout

Generation and Post Layout Extraction for experiments 7 to 9
Analyze the power, area and timing for experiments 7 to 9 by performing Pre-Layout and Post Layout Simulations.

Analog Circuit Design

1. Design and Simulate a CMOS Inverting Amplifier.
2. Design and Simulate basic Common Source, Common Gate and Common Drain Amplifiers. Analyze the input impedance, output impedance, gain and bandwidth for experiments 10 and 11 by performing Schematic Simulations.
3. Design and simulate simple 5 transistor differential amplifier. Analyze Gain, Bandwidth and CMRR by performing Schematic Simulations.

MINIPROJECT

TOTAL: 60 PERIODS

OUTCOMES:

On successful completion of the course student will be able to:

1. Write HDL code for basic as well as advanced digital integrated circuits.
2. Analyze and Import the logic modules into FPGA Boards.
3. Synthesize Place and Route the digital IPs.
4. Design, Simulate and Extract the layouts of Analog IC Blocks using EDA tools.
5. Design, Simulate and Extract the layouts of Digital IC Blocks using EDA tools.
6. Apply the knowledge of VLSI design to real time applications.

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PROSPERITY ENDURANCE CHARACTER

21EC1612	WIRELESS COMMUNICATION AND NETWORKS LABORATORY	L	T	P	C
		0	0	4	2

OBJECTIVES:

- To understand and capture an experimental approach to digital wireless communication.
- To give insight on the characteristics of various antennas.
- To Implement Error Control Coding Schemes.
- To implement and analyze different network protocols.
- To learn and use network commands.
- To be familiar with the various routing algorithms.

LIST OF WIRELESS COMMUNICATION EXPERIMENTS

1. Wireless Channel Simulation including fading and Doppler effects.
2. Simulation of Channel Estimation, Synchronization & Equalization techniques.
3. Analyzing Impact of Pulse Shaping and Matched Filtering using Software Defined Radios.
4. OFDM Signal Transmission and Reception using Software Defined Radios.
5. Radiation pattern of dipoles, Loop and patch antenna.
6. Directivity of end fire array and pyramidal horn antenna.

LIST OF NETWORKS EXPERIMENTS

1. Implementation of Error Detection / Error Correction Techniques.
2. Implementation of Stop and Wait and Sliding window Protocols.
3. Implementation of High Level Data Link Control.
4. Implementation of IP Commands such as ping, Trace route, nslookup and IP address configuration.
5. To create scenarios and study the performance of networks with CSMA / CA protocol and compare with CSMA/CD protocols.
6. Network Topology – Mesh, Star, Bus, Ring, Hybrid.
7. Implementation of Distance vector and Link state routing algorithms.
8. Study of Network simulator (NS) and simulation of Congestion Control Algorithms using NS.
9. Implementation of Encryption and Decryption Algorithms using any programming language.

TOTAL: 60 PERIODS

OUTCOMES:

On successful completion of the course student will be able to:

1. Estimate the Wireless channel characteristics and analyze the performance of Wireless communication system.
2. Obtain the radiation pattern and directivity of various antennas.
3. Use simulation tools to analyze the performance of various network protocols.
4. Simulate the network with different configurations to measure the performance parameters.
5. Analyze various routing algorithms.
6. Illustrate the operations of network protocols and algorithms.

VII SEMESTER

21EC1701	EMBEDDED SYSTEMS AND ROBOTICS	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To understand the basics of Embedded and Robotics system.
- To study the Architecture of ARM Processor.
- To understand interfacing concepts of ARM.
- To select appropriate hardware and microcontrollers based on need of application.
- To illustrate about robotic vision.
- To apply robot based concepts in AI.

UNIT - I INTRODUCTION TO EMBEDDED AND ROBOTICS 9

Introduction Embedded systems, Definition, Examples and components of embedded Systems, Embedded System Design Process, Various Embedded core controllers. Robotics -Definition and origin of robotics – degrees of freedom – Robot classifications and specifications – Asimov's laws of robotics.

UNIT - II ARM PROCESSOR 9

ARM design philosophy, data flow model and core architecture, registers, program status register, instruction pipeline, interrupts and vector table, operating modes and ARM processor families.

UNIT - III INTERFACING WITH ARM 9

Addressing modes, Instruction Sets: Data processing instructions, branch, load, store instructions, PSR instructions, and conditional instructions. Interfacings- LED blinking, simple I/O Switch, ADC, DAC, Stepper Motor and Sensor Interfacing.

UNIT - IV ROBOTIC VISION 9

Industrial application of vision controlled robotic system-process of imaging-architecture of robotics vision system-image acquisition-description of other components of vision systems-image representation - image processing.

UNIT - V AI ROBOTICS 9

Intelligent systems- elements of artificial intelligence- system architecture-applications of advanced robot-fuzzy logic control-advanced concept and procedures-future development-impact on employment.

TOTAL: 45 PERIODS

OUTCOMES:

On successful completion of the course student will be able to:

1. Gain knowledge of theory and practice related to Embedded and Robotic System.
2. Provide depth knowledge about ARM architecture and its interfacing.
3. Identify, formulate and solve engineering problems by using Embedded Systems.
4. Understand the vision controlled robotic system.
5. Realize the description of components of vision system.
6. Understand the applications of robotics in AI.

TEXT BOOKS:

1. K.V.K.K.Prasad, "Embedded Real Time Systems: Concepts, Design and Programming" 1st Edition, Dreamtech Publication,2014.
2. Rajkamal, "Embedded System: Architecture, Programming and Design", TMH3.
3. R.K.Mittal and I.J.Nagrath, Robotics and Control, Tata McGraw Hill, New Delhi,4th Reprint, 2005.
4. James G. Keramas , Robot Technology Fundamendals India Edition.

REFERENCES:

1. Muhammad Ali Mazidi Shujen Chen, Sepehr Naimi Sarmad Naimi "Embedded Programming Using C Language", 1st Edition, Freescale ARM Cortex-M.
2. Jonathan W Valvano,Embedded Microprocessor System:Real Time Interfacing, 3rd Edition, Thomson Engineering,2012.
3. John M. Holland, "Designing Autonomous Mobile Robots-Inside the mind of an Intelligent Machine", Newnes Publication, 2004.
4. Groover, M.P., Weiss, M., Nagel, R.N., & Odrey, N.G. Industrial robotics - technology, programming, and applications.
5. Shibu K.V, "Introduction to Embedded Systems", McGraw Hill. 2014.

21EC1702	MICROWAVE DEVICES AND CIRCUITS	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To give insight of microwave passive and semiconductor devices.
- To give a thorough understanding of the working operation of Microwave tubes.
- To instill knowledge on microwave integrated circuits and measurement techniques of various microwave parameters.

UNIT - I TWO PORT NETWORK 9

Microwave frequency bands, Applications of Microwaves, Review of Low frequency parameters: Impedance, Admittance, Hybrid and ABCD parameters, High Frequency parameters, Formulation of S parameters, Properties of S parameters, Reciprocal and lossless Network, Transmission matrix.

UNIT - II MICROWAVE PASSIVE DEVICES 9

Theory and analysis: Microwave Junctions – E plane, H plane and Magic Tee, Waveguide Directional Coupler, T junction and Wilkinson Power Divider, Phase shifters, Attenuator, Circulator, Isolator, Matched termination.

UNIT - III MICROWAVE SEMICONDUCTOR DEVICES 9

Crystal and Schottky diode, PIN diode, Gunn diode, Tunnel diode, IMPATT diode, Varactor diode, Microwave Bipolar and Field Effect Transistor, High Electron Mobility Transistor.

UNIT - IV MICROWAVE TUBES 9

Theory and application of two cavity Klystron Amplifier, Reflex Klystron oscillator, Traveling wave tube amplifier, Cylindrical Magnetron oscillator, Carcinotron oscillator.

UNIT - V MICROWAVE MEASUREMENTS AND INTEGRATED CIRCUITS 9

Measurement of Impedance, Frequency, Power, VSWR, Q-factor, Dielectric constant, Attenuation, S-parameters, and Microwave Integrated circuits - Materials, fabrication techniques, MIC components.

TOTAL: 45 PERIODS

OUTCOMES:

On successful completion of the course student will be able to:

1. Understand the concept of low and high frequency parameters.
2. Understand the concept of microwave passive devices.
3. Explain the working operation of various microwave semiconductor devices.
4. Understand the working operation of various microwave tubes.
5. Understand the various methods of measuring microwave parameters.
6. Explain the basics of microwave integrated circuits.

TEXT BOOKS:

1. Samuel Y Liao, “Microwave Devices & Circuits”, Prentice Hall of India, 2006.
2. Annapurna Das and Sisir K Das, “Microwave Engineering”, Tata Mc Graw Hill Publishing Company Ltd, New Delhi, 2005.

REFERENCES:

1. David M. Pozar, "Microwave Engineering", Fourth Edition, Wiley India, 2012.
2. Robert E Colin, “Foundations for Microwave Engineering”, John Wiley & Sons Inc, 2005.
3. Thomas H Lee, “Planar Microwave Engineering: A Practical Guide to Theory, Measurements and Circuits”, Cambridge University Press, 2004.

21EC1703	OPTICAL COMMUNICATION AND NETWORKS	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To study about the various optical fiber modes, configuration and fabrication techniques.
- To understand the transmission characteristics of optical fibers.
- To learn about the various optical sources, detectors and transmission techniques.
- 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

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

UNIT - II TRANSMISSION CHARACTERISTIC OF OPTICAL FIBER 9

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

UNIT - III OPTICAL SOURCES AND DETECTORS 9

Sources: Intrinsic and extrinsic material-direct and indirect band gaps-LED-LED structures- surface emitting LED-Edge emitting LED-quantum efficiency and LED power-light source materials-modulation of LED-LASER diodes-modes and threshold conditions-Rate equations-external quantum efficiency-resonant frequencies-structures and radiation patterns-single mode laser-external modulation-temperature effort.

Detectors: PIN photo detector-Avalanche photo diodes-Photo detector noise-noise sources-SNR-detector response time-Avalanche multiplication noise-temperature effects- comparisons of photo detectors.

UNIT - IV OPTICAL RECEIVER, MEASUREMENTS AND COUPLING 9

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

UNIT - V OPTICAL COMMUNICATION SYSTEMS AND NETWORKS 9

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

TOTAL: 45 PERIODS

OUTCOMES:

On successful completion of the course student will 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. Explain optical sources and detectors with their use in optical communication system.
4. Discuss fiber optic receiver systems and measurement techniques.
5. Understand fiber joints and coupling.
6. Analyze optical communication systems and its networks.

TEXT BOOKS:

1. P Chakrabarti, "Optical Fiber Communicationǁ, McGraw Hill Education (India) Private Limited, 2016.
2. Gred Keiser,"Optical Fiber Communicationǁ, McGraw Hill Education (India) Private Limited. Fifth Edition, Reprint 2013.

REFERENCES:

1. John M. Senior , “Optical Fiber Communication”, Second Edition, Pearson Education, 2007.
2. Rajiv Ramaswami,”Optical Networks” , Second Edition, Elsevier , 2004.
3. J.Gower, “Optical Communication System”, Prentice Hall of India, 2001.
4. Govind P. Agrawal, “Fiber-optic communication systems”, third edition, John Wiley & sons, 2004.

21EC1711	EMBEDDED SYSTEMS AND ROBOTICS LABORATORY	L	T	P	C
		0	0	4	2

OBJECTIVES:

- Learn the working of ARM processor.
- Understand the Building Blocks of Embedded Systems.
- Know the characteristics of Real Time Systems.
- Understand about Arduino microcontroller.
- Select appropriate hardware and microcontrollers based on need of application.
- Control motors using Arduino.

LIST OF EXPERIMENTS

1. Study of ARM microcontroller system
2. Interfacing ADC and DAC with ARM7.
3. Interfacing LED and to verify the output in ARM7.
4. Interfacing PWM and to verify the output in ARM7.
5. Interfacing real time clock and serial port in ARM7.
6. Interfacing keyboard and LCD with ARM7.
7. Interfacing stepper motor with ARM7
8. Interfacing temperature sensor with ARM7.
9. Control the dc motor on Arduino Robot in all directions.
10. Control the servo motor using Arduino board
11. Build a model with line following algorithm and run with Arduino Board.
12. Mini Projects using embedded system and Robotics.

TOTAL: 60 PERIODS

OUTCOMES:

On successful completion of the course student will be able to:

1. Design applications using ARM processor.
2. Write programs for interfacing keyboard, display, motor and sensor.
3. Develop programs for hardware interfacing with Arduino.
4. Formulate a mini project using embedded system and robotics.
5. Function effectively as an individual and in a team to accomplish the given task.
6. Gain knowledge to identify microcontroller and design a system for given application.

21EC1712 ADVANCED COMMUNICATION LABORATORY

L	T	P	C
0	0	4	2

OBJECTIVES:

- Understand the working principle of optical sources, detector, fibers
- Develop understanding of simple optical communication link
- Understand the measurement of BER, Pulse broadening
- Understand the characteristics of Microwave Devices
- Measure Various Microwave parameters
- Understand the characteristics of Microwave IC Filter

LIST OF OPTICAL EXPERIMENTS

1. Measurement of connector, bending and fiber attenuation losses.
2. Numerical Aperture and Mode Characteristics of Fibers.
3. DC Characteristics of LED and PIN Photo diode.
4. Fiber optic Analog and Digital Link Characterization - frequency response (analog), eye diagram and BER (digital)

LIST OF MICROWAVE EXPERIMENTS

1. VSWR and Impedance Measurement and Impedance Matching
2. Characterization of Directional Couplers, Isolators, Circulators
3. Gunn Diode Characteristics
4. Microwave IC – Filter Characteristics

TOTAL: 60 PERIODS

OUTCOMES:

On successful completion of the course student will be able to:

1. Analyze the performance of simple optical link by measurement of losses and analyzing the mode characteristics of fiber.
2. Develop simple Optical communication Link.
3. Analyze the Eye Pattern, Pulse broadening of optical fiber and the impact on BER.
4. Understand the intricacies in Microwave System design.
5. Measure the various Microwave parameters.
6. Analyze the characteristics of Microwave IC Filter.

SYLLABUS OF PROFESSIONAL ELECTIVE COURSES: VERTICALS

VERTICAL I VLSI CHIP DESIGN AND TESTING

21EC1901	ASIC DESIGN	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To learn the fundamentals of ASIC and its design methods.
- To gain knowledge on programmable architectures for ASICs.
- To learn advanced FPGA architectures.
- To understand the physical design of ASIC.
- To analyze algorithms of physical design of ASIC.
- To gain knowledge about ASIC System on Chip design.

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

Types of Asics - Design Flow - CMOS Transistors - Combinational Logic Cell – Sequential Logic Cell - Data Path Logic Cell - Transistors as Resistors - Transistor Parasitic Capacitance- Logical Effort.

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

Anti Fuse - Static RAM - EPROM and EEPROM Technology - ACTEL ACT- Xilinx LCA –ALTERA FLEX - ALTERA MAX DC & AC Inputs and Outputs - Clock & Power Inputs - Xilinx I/O Blocks.

UNIT - III PROGRAMMABLE ASIC ARCHITECTURE 9

Architecture and Configuration of ARTIX / Cyclone and KINTEX Ultra Scale / STRATIX FPGA – Micro-Blaze / NIOS Based Embedded Systems – Signal Probing Techniques.

UNIT - IV LOGIC SYNTHESIS, PLACEMENT AND ROUTING 9

Logic Synthesis - Floor Planning Goals and objectives, Measurement of Delay in Floor Planning, Floor Planning Tools, I/O and Power Planning, Clock Planning, Placement Algorithms. Routing: Global Routing, Detailed Routing, Special Routing.

UNIT - V SYSTEM-ON-CHIP DESIGN 9

SoC Design Flow, Platform-Based and IP Based SoC Designs, Basic Concepts of Bus Based Communication Architectures, High Performance Filters using Delta-Sigma Modulators, Applications: Digital Camera, SDRAM, High Speed Data standards.

TOTAL: 45 PERIODS

OUTCOMES:

On successful completion of the course student will be able to:

1. Apply Logical Effort Technique for predicting Delay, Delay Minimization and FPGA architectures.
2. Design Logic Cells and I/O Cells.
3. Analyze the various resources of recent FPGAs.
4. Understand the Algorithms for Floor Planning and Placement of Cells.
5. Apply Routing Algorithms for Optimization of Length and Speed.
6. Understand System on Chip Design of ASIC.

TEXT BOOKS:

1. M.J.S.Smith,“Application Specific Integrated Circuits, Pearson”, 2004
2. Steve Kilts,“Advanced FPGA Design”, Wiley Inter-Science,2006.

REFERENCES:

1. Wayne Wolf , ”FPGA-Based System Design”, Prentice Hall PTR, 2009.
2. Farzad Nekoogar and Faranak Nekoogar, “From ASICs to SOCs: A Practical Approach “, Prentice Hall PTR, 2003.
3. Roger Woods, John Mcallister, Dr. Ying Yi, Gaye Lightbod,“FPGA-Based Implementation of Signal Processing Systems”, Wiley, 2008.

21EC1902	CAD FOR VLSI DESIGN	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To introduce the VLSI design methodologies and design methods.
- To understand data structures and algorithms required for VLSI design.
- To study algorithms for partitioning and placement.
- To study algorithms for floor planning and routing.
- To study different modelling in VLSI design
- To gain knowledge about simulation and synthesis of VLSI design

UNIT – I INTRODUCTION 9

Introduction to VLSI Design Methodologies - VLSI Design Cycle - New Trends in VLSI Design Cycle - Physical Design Cycle - New Trends in Physical Design Cycle - Design Styles - Review of VLSI Design Automation Tools.

UNIT - II DATA STRUCTURES AND BASIC ALGORITHMS 9

Introduction to Data Structures and Algorithms - Algorithmic Graph Theory and Computational Complexity - Tractable and Intractable Problems - General Purpose Methods for Combinatorial Optimization.

UNIT - III PARTITIONING AND PLACEMENT 9

Layout Compaction - Problem Formulation -Algorithms for Constraint Graph Compaction - Partitioning - Placement - Placement Algorithms.

UNIT - IV FLOOR PLANNING AND ROUTING 9

Floor planning - Problem Formulation - Floorplanning Algorithms - Routing - Area Routing - Global Routing - Detailed Routing.

UNIT - V MODELLING, SIMULATION AND SYNTHESIS 9

Simulation - Gate Level Modeling and Simulation - Logic Synthesis and Verification Binary Decision Diagrams - High Level Synthesis.

TOTAL: 45 PERIODS

OUTCOMES:

On successful completion of the course student will be able to:

1. Apply various VLSI design methodologies.
2. Understand different data structures and algorithms required for VLSI design.
3. Apply algorithms for partitioning and placement.
4. Apply algorithms for floor planning and routing.
5. Analyze different modellings in VLSI design.
6. Understand simulation and synthesis of VLSI design.

TEXT BOOKS:

1. Sabih H. Gerez, “Algorithms for VLSI Design Automation”, Second Edition, Wiley-India, 2017.
2. Naveed a. Sherwani, “Algorithms for VLSI Physical Design Automation”, 3^{rd} Edition,Springer, 2017.

REFERENCES:

1. Charles J. Alpert, Dinesh P. Mehta and Sachin S Sapatnekar,“Handbook of Algorithms for Physical Design Automation”, CRC Press, 1^{st} Edition, 2009.
2. N.A. Sherwani, “Algorithms for VLSI Physical Design Automation”,Kluwer Academic Publishers, 2002.

21EC1903	MIXED SIGNAL IC DESIGN	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To study the mixed signal of submicron CMOS circuits
- To understand the various integrated based filters and topologies
- To learn architectures of various data converters
- To understand modeling of data converters
- To gain knowledge about improving SNR of various filters
- To 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 - MOSFET Switch, Delay Elements, 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, GmC integrators, Discrete time integrators, Filtering Topologies-Bilinear transfer function, 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 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.

TOTAL: 45 PERIODS

OUTCOMES:

On successful completion of the course student will be able to:

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

TEXT BOOKS:

1. R.Jacob Baker, "CMOS Mixed Signal Circuit Design", Wiley India, IEEE Press, reprint 2008.
2. Floyd M. Gardner ,"Phase Lock Techniques" , John wiley & Sons, Inc 2005

REFERENCES:

1. Behzad Razavi , " Design of Analog CMOS Integrated Circuits ", McGraw Hill, 33rd Reprint, 2016.
2. R.Jacob Baker," CMOS Circuit Design, Layout and Simulation", Wiley India, IEEE Press, Second Edition, reprint 2009.

21EC1904	LOW POWER IC DESIGN	L	T	P	C
		3	0	0	3

OBJECTIVES:

- Identify sources of power in an IC.
- Identify the power reduction techniques based on technology independent and technology dependent methods.
- Identify suitable techniques to reduce the power dissipation.
- To gain knowledge about advanced techniques for low power IC design.
- Estimate power dissipation at various levels in IC design.
- Develop algorithms for low power dissipation.

UNIT – I POWER DISSIPATION IN CMOS 9

Hierarchy of Limits of Power - Sources of Power Consumption - Physics of Power Dissipation in CMOS FET Devices - Basic Principle of Low Power Design.

UNIT - II POWER OPTIMIZATION 9

Logic Level Power Optimization - Circuit Level Low Power Design - Gate Level Low Power Design -Architecture Level Low Power Design - VLSI Subsystem Design of Adders, Multipliers, PLL, Low Power Design.

UNIT - III DESIGN OF LOW POWER CMOS CIRCUITS 9

Computer Arithmetic Techniques for Low Power System - Reducing Power Consumption in Combinational Logic, Sequential Logic, Memories - Low Power Clock - Advanced Techniques - Special Techniques, Adiabatic Techniques.

UNIT - IV POWER ESTIMATION 9

Power Estimation Techniques, Circuit Level, Gate Level, Architecture Level, Behavioral Level, Logic Power Estimation - Simulation Power Analysis -Probabilistic Power Analysis.

UNIT - V SYNTHESIS AND SOFTWARE DESIGN FOR LOW POWER CMOS CIRCUIT 9

Synthesis for Low Power - Behavioral Level Transform -Algorithms for Low Power - Software Design for Low Power.

TOTAL: 45 PERIODS

OUTCOMES:

On successful completion of the course student will be able to:

1. Understand power dissipation in MOS circuits.
2. Analyze power optimization at various abstraction levels.
3. Apply low power techniques for VLSI circuits.
4. Understand advanced techniques for low power IC design.
5. Analyze power estimation at various levels in IC design.
6. Develop algorithms to reduce power dissipation by software.

TEXT BOOKS:

1. J.Rabaey, “Low Power Design Essentials (Integrated Circuits and Systems)”, Springer, 2017.
2. Kaushik Roy and S.C.Prasad,”Low Power CMOS VLSI Circuit Design”, Wiley, 2009.

REFERENCES:

1. J.B.Kulo and J.H Lou,”Low Voltage CMOS VLSI Circuits”, Wiley 1999.
2. James B.Kulo, Shih-Chia Lin, “Low Voltage SOI CMOS VLSI Devices and Circuits”, John Wiley and Sons, Inc. 2001.

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21EC1905 VLSI TESTING AND DESIGN FOR TESTABILITY

L	T	P	C
3	0	0	3

OBJECTIVES:

- To understand basics of testing and fault modeling.
- To learn test generation for combinational logic circuits.
- To learn test generation for sequential logic circuits.
- To study various approaches for testability.
- To gain knowledge about test pattern generation and algorithms.
- To study fault diagnosis in VLSI circuits.

UNIT – I TESTING AND FAULT MODELING 9

Introduction to testing - Faults in Digital Circuits - Modeling of faults - Logical Fault Models -Fault detection - Fault Location - Fault dominance - Logic simulation - Types of simulation -Delay models - Gate Level Event - driven simulation.

UNIT - II TEST GENERATION 9

Test generation for combinational logic circuits - Testable combinational logic circuit design - Test generation for sequential circuits - design of testable sequential circuits.

UNIT - III DESIGN FOR TESTABILITY 9

Design for Testability - Ad-hoc design - generic scan based design - classical scan based design- system level DFT approaches.

UNIT - IV SELF - TEST AND TEST ALGORITHMS 9

Built-In self-test - test pattern generation for BIST - Circular BIST - BIST Architectures - Testable Memory Design - Test Algorithms - Test generation for Embedded RAMs

UNIT - V FAULT DIAGNOSIS 9

Logical Level Diagnosis - Diagnosis by UUT reduction - Fault Diagnosis for Combinational Circuits - Self-checking design - System Level Diagnosis.

TOTAL: 45 PERIODS

OUTCOMES:

On successful completion of the course student will be able to:

1. Analyze the concept of testing and fault in VLSI digital circuits.
2. Apply test generation for combinational logic circuits.
3. Apply test generation for sequential logic circuits.
4. Realize various approaches for testability.
5. Understand test pattern generation and algorithms.
6. Analyze fault diagnosis in VLSI circuits.

TEXT BOOKS:

1. A.L.Crouch,“Design Test for Digital IC’s and Embedded Core Systems, Prentice Hall International, 2007.
2. M. Abramovici, M.A.Breuer and A.D. Friedman,“Digital systems and Testable Design”, Jaico Publishing House, 2001.

REFERENCES:

1. M.L.Bushnell and V.D.Agrawal,”Essentials of Electronic Testing for Digital, Memory and Mixed Signal VLSI Circuits”, Kluwer Academic Publishers, 2013.
2. P.K. Lala,”Digital Circuit Testing and Testability”, Academic Press, 2002.

21EC1906	SYSTEM ON CHIP	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To learn the fundamental system Processor architecture
- To gain knowledge on design concepts underlying system on chips
- To study processor selection for SoCs
- To introduce SOC memory design
- To learn basic interconnect architectures and SOC customization
- To familiarize the concepts of SOC to FPGA based embedded processor

UNIT – I SYSTEM ARCHITECTURE: OVERVIEW 9

Components of the system processor architectures-Memory and addressing system level - interconnection- SoC design requirements and specifications-design integration- design complexity cycle time, die area and cost, ideal and practical scaling, area-time-power trade off in processor design, Configurability.

UNIT - II PROCESSOR SELECTION FOR SOCs 9

Overview -soft processors, processor core selection. Basic concepts, instruction set, branches, interrupts and exceptions, Basic elements in instruction handling - Minimizing pipeline delays -reducing the cost of branches -Robust Processors-Vector processors, VLIW processors, Superscalar processors.

UNIT - III MEMORY DESIGN 9

SoC external memory, SoC internal memory, Scratch pads and cache-memory cache organization and write policies-strategies for line replacement at miss time - split I and D caches-multilevel caches-SoC memory systems-board based memory systems-simple processor/memory interaction.

UNIT - IV INTERCONNECT ARCHITECTURES AND SOC CUSTOMIZATION 9

Bus architectures - SoC standard buses AMBA, Core Connect-Processor customization approaches -Reconfigurable technologies-mapping designs onto reconfigurable devices - FPGA based design-Architecture of FPGA, FPGA interconnect technology, FPGA memory, Floor plan and routing.

UNIT - V FPGA BASED EMBEDDED PROCESSOR 9

Hardware software task partitioning-FPGA fabric Immersed Processors-Soft Processors and Hard Processors -Tool flow for Hardware/Software Co-design-Interfacing Processor with memory and peripherals -Types of On-chip interfaces - Wishbone interface, Avalon Switch Matrix, OPB Bus Interface, creating a Customized Microcontroller – FPGA based Signal Interfacing and Conditioning.

TOTAL: 45 PERIODS

OUTCOMES:

On successful completion of the course student will be able to:

1. Understand the fundamental system Processor architecture
2. Analyse design concepts underlying system on chips.
3. Apply knowledge of processor selection for SoCs.
4. Understand the design of SOC memory
5. Analyze interconnect architectures and SOC customization
6. Apply the concepts of SOC to FPGA based embedded processor

TEXT BOOKS:

1. Flynn, MJ, Luk, W, “Computer System Design: System-on-Chip”, Wiley India Pvt. Ltd, 2011.
2. Steve Furber, “Arm System-On-Chip Architecture”, 2/E. India, Pearson Education, 2001.

REFERENCES:

1. Wayne Wolf, “Modern VLSI Design -System- on-Chip Design”, Prentice Hall, 3rd Edition, 2008.
2. Wayne Wolf, “Modern VLSI Design – IP based Design”, Prentice Hall, 4th Edition, 2008 .

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21EC1907	NETWORKS ON CHIP	L T P C 3 0 0 3

OBJECTIVES:

- To Understand the concept of Network - on - Chip
- To Learn router architecture designs
- To gain knowledge about routing algorithms
- To perform testing of NOC
- To study about fault tolerance of NOC
- To understand about three dimensional integration of Network-on-Chip

UNIT - I INTRODUCTION TO NOC 9

Introduction to NOC - OSI layer rules in NOC - Interconnection Networks in Network-on-Chip -Network Topologies - Switching Techniques - Routing Strategies - Flow Control Protocol Quality-of-Service Support

UNIT - II ARCHITECTURE DESIGN 9

Switching Techniques and Packet Format - Asynchronous FIFO Design -GALS Style of Communication - Wormhole Router Architecture Design - VC Router Architecture Design - Adaptive Router Architecture Design

UNIT - III ROUTING ALGORITHM 9

Packet routing-QOS, Congestion control and Flow control - Router Design - Network Link Design - Efficient and Deadlock-Free Tree-Based Multicast Routing Methods - Path-Based Multicast Routing for 2D and 3D Mesh Networks- Fault-Tolerant Routing Algorithms - Reliable and Adaptive Routing Algorithms

UNIT - IV TEST AND FAULT TOLERANCE OF NOC 9

Design-Security in Networks-On-Chips-Formal Verification of Communications in Networks-on Chips-Test and Fault Tolerance for Networks-on-Chip Infrastructures-Monitoring Services for Networks-on-Chips.

UNIT - V THREE-DIMENSIONAL INTEGRATION OF NETWORK-ON-CHIP 9

Three-Dimensional Networks-on-Chips Architectures - A Novel Dimensionally-Decomposed Router for on-Chip Communication in 3D Architectures - Resource Allocation for QoS on-Chip Communication - on-Chip Protocols, Processor Traffic Modeling for Networks-on-Chip

TOTAL: 45 PERIODS

OUTCOMES:

On successful completion of the course student will be able to:

1. Understand the concept of Network - on – Chip.
2. Understand different router architecture design.
3. Apply different routing algorithms.
4. Perform testing of NOC.
5. Learn fault tolerance of NOC.
6. Understand about three dimensional integration of Network-on-chip.

TEXT BOOKS:

1. Fayez Gebali,Haytham Elmiligi, Mohamed Watheq E1-Kharashi, “Networks-On-Chips Theory and Practice CRC Press, 2009.
2. Konstantinos Tatas and Kostas Siozios "Designing 2D and 3D Network-On-Chip Architectures” 2013.

REFERENCES:

1. Palesi, Maurizio, Daneshtalab, Masoud “Routing Algorithms in Networks-On-Chip” 2014
2. Chrysostomos Nicopoulos, Vijaykrishnan Narayanan, Chita R.Das, “Networks-On – Chip Architectures Holistic Design Exploration”, Springer, 2010

Vertical II - Signal Processing

21EC1908	**DSP ARCHITECTURE AND PROGRAMMING**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

OBJECTIVES:

- To understand the Basics and Fundamentals of Digital Signal Processors
- To study TMS320C5x DSP's Architecture, On-chip Peripherals and Instruction set
- To study TMS320C6x DSP's Architecture, On-chip Peripherals and Instruction set
- To study the Advanced DSP Architecture and FFT Calculation
- To write a Program for signal processing applications
- To study 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 TMS320C5X PROCESSOR 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.

TOTAL: 45 PERIODS

OUTCOMES:

On successful completion of the course student will be able to:

1. Analyze the concepts of Digital Signal Processors.
2. Demonstrate their ability to program the TMS320C5x DSP processor for signal processing applications.
3. Demonstrate their ability to program the TMS320C6x DSP processor for signal processing applications.
4. Analyze Advanced DSP Architecture.
5. Compute Fast Fourier Transform.
6. Discuss, compare and select the suitable Advanced DSP Processors for real-time signal processing applications.

TEXT BOOKS:

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.

REFERENCES:

1. Rulph Chassaing and Donald Reay, "Digital Signal Processing and Applications with the C6713 and C6416 DSK", John Wiley & Sons, Inc., Publication, 2012 (Reprint).
2. User guides Texas Instruments, Analog Devices and NXP.

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21EC1909	ADVANCED DIGITAL SIGNAL PROCESSING	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To learn and understand the concepts of stationary and non-stationary random signals and analysis & characterization of discrete-time random processes.
- To enunciate the significance of estimation of power spectral density of random processes.
- To introduce the principles of optimum filters such as Wiener and Kalman filters
- To introduce the principles of adaptive filters and its processes.
- To learn the applications of adaptive filters relates to communication Engineering.
- To introduce the concepts of multi-resolution analysis.

UNIT - I DISCRETE-TIME RANDOM PROCESSES 9

Random variables - ensemble averages a review, random processes - ensemble averages,autocorrelation and autocovariance matrices, ergodic random process, white noise, filteringrandom processes, spectral factorization, special types of random processes - AR, MA, ARMA

UNIT - II SPECTRUM ESTIMATION 9

Bias and consistency, Non-parametric methods - Periodogram, modified-Periodogram–performance analysis, Bartlett's method, Welch's method, Blackman-Tukey method, Performance comparison, Parametric methods - autoregressive (AR) spectrum estimation-autocorrelation method, Prony's method, solution using Levinson Durbin recursion.

UNIT - III OPTIMUM FILTERS 9

Wiener filters - FIR Wiener filter - discrete Wiener Hopf equation, Applications - filtering, linear prediction, IIR Wiener filter - causal and non-causal filters, Recursive estimators - discrete Kalman filter.

UNIT - IV ADAPTIVE FILTERS 9

Principles and properties of adaptive filters - FIR adaptive filters. Adaptive algorithms – steepest descent algorithm, the LMS algorithm – convergence, Applications of adaptive filtering – noise cancellation, channel equalization.

UNIT - V MULTIRESOLUTION ANALYSIS 9

Short-time Fourier Transform - Heisenberg uncertainty principle, Principles of multi-resolution analysis - sub-band coding, the continuous and discrete wavelet transform – properties, Applications of wavelet transform - noise reduction, image compression

TOTAL: 45 PERIODS

OUTCOMES:

On successful completion of the course student will be able to:

1. Articulate and apply the concepts of special random processes in practical applications.
2. Choose appropriate spectrum estimation techniques for a given random process.
3. Articulate and apply the principles of optimum filters such as Wiener and Kalman filters.
4. Apply optimum filters appropriately for a given communication application.
5. Apply appropriate adaptive algorithm for processing non-stationary signals.
6. Apply and analyze wavelet transforms for signal and image processing based applications

TEXT BOOKS:

1. Monson H. Hayes, "Statistical digital signal processing and modeling", John Wiley and Sons Inc.New York, Indian reprint 2008.
2. P. P. Vaidyanathan, "Multirate systems and filter banks", Prentice Hall Inc. 1993.

REFERENCES:

1. John G. Proakis & Dimitris G.Manolakis, “Digital Signal Processing – Principles, Algorithms & Applications”, Fourth Edition, Pearson Education / Prentice Hall, 2007.
2. Sophoncles J. Orfanidis, "Optimum signal processing", McGraw Hill, 2000.

21EC1910	DIGITAL IMAGE AND VIDEO PROCESSING	L	T	P	C
		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.
- To understand the basics of video processing.

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.

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 AND SEGMENTATION 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, Segmentation-Edge detection, Edge linking via Hough transform - Thresholding - Region based segmentation -Region growing - Region splitting and merging -Segmentation by morphological watersheds.

UNIT - IV 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.

UNIT - V BASICS OF VIDEO PROCESSING 9

Analog video, Digital Video, Time varying Image Formation models- 3D motion models, Geometric Image formation, Photometric Image formation, sampling of video signals, filtering operations.

TOTAL: 45 PERIODS

OUTCOMES:

On successful completion of the course student will be able to:

1. Understand the basics and fundamentals of digital image processing, such as digitization, sampling, quantization, and 2D-transforms.
2. Operate on images using the techniques of smoothing, sharpening and enhancement.
3. Apply the restoration concepts and filtering techniques.
4. Apply segmentation and features extraction concepts on digital images.
5. Understand various compression standards and recognition techniques.
6. Understand the basics of video processing.

TEXT BOOKS:

1. Rafael C. Gonzalez, Richard E. Woods, ‘Digital Image Processing’, Pearson, Third Edition, 2010.
2. Anil K. Jain, ‘Fundamentals of Digital Image Processing’, Pearson, 2002.
3. Yao wang, Joem Ostarmann and Ya – quin Zhang, “Video processing and communication”,1st edition, PHI.

REFERENCES:

1. Kenneth R. Castleman, ‘Digital Image Processing’, Pearson, 2006.
2. Rafael C. Gonzalez, Richard E. Woods, Steven Eddins, ‘Digital Image Processing using MATLAB’, Pearson Education, Inc., 2011.
3. D,E. Dudgeon and RM. Mersereau, ‘Multidimensional Digital Signal Processing’, Prentice Hall Professional Technical Reference, 1990.
4. William K. Pratt, ‘Digital Image Processing’, John Wiley, New York, 2002.
5. Milan Sonka et al ‘Image processing, analysis and machine vision’, Brookes/Cole, Vikas Publishing House, 2nd edition, 1999.
6. M. Tekalp ,”Digital video Processing”, Prentice Hall International, 2015.

21EC1911	VLSI SIGNAL PROCESSING	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To introduce techniques for pipelining and parallel processing of digital filters.
- To learn the DSP structures to suit VLSI implementations.
- To introduce techniques for altering the existing DSP structures to suit VLSI implementation.
- To introduce efficient design of bit-level arithmetic DSP architectures.
- To understand numerical strength reduction, wave analysis suitable for VLSI.
- To study some applications of asynchronous pipelining.

UNIT – I PIPELINING AND PARALLEL PROCESSING OF DIGITAL FILTERS 9

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

UNIT - II ALGORITHMIC STRENGTH REDUCTION TECHNIQUE I 9

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

UNIT - III ALGORITHIMIC STRENGTH REDUCTION TECHNIQUE II 9

Fast convolution - Cook-Toom algorithm, modified Cook-Toom algorithm, Pipelined and parallel recursive filters - Look-Ahead pipelining in first-order IIR filters, Look-Ahead pipelining with powerof-2 decomposition, Clustered look-ahead pipelining, Parallel processing of IIR filters, combined pipelining and parallel processing of IIR filters.

UNIT - IV BIT-LEVEL ARITHMETIC ARCHITECTURES 9

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

UNIT - V NUMERICAL STRENGTH REDUCTION, WAVE AND ASYNCHRONOUS PIPELINING 9

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

TOTAL: 45 PERIODS

OUTCOMES:

On successful completion of the course student will be able to:

1. Implement techniques for pipelining and parallel processing of digital filters,.
2. Apply the suitable DSP structures for VLSI implementations.
3. Apply techniques for altering the existing DSP structures.
4. Design of bit-level arithmetic DSP architectures.
5. Apply numerical strength reduction, wave analysis suitable for VLSI.
6. Develop applications using asynchronous pipelining.

TEXT BOOKS:

1. Keshab K. Parhi, "VLSI Digital Signal Processing Systems, Design and implementation", Wiley, Interscience, 2007.

REFERENCES:

1. U. Meyer – Baese, " Digital Signal Processing with Field Programmable Gate Arrays", Springer, Second Edition, 2004

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21EC1912	**SPEECH PROCESSING**	**L T P C** **3 0 0 3**

OBJECTIVES:

- To understand the speech production mechanism.
- To understand the various speech analysis techniques and speech models.
- To understand the speech compression coding techniques.
- To understand the speech recognition techniques.
- To know the speaker recognition techniques.
- To understand speech synthesis techniques.

UNIT – I SPEECH SIGNAL CHARACTERISTICS & ANALYSIS 9

Speech production process - speech sounds and features- Phonetic Representation of Speech- representing speech in time and frequency domains - Short-Time Analysis of Speech - Short- Time Energy and Zero-Crossing Rate - Short-Time Autocorrelation Function - Short-Time Fourier Transform (STFT) - Speech Spectrum - Cepstrum - Mel-Frequency Cepstrum Coefficients - Hearing and Auditory Perception - Perception of Loudness - Critical Bands - Pitch Perception

UNIT - II SPEECH COMPRESSION CODING TECHNIQUES 9

Need for speech coding, Waveform coding of speech – PCM, Adaptive PCM, DPCM, ADPCM, Delta Modulation, Adaptive Delta Modulation, G.726 Standard for ADPCM, Parametric Speech Coding – Channel Vocoders, Linear Prediction Based Vocoders, Code Excited Linear Prediction (CELP) based Vocoders, Sinusoidal speech coding techniques, Hybrid coder, Transform domain coding of speech

UNIT - III SPEECH RECOGNITION 9

LPC for speech recognition- Hidden Markov Model (HMM)- training procedure for HMM- subword unit model based on HMM- language models for large vocabulary speech recognition – Overall recognition system based on subword units - Context dependent subword units- Semantic post processor for speech recognition.

UNIT - IV SPEAKER RECOGNITION 9

Acoustic parameters for speaker verification- Feature space for speaker recognition- similarity measures- Text dependent speaker verification-Text independent speaker verification techniques.

UNIT - V TEXT TO SPEECH SYNTHESIS 9

Text to speech synthesis(TTS)-Concatenative-Unit selection synthesis , Diphone synthesis, Domain-specific synthesis- HMM-based synthesis and waveform synthesis methods, sub-word units for TTS, intelligibility and naturalness-role of prosody

TOTAL: 45 PERIODS

OUTCOMES:

On successful completion of the course student will be able to:

1. Analyze speech production mechanism.
2. Analyze and Design various speech techniques and speech models.
3. Design speech compression coding techniques.
4. Configure speech recognition techniques.
5. Design speaker recognition systems.
6. Design text to speech synthesis systems.

TEXT BOOKS:

1. L. R. Rabiner and R. W. Schafer, “Introduction to Digital Signal Processing, Foundations and Trends in Signal Processing”, Vol. 1, Nos. 1–2 (2007) 1–194.
2. Ben Gold and Nelson Morgan “Speech and Audio signal processing-processing and perception of speech and music”, John Wiley and sons 2006.

REFERENCES:

1. Lawrence Rabiner, Biiing - Hwang Juang and B.Yegnanarayana “Fundamentals of Speech Recognition”, Pearson Education, 2009.
2. Claudio Becchetti and Lucio Prina Ricotti, “Speech Recognition”, John Wiley and Sons, 1999.
3. Donglos O shanhnessy “Speech Communication: Human and Machine”, 2nd Ed. University press 2001.

21EC1913	**COMPUTER VISION**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

OBJECTIVES:

- To review image processing techniques for computer vision.
- To understand shape and region analysis.
- To understand Hough Transform and its applications to detect lines, circles, ellipses.
- To understand three-dimensional image analysis techniques.
- To understand motion analysis.
- To study some applications of computer vision algorithms.

UNIT – I IMAGE PROCESSING FOUNDATIONS 9

Review of image processing techniques - classical filtering operations - Thresholding techniques - edge detection techniques - corner and interest point detection - mathematical morphology – texture.

UNIT - II SHAPES AND REGIONS 9

Binary shape analysis - connectedness - object labeling and counting - size filtering - distance functions - skeletons and thinning - deformable shape analysis - boundary tracking procedures - active contours - shape models and shape recognition - centroidal profiles - handling occlusion - boundary length measures - boundary descriptors - chain codes - Fourier descriptors - region descriptors – moments.

UNIT - III HOUGH TRANSFORM 9

Line detection - Hough Transform (HT) for line detection - foot-of-normal method - line localization - line fitting - RANSAC for straight line detection - HT based circular object detection - accurate center location - speed problem - ellipse detection - Case study: Human Iris location - hole detection - generalized Hough Transform (GHT) - spatial matched filtering - GHT for ellipse detection - object location - GHT for feature collation.

UNIT - IV 3D VISION AND MOTION 9

Methods for 3D vision - projection schemes - shape from shading - photometric stereo - shape from texture - shape from focus - active range finding - surface representations - point-based representation - volumetric representations - 3D object recognition - 3D reconstruction - introduction to motion - triangulation - bundle adjustment - translational alignment - parametric motion - spline-based motion - optical flow - layered motion.

UNIT - V APPLICATIONS 9

Application: Photo album - Face detection - Face recognition - Eigen faces - Active appearance and 3D shape models of faces Application- Surveillance - foreground-background separation - particle filters - Chamfer matching, tracking, and occlusion - combining views from multiple cameras - human gait analysis Application: In-vehicle vision system: locating roadway - road markings - identifying road signs - locating pedestrians.

TOTAL: 45 PERIODS

OUTCOMES:

On successful completion of the course student will be able to:

1. Implement fundamental image processing techniques required for computer vision.
2. Perform shape analysis.
3. Apply Hough Transform for line, circle, and ellipse detections.
4. Apply 3D vision techniques.
5. Implement motion related techniques.
6. Develop applications using computer vision techniques.

TEXT BOOKS:

1. D. L. Baggio et al., “Mastering OpenCV with Practical Computer Vision Projects”, Packt Publishing, 2012.
2. E. R. Davies, “Computer & Machine Vision”, Fourth Edition, Academic Press, 2012.
3. Jan Erik Solem, “Programming Computer Vision with Python: Tools and algorithms for analyzing images”, O'Reilly Media, 2012.

REFERENCES:

1. Mark Nixon and Alberto S. Aquado, “Feature Extraction & Image Processing for Computer Vision”, Third Edition, Academic Press, 2012.
2. R. Szeliski, “Computer Vision: Algorithms and Applications”, Springer 2011.
3. Simon J. D. Prince, “Computer Vision: Models, Learning, and Inference”, Cambridge University Press, 2012.

21EC1914	UNDERWATER IMAGING SYSTEMS AND IMAGE PROCESSING	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To learn the fundamental components of optical imaging
- To learn the fundamentals of optical image processing
- To understand the challenges involved in Underwater imaging
- To understand the fundamental of Ocean Acoustics
- To Understand the principle of image processing techniques
- To Learn the SONAR Systems and various applications

UNIT – I FUNDAMENTAL COMPONENTS OF OPTICAL IMAGE PROCESSING SYSTEM 9

Fundamentals and application of image processing, Human and Computer Vision, Introduction on Digital Camera-Focal length, Aperture, Shutter Speed, Spatial Resolution, Underwater lights and its importance, Halogen, LED, Colour Temperature, lumens, Beam angle, Image File format- JPEG, PNG, TIFF, BMP, GIF.

UNIT - II OPTICAL IMAGE PROCESSING 9

Image Formation, Digitization, Sampling and Quantization, Geometric Transformation, Interpolation, Image Reconstruction, Spatial Filtering, Histogram, Binary Image, Color Fundamentals, Color transformations, Color Interpolation, Morphology, Image segmentation, Pattern Recognition, Challenges involved in underwater optical imaging.

UNIT - III FUNDAMENTALS OF UNDERWATER ACOUSTICS 9

Acoustic waves, Acoustic pressure, Velocity and density, Frequency and wavelength, Intensity and power, Logarithmic notation- Decibels, absolute references and levels, Source Level, Basics of propagation losses, Target Strength, Back scattering, Acoustic noise, Multiple paths, Doppler effect, Time characteristics of echoes, Active and passive sonar equations, Underwater electro acoustic transducers- projectors and hydrophones, General Structure of SONAR systems.

UNIT - IV SONAR SIGNAL PROCESSING 9

Spatial signals-Signals in space and time, Co-ordinate systems, Propagating waves, Wave number- frequency space, Finite continuous apertures, Spatial sampling, Directivity, Beamforming, Time and frequency domain beamforming, Array gain, Angular resolution, Transmitting signalsNarrowband Vs Chirp, Matched filtering, Range resolution, Time Varying Gain (TVG), Signal intensity to image conversion.

UNIT - V DIFFERENT TYPES OF SONAR SYSTEMS 9

Passive and active sonars, Single beam echo sounder, Multi beam echo sounder, Sub-bottom profiler, Sediment profiler, Side scan sonar, Synthetic aperture sonar, Forward looking sonar.

TOTAL: 45 PERIODS

OUTCOMES:

On successful completion of the course student will be able to:

1. Understand the techniques for underwater imaging
2. Understand the fundamentals of optical image processing
3. Understand the fundamentals of underwater acoustics and ambient noise
4. Exposer for array processing techniques for underwater imaging applications
5. Design of Filter and impedance matching circuits
6. Know about SONAR system and its applications

TEXT BOOKS:

1. Bernd Jahne, “Digital Image processing, Sixth Edition, Springer,2005
2. Rafael C. Gonzalez, Richard E. Woods, Steven Eddins, “Digital Image Processing using MATLAB, Third Edition, Gatesmark Publishing,2020
3. P.K. Thiruvikraman,”A Course on Digital Image processing with MATLAB, First Edition, IOP Publishing,2020

REFERENCES:

1. Tinku & Ajoy K. Ray,”Image Processing principles & Applications, First Edition, WileyInterscience,2005
2. Xavier Lurton,”An Introduction to Underwater Acoustics (Principles andapplications), Second Edition, Springer,2010
3. Don H. Johnson and Dan E. Dudgeon,”Array Signal Processing: Concepts and Techniques, First Edition, Prentice Hall,1993
4. Harry L. Van Trees,”Optimum Array Processing, First Edition, Wiley Interscience,2002
5. Richard O. Nielsen,”Sonar Signal Processing, First Edition, Artech House,1991
6. A. D. Waite,”SONAR for Practicing Engineers, Third Edition, Wiley,2002

VERTICAL III - RF TECHNOLOGIES

		L	T	P	C
21EC1915	**ELECTROMAGNETIC INTERFERENCE AND COMPATABILITY**	**3**	**0**	**0**	**3**

OBJECTIVES:

- To introduce the basic concepts of Electromagnetic Interference
- To explain 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.

TOTAL: 45 PERIODS

OUTCOMES:

On successful completion of the course student will be able to:

1. Understand the basic concepts of EMI/EMC.
2. Identify the various types and mechanisms of Electromagnetic Interference.
3. Understand various EMI coupling principles.
4. Understand EMC design for circuits and PCBs.
5. Propose a suitable EMI mitigation technique.
6. 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.
2. Henry W.Ott., “Noise Reduction Techniques in Electronic Systems”, A Wiley Inter Science Publications, John Wiley and Sons, Newyork, 1988.

REFERENCES:

1. C.R.Paul, “Introduction to Electromagnetic Compatibility” , John Wiley and Sons, Inc,1992.
2. Bemhard Keiser, “Principles of Electromagnetic Compatibility”, 3rd Ed, Artech house,Norwood,1986.
3. Don R. J.White Consultant Incorporate, “Handbook of EMI/EMC”, Vol I-V, 1988.

21EC1916	RFID SYSTEMS AND APPLICATIONS	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To understand the fundamentals of RFID systems and Sensors
- To know the design challenges needed for analysis of RFID Enabled Sensors
- To develop awareness to RFID Applications.

UNIT - I FUNDAMENTALS AND OPERATING PRINCIPLES OF RFID 9

Introduction - Barcode Systems, magnetic Strip Card, Smart cards, RFID systems-History of RFID - RFID Tag Components: Tag Antenna, Integrated Circuits, Substrate. RFID Tag Types: Passive Tags, Active Tags, 1-Bit Transponder and Chip less Tags.

UNIT - II COMMUNICATION IN RFID SYSTEMS 9

Coupling Mechanisms-Data Encoding- Multipath Effect-Tag Reader and Sensor Communication-Passive Systems-Active Systems, UWB, Zigbee and Wi-Fi Tags.

UNIT - III OPERATING PRINCIPLES OF SENSORS 9

Types of Sensors, Use of Sensors, Basic Considerations of Sensor Design, Requirements for Accuracy, Requirements for Resolution, Environment of the Sensor, Calibration, Wireless Sensors and Wireless Sensor Networks.

UNIT - IV DESIGN OF RFID-ENABLED SENSORS 9

RFID Antenna Design Challenges, Antenna Basics and the Dipole, Passive RFID Antennas Using Serial Stubs, Bowtie T-Match RFID Antenna, Passive RFID Antenna Using Inductively Coupled Feed Structure, Voltage Multiplier for RFID Integrated Circuits, Microcontroller for Active RFID-Enabled Sensor.

UNIT - V RFID APPLICATIONS 9

Access Control Transportation Ticketing-Personnel identification – Vehicle identification-Production line monitoring. Long range RFID applications: Supply chain management-Mail and shipping-Clothing Tags-Food production control.

TOTAL: 45 PERIODS

OUTCOMES:

On successful completion of the course student will be able to:

1. Describe the functions and operations of an RFID components and systems.
2. Outline the performance characteristics of different types of RFID systems.
3. Understand the basic consideration and requirement of RFID sensors.
4. Analyze the antenna design considerations for RFID-enabled sensors.
5. Explain the essential components of IC or microcontrollers and their potential use in RFID-enabled sensors.
6. Develop RFID for Social and Environmental Applications.

TEXT BOOKS:

1. Amin Rida, LiYang, Manos Tentzeris, "RFID-Enabled Sensor Design and Applications", 2nd Edition, Artech house, 2010.
2. V. Daniel Hunt, Alber Puglia, Mike Puglia, "RFID: A guide for radio frequency identification", Wiley & Sons, Inc., Publication, 2011.

REFERENCES:

1. Klaus Finkenzeller, "RFID Handbook – Fundamentals and applications in contact less smart cards, radio frequency identification and near-field communication", 3rd edition,Wiley 2010.
2. Steven Shepard, "Radio Frequency Identification", 1st Edition, McGraw Hill, 2011.

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21EC1917	RF MEMS	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To understand the basic principles of RF MEMS.
- To study and explore MEMS switches.
- To give a thorough understanding of MEMS Inductors and Capacitors.
- To give insight on micro-machined RF filters and phase shifters.

UNIT - I INTRODUCTION OF RF MEMS 9

MEMS, Micro-fabrications for MEMS, Electromechanical transducers, Micro-sensing for MEMS, Materials for MEMS.

UNIT - II RF MEMS SWITCHES AND MICRO RELAYS 9

Switch parameters, Basics of switching, Switches for RF and microwave applications, Actuation mechanisms for MEMS devices, Bistable micro relays and micro-actuators, Dynamics of the switch operation, MEMS switch design, modeling and evaluation, MEMS switch design considerations.

UNIT - III MEMS INDUCTORS AND CAPACITORS 9

MEMS inductors: Self-inductance and mutual inductance, Micro-machined inductors, Effect of inductor layout, Reduction of stray capacitance of planar inductors, Approaches for improving the quality factor, Types of Inductors.
MEMS capacitors: MEMS gap-tuning capacitors, MEMS area-tuning capacitors, Dielectric tunable capacitors.

UNIT - IV MICROMACHINED RF FILTERS 9

Modeling of mechanical filters, modeling of resonator- mechanical coupling components- general consideration for mechanical filters, Micro-mechanical filters, Surface acoustic wave filters, Bulk acoustic wave filters, Micro-machined filters for millimeter wave frequencies.

UNIT - V MICROMACHINED PHASE SHIFTERS 9

Types of phase shifters and their limitations, MEMS phase shifters, switched delay line phase shifters- distributed MEMS phase shifters-polymer, Ferroelectric phase shifters, Distributed parallel plate capacitor – Interdigital capacitor phase shifters, Applications

TOTAL: 45 PERIODS

OUTCOMES:

On successful completion of the course student will be able to:

1. Understand the basic principles of RF MEMS.
2. Explain the operation of RF MEMS switches and micro relays.
3. Explain the operation of MEMS Inductors and Capacitors.
4. Compare the properties of MEMS inductors and capacitors.
5. Understand the working operation of various micro-machined RF filters.
6. Explain the different types of micro-machined phase shifters.

TEXT BOOKS:

1. Vijay K.Varadan, Vinoy.K.J and Jose.K.A, “RF MEMS and Their Applications”, Reprint, John Wiley & Sons, 2003.
2. Gabriel M. Rebeiz, “RF MEMS: Theory, Design, and Technology”, Wiley, 2003.

REFERENCES:

1. Hector J. De Los Santos, “Introduction to Micro electromechanical Microwave Systems”, 2nd Edition, Artech House, 2004.
2. Jacopo Iannacci, “Practical Guide to RF-MEMS”, John Wiley & Sons, 2013.
3. NadimMaluf, Kirt Williams, "Introduction to Micro electromechanical Systems Engineering", Artech House, 2004.

21EC1918	SMART ANTENNAS	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To understand the basic principles of smart antennas.
- To study insight on various DOA estimation techniques.
- To explore the basics on beamforming.
- To gain knowledge on integration of smart antennas and its processing methods.

UNIT - I INTRODUCTION TO SMART ANTENNAS 9

Need for Smart Antennas, Overview, Smart Antenna Configurations, Space Division Multiple Access (SDMA), Architecture of a Smart Antenna System, Benefits and Drawbacks, Basic Principles, Mutual Coupling Effects.

UNIT - II DOA ESTIMATION FUNDAMENTALS 9

Array Response Vector, Received Signal Model, Subspace-Based Data Model, Signal Auto-covariance Matrices, Conventional DOA Estimation Methods - Conventional Beamforming Method - Capon's Minimum Variance Method, Subspace Approach to DOA Estimation - MUSIC Algorithm - ESPRIT Algorithm, Uniqueness of DOA Estimates.

UNIT - III BEAMFORMING ALGORITHMS 9

The Classical Beamformer, Statistically Optimum Beamforming Weight Vectors- The Maximum SNR Beamformer- The Multiple Sidelobe Canceller and the Maximum SINR Beamformer- Minimum Mean Square Error (MMSE)- Direct Matrix Inversion (DMI)- Linearly Constrained Minimum Variance (LCMV), Adaptive Algorithms for Beamforming- The Least Mean-Square (LMS) Algorithm- The Recursive Least-Squares (RLS) Algorithm

UNIT - IV SPACE–TIME PROCESSING 9

Discrete Space–Time Channel and Signal Models, Space–Time Beamforming, Intersymbol and Co-Channel Suppression, Space–Time Processing for DS-CDMA, Capacity and Data Rates in MIMO Systems.

UNIT - V ADAPTIVE ARRAYS 9

Spatial covariance matrix, multi-beam arrays, Scanning arrays, switched beam beamformers, Fully adaptive beamformers - Temporal reference beamforming, spatial reference beamforming, Blind beamforming algorithms – DILFAST and SCORE algorithm

TOTAL: 45 PERIODS

OUTCOMES:

On successful completion of the course student will be able to:

1. Understand the basic principles of smart antennas.
2. Explain various DOA estimation techniques.
3. Understand the fundamentals of Beamforming and its algorithm.
4. Explain the importance of integration of smart antennas using various algorithms.
5. Explain the concept of space time processing.
6. Explain the various factors for space time processing for DS-CDMA.

TEXT BOOKS:

1. Constantine A. Balanis & Panayiotis I. Ioannides, “Introduction to Smart Antennas”, Morgan & Claypool Publishers’ series
2. Joseph C. Liberti Jr., Theodore S Rappaport, “Smart Antennas for Wireless Communications IS

REFERENCES:

1. T.S Rappaport, “Smart Antennas Adaptive Arrays Algorithms and Wireless Position Location”, IEEE press 1998, PTR – PH publishers 1999.
2. Lal Chand Godara, “Smart Antennas”, CRC Press, LLC-20.
3. Ben Allen, M. Ghavami, “Adaptive Array Systems: Fundamentals and Applications’, John Wiley & Sons, Ltd, 2005.

21EC1919	RF SYSTEM DESIGN	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To understand the fundamentals of RF design and Microwave integrated circuits.
- To understand the various components of RF system for Wireless Communications.
- To know the basic techniques needed for analysis of RF systems.

UNIT - I RF DEVICES & IMPEDANCE MATCHING 9

Active RF components: Semiconductor basics in RF, bipolar junction transistors, RF field effect transistors, High electron mobility transistors, Impedance matching networks- Matching using discrete components and stub tuning.

UNIT - II ACTIVE RF COMPONENT & MODELING 9

Diode Model - Linear and Non-linear Diode Model, Transistor models- Large-Signal BJT Models - Small-Signal BJT Models, Measurements of Active devices- DC Characterization of Bipolar Transistor - Measurements of AC Parameters of Bipolar Transistor- scattering parameter device characterization.

UNIT - III RF TRANSISTOR AMPLIFIERS 9

Characteristics of Amplifier, Amplifier power relations, Stability consideration, constant gain, Noise figure circles, constant VSWR circles, Broadband high power and multistage amplifiers.

UNIT - IV RF FILTER 9

Basic resonators and Filter configuration - Filter Types and Parameters- Low-Pass Filter- High-Pass Filter-Bandpass and Bandstop Filters - Insertion Loss, special filter realization- Butterworth-Type Filter- Chebyshev-Type Filters.

UNIT - V OSCILLATOR & MIXER 9

Basic oscillator model, Negative Resistance Oscillator , Quartz Oscillators, High frequency oscillator configuration- Dielectric Resonator Oscillators - YIG-Tuned Oscillator - Gum Element Oscillator, Basic characteristics of mixers - Single-Ended Mixer Design - Single-Balanced Mixer - Double-Balanced Mixer.

TOTAL: 45 PERIODS

OUTCOMES:

On successful completion of the course student will be able to:

1. Understand the basic concepts of various RF devices.
2. Explain the design of various impedance matching networks.
3. Describe the characteristics of active RF components.
4. Explore the concepts of RF transistor amplifiers.
5. Understand the design and implementation of RF filters.
6. Explain the basic concepts of RF Oscillator and Mixer.

TEXT BOOKS:

1. Reinhold Ludwig and Pavel Bretshko, “RF Circuit design Theory and Applications”, Pearson Education, Inc., 2006
2. B.Razavi, “RF Microelectronics”, Pearson Education, 1997.

REFERENCES:

1. David. M. Pozar, “Microwave Engineering”, 4th Edition, John Wiley & Sons, Inc
2. Ingo Wolff, “Coplanar Microwave Integrated circuits”, John Wiley and sons, New Jersey, 2006.
3. T. Lee, “Design of CMOS RF Integrated Circuits”, Cambridge, 2004.

PANIMALAR ENGINEERING COLLEGE CHENNAI. JAISAKTHI EDUCATIONAL TRUST

21EC1920 SIGNAL INTEGRITY FOR HIGH SPEED DESIGN

L	T	P	C
3	0	0	3

OBJECTIVES:

- To study the signal propagation on transmission lines.
- To explore multi-conductor transmission lines.
- To study the insights on non-ideal effects.
- To introduce methods to improve the signal transmission characteristics.

UNIT - I SIGNAL PROPAGATION ON TRANSMISSION LINES 9

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

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

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

UNIT - III NON-IDEAL EFFECTS 9

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

UNIT - IV POWER CONSIDERATIONS AND SYSTEM DESIGN 9

SSN/SSO, DC power bus design, layer stack up, SMT decoupling, Logic families, power consumption, and system power delivery, Logic families and speed Package types and parasitic 32, SPICE, IBIS models, Bit streams, PRBS and filtering functions of link-path components, Eye diagrams, jitter, inter-symbol interference Bit-error rate, Timing analysis.

UNIT - V CLOCK DISTRIBUTION AND CLOCK OSCILLATORS 9

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

TOTAL: 45 PERIODS

OUTCOMES:

On successful completion of the course student will be able to:

1. Identify sources affecting the speed of digital circuits.
2. Characterize and model multi-conductor transmission line.
3. Identify methods to improve the signal transmission characteristics.
4. Analyze non-ideal effects of transmission line.
5. Analyze clock distribution system.
6. Understand clock oscillators.

TEXT BOOKS:

1. H. W. Johnson and M. Graham, "High-Speed Digital Design: A Handbook of Black Magic", Prentice Hall, 1993.
2. S. Hall, G. Hall, and J. McCall, "High-Speed Digital System Design: A Handbook of Interconnect Theory and Design Practices", Wiley-Interscience, 2000.

REFERENCES:

1. Douglas Brooks, "Signal Integrity Issues and Printed Circuit Board Design", Prentice Hall PTR, 2003.
2. Eric Bogatin, "Signal Integrity – Simplified", Prentice Hall PTR, 2003.

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21EC1921	COMPUTATIONAL ELECTROMAGNETICS	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To build the concepts on computational electromagnetic theory
- To compute various types of problems on electromagnetics
- To develop analytical and numerical skill on electromagnetics
- To introduce the concepts on applications of computational electromagnetic theory

UNIT - I EM REVIEW 9

E-field - Permittivity – Coulomb's Law - Flux of a vector field – Gauss's Law for E fields (Integral) - Divergence – Gauss's Law for E fields (Differential) B-field - Permeability - Biot-Savart law – Gauss's law for B fields (integral and differential) - Divergence Theorem - Circulation of a vector field - Curl - Stokes Theorem. Gradient. Laplacian. Poisson and Laplace equations. Ampere-Maxwell Law - Faraday-Maxwell Law - Continuity equation - Constitutive equations.

UNIT - II NUMERICAL DIFFERENTIATION 9

Forward difference - Backward difference - Central difference - Higher order derivatives - Partial derivatives - Solution of Linear Systems: Matrix equivalent. Solution sets - Direct vs Iterative methods - Sparse matrices – Libraries - Gaussian Elimination - Gauss-Seidel method - Numerical Integration Riemann Sums Left/right-point rules Midpoint -Trapezoid - Simpsons rules -Error bounds -Numerical Integration Examples

UNIT - III METHOD OF MOMENTS 9

Greens Functions - Surface equivalence principle - Electrostatic formulation - Magnetostatic formulation - Electric Field Integral Equation - Magnetic Field Integral Equation - Direct and Iterative Solvers

UNIT - IV FINITE DIFFERENCE TIME DOMAIN METHODS 9

1D wave propagation - Vee Algorithm - Numerical dispersion and stability - Perfectly matched absorbing boundary conditions - Dispersive materials.\xa0Antenna and scattering problems with FDTD - Non-uniform grids - Conformal grids – Periodic structures

UNIT - V APPLICATIONS OF CEM 9

Antennas - Biological electromagnetic effects - Electronic packing and High speed circuits - Microwave devices and circuits - Environmental issues - Surveillance and intelligence gathering - Homeland security - Signal integrity.

TOTAL: 45 PERIODS

OUTCOMES:

On successful completion of the course student will be able to:

1. To understand the concepts on computational electromagnetic theory
2. To compute various types of problems on electromagnetics
3. To understand various types of analytical and numerical techniques to solve problems on electromagnetics
4. To Understand the concepts and analysis approaches of MoM and FDTD methods.
5. To apply various types of analytical and numerical techniques to solve a boundary value problem related to electromagnetics.
6. To comprehend various applications of computational electromagnetic theory

TEXT BOOKS:

1. Walton C Gibson , "The Method of Moments in Electromagnetics", CRC Press, 2014.
2. Peterson, Scott L Ray and Raj Mittra , "Computational Methods for Electromagnetics", IEEE Press Series on Electromagnetic Wave Theory, 1998.

REFERENCES:

1. Roger F Harrington, "Field Computation by Moment Methods", IEEE Press, 1993.
2. Taflove A, Hagness SC , "Computational Electrodynamics: The Finite Difference Time Domain Method", Artech House, 2004.

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VERTICAL IV BIOMEDICAL TECHNOLOGIES

21EC1922	MEDICAL ELECTRONICS	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To gain knowledge about the various physiological parameters both electrical and non-electrical
- To understand the methods of recording and also transmitting the physiological 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 AND IMAGING SYSTEM 9

Cardiac pacemakers, DC Defibrillator, Dialyser, Ventilators – Positive pressure ventilator, Magnetic Resonance Imaging Systems, Ultrasonic Imaging Systems – principles - Types -Applications.

UNIT - IV PHYSICAL MEDICINE AND BIOTELEMETRY 9

Diathermies - Shortwave, Ultrasonic and Microwave type and their applications, Surgical Diathermy, Biotelemetry - Single channel – Multichannel – Applications.

UNIT - V RECENT TRENDS IN MEDICAL INSTRUMENTATION 9

Telemedicine for healthcare , Insulin Pumps, Radio pill, Endomicroscope, Brain machine interface: Fundamentals of BMI – Structure of BMI system – Classification of BMI, Lab on a chip (LOC) - Challenges of LOC- Applications of LOC.

TOTAL: 45 PERIODS

OUTCOMES:

On successful completion of the course student will be able to:

1. Discuss the human body electro- physiological parameters and recording of bio-potentials.
2. Describe the measurement techniques for various non electrical parameters.
3. Interpret the various assist devices used in the hospitals viz. pacemakers, defibrillators, dialyzers and ventilators.
4. Comprehend physical medicine methods eg. Ultrasonic, shortwave, microwave surgical diathermies.
5. Describe the principles of Bio –Telemetry.
6. Explain the recent trends in medical instrumentation.

TEXT BOOKS:

1. Leslie Cromwell, “Biomedical Instrumentation and Measurement”, Prentice Hall of India, New Delhi, 2017.

REFERENCES:

1. Khandpur, R.S., “Handbook of Biomedical Instrumentation”, TATA Mc Graw-Hill, New Delhi, 2013.
2. John G.Webster, “Medical Instrumentation Application and Design”, 3rd Edition, Wiley India, 2014.

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21EC1923	WEARABLE MEDICAL DEVICES	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To know the hardware requirement of wearable systems.
- To understand the communication and security aspects in the wearable devices.
- To know the applications of wearable devices in the field of medicine.

UNIT - I INTRODUCTION TO WEARABLE SYSTEMS AND SENSORS 9

Wearable Systems- Introduction, Need for Wearable Systems, Drawbacks of conventional Systems for Wearable Monitoring, Applications of Wearable Systems, Types of Wearable Systems, Components of wearable Systems. Sensors for wearable systems-Inertia movement sensors, Respiration activity sensor, Inductive plethysmography, Impedance plethysmography, pneumography, Wearable ground reaction force sensor.

UNIT - II SIGNAL PROCESSING AND ENERGY HARVESTING FOR WEARABLE DEVICES 9

Wearability issues -physical shape and placement of sensor, Technical challenges- sensor design, signal acquisition, sampling frequency for reduced energy consumption, Rejection of irrelevant information. Power Requirements- Solar cell, Vibration based, Thermal based, Human body as a heat source for power generation, Hybrid thermoelectric photovoltaic energy harvests, Thermopiles.

UNIT - III WIRELESS HEALTH SYSTEMS 9

Need for wireless monitoring, Definition of Body area network, BAN and Healthcare, Technical Challenges- System security and reliability, BAN Architecture – Introduction, Wireless communication Techniques.

UNIT - IV SMART TEXTILE 9

Introduction to smart textile- Passive smart textile, active smart textile. Fabrication Techniques- Conductive Fibres, Treated Conductive Fibres, Conductive Fabrics, Conductive Inks. Case study- smart fabric for monitoring biological parameters - ECG, respiration.

UNIT - V APPLICATIONS OF WEARABLE SYSTEMS 9

Medical Diagnostics, Medical Monitoring-Patients with chronic disease, Hospital patients, Elderly patients, neural recording, Gait analysis, Sports Medicine.

TOTAL: 45 PERIODS

OUTCOMES:

On successful completion of the course student will be able to:

1. Describe the concepts of wearable system.
2. Explain the energy harvestings in wearable device.
3. Analyze the signal from bio sensors.
4. Use the concepts of BAN in health care.
5. Illustrate the concept of smart textile.
6. Compare the various wearable devices in healthcare system.

TEXT BOOKS:

1. Annalisa Bonfiglo and Danilo De Rossi, “Wearable Monitoring Systems, Springer”, 2011.
2. Zhang and Yuan-Ting, “Wearable Medical Sensors and Systems,Springer”, 2013.
3. Edward Sazonov and Micheal R Neuman, “Wearable Sensors: Fundamentals, Implementation and Applications”, Elsevier, 2014.
4. Mehmet R.Yuce and Jamil Y.Khan, “Wireless Body Area Networks Technology, implementation applications”, Pan Stanford Publishing Pvt.Ltd, Singapore, 2012.

REFERENCES:

1. Sandeep K.S, Gupta, Tridib Mukherjee and Krishna Kumar Venkatasubramanian, Body Area Networks Safety, Security, and Sustainability, Cambridge University Press, 2013.
2. Guang-Zhong Yang, Body Sensor Networks, Springer, 2006.

21EC1924	HUMAN ASSIST DEVICES	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To study the role and importance of machines that takes over the functions of the heart and lungs.
- To study various mechanical techniques that helps a non-functioning heart.
- To learn the functioning of the artificial kidney.
- To understand the tests to assess the hearing loss and development of electronic devices to compensate for the loss.
- To study about recent techniques used in arm and legs replacement.

UNIT - I HEART LUNG MACHINE AND ARTIFICIAL HEART 9

Condition to be satisfied by the H/L System. Different types of Oxygenators, Pumps, Pulsatile and Continuous Types, Monitoring Process, Shunting, The Indication for Cardiac Transplant, Driving Mechanism, Blood Handling System, Functioning and different types of Artificial Heart, Schematic for temporary bypass of left ventricle.

UNIT - II CARDIAC ASSIST DEVICES 9

Assisted through Respiration, Right and left Ventricular Bypass Pump, Auxiliary ventricle, Open Chest and Closed Chest type, Intra Aortic Balloon Pumping, Prosthetic Cardiac valves, Principle of External Counter pulsation techniques.

UNIT - III ARTIFICIAL KIDNEY 9

Indication and Principle of Haemodialysis, Membrane, Dialysate, types of filter and membranes, Different types of hemodialyzers, Monitoring Systems, Wearable Artificial Kidney, Implanting Type.

UNIT - IV RESPIRATORY AND HEARING AIDS 9

Ventilator and its types-Intermittent positive pressure, Breathing Apparatus Operating Sequence, Electronic IPPB unit with monitoring for all respiratory parameters. Types of Deafness, Hearing Aids, wearable devices for hearing correction.

UNIT - V PROSTHETIC AND ORTHOTIC DEVICES 9

Hand and Arm Replacement - Different Types of Models Externally Powered Limb Prosthesis, Lower Limb and Upper limb orthotic devices, Functional Electrical Stimulation, Sensory Assist Devices, Materials for Prosthetic and orthotic devices.

TOTAL: 45 PERIODS

OUTCOMES:

On successful completion of the course student will be able to:

1. Explain the principles and construction of artificial heart.
2. Illustrate the function of Heart lung machine.
3. Understand various mechanical techniques that improve heart function
4. Explain the functioning of the membrane or filter that cleanses the blood.
5. Describe the tests to assess the hearing loss and development of wearable devices for the hearing loss.
6. Explore the different types of models for Prosthethic and orthotic purpose.

TEXT BOOKS:

1. John. G . Webster, “Bioinstrumentation”, John Wiley & Sons (Asia) Pvt Ltd , 2014.
2. Joseph D.Bronzino, “The Biomedical Engineering Handbook”, Third Edition: Three Volume Set, CRC Press, 2006.

REFERENCES:

1. Andreas.F. Von racum, “Hand book of bio material evaluation”, Mc-Millan publishers, 2000.
2. Gray E Wnek, Gray L Browlin, “Encyclopedia of Biomaterials and Biomedical Engineering” Marcel Dekker Inc New York 2004.
3. D.S. Sunder, “Rehabilitation Medicine”, 3rd Edition, Jaypee Medical Publication, 2010.
4. Albert M.Cook and Webster J.G., “Therapeutic Medical Devices”, Prentice Hall Inc., New Jersey,2013.

21EC1925	MEDICAL IMAGING SYSTEMS	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To understand the generation of X-ray and its uses in Medical imaging.
- To describe the principle of Computed Tomography.
- To know the techniques used for visualizing various sections of the body.
- To learn the principles of different radio diagnostic equipment in Imaging.
- To discuss the radiation therapy techniques and radiation safety.

UNIT - I X RAYS 9

Nature of X-rays- X-Ray absorption – Tissue contrast, X- Ray Equipment (Block Diagram) – X-Ray Tube, the collimator, Bucky Grid, power supply, Digital Radiography - discrete digital detectors, storage phosphor and film scanning, X-ray Image Intensifier tubes – Fluoroscopy – Digital Fluoroscopy, Angiography, cine Angiography, Digital subtraction Angiography, Mammography.

UNIT - II COMPUTED TOMOGRAPHY 9

Principles of tomography, CT Generations, X- Ray sources- collimation- X- Ray detectors – Viewing systems – spiral CT scanning – Ultra fast CT scanners, Image reconstruction techniques – back projection and iterative method.

UNIT - III MAGNETIC RESONANCE IMAGING 9

Fundamentals of magnetic resonance- properties of electromagnetic waves : speed , amplitude, phase, orientation and waves in matter - Interaction of Nuclei with static magnetic field and Radio frequency wave- rotation and precession – Induction of magnetic resonance signals – bulk magnetization – Relaxation processes T1 and T2, Block Diagram approach of MRI system – system magnet (Permanent, Electromagnet and Superconductors), generations of gradient magnetic fields, Radio Frequency coils (sending and receiving), shim coils, Electronic components, fMRI.

UNIT - IV NUCLEAR IMAGING 9

Radioisotopes- alpha, beta, and gamma radiations, Radio Pharmaceuticals. Radiation detectors – gas filled, ionization chambers, proportional counter, GM counter and scintillation Detectors, Gamma camera – Principle of operation, collimator, photomultiplier tube, X-Y positioning circuit, pulse height analyzer. Principles of SPECT and PET.

UNIT - V RADIATION THERAPY AND RADIATION SAFETY 9

Radiation therapy – linear accelerator, Telegamma Machine, SRS – SRT – Recent Techniques in radiation therapy – 3D CRT – IMRT – IGRT and Cyber knife – radiation measuring instruments Dosimeter, film badges, Thermo Luminescent dosimeters – electronic dosimeter – Radiation protection in medicine – radiation protection principles.

TOTAL: 45 PERIODS

OUTCOMES:

On successful completion of the course student will be able to:

1. Describe the working principle of the X-ray machine and its application.
2. Illustrate the principle computed tomography.
3. Interpret the technique used for visualizing various sections of the body using Magnetic Resonance Imaging.
4. Demonstrate the applications of radionuclide imaging.
5. Analyze different imaging techniques and choose appropriate imaging equipment for better diagnosis and outline the methods of radiation safety.
6. Outline the methods of radiation safety.

TEXT BOOKS:

1. Isaac Bankman, I. N. Bankman , "Handbook Of Medical Imaging: Processing and Analysis(Biomedical Engineering)",Academic Press,2000.
2. Jacob Beutel (Editor), M. Sonka (Editor), "Handbook of Medical Imaging", Volume 2. Medical Image Processing and Analysis, SPIE Press 2000.
3. Khin Wee Lai, Dyah Ekashanti Octorina Dewi "Medical Imaging Technology", Springer Singapore, 2015.

REFERENCES:

1. Khandpur R.S, "Handbook of Biomedical Instrumentation", Tata McGraw – Hill, New Delhi, 2003.
2. Dougherty, Geoff(Ed.), "Medical Image Processing- Techniques and Applications " , Springer -Verlag New York, 2011.

21EC1926	WIRELESS BODY AREA NETWORKS	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To know the hardware requirement of BAN.
- To understand the communication and security aspects in the BAN.
- To know the applications of BAN in the field of medicine.

UNIT - I INTRODUCTION TO BAN 9

Definition, BAN and Healthcare, Technical Challenges- Sensor design, biocompatibility, Energy Supply, optimal node placement, number of nodes, System security and reliability, BAN Architecture – Introduction.

UNIT - II HARDWARE FOR BAN 9

Processor-Low Power MCUs, Mobile Computing MCUs, Integrated processor with radio transceiver, Memory, Antenna-PCB antenna, Wire antenna, Ceramic antenna, External antenna, Antenna design and testing, Sensor Interface, Power sources-Batteries and fuel cells for sensor nodes.

UNIT - III TECHNOLOGIES FOR BAN 9

RF communication in Body, Propagation, Base Station-Network topology-Standalone BAN, Wireless personal Area Network Technologies-IEEE 802.15.1, IEEE P802.15.13, IEEE 802.15.14.

UNIT - IV COEXISTENCE ISSUES WITH BAN 9

Interferences – Intrinsic - Extrinsic, Effect on transmission, Counter measures- on physical layer and data link layer, Regulatory issues-Medical Device regulations, Security and Self-protection-Bacterial attacks, Virus infection, Secured protocols, Self-protection.

UNIT - V APPLICATIONS OF BAN 9

Monitoring patients with chronic disease, Hospital patients, Elderly patients, Cardiac arrhythmias monitoring, Multi patient monitoring systems, Multichannel Neural recording, Gait analysis, Sports Medicine, Electronic pill.

TOTAL: 45 PERIODS

OUTCOMES:

On successful completion of the course student will be able to:

1. Comprehend and appreciate the significance and role of this course in the present contemporary world.
2. Explain various processors used for BAN.
3. Design a BAN for appropriate application in medicine.
4. Assess the efficiency of communication and the security parameters.
5. Understand the need for medical device regulation and regulations followed in various Regions.
6. Extend the concepts of BAN for medical applications.

TEXT BOOKS:

1. Sandeep K.S. Gupta,Tridib Mukherjee, Krishna Kumar Venkata Subramanian, “Body Area Networks Safety, Security, and Sustainability’’, Cambridge University Press, 2013.
2. Mehmet R. Yuce, Jamil Y.Khan, “Wireless Body Area Networks Technology, Implementation, and Applications”, Pan Stanford Publishing Pte. Ltd., Singapore, 2012.

REFERENCES:

1. Zhang, Yuan-Ting, “Wearable Medical Sensors and Systems’’, Springer, 2013.
2. Guang-Zhong Yang(Ed.), “Body Sensor Networks’’, Springer, 2006.
3. Annalisa Bonfiglio, Danilo De Rossi, "Wearable Monitoring Systems", Springer, 2011.

21EC1927	BRAIN COMPUTER INTERFACE AND APPLICATIONS	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To understand the basic concepts of brain computer interface.
- To study the various signal acquisition methods.
- To study the signal processing methods used in BCI.

UNIT - I INTRODUCTION TO BCI 9

Fundamentals of BCI – Structure of BCI system – Classification of BCI – Invasive, Non-invasive and Partially invasive BCI – EEG signal acquisition - Signal Preprocessing – Artifacts removal.

UNIT - II ELECTROPHYSIOLOGICAL SOURCES 9

Sensorimotor activity – Mu rhythm, Movement Related Potentials – Slow Cortical Potentials-P300 - Visual Evoked Potential - Activity of Neural Cells - Multiple Neuromechanisms.

UNIT - III FEATURE EXTRACTION METHODS 9

Time/Space Methods – Fourier Transform, PSD – Wavelets – Parametric Methods – AR, MA, ARMA models – PCA – Linear and Non-Linear Features.

UNIT - IV FEATURE TRANSLATION METHODS 9

Linear Discriminant Analysis – Support Vector Machines - Regression – Vector Quantization– Gaussian Mixture Modeling – Hidden Markov Modeling – Neural Networks.

UNIT - V APPLICATIONS OF BCI 9

Functional restoration using Neuroprosthesis - Functional Electrical Stimulation, Visual Feedback and control - External device control, Case study: Brain actuated control of mobile Robot.

TOTAL: 45 PERIODS

OUTCOMES:

On successful completion of the course student will be able to:

1. Describe BCI system and its potential applications.
2. Analyze event related potentials.
3. Analyze sensory motor rhythms.
4. Compute features suitable for BCI.
5. Design classifier for a BCI system.
6. Implement BCI for various applications.

TEXT BOOKS:

1. Bernhard Graimann, Brendan Allison, Gert Pfurtscheller, “Brain-Computer Interfaces: Revolutionizing Human-Computer Interaction”, Springer, 2010.
2. Mehmet R. Yuce, Jamil Y.Khan, “Wireless Body Area Networks Technology, Implementation, and Applications”, Pan Stanford Publishing Pte. Ltd., Singapore, 2012.

REFERENCES:

1. R. Spehlmann, “EEG Primer”, Elsevier Biomedical Press, 2001.
2. Arnon Kohen, “Biomedical Signal Processing”, Vol I and II, CRC Press Inc, Boca Rato, Florida, 2006.
3. Bishop C.M., “Neural Networks for Pattern Recognition”, Oxford, Clarendon Press, 2005.

21EC1928	THERAPEUTIC EQUIPMENT	L T P C 3 0 0 3

OBJECTIVES:

- To learn the principles of cardiac assist devices.
- To understand the need and use of extracorporeal devices, and the use of lasers in medicine.
- To enable the students to gain knowledge on the working of therapeutic clinical equipment.

UNIT - I CARDIAC AND RESPIRATORY THERAPY EQUIPMENT 9

Cardiac Pacemaker: Internal and External Pacemaker– Programmable pacemakers, Cardiac Defibrillators: AC and DC Defibrillator- Internal and External Defibrillators - Protection Circuit, types of Ventilators – Pressure, Volume, and Time controlled. Basic principles of electromechanical, pneumatic and electronic ventilators.

UNIT - II BIOMECHANICAL THERAPEUTIC EQUIPMENT 9

Electrodiagnosis, Therapeutic radiation, Electrotherapy, Electrodes, Stimulators for Nerve and Muscle, Functional Electrical Stimulation, peripheral nerve stimulator, ultrasonic stimulators, Stimulators for pain and relief - Inferential Therapy Unit, TENS, GAIT Assessment and Therapy.

UNIT - III BODY CARE EQUIPMENT 9

Skin Treatment: Ultrasonic spot remove, vacuum therapy unit, Skin tightening, Wrinkle Reduction, Facial and Rejuvenation, Laser hair therapy machine, Body Slimmer/Shaper – Deep Heat Therapy, Massager, Fitness – Treadmill, Bike

UNIT - IV DENTAL CARE EQUIPMENT 9

Dental Chair - Dental Hand pieces and Accessories: Evolution of rotary equipment, Low-speed hand piece, High-speed hand piece, Hand piece maintenance, Vacuum and Pneumatic techniques: Vacuum techniques, Oral evacuation systems, Vacuum pump, Pneumatic techniques, Dental compressor, Decontamination Unit and constant fumigation unit, Dental Radiography: Dental X-ray Machine

UNIT - V HEAT & PHOTON THERAPY EQUIPMENT 9

High frequency heat therapy, Short wave diathermy, Microwave diathermy, Ultrasonic therapy, Lithotripsy. Therapeutic UV and IR Lamps, Basic principles of Biomedical LASERS, Applications of lasers in medicine, CO_2 laser, He-Ne laser, Nd-YAG and Ruby laser.

TOTAL: 45 PERIODS

OUTCOMES:

On successful completion of the course student will be able to:

1. Suggest suitable therapeutic devices for ailments related to cardiology.
2. Suggest suitable therapeutic devices for ailments related to pulmonology, neurology.
3. Comprehend the principles of bodycare equipment
4. Understand the operation of dental care equipment.
5. Analyze the different types of therapies for suitable applications.
6. Appreciate the application of lasers in biomedical applications

TEXT BOOKS:

1. Khandpur. R.S.,"Handbook of Biomedical Instrumentation". Second Edition. Tata McGrawHill Pub. Co., Ltd. 2013.
2. John.G.Webster. "Medical Instrumentation, Application and Design". Fourth Edition.Wiley &s ons, Inc., NewYork. 2019.

REFERENCES:

1. Leslie Cromwell, Fred. J. Weibell & Erich. A. Pfeiffer. "Biomedical Instrumentation and Measurements". Second Edition. Prentice Hall Inc.2020.
2. John Low & Ann Reed. "Electrotherapy Explained, Principles and Practice". Second Edition. Butterworth Heinemann Ltd. 2019.
3. Joseph. J. Carr, John Michael Brown, "Introduction to Biomedical Equipment Technology", Prentice Hall and Technology, 2018.

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VERTICAL V WIRELESS NETWORKS AND IOT

21EC1929	WIRELESS NETWORKS	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To understand the concept about Wireless networks, protocol stack and standards.
- To understand and analyze 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 WLANS 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.

TOTAL: 45 PERIODS

OUTCOMES:

On successful completion of the course student will be able to:

1. Understand the key concepts of wireless networks, standards, technologies and their basic operations.
2. Analyze the network layer solutions for wireless networks.
3. Familiarize with the fundamentals of 3G Services, its protocols and applications.
4. Acquainted with in depth knowledge on internetworking of WLAN and WWAN.
5. Learn about evolution of 4G Networks, its architecture and applications.
6. Implement different type of applications for smart phones and mobile devices with latest network strategies.

TEXT BOOKS:

1. Jochen Schiller, “Mobile Communication”, Second Edition, Pearson Education 2012.
2. Vijay Garg, “Wireless Communications and networking”, First Edition, Elsevier 2007.

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, Joy kuri, “Wireless Networking”, First Edition, Elsevier 2011.
3. Simon Haykin, Michael Moher, David Koilpillai, ―Modern Wireless Communications‖, First Edition, Pearson Education 2013.

21EC1930	ADHOC AND WIRELESS SENSOR NETWORKS	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To learn Ad hoc network and Sensor Network fundamentals.
- To understand the different routing protocols.
- To have an in-depth knowledge on sensor network architecture and design issues.
- To understand the transport layer and security issues possible in Ad hoc networks.
- To understand the transport layer and security issues possible in Sensor networks.
- To 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 6r 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.

TOTAL: 45 PERIODS

OUTCOMES:

On successful completion of the course student will be 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.
6. Gain knowledge to 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.
2. HolgerKarl , Andreas willig, "Protocol and Architecture for Wireless Sensor Networks", John wiley publication, Jan 2006.

REFERENCES:

1. Feng Zhao, Leonidas Guibas, "Wireless Sensor Networks: an information processing approach", Elsevier publication, 2004.
2. Charles E. Perkins, "Ad Hoc Networking", Addison Wesley, 2000.
3. I.F. Akyildiz, W. Su, Sankarasubramaniam, E. Cayirci, "Wireless sensor networks: a survey", computer networks, Elsevier, 2002, 394 - 422.

21EC1931	COOPERATIVE COMMUNICATIONS AND NETWORKING	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To introduce the key concepts of Cooperative communications protocols.
- To learn about the concepts of multi node Cooperative communications.
- To understand the concepts of differential modulations for various cooperative communications.
- To bring out the concepts of cooperative networks.
- To present the application of cooperative networks in broadband communication.

UNIT - I COOPERATIVE COMMUNICATIONS WITH SINGLE RELAY 9

Cooperative communications, Cooperation protocols, System model, SER analysis for DF protocol, SER analysis for AF protocol, Comparison of DF and AF cooperation gains, Trans-modulation in relay communications

UNIT - II MULTI-NODE COOPERATIVE COMMUNICATIONS 9

Multi-node decode-and-forward protocol, Multi-node amplify-and-forward protocol, Distributed space–time coding (DSTC), Distributed space–frequency coding (DSFC)

UNIT - III DIFFERENTIAL MODULATION FOR COOPERATIVE COMMUNICATIONS 9

Differential modulation, Differential modulations for DF cooperative communications, Differential modulation for AF cooperative communications

UNIT - IV COOPERATIVE NETWORKING 9

Cognitive multiple access via cooperation - System model, CCMA protocols, Stability analysis, Throughput region, Delay analysis; Content-aware cooperative multiple access - System model, protocol, Dynamic state model, Performance analysis.

UNIT - V BROADBAND COOPERATIVE COMMUNICATIONS AND COVERAGE EXPANSION 9

System model, Cooperative protocol and relay-assignment scheme, Performance analysis, Performance lower bound and Optimum relay location.

TOTAL: 45 PERIODS

OUTCOMES:

On successful completion of the course student will be able to:

1. Understand the key concepts of Cooperative communications.
2. Learn about the concepts of multi node Cooperative communications.
3. Understand the concepts of differential modulations for cooperative communications.
4. Understand about cooperative networks.
5. Apply the Cooperative communication and networking concepts to broadband communications.
6. Able to develop various networks to expand coverage area.

TEXT BOOKS:

1. K.j.Ray liu, Ahmed k.Sadek, weifeng Su and Andres kwasinski “Cooperative Communications and Networking” Cambridge University Press, 2009.

REFERENCES:

1. Y.-W. Peter Hong , Wan-Jen Huang , C.-C. Jay Kuo., “Cooperative Communications and Networking: Technologies and System Design”,Kindle Edition, 2010.
2. Gerhard kramer, Ivana maric and Roy D, “Cooperative Communications (Foundations and Trends in Networking)” , Ebook PDF, Kindle Edition, in 2006.

21EC1932	IoT AND ITS APPLICATIONS	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To know the fundamentals of IoT.
- To bring the IoT perspective in thinking and building solutions using Arduino and Raspberry pi.
- To provide overview of applications of IoT and relevant technologies.
- To explore various components of the Internet of things such as Sensors, internetworking and cyber space.
- To be able to design and implement IoT circuits and solutions.

UNIT - I INTRODUCTION TO IoT SYSTEMS 9

Introduction to IoT: Sensing, Actuation, Networking basics, Communication Protocols, Sensor Networks, Machine-to-Machine Communications, IoT Definition, Characteristics. IoT Functional Blocks, Physical design of IoT, Logical design of IoT, Communication models & APIs.

UNIT - II M2M FOR IoT 9

The Vision-Introduction, From M2M to IoT, M2M towards IoT-the global context, A use case example, Differing Characteristics. Definitions, M2M Value Chains, IoT Value Chains, An emerging industrial structure for IoT.

UNIT - III M2M VS IoT AN ARCHITECTURAL OVERVIEW 9

Building architecture, Main design principles and needed capabilities, An IoT architecture outline, standards considerations. Reference Architecture and Reference Model of IoT.

UNIT - IV IoT REFERENCE ARCHITECTURE 9

Getting Familiar with IoT Architecture, Various architectural views of IoT such as Functional, Information, Operational and Deployment. Constraints affecting design in IoT world-Introduction, Technical design Constraints.

UNIT - V DOMAIN SPECIFIC APPLICATIONS OF IoT 9

Home automation, Industry applications, Surveillance applications, Other IoT applications. Cisco IoT system – IBM Watson IoT platform – Manufacturing – Converged Plant wide Ethernet Model (CPwE) – Power Utility Industry – Grid Blocks Reference Model – Smart and Connected Cities: Layered architecture, Smart Lighting, Smart Parking Architecture and Smart Traffic Control.

TOTAL: 45 PERIODS

OUTCOMES:

On successful completion of the course student will be able to:

1. Articulate IoT sensing and actuation methods and physical design of IoT systems.
2. Interpret the M2M architecture for IoT.
3. Relate architecture overview of IoT systems.
4. Infer knowledge on IoT reference architecture.
5. Memorize various application of domain specific IoT system.
6. Able to develop various projects related to IoT.

TEXT BOOKS:

1. Jan Holler, Vlasios Tsiatsis, Catherine Mulligan, Stefan Avesand, Stamatis Karnouskos, David Boyle, “From Machine-to-Machine to the Internet of Things:Introduction to a New Age of Intelligence”, 1st Edition, Academic Press, 2014.
2. Vijay Madisetti and Arshdeep Bahga, “Internet of Things (A Hands-onApproach)”, 1st Edition, VPT, 2014.

REFERENCES:

1. Francis daCosta, “Rethinking the Internet of Things: A Scalable Approach to Connecting Everything”, 1st Edition, Apress Publications, 2013
2. Cuno Pfister, “Getting Started with the Internet of Things”, O‟Reilly Media, 2011, ISBN: 978-1-4493- 9357-1

21EC1933	IOT BASED SYSTEM DESIGN	L T P C 3 0 0 3

OBJECTIVES:

- To understand Smart Objects and IoT Architectures.
- To learn about various IOT-related protocols.
- To build simple IoT Systems using Arduino and Raspberry Pi.
- To understand data analytics and cloud in the context of IoT.
- To develop IoT infrastructure for popular applications.

UNIT - I FUNDAMENTALS OF IoT 9

Evolution of Internet of Things - Enabling Technologies - 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 - II 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 - Application Transport Methods: Supervisory Control and Data Acquisition - Application Layer Protocols: CoAP and MQTT

UNIT - III 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 - IV DATA ANALYTICS AND SUPPORTING SERVICES 9

Structured Vs Unstructured Data and Data in Motion Vs Data in Rest - Role of Machine Learning - No SQL Databases - Hadoop Ecosystem - Apache Kafka, Apache Spark - Edge Streaming Analytics and Network Analytics - Xively Cloud for IoT, Python Web Application Framework - Django - AWS for IoT - System Management with NETCONF-YANG.

UNIT - V CASE STUDIES/INDUSTRIAL APPLICATIONS 9

Cisco IoT system - IBM Watson IoT platform - Manufacturing - Converged Plantwide Ethernet Model (CPwE) - Power Utility Industry - GridBlocks Reference Model - Smart and Connected Cities: Layered architecture, Smart Lighting, Smart Parking Architecture and Smart Traffic Control.

TOTAL: 45PERIODS

OUTCOMES:

On successful completion of the course student will be able to:

1. Gain the Knowledge of IoT devices.
2. Analyze various protocols for IoT.
3. Design a PoC of an IoT system using Rasperry Pi/Arduino.
4. Apply data analytics and use cloud offerings related to IoT.
5. Analyze applications of IoT in real time scenario.
6. Gain knowledge to build basic smart devices.

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.
2. Arshdeep Bahga, Vijay Madisetti, “Internet of Things – A hands-on approach”, Universities Press, 2015.
3. Rajkamal, “Internet of Things: Architecture, Design Principles And Applications”, McGraw Hill Higher Education, 2016

REFERENCES:

1. Olivier Hersent, David Boswarthick, Omar Elloumi , “The Internet of Things – Key applications and Protocols”, Wiley, 2012.
2. Jan Ho¨ ller, Vlasios Tsiatsis , 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.
3. Dieter Uckelmann, Mark Harrison, Michahelles, Florian (Eds), “Architecting the Internet of Things”, Springer, 2011.
4. Michael Margolis,” Arduino Cookbook, Recipes to Begin, Expand, and Enhance Your Projects”, 2nd Edition, O'Reilly Media, 2011.

21EC1934	INDUSTRIAL IOT 4.0	L T P C 3 0 0 3

OBJECTIVES:

- To learn and understand the Importance of IIoT in industrial applications.
- To uunderstand the architecture and protocols of IIOT.
- To apply the IIoT concepts in building solutions to Industrial problems.
- To uunderstand the need of Industry 4.0.
- To learn and understand the Industry 4.0 real-world applications.
- To design and develop various industrial projects.

UNIT - I INTRODUCTION ON INDUSTRIAL IOT (IIOT) 9

Introduction on IIoT, History of IIoT, IIoT System components: Sensors, Gateways, Routers, Modem, Cloud brokers, servers and its integration, sensors and interfacing: Introduction to sensors, Transducers, Classification, Roles of sensors in IIoT, Various types of sensors, Design of sensors, sensor architecture, special requirements for IIoT sensors, Role of actuators, types of actuators.

UNIT - II IIOT ARCHITECTURE AND PROTOCOLS 9

Industrial Internet of things -Reference Architecture,complete architecture of IIOT with interfacing, Need of protocols; Types of Protocols, Wi-Fi, Wi-Fi direct, Zigbee, Z wave, BACnet, BLE, Modbus, SPI, I2C, IIoT protocols - COAP, MQTT, 6LoWPAN, LWM2M, AMPQ IIoT cloud platforms: Overview of COTS cloud platforms, Predix, PTC Thing Worx, Microsoft Azure etc. Data analytics, cloud services, Business models: SaaS, PaaS, IaaS.

UNIT - III IIOT DATA MONITORING & CONTROL 9

IoT Gate way, IoT Edge Systems and It's Programming, Cloud computing, Real Time Dashboard for Data Monitoring, Data Analytics and Predictive Maintenance with IIoT technology.

UNIT - IV INDUSTRY 4.0 9

The revolution on Industry 4.o, Sustainability assessment of Manufacturing Industries, Lean Production system, Smart factories, Cyber-physical systems, Collaboration platform and Product lifecycle management, Role of Industry 4.0 in Artificial Intelligence, Big Data and Advanced Technologies.

UNIT - V CASE STUDIES ON IIOT AND INDUSTRY 4.0 9

IIOT Applications: Healthcare, Power Plants, Inventory Management & Quality Control, Plant Safety and Security (Including AR and VR safety applications), Facility Management, Milk Processing and Packaging Industries, Food Industry.

OUTCOMES:

On successful completion of the course student will be able to:

1. Apply M2M protocols for development of IIoT Applications.
2. Understand the elements of IIoT to build a total control plane in an Industrial application.
3. Learn and understand the concept of IIOT architecture and protocols.
4. Build smart factory based on the concepts.
5. Build Industrial Applications.
6. Able to develop various industrial projects.

TEXT BOOKS:

1. Sudip Misra, Chandana Roy, Anandarup Mukherjee, " Introduction to Industrial Internet of Things and Industry 4.0", 1st edition, CRC Publisher, December 2020.
2. Industry 4.0: The Industrial Internet of Things Alasdair Gilchrist Publications: Apress, 2016.

REFERENCES:

1. HakimaChaouchi, “ The Internet of Things Connecting Objects to the Web”,Willy Publications, 2010.
2. Olivier Hersent, David Boswarthick, Omar Elloumi, “The Internet of Things: Key Applications and Protocols”, ,2ndEdition, Willy Publications, 2010
3. Inside the Internet of Things (IoT), Deloitte University Press, 2016.
4. Ovidiu, Peter, “ Internet of Things-From Research and Innovation to Market Deployment” River Publishers Series, 2014.

ENGINEERING COLLEGE CHENNAI JAISAKTHI EDUCATIONAL TRUST

21EC1935	WIRELESS SENSOR NETWORK DESIGN	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To understand the fundamentals of wireless sensor network
- To gain knowledge on the MAC and Routing Protocols of WSN
- To get exposed to 6LOWPAN technology
- To acquire knowledge on the protocols required for developing real time applications using WSN and 6LOWPAN
- To gain knowledge about operating system related to WSN and 6LOWPAN

UNIT - I INTRODUCTION 9

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

UNIT - II MAC AND ROUTING PROTOCOLS 9

MAC protocols - fundamentals, low duty cycle protocols and wakeup concepts, contention and Schedule-based protocols - SMAC, BMAC,TRAMA, Routing protocols - Requirements, Classification -SPIN, Directed Diffusion, COUGAR, ACQUIRE, LEACH, PEGASIS.

UNIT - III 6LOWPAN 9

6LoWPAN Architecture - protocol stack, Adaptation Layer, Link layers - Addressing, Routing – Mesh - Under - Route-Over, Header Compression - Stateless header compression - Context- based header compression, Fragmentation and Reassembly, Mobility - types, Mobile IPv6, Proxy Home Agent, Proxy MIPv6, NEMO - Routing - MANET, ROLL, Border routing.

UNIT - IV APPLICATIONS 9

Design Issues, Protocol Paradigms - end-to-end, Real time streaming and sessions, Publish/subscribe, Web service paradigms, Common Protocols -Web service protocols, MQ telemetry transport for sensor networks (MQTT-S), ZigBee compact application protocol (CAP),Service discovery, Simple network management protocol (SNMP), Real-time transport and sessions, Industry- Specific protocols.

UNIT - V TOOLS 9

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

TOTAL: 45 PERIODS

OUTCOMES:

On successful completion of the course student will be able to:

1. Design solutions for WSNs applications.
2. Develop efficient MAC and Routing Protocols.
3. Design solutions for 6LOWPAN applications.
4. Develop efficient layered protocols in 6LOWPAN.
5. Use Tiny OS and Contiki OS in WSNs applications.
6. Use 6LOWPAN applications.

REFERENCES:

1. Holger Karl , Andreas willig, "Protocol and Architecture for Wireless Sensor Networks", John Wiley Publication, 2006.
2. Anna Forster, "Introduction to Wireless Sensor Networks", Wiley, 2017.
3. Zach Shelby Sensinode and Carsten Bormann, "6LoWPAN: The Wireless Embedded Internet" John Wiley and Sons, Ltd, Publication, 2009.
4. Philip Levis, "TinyOS Programming", 2006 –www.tinyos.net.
5. The Contiki Operating System.http://www.sics.se/contiki.

PANIMALAR ENGINEERING COLLEGE, CHENNAI. JAISAKTHI EDUCATIONAL TRUST

VERTICAL VI SPACE TECHNOLOGIES

21EC1936	RADAR TECHNOLOGIES	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To explore the concepts of radar and its frequency bands.
- To understand Doppler Effect and get acquainted with the working principles of CW radar, FM- CW radar.
- To impart the knowledge of functioning of MTI and Pulse Doppler Radar.
- To learn the functioning of tracking radars and compare various trackers.
- To study the significance of radar components and its applications.

UNIT - I BASICS OF RADAR 9

Maximum Unambiguous Range, Simple form of Radar Equation, Radar Block Diagram and Operation, Radar Frequencies and Applications. Prediction of Range Performance, Minimum Detectable Signal, Receiver Noise, Integration of Radar Pulses, Radar Cross Section of Targets, Transmitter Power.

UNIT - II CW AND FREQUENCY MODULATED RADAR 9

Doppler Effect, CW Radar – Block Diagram, Isolation between Transmitter and Receiver, Non-zero IF Receiver, Receiver Bandwidth Requirements, Applications of CW radar. FM-CW Radar: Range and Doppler Measurement, Block Diagram and Characteristics, FM-CW altimeter.

UNIT - III MTI AND PULSE DOPPLER RADAR 9

MTI and Pulse Doppler Radar: Principle, MTI Radar – Power Amplifier Transmitter and Power Oscillator Transmitter, Delay Line Cancellers – Filter Characteristics, Blind Speeds, Double Cancellation, Staggered PRFs. Range Gated Doppler Filters. MTI Radar Parameters, Limitations to MTI Performance**,** MTI versus Pulse Doppler Radar.

UNIT - IV TRACKING RADAR 9

Tracking with Radar, Sequential Lobing, Conical Scan, Mono pulse Tracking Radar Amplitude Comparison Mono pulse (one- and two- coordinates), Phase Comparison Mono pulse, Tracking in Range, Acquisition and Scanning Patterns, Comparison of Trackers.

UNIT - V RADAR COMPONENTS 9

Radar Displays – types. Duplexers – Branch type and Balanced type, Circulators as Duplexers. Steered Phased Array Antennas- Basic Concepts Introduction to Phased Array Antennas – Basic Concepts, Phase Shifters, Frequency Scan Arrays, Array Elements, and Feeds for Arrays.

TOTAL: 45PERIODS

OUTCOMES:

On successful completion of the course student will be able to:

1. Gain knowledge about the fundamentals of radar operation and radar range equation.
2. Understand the functioning and applications of CW and FM-CW Radar.
3. Study the principle, performance and limitations of MTI and PULSE DOPPLER radar.
4. Describe the basic operation of tracking radar to detect the location and trajectory path of target.
5. Illustrate the classification of Phased Array Antennas used in radar communication.
6. Identify the different types of display devices & duplexers.

TEXT BOOKS:

1. Merrill I. Skolnik, "Introduction to Radar Systems", Tata Mc Graw Hill Edition, 3rd Ed., 2001.
2. Byron Edde, "Radar: Principles, Technology, Applications", Pearson Education, 2004.

REFERENCES:

1. Peyton Z. Peebles, "Radar Principles", Jr., Wiley India Pvt. Ltd., 2009.
2. Mark A. Richards, James A. Scheer, William A. Holm Yesdee, "Principles of Modern Radar: Basic Principles", 2013.
3. Merrill I. Skolnik, "Radar Handbook", 3rd Ed., McGraw Hill Education, 2008.

21EC1937	PLANETARY SCIENCE	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To understand the formation of solar systems and the planetary properties.
- To study the composition and formation of planetary atmosphere.
- To impart the knowledge of satellites of different planets and the structure of rings.
- To learn about the formation of various planets.
- To understand the biological thermodynamics for the existence of life in the planets.

UNIT - I INTRODUCTION TO PLANETARY SCIENCE 9

A Brief History of the Planetary Sciences, Inventory of the Solar System, Planetary Properties, Formation of the Solar System, The Two-Body Problem, The Three-Body Problem, Perturbations and Resonances, Stability of the Solar System, Dynamics of Spherical Bodies, Orbits about an Oblate Planet.

UNIT - II PLANETARY ATMOSPHERE 9

Thermal Structure- Sources and Transport of Energy- Observed Thermal Profiles, Atmospheric Composition, Clouds, Meteorology- Coriolis Effect-Winds Forced by Solar Heating, Photochemistry-Photolysis and Recombination-Photoionization: Ionospheres, Molecular and Eddy Diffusion, Atmospheric Escape, Secondary Atmospheres-Formation, Climate Evolution.

UNIT - III PLANETARY SATELLITES AND RINGS 9

Moons of Mars: Phobos and Deimos, Satellites of Jupiter, Satellites of Saturn, Satellites of Uranus, Satellites of Neptune, Tidal Forces and Roche's Limit, Flattening and Spreading of Rings- Jupiter's Rings-Saturn's Rings-Uranus's Rings-Neptune's Rings, Ring–Moon Interactions.

UNIT - IV PLANETARY FORMATION 9

Solar System Constraints, Star Formation: A Brief Overview, Evolution of the Protoplanetary Disk, Growth of Solid Bodies, Formation of the Terrestrial Planets, Formation of the Giant Planets, Planetary Migration, Small Bodies Orbiting the Sun, Planetary Rotation, Satellites of Planets and of Minor Planets.

UNIT - V PLANETS AND LIFE 9

Drake Equation, Biological Thermodynamics, Circumstellar Habitable Zones, Planetary Requirements for Life- Biogeochemical Cycles-Gravitational and Magnetic Fields-Giant Planets and Life, Impacts and Other Natural Disasters- K–T Event-Frequency of Impacts-Volcanos and Earthquakes, Life Affects of Planets, Origin of Life, Detecting Extraterrestrial Life.

TOTAL: 45 PERIODS

OUTCOMES:

On successful completion of the course student will be able to:

1. Describe the properties of planets gravitational interactions between bodies.
2. Gain knowledge on structure, dynamics and escape of planetary atmospheres.
3. Learn about the satellites of various planets and formation of rings.
4. Acquire in depth knowledge of development of various stages of planets.
5. Explain the affects of planet on the evolution of life.
6. Obtain deeper understanding on thermodynamics and other basic physics for planetary sciences.

TEXT BOOKS:

1. Jack J. Lissauer, Imke de Pater, “Fundamental Planetary Science: Physics, Chemistry and Habitability”, Cambridge University Press, 2019.

REFERENCES:

1. Colette Salyk, Kevin Lewis, “Introductory Notes on Planetary Science The solar system, exoplanets and planet formation”, IOP Publishing, 2020.

21EC1938	REMOTE SENSING	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To know the concepts of Remote Sensing and energy resources.
- To know the types of remote sensing and sensor characteristics.
- To understand the Digital Imaging concepts.
- To understand the Data integration and analysis of remote sensing.
- To learn the Applications of remote sensing.

UNIT - I BASICS OF REMOTE SENSING 9

Concepts of Remote Sensing - elements involved in remote sensing, remote sensing terminology & units, energy resources, energy interactions with earth surface features & atmosphere, atmospheric effects, Recording of Energy by Sensor, Transmission, Reception, and Processing.

UNIT - II TYPES OF REMOTE SENSING AND SENSOR CHARACTERISTICS 9

Types of Remote Sensing: Classification Based on Platform, Energy source, Imaging media, Electromagnetic spectrum, Number of Bands, Characteristics of Images, Orbital Characteristics of Satellite, Remote sensing satellites, Sensor Resolutions, Image Referencing System, Unmanned Aerial Vehicle-based Remote Sensing.

UNIT - III DIGITAL IMAGING 9

Digital Image, Sensor: Dispersing Element, Filter, Spectrometer and Spectroradiometer, Detectors, Imaging by Scanning Technique, Hyper-Spectral Imaging, Imaging by Non-Scanning Technique, Thermal Remote Sensing.

UNIT - IV DATA INTEGRATION AND ANALYSIS 9

Multi-Approach of Remote Sensing, Integration with Ground Truth and Other Ancillary Data, Integration of Transformed Data, Integration with GIS, Process of Remote Sensing Data Analysis, Limitations of Remote Sensing Data Analysis..

UNIT - V APPLICATIONS OF REMOTE SENSING 9

Introduction, Land-Cover and Land-Use, Agriculture: Crop Type Mapping, Crop Monitoring, and Crop Damage Assessment, Forestry: Clear-cut Mapping and Deforestation, Species Identification and Typing, Burn Mapping, Geology: Structural Mapping and Terrain Analysis, Geologic Unit Mapping, Oceans, and Coastal Monitoring, Monitoring of Atmospheric Constituents.

TOTAL: 45PERIODS

OUTCOMES:

On successful completion of the course student will be able to:

1. Describe different concepts and terms used in Remote Sensing and its data.
2. Understand the types of remote sensing and sensor characteristics.
3. Understand the functions of Digital Imaging techniques.
4. Evaluate the accuracy of Data and integration with GIS.
5. Understand the process of remote sensing data analysis.
6. Understand the applications of remote sensing.

TEXT BOOKS:

1. Basudeb Bhatta, "Remote Sensing and GIS", Oxford University Press, 2nd Edition, 2011.
2. Paul Jude Gibson, "Introductory Remote Sensing: Principles and Concepts", Routledge, 11 New Fetter Lane, Landon, UK. 2000. ISBN: 0-415-17024-9.
3. Kang-tsung Chang, "Introduction to Geographic Information systems", McGraw Hill Education (Indian Edition), 7th Edition, 2015.
4. Michael N. Demers, "Fundamentals of Geographic Information systems", 4th Edition, Wiley Publishers, 2012.

REFERENCES:

1. Thomas M. Lillesand and Ralph W. Kiefer, "Remote Sensing and Image Interpretation", Wiley Publishers, 7th Edition, 2015.
2. Tor Bernhardsen, "Geographic Information systems – An Introduction", Wiley India Publication, 3rd Edition, 2010.
3. Satheesh Gopi, R. SathiKumar, N. Madhu, "Advanced Surveying: Total Station, GIS and Remote Sensing" Pearson Education, 1st Edition, 2007.
4. M. Anji Reddy, "Textbook of Remote Sensing and Geographical Information systems".

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21EC1939	NAVIGATION SYSTEMS	L T P C 3 0 0 3

OBJECTIVES:

- To understand the Principles of geodesy with reference to GPS.
- To know the concept of positioning and different techniques.
- To understand the satellite system configurations.
- To processing of GPS data to help for satellite survey.
- To understand the applications of satellite geodesy.

UNIT - I BASICS OF GEO POSITIONING 9

Definition – Fundamental goals of Geodesy – Definitions – basic concepts – Historical perspective – development applications in Satellite Geodesy – Geoid and Ellipsoid satellite orbital motion – Keplerian motion – Kepler's Law – Perturbing forces – Geodetic satellite.

UNIT - II OBSERVATION TECHNIQUES 9

Determination of direction by photography – SECOR – Electronic observation techniques – Doppler Effect – Positioning concept – Development of TRANSIT satellites.

UNIT - III SATELLITE SYSTEM 9

GPS – Different segments – space control and user segments – satellite configuration – GPS signal structure – Orbit determination and Orbit representation Anti Spoofing and Selective Availability – Task of control segment – GPS receivers – main receiver components – Example of GPS receivers.

UNIT - IV GPS DATA PROCESSING 9

GPS observables – code and carrier phase observation – linear combination and derived observables – concept of parameter estimation – data processing – software modules – solutions of cycle slips ambiguities RINEX format. Concepts of rapid static methods with GPS semi kinematic and pure kinematic methods – basic constellation of satellite geometry & accuracy measures.

UNIT - V SATELLITE GEODESY APPLICATIONS 9

Geodetic control surveys, Cadastral surveying, Photogrammetry & Remote Sensing, Engineering applications, and Monitoring – GIS. GLONASS, GALILEO, COMPASS and IRNSS satellite configuration comparison – Satellite Laser Ranging & Applications – Concepts of satellite altimetry.

TOTAL: 45 PERIODS

OUTCOMES:

On successful completion of the course student will be able to:

1. Learn to identify Geodesy and their functions, orbital motion.
2. Understand the concept of positioning and different techniques.
3. Identify the satellite system configurations.
4. Understand the Processing of GPS data to help for satellite survey.
5. Identify error sources in GPS observations.
6. Understand the applications of satellite geodesy.

TEXT BOOKS:

1. Gunter Seeber, “Satellite Geodesy”, Copy Right 2003 By Walter De Gruyter 1993, ISBN: 3- 11-017549-5.
2. Hofmann W. B, Lichtenegger. H, Collins. J, “Global Positioning System – Theory and Practice”, Springer Verlag Wein, New York.-2008.
3. Alfred Leick , “GPS Satellite Surveying”, 3rd Edition, John Wiley and Sons 2004.

REFERENCES:

1. G. S. Rao, “Global Navigation Satellite Systems”, 2010 Tata McGraw Hill Education Pvt. Ltd.
2. Guocheng Xu , “GPS Theory, Algorithms and Applications”, Springer-Verlag, 2003.

21EC1940	SATELLITE COMMUNICATION	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To enable the student to become familiar with the basics of satellite orbits and launching.
- To understand the subsystems of satellite segment and earth segment.
- To analyze the basic link design for satellite.
- To study the various methods of satellite access.
- To familiarize with the applications of satellites.

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).

TOTAL: 45 PERIODS

OUTCOMES:

On successful completion of the course student will be able to:

1. Explain the basics of satellite orbits and launching procedures.
2. Describe the various subsystems of earth segment and space segment.
3. Analyze the satellite Link design for transmission and reception of signals.
4. Choose appropriate multiple access technique for a given satellite communication application.
5. Impart knowledge about the applications of Satellite Communications.
6. Analyze the effects of various parameters on Satellite System performance.

TEXT BOOKS:

1. Dennis Roddy, “Satellite Communication”, 4^{th} Edition, Mc Graw Hill International, 2006.
2. Timothy, Pratt, Charles, W.Bostain, JeremyE.Allnutt,"Satellite Communication”,2^{nd} Edition, Wiley Publications,2002

REFERENCES:

1. Wilbur L.Pritchard, Hendri G. Suyderhoud, Robert A. Nelson, “Satellite Communication Systems Engineering”, Prentice Hall/Pearson, 2007.
2. K. N Raja Rao,” Fundamental of Satellite Communications”, PHI, 2004.
3. Richharia, “Satellite Communication Systems-Design Principles”, Macmillan 2003.
4. Anil K. Maini, Varsha Agrawal, “Satellite Communications”, Wiley India Pvt. Ltd., 2015.

21EC1941	AVIONICS SYSTEMS	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To study the need for avionics system and its subsystems.
- To understand the trends in display technology.
- To impart knowledge on the architecture of the avionic systems and its features.
- To learn about the integrated avionics and weapon system and its maintenance.
- To know modular avionics packaging and EMI/EMC requirements in avionics.

UNIT - I OVERVIEW 9

Need for Avionics in civil and military aircraft and space systems – Integrated Avionics system – Typical avionics sub systems – Design approaches and recent advances - Application Technologies.

UNIT - II DISPLAYS AND I/O DEVICES 9

Control and display technologies CRT, LED, LCD, EL and plasma panel - Touch screen - Direct voice input (DVI) - Civil cockpit and military cockpit: MFDS, HUD, MFK, HOTAS, HMD.

UNIT - III DIGITAL AVIONICS ARCHITECTURE 9

Avionics system architecture– Features and applications of Data buses MIL–STD 1553 B – ARINC 429 -ARINC 629 - SAFEbus /FlexRay - Time triggered communication protocol/controller Area network - AFDX - CSDB.

UNIT - IV ELECTRONIC FLIGHT CONTROL SYSTEM 9

Types of modern control system, Integrated avionics and weapon system, Fault tolerant systems, Utility systems reliability and maintainability: maintenance - Built in test equipment, certification. Case Study: Air Traffic Control Logic.

UNIT - V PACKAGING AND EMI/EMC 9

Modular Avionics Packaging, Trade-off studies, ARINC and DOD types, system cooling, EMI/EMC requirements BIT and CFDS, Automatic Test Equipment, Speeds maintenance, ATLAS, Remote diagnostics and maintenance support-Life Cycle Costs for Military and Civil Avionics.

TOTAL: 45 PERIODS

OUTCOMES:

On successful completion of the course student will be able to:

1. Conceptualize systems and subsystems of avionics.
2. Get familiarize with the control and display technologies.
3. Explain the features and application of the digital avionics system.
4. Develop knowledge on the fault system and maintenance of flight control system
5. Identify the packaging techniques and standards of avionics systems.
6. Understand the maintenance and cost aspects of avionics systems.

TEXT BOOKS:

1. Collinson R.P.G. “Introduction to Avionics”, Chapman and Hall, 3rd edition, 2011.
2. Cary R .Spitzer, “The Avionics Handbook”, CRC Press, 2000.

REFERENCES:

1. Spitzer, C.R. “Digital Avionics Systems”, CRC Press, Taylor & Francis Group, Boca Raton,2015.
2. Brain Kendal, “Manual of Avionics”, Wiley India Pvt Ltd, 3rd edition, 2011.
3. Middleton, D.H. “Avionics Systems”, Longman Scientific and Technical, Longman Group UK Ltd., England, 1989.

21EC1942	ROCKETRY AND SPACE MECHANICS	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To introduce solar system and solar time.
- To introduce the basic concepts of orbital mechanics with particular emphasis on interplanetary trajectories.
- To know rocketry and missile systems.
- To understand the rocket motion through atmosphere.
- To know the stages and control methods of rocket vehicle.

UNIT - I SOLAR SYSTEM 9

The Solar System – References Frames and Coordinate Systems-The Celestial Sphere– The Ecliptic – Motion of Vernal Equinox-Sidereal Time – Solar Time – Standard Time –The Earth's Atmosphere-Galilean transformation Keplers Law, Newton Law of gravitation.

UNIT - II SATELLITE ORBITS 9

Estimation of orbital and escape velocity - The many body Problem – Lagrange Jacobian Identity-The Circular Restricted Three Body Problem-Liberation Points-Relative Motion in the N-body Problem Two – Body Problem-Satellite Orbits – Relations between Position and Time – Orbital Elements.

UNIT - III ROCKET MOTOR 9

Principle of operation of rocket motor - thrust equation- one dimensional and two dimensional rocket motions in free space and homogeneous gravitational fields- Description of vertical, inclined and gravity turn trajectories determinations of range and altitude- simple approximations to burnout velocity.

UNIT - IV ROCKET MOTION 9

Description of various loads experienced by a rocket passing through atmosphere-drag estimation – wave drag, skin friction drag, form drag and base pressure drag-Boat-tailing in missiles –performance at various altitudes.

UNIT - V ROCKET STAGES 9

Need for multi staging of rocket vehicle- multistage vehicle optimization- Stage separation dynamics and separation techniques- Aerodynamic and jet control methods of rocket vehicles – SITVC- Basics of rocket nozzles – principle- Conical and bell shaped nozzles- Adapted nozzles- Rocket dispersion – launching problems.

TOTAL: 45 PERIODS

OUTCOMES:

On successful completion of the course student will be able to:

1. Know about solar system and solar time
2. Understand the orbital mechanics with particular emphasis on interplanetary trajectories.
3. Awareness about the rocketry and missile systems
4. Know about rocket motion through atmosphere.
5. Understand the stages of rocket vehicle.
6. Understand the control methods used in rocket vehicle.

TEXT BOOKS:

1. G.P. Sutton, "Rocket Propulsion Elements", John Wiley & Sons Inc., New York, 5th Edition, 1986.
2. J.W. Cornelisse, "Rocket Propulsion and Space Dynamics", J.W. Freeman & Co., Ltd., London, 1982.

REFERENCES:

1. Van de Kamp, "Elements of astromechanics", Pitman Publishing Co., Ltd., London, 1980.
2. E.R. Parker, "Materials for Missiles and Spacecraft", McGraw-Hill Book Co., Inc., 1982.

PANIMALAR ENGINEERING COLLEGE CHENNAI. JAISAKTHI EDUCATIONAL TRUST

VERTICAL VII RADIO COMMUNICATION AND BROADBAND NETWORKS

21EC1943	BROADBAND ACCESS TECHNOLOGIES	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To understand the various Access Technologies.
- To understand the functions of Digital Subscriber Lines.
- To comprehend operation of Cable Modem.
- To explore various Fiber Access Technologies.
- To comprehend the concepts of Broad Band Access.

UNIT - I REVIEW OF ACCESS TECHNOLOGIES 9

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

UNIT - II DIGITAL SUBSCRIBER LINES 9

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

UNIT - III CABLE MODEM 9

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

UNIT - IV FIBER ACCESS TECHNOLOGIES 9

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

UNIT - V BROAD BAND WIRELESS 9

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

TOTAL: 45 PERIODS

OUTCOMES:

On successful completion of the course student will be able to:

1. Describe the various Access Technologies.
2. Identify the functions of Digital Subscriber Lines.
3. Apply operation of Cable Modem.
4. Analyze various Fiber Access Technologies.
5. Explain the concepts of Broad Band Access.

TEXT BOOKS:

1. Niel Ransom and Albert A. Azzam, “Broadband Access Technologies: ADSL, VDSL Cable Modem, Fiber and LMDS”, McGraw Hill 1999.
2. Gilbert Held, “Next Generation Modems: A Professional Guide to DSL and cable modems”, John Wiley & sons.

REFERENCES:

1. Walter J Woralski, “ADSL and DSL Technologies”, McGraw Hill computer Communication series, 1998.
2. William Webb, “Introduction to Wireless Local Loop broadband and narrow band system”, Artech House, 2000.
3. Martin P. Clarke, “Wireless Access Network: Fixed Wireless Access and WLL network Design and operation”, John Wiley & Sons 2000.

21EC1944	SOFTWARE DEFINED NETWORKS	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To understand the need for SDN and its data plane operations.
- To understand the functions of control plane.
- To comprehend the migration of networking functions to SDN environment.
- To explore various techniques of network function virtualization.
- To comprehend the concepts behind network virtualization.

UNIT - I SDN: BACKGROUND AND DATA PLANE 9

Evolving Network Requirements – The SDN Approach – SDN and NFV-Related Standards – SDN Data Plane – Open Flow Logical Network Device – Open Flow Protocol.

UNIT - II SDN CONTROL PLANE 9

SDN Control Plane Architecture: Southbound Interface, Northbound Interface – Control Plane Functions – ITU-T Model – Open Daylight – REST – Cooperation and Coordination among Controllers.

UNIT - III SDN APPLICATION PLANE 9

SDN Application Plane Architecture – Network Services Abstraction Layer – Traffic Engineering – Measurement and Monitoring – Security – Data Center Networking - Mobility and Wireless – Information-centric Networking.

UNIT - IV NETWORK FUNCTION VIRTUALIZATION 9

NFV Concepts – Benefits and Requirements – Reference Architecture – NFV Infrastructure – Virtualized Network Functions – NFV Management and Orchestration – NFV Use cases – SDN and NFV.

UNIT - V NETWORK VIRTUALIZATION 9

Virtual LANs – Open Flow VLAN Support – Virtual Private Networks – Network Virtualization – Open Daylight's Virtual Tenant Network – Co Software-Defined Infrastructure.

TOTAL: 45 PERIODS

OUTCOMES:

On successful completion of the course student will be able to:

1. Describe the motivation behind SDN and its data plane (K2).
2. Identify the functions of control plane (K3).
3. Apply SDN to networking applications (K3).
4. Apply various operations of network function virtualization.
5. Explain various use cases of SDN.

TEXT BOOKS:

1. William Stallings, “Foundations of Modern Networking: SDN, NFV, QoE, IoT and Cloud”, Pearson Education, 1st Edition, 2015.
2. Thomas D Nadeau, Ken Gray, “SDN: Software Defined Networks”, O’Reilly Media, 2013.

REFERENCES:

1. Fei Hu, “Network Innovation through OpenFlow and SDN: Principles and Design”, 1st Edition, CRC Press, 2014.
2. Paul Goransson, Chuck Black Timothy Culver, “Software Defined Networks: A Comprehensive Approach”, 2nd Edition, Morgan Kaufmann Press, 2016.
3. Oswald Coker, SiamakAzodolmolky, “Software-Defined Networking with OpenFlow”, 2nd Edition, O’Reilly Media, 2017.

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21EC1945	COGNITIVE RADIO NETWORKS	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To understand the concepts of cognitive radio.
- To familiarize with Architecture of Cognitive Radio.
- To learn spectrum sensing and dynamic spectrum access.
- To acquaint the fundamentals of MAC & Network Layer Design in Cognitive Radio.
- To introduce the Advancement in 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

Cognitive Radio – functions, components and design rules, Cognition cycle – orient, plan, decide and act phases, Inference Hierarchy, Architecture maps, Building the Cognitive Radio Architecture on Software defined Radio Architecture, 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 , Bayesian Approach, Neyman Pearson fusion rule for spectrum sensing, Optimum spectrum sensing – Kullback Leibler Divergence 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 – Multichannel MAC - slotted ALOHA – CSMA, Network layer design – routing in cognitive radios, flow control and error control techniques.

UNIT - V ADVANCED TOPICS IN COGNITIVE RADIO 9

Cognitive radio for Internet of Things - Features and applications – Enabling technologies and protocols – M2M technologies - Data storage and analysis techniques - Requirement and challenges of IoT – Energy efficiency– MIMO Cognitive Radio – Power allocation algorithms.

TOTAL: 45 PERIODS

OUTCOMES:

On successful completion of the course student will be able to:

1. Understand the concepts of cognitive radio.
2. Familiarize with Architecture of Cognitive Radio.
3. Learn spectrum sensing and dynamic spectrum access.
4. Compare MAC and network layer design for cognitive radio.
5. Discuss cognitive radio for Internet of Things and M2M technologies.

TEXT BOOKS:

1. Alexander M. Wyglinski, MaziarNekovee, Thomas Hou, “Cognitive Radio Communications and Networks”, Academic Press, Elsevier, 2010.
2. Bruce Fette, “Cognitive Radio Technology”, Newnes, 2006.

REFERENCES:

1. Kwang-Cheng Chen, Ramjee Prasad, “Cognitive Radio Networks”, John Wiley and Sons, 2009.
2. HuseyinArslan (Ed.), “Cognitive Radio, Software Defined Radio, and Adaptive Wireless Systems, Springer, 2007.
3. S.Shanmugavel, M.A.Bhagyaveni, R.Kalidoss, “Cognitive Radio-An Enabler for Internet of things”, River Publishers, 2017.

21EC1946	WIRELESS BROAD BAND NETWORKS	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To study the various network layer and transport layer protocols for wireless networks.
- To study the architecture and interference mitigation techniques in 3G standards.
- To learn about 4G technologies and LTE-A in mobile cellular networks.
- To learn about the layer level functionalities in interconnecting networks.
- To study the emerging techniques in 5G network

UNIT - I WIRELESS PROTOCOLS 9

Mobile network layer- Fundamentals of Mobile IP, data forwarding procedures in mobile IP, IPv4, IPv6, IP mobility management, IP addressing - DHCP, Mobile transport layer-Traditional TCP, congestion control, slow start, fast recovery/fast retransmission, classical TCP improvements- Indirect TCP, snooping TCP, Mobile TCP.

UNIT - II 3G EVOLUTION 9

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

UNIT - III 4G EVOLUTION 9

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

UNIT - IV BROAD BAND LAYER-LEVEL FUNCTIONS 9

Characteristics of wireless channels - downlink physical layer, uplink physical layer, MAC scheme -frame structure, resource structure, mapping, synchronization, reference signals and channel estimation, SC-FDMA, interference cancellation – CoMP, Carrier aggregation, Services - multimedia broadcast/multicast, location-based services.

UNIT - V 5G EVOLUTION 9

5G Roadmap - Pillars of 5G - 5G Architecture, The 5G internet - IoT and context awareness - Networking reconfiguration and virtualization support - Mobility QoS control - emerging approach for resource over provisioning, Small cells for 5G mobile networks- capacity limits and achievable gains with densification - Mobile data demand, Demand Vs Capacity, Small cell challenges, conclusion and future directions.

TOTAL: 45 PERIODS

OUTCOMES:

On successful completion of the course student will be able to:

1. Design and implement the various protocols in wireless networks.
2. Analyze the architecture of 3G network standards.
3. Analyze the difference of LTE-A network design from 4G standard.
4. Design the interconnecting network functionalities by layer level functions.
5. Explore the current generation (5G) network architecture.

TEXT BOOKS:

1. Kaveh Pahlavan, “Principles of wireless networks”, Prentice-Hall of India, 2008.
2. Jonathan Rodriguez, "Fundamentals of 5G Mobile networks", John Wiley, 2015.

REFERENCES:

1. Vijay K.Garg, “Wireless Network Evolution - 2G & 3G”. Prentice Hall, 2008.
2. Clint Smith,P.E, Dannel Collins, “3G Wireless Networks” Tata McGraw- Hill, 2nd Edition, 2011.
3. SassanAhmadi, “LTE-Advanced – A practical systems approach to understanding the 3GPP LTE Releases 10 and 11 radio access technologies”, Elsevier, 2014.

21EC1947	MASSIVE MIMO NETWORKS	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To gain knowledge about massive MIMO networks.
- To understand the massive MIMO propagation channels.
- To learn about channel estimation in single cell massive MIMO systems.
- To comprehend the channel estimation in and multicell massive MIMO systems.
- To comprehend the concepts of massive MIMO deployment in the context of single cell and multicell deployment.

UNIT - I MASSIVE MIMO NETWORKS 9

Definition of Massive MIMO, Correlated Rayleigh Fading, System Model for Uplink and Downlink, Basic Impact of Spatial Channel Correlation, Channel Hardening and Favourable Propagation, Local Scattering Spatial Correlation Model.

UNIT - II MASSIVE MIMO PROPAGATION CHANNEL 9

Favorable Propagation and Deterministic Channels-Capacity Upper Bound-Distance from Favorable Propagation-Favorable Propagation and Linear Processing-Singular Values and Favorable Propagation, Favorable Propagation and Random Channels-Independent Rayleigh Fading-Uniformly Random Line-of-Sight (UR-LoS)-Independent Rayleigh Fading versus UR-LoS - Finite-Dimensional Channels.

UNIT - III SINGLE-CELL SYSTEMS 9

Uplink Pilots and Channel Estimation - Orthogonal Pilots- De-Spreading of the Received Pilot Signal-MMSE Channel Estimation, Uplink Data Transmission - Zero-Forcing -Maximum-Ratio, Downlink Data Transmission-Linear Precoding-Zero-Forcing-Maximum-Ratio, Discussion-Interpretation of the Effective SINR Expressions-Implications for Power Control-Scaling Laws and Upper Bounds on the SINR - Near-Optimality of Linear Processing when M >> K - Net Spectral Efficiency - Limiting Factors: Number of Antennas and Mobility.

UNIT - IV MULTI-CELL SYSTEMS 9

Uplink Pilots and Channel Estimation, Uplink Data Transmission - Zero-Forcing - Maximum-Ratio, Downlink Data Transmission -Zero-Forcing - Maximum-Ratio, Discussion -Asymptotic Limits with Infinite Numbers of Base Station Antennas - The Effects of Pilot Contamination - Non-Synchronous Pilot Interference.

UNIT - V CELL DEPLOYMENT IN MIMO 9

Single-Cell Deployment Example: Fixed Broadband Access in Rural Area, Multi-Cell Deployment: Preliminaries and Algorithms, Multi-Cell Deployment Examples: Mobile Access - Dense Urban.

TOTAL: 45 PERIODS

OUTCOMES:

On successful completion of the course student will be able to:

1. Understand and explain massive MIMO networks.
2. Analyze massive MIMO propagation channels and their capacity bounds.
3. Examine channel estimation techniques for single cell system.
4. Analyze channel estimation techniques for multi cell system.
5. Explain the concepts underlying the deployment of single and multicell massive MIMO systems.

TEXT BOOKS:

1. Thomas L. Marzetta, Erik G. Larsson, Hong Yang, Hien Quoc Ngo, "Fundamentals of Massive MIMO", Cambridge University Press 2016.
2. Emil Björnson, Jakob Hoydis and Luca Sanguinetti (2017), "Massive MIMO Networks: Spectral, Energy, and Hardware Efficiency", Foundations and Trends, Now, 2017.

REFERENCES:

1. Long Zhao, Hui Zhao, Kan Zheng, "Wei Xiang Massive MIMO in 5G Networks: Selected Applications", Springer 2018.
2. Leibo Liu, Guiqiang Peng, Shaojun Wei, "Massive MIMO Detection Algorithm and VLSI Architecture", Springer 2019.
3. Shahid Mumtaz, Jonathan Rodriguez, Linglong Dai, "mmWave Massive MIMO A Paradigm for 5G", Elsevier, 2017.

21EC1948 5G AND BEYOND COMMUNICATION NETWORKS

L	T	P	C
3	0	0	3

OBJECTIVES:

- To get acquainted with the fundamentals of 5G networks.
- To study the processes associated with 5G architecture.
- To study spectrum sharing and spectrum trading.
- To learn the security features in 5G networks.
- To study the introduction of 6G system.

UNIT - I 5G CONCEPTS AND CHALLENGES 9

Fundamentals of 5G technologies, overview of 5G core network architecture,5G new radio and cloud technologies, Radio Access Technologies (RATs), EPC for 5G.

UNIT - II NETWORK ARCHITECTURE 9

5G architecture and core, network slicing, multi access edge computing(MEC)visualization of 5G components, end-to-end system architecture, service continuity, relation to EPC, and edge computing. 5G protocols: 5G NAS,NGAP, GTP-U, IPSec and GRE.

UNIT - III DYNAMIC SPECTRUM MANAGEMENT 9

Mobility management, Command and control, spectrum sharing and spectrum trading, cognitive radio based on 5G, millimeter waves.

UNIT - IV SECURITY IN 5G NETWORKS 9

Security features in 5G networks, network domain security, user domain security, flow based QoS framework, mitigating the threats in 5G.

UNIT - V 6G WIRELESS NETWORKS 9

6G Vision, Usage Scenarios, and Requirements, Architecture -Large-Dimensional and Autonomous 6G Networks, AI-Enabled Innovative Wireless Network Design, Promising Technologies for 6G Networks.

TOTAL: 45 PERIODS

OUTCOMES:

On successful completion of the course student will be able to:

1. Explore the concepts of 5G networks.
2. Comprehend the 5G architecture and protocols.
3. Understand dynamic spectrum management.
4. Familiarize the security aspects in 5G networks.
5. Understand the concepts of 6G networks.

TEXT BOOKS:

1. Stephen Rommer, “5G Core networks: Powering Digitalization”, Academic Press, 2019.
2. SaroVelrajan, “An Introduction to 5G Wireless Networks : Technology, Concepts and Use cases”, First Edition, 2020.

REFERENCES:

1. Jyrki.Penttinen,“5G Simplified: ABCs of Advanced Mobile Communications”, Copyrighted Material.
2. Wan Lee Anthony,” 5G system Design: An end to end Perspective”, Springer Publications, 2019.
3. Z. Zhang, Y. Xiao, Z. Ma, M. Xiao, Z. Ding, X. Lei, G. K. Karagiannidis, and P. Fan, “6G wireless networks: Vision, requirements, architecture, and key technologies,” IEEE Vehicular Technology Magazine, vol. 14, pp. 28–41, March 2019.

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21EC1949 **PHOTONIC NETWORKS**

L	T	P	C
3	0	0	3

OBJECTIVES:

- To introduce the relevance of Photonic Networks to the existing technology.
- To enable the student to understand the importance of the infrastructure in photonic networks.
- To familiarize with the architectures and the protocol stack.
- To expose the student to the advances in networking and switching domains.
- To enable the student to understand the network design and management.

UNIT - I PHOTONIC SYSTEM COMPONENTS 9

Light Propagation in optical fibers – Loss & bandwidth, System limitations, NonLinear effects; Solitons; Optical Network Components – Couplers, Isolators & Circulators, Multiplexers & Filters, Optical Amplifiers, Switches, Wavelength Converters.

UNIT - II PHOTONIC NETWORK ARCHITECTURE 9

Introduction to Optical Networks; SONET / SDH, Metropoliton - Area Networks, Layered Architecture ; Broadcast and Select Networks – Topologies for Broadcast Networks, Media-Access Control Protocols, Testbeds for Broadcast & Select WDM; Wavelength Routing Architecture.

UNIT - III WAVELENGTH ROUTING NETWORKS 9

The optical layer, Node Designs, Optical layer cost tradeoff, Routing and wavelength assignment, Virtual topology design, Wavelength Routing Testbeds, Architectural variations.

UNIT - IV PACKET SWITCHING AND ACCESS NETWORKS 9

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

UNIT - V NETWORK DESIGN AND MANAGEMENT 9

Transmission System Engineering – System model, Power penalty - transmitter, receiver, Optical amplifiers, crosstalk, dispersion; Wavelength stabilization ; Overall design considerations; Control and Management – Network management functions, Configuration management, Performance management, Fault management, Optical safety, Service interface.

TOTAL: 45 PERIODS

OUTCOMES:

On successful completion of the course student will be able to:

1. To comprehend and appreciate the significance and role of Photonic Networks in the present contemporary world.
2. To use the backbone infrastructure of photonic networks for our present and future communication needs.
3. Discuss the architectures and the protocol stack in use.
4. Describe the advances and recent trends in the networking and switching approaches.
5. Compare the differences in the design of data plane, control plane, routing, switching, resource allocation methods, Network management and protection methods in vogue.

TEXT BOOKS:

1. Rajiv Ramaswami and Kumar N. Sivarajan,"Optical Networks: A Practical Perspective", Harcourt Asia Pvt Ltd., 3rd Edition, 2004.
2. C. Siva Ram Moorthy and Mohan Gurusamy, "WDM Optical Networks: Concept, Design and Algorithms", Prentice Hall of India, Ist Edition, 2002.

REFERENCES:

1. P.E. Green, Jr., "Fiber Optic Networks", Prentice Hall, NJ, 1993.

Biswanath Mukherjee, "Optical WDM Networks", Springer Series, 2006.

2. Martin P. Clarke, "Wireless Access Network: Fixed Wireless Access and WLL network Design and operation", John Wiley & Sons 2000.

VERTICAL VIII EMERGING TECHNOLOGIES

21EC1950	CRYPTOGRAPHY AND SECURITY PRACTICES	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To learn the fundamentals of networks security, security architecture, threats and vulnerabilities.
- To know the fundamental mathematical concepts related to Symmetric Key Cryptography.
- To know the fundamental mathematical concepts related to Asymmetric Key Cryptography.
- To comprehend the various types of data integrity and authentication schemes.
- To understand various Security Practices and System Security.

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 KEY 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.

TOTAL: 45 PERIODS

OUTCOMES:

On successful completion of the course student will be able to:

1. Understand the concept of security needed in computers and networks along with various possible attacks.
2. Analyze 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.
6. Understand types of System security.

TEXT BOOKS:

1. William Stallings, “Cryptography and Network Security - Principles and Practice”, Seventh Edition, Pearson Education, 2017.

REFERENCES:

1. C K Shyamala, N Harini and Dr. T R Padmanabhan, “Cryptography and Network Security”, Wiley India Pvt.Ltd.
2. Behrouz A. 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

21EC1951	BLOCK CHAIN TECHNOLOGIES AND APPLICATIONS	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To learn the fundamentals of Block chain.
- To explain the details of Bitcoin and its different components.
- To incorporate the consensus of Block chain.
- To understand the Ethereum development environment.
- To learn the applications of Block chain.

UNIT - I INTRODUCTION 9

Block chain history, basics, architectures, Types of block chain, Basic Cryptographic primitives used in Block chain –Secure- Collision Resistant hash functions - Digital signature - Public key cryptosystems – Zero knowledge proof systems - Need for Distributed Record Keeping - Modelling faults and adversaries- Byzantine Generals problem - Consensus algorithms and their scalability problems - Why Nakamoto Came up with Block chain based crypto currency.

UNIT - II BITCOIN 9

Fundamentals, aspects of bitcoins, properties of bitcoins, Digital Keys and Addresses – Transactions, life cycle, data structure, types – Structure of the block chain – Mining – Bitcoin Networks and Payments – Wallets – Alternative coins – Smart Contracts – Definition – Recardian contracts.

UNIT - III BITCOIN CONSENSUS 9

Bitcoin Consensus, Proof of Work (PoW)- Hashcash PoW , Bitcoin PoW, Attacks on PoW ,monopoly problem- Proof of Stake- Proof of Burn - Proof of Elapsed Time - Bitcoin Miner, Mining Difficulty, Mining Pool-Permissioned model and use cases, Design issues for Permissioned Blockchains, Execute contracts- Consensus models for permissioned blockchain-Distributed consensus in closed environment Paxos.

UNIT - IV ETHEREUM 9

Setting up Ethereum development tools – Solidity language – Ethereum accounts, key pairs, working with Externally Owned Accounts (EOA), contract accounts – Smart contracts, structure, setting up and interaction, examples – Decentralised applications, implementation, case studies – Whisper protocol – Swarm architecture and concepts.

UNIT - V APPLICATIONS 9

Applications of block chain in cyber security- integrity of information- E-Governance, Finance, Internet of things, Health and other contract enforcement mechanisms.

TOTAL: 45 PERIODS

OUTCOMES:

On successful completion of the course student will be able to:

1. Define the fundamentals of Blockchain.
2. Explain the different steps in the use of Bitcoins.
3. Understand the basics of Bitcoin consensus.
4. Describe the Consensus of Blockchain.
5. Analyze the Ethereum.
6. Inspect various applications of Block chain.

TEXT BOOKS:

1. S.Shukla,n M.Dhawan, S.Sharma, S. Venkatesan, “Blockchain Technology: Cryptocurrency and Applications”, Oxford University Press 2019.
2. Arvind Narayanan, Joseph Bonneau, Edward Felten, Andrew Miller and Steven Goldfeder, “Bitcoin and cryptocurrency technologies: a comprehensive introduction”, Princeton University Press,2016.

REFERENCES:

1. Imran Bashir, “Mastering Blockchain: Distributed Ledger Technology, Decentralization, and Smart Contracts Explained”, Second Edition, Packt Publishing, 2018.
2. Alex Leverington, “Ethereum Programming”, Packt Publishing Limited, 2017.
3. Arshdeep Bahga and Vijay Madisetti, “Blockchain Applications : A Hands-On Approach”, 2017.

21EC1952 **DATA SCIENCE AND ANALYTICS**

L	T	P	C
3	0	0	3

OBJECTIVES:

- To understand the techniques and processes of data science.
- To apply descriptive data analytics.
- To visualize data for various applications.
- To understand inferential data analytics.
- To analyze and build predictive models from data

UNIT - I INTRODUCTION TO DATA SCIENCE 9

Need for data science – benefits and uses – facets of data – data science process – setting the research goal – retrieving data – cleansing, integrating, and transforming data – exploratory data analysis – build the models– presenting and building applications.

UNIT - II DESCRIPTIVE ANALYTICS 9

Frequency distributions–Outliers–interpreting distributions–graphs–averages-describing variability – interquartile range – variability for qualitative and ranked data - Normal distributions – z-scores –correlation – scatter plots – regression – regression line – least squares regression line –standard error of estimate – interpretation of r2 – multiple regression equations – regression toward the mean.

UNIT - III INFERENTIAL STATISTICS 9

Populations – samples – random sampling – Sampling distribution-standard error of the mean –Hypothesis testing– z-test procedure–decision rule–calculations– decisions–interpretations – one-tailed and two-tailed tests – Estimation – point estimate – confidence interval –level of confidence– effect of sample size.

UNIT - IV ANALYSIS OF VARIANCE 9

t-test for one sample – sampling distribution of t – t-test procedure – t-test for two independent samples – p-value – statistical significance – t-test for two related samples. F-test – ANOVA – Two-factor experiments–three tests –two-factor ANOVA – Introduction to chi-square tests.

UNIT - V PREDICTIVE ANALYTICS 9

Linear least squares–implementation–goodness of fit–testing a linear model–weighted resampling. Regression using Stats Models – multiple regression – nonlinear relationships – logistic regression – estimating parameters – Time series analysis – moving averages – missing values –serial correlation– autocorrelation. Introduction to survival analysis.

TOTAL: 45 PERIODS

OUTCOMES:

On successful completion of the course student will be able to:

1. Explain the data analytics pipeline.
2. Analyze the techniques of data science.
3. Describe and visualize data.
4. Perform statistical inferences from data.
5. Analyze the variance in the data.
6. Propose models for predictive analytics.

TEXT BOOKS:

1. David Cielen, ArnoD.B.Meysman, and MohamedAli,“Introducing Data Science”,Manning Publications,2016.
2. Robert S.Witte and JohnS.Witte,“Statistics”,Eleventh Edition, Wiley Publications, 2017.
3. JakeVander Plas,“Python DataScience Handbook”,O’Reilly,2016.

REFERENCES:

1. Allen B.Downey,“ThinkStats: Exploratory Data Analysis in Python”, Green Tea Press,2014.
2. Sanjeev J.Wagh, Manisha S.Bhende, Anuradha D.Thakare, “Fundamentals of Data Science”, CRC Press,2022.
3. Chirag Shah,“A Hands-on Introduction to Data Science”, Cambridge University Press, 2020.
4. Vineet Raina, Srinath Krishnamurthy, “Building an Effective Data Science Practice: A Framework to Bootstrap and Manage a Successful Data Science Practice”, A press, 2021.

JAISAKTHI EDUCATIONAL TRUST

21EC1953	MACHINE LEARNING ALGORITHMS	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To grasp the fundamental concepts of Machine Learning.
- To understand supervised learning and their applications.
- To realize the concepts and algorithms of unsupervised learning.
- To study advanced learning techniques in Machine Learning.
- To study applications of machine learning in real world domains.

UNIT - I INTRODUCTION TO ML ALGORITHMS 9

Machine Learning–Types of Machine Learning –Machine Learning process-preliminaries, testing Machine Learning algorithms, turning data into Probabilities, and Statistics for Machine Learning- Probability theory – Probability Distributions – Decision Theory.

UNIT - II SUPERVISED LEARNING ALGORITHMS 9

Linear Models for Regression – Linear Models for Classification- Discriminant Functions, Probabilistic Generative Models, Probabilistic Discriminative Models – Decision Tree Learning – Bayesian Learning, Naïve Bayes – Ensemble Methods, Bagging, Boosting, Neural Networks, Multi- layer Perceptron, Feed- forward Network, Error Back propagation - Support Vector Machines.

UNIT - III UNSUPERVISED LEARNING ALGORITHMS 9

Clustering- K-means – EM Algorithm- Mixtures of Gaussians –Dimensionality Reduction, Linear Discriminant Analysis, Factor Analysis, Principal Components Analysis, Independent Components Analysis.

UNIT - IV COMPUTATIONAL LEARNING THEORY 9

Sampling-Basic Sampling methods, Monte Carlo, Gibbs Sampling – Computational Learning Theory – Mistake Bound Analysis – Reinforcement learning – Markov Decision processes, Deterministic and Non-deterministic Rewards and Actions, Temporal Difference Learning Exploration.

UNIT - V IMPLEMENTATION OF ML ALGORITHMS 9

Image fusion-object recognition-speech analysis-text document clustering-handwritten digit recognition-image segmentation-spam email classification.

TOTAL: 45 PERIODS

OUTCOMES:

On successful completion of the course student will be able to:

1. Analyze Classification and Regression in Supervised learning
2. Familiar with Unsupervised Learning.
3. Design a learning model appropriate to the application.
4. Design a Neural Network for an application.
5. Use a tool to implement typical Clustering algorithms for different types of applications.
6. Identify applications suitable for different types of Machine Learning with suitable justification.

TEXT BOOKS:

1. Stephen Marsland, “Machine Learning – An Algorithmic Perspective”, Chapman and Hall, CRC Press, Second Edition, 2014.
2. Kevin P. Murphy, “ Machine Learning: A Probabilistic Perspective”, MIT Press, 2012.

REFERENCES:

1. Christopher Bishop” Pattern Recognition and Machine Learning”, Springer, 2007.
2. Ethem Alpaydin,, “Introduction to Machine Learning”, MIT Press, Third Edition, 2014.
3. Tom Mitchell, “Machine Learning”, McGraw-Hill, 1997.

21EC1954	DEEP LEARNING	L T P C 3 0 0 3

OBJECTIVES:

- To understand the basic ideas and principles of Neural Networks.
- To learn the basic concepts of Deep Learning algorithms.
- To familiarize the student with convolutional neural networks.
- To understand Deep Learning Architectures.
- To familiarize about Deep Learning Applications.

UNIT - I BASICS OF NEURAL NETWORKS 9

Basic concept of Neurons – Activation functions - Perceptron - components - Algorithm – Perceptron models -Feed Forward and Back Propagation Networks.

UNIT - II INTRODUCTION TO DEEP LEARNING 9

Feed Forward Neural Networks – Gradient Descent – Back Propagation Algorithm – Vanishing Gradient problem – Mitigation – RelU Heuristics for Avoiding Bad Local Minima – Heuristics for Faster Training – Nestors Accelerated Gradient Descent – Regularization – Dropout.

UNIT - III CONVOLUTIONAL NEURAL NETWORKS 9

CNN Architectures – Operation - Convolution – Pooling Layers – Transfer Learning – Categories - Strategies - Applications - Transfer Learning for Image Classification.

UNIT - IV DEEP LEARNING ARCHITECTURES 9

LSTM, GRU, Encoder/Decoder Architectures – Autoencoders – Standard - Sparse – Denoising – Contractive - Variational Autoencoders – Adversarial Generative Networks – Autoencoder and DBM.

UNIT - V APPLICATIONS OF DEEP LEARNING 9

Image Segmentation – Object Detection – Image generation with Generative Adversarial Networks – Video to Text with LSTM Models – Case Study: Named Entity Recognition – Parsing and Sentiment Analysis using Recursive Neural Networks – Sentence Classification using Convolutional Neural Networks – Dialogue Generation with LSTMs.

TOTAL: 45 PERIODS

OUTCOMES:

On successful completion of the course student will be able to:

1. Understand the basic concepts of Neural networks.
2. Familiarize with Deep Learning Algorithms.
3. Understand Convolutional Neural Networks.
4. Organize Transfer Learning categories and strategies.
5. Discuss more Deep Learning Architectures.
6. Learn about applications of Deep Learning in Image Processing.

TEXT BOOKS:

1. Ian Good Fellow, Yoshua Bengio, Aaron Courville, “Deep Learning”, MIT Press, 2017.
2. Francois Chollet, “Deep Learning with Python”, Manning Publications, 2018.
3. Phil Kim, “Matlab Deep Learning: With Machine Learning, Neural Networks and Artificial Intelligence”, Apress , 2017.

REFERENCES:

1. Ragav Venkatesan, Baoxin Li,”Convolutional Neural Networks in Visual Computing”, CRCPress, 2018.
2. Navin Kumar Manaswi, “Deep Learning with Applications Using Python”, Apress, 2018.
3. Joshua F. Wiley, “R Deep Learning Essentials”, Packt Publications, 2016.

21EC1955	HUMAN COMPUTER INTERACTION	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To determine the necessity of user interaction by understanding usability engineering and user modeling.
- To learn the methodologies for designing interactive systems.
- To examine the evaluation methodologies of design.
- To understand design issues for web platforms.
- To understand design issues for mobile platforms and interaction with machines.

UNIT - I HCI AND USABILITY 9

Context of Interaction – Ergonomics - Designing Interactive systems – Understanding Users – cognition and cognitive frameworks, User Centered approaches, Usability, Universal Usability, Understanding and conceptualizing interaction, Guidelines, Principles and Theories.

UNIT - II INTERACTION STYLES 9

HCI patterns, design frameworks, design methods, prototyping. Understanding interaction styles, Direct Navigation and Immersive environments, Fluid navigation, Expressive Human and Command Languages, Communication and Collaboration.

UNIT - III USER EXPERIENCE DESIGN 9

Frameworks for User Centric Computing, Computational models of users, Advancing the user experience, Timely user Experience, Information search, Data Visualization.

UNIT - IV COGNITIVE SYSTEMS AND EVALUATION OF HCI 9

Communication and collaboration models Task analysis, dialog notations and design, Evaluation Techniques- assessing user experience- usability testing – Heuristic evaluation and walkthroughs, analytics predictive models.

UNIT - V INTERACTION TECHNIQUES FOR WEB, MOBILE & MACHINES 9

Designing websites, social media, Collaborative environments, Agents and Avatars, Ubiquitous computing, Mobile Computing, Wearable Computing, Introduction to M2M, drone and autonomous vehicle interaction.

TOTAL: 45 PERIODS

OUTCOMES:

On successful completion of the course student will be able to:

1. Design for usability based on a variety of classic Universal user-centric models.
2. Use complex interaction styles and techniques for contextual design.
3. Evaluate interaction designs and implementations.
4. Understand the models and theories for user interaction.
5. Suggest suitable designs for web applications.
6. Understand the basics of interaction with mobiles and machines.

TEXT BOOKS:

1. Ben Shneiderman, Catherine Plaisant, Maxine Cohen, Steven Jacobs, Niklas Elmqvist "Designing the User Interface: Strategies for Effective Human-Computer Interaction", Sixth Edition, Pearson Education, 2017.
2. Jenny Preece, Helen Sharp, Yvonne Rogers, "Interaction Design: Beyond Human Computer Interaction", Wiley, 5th Edition, 2019.

REFERENCES:

1. Alan Dix, Janet Finlay, Gregory Abowd, Russell Beale, "Human Computer Interaction", Third Edition, Pearson Education, 2004.
2. David Benyon, "Designing User Experience: A guide to HCI, UX and interaction design", 4th Edition, Pearson, 2018.
3. Samit Bhattacharya, "Human-Computer Interaction: User-Centric Computing for Design", McGraw-Hill India, 1st Edition, 2019.
4. Alan Dix, Steve Gill, Devina Ramduny-Ellis, Jo Hare, "TouchIT: Understanding Design in a Physical-Digital World", Oxford University Press, 1st Edition, 2022.
5. Alan Cooper, Robert Reimann, David Cronin, Christopher Noessel, "About Face: The Essentials of Interaction Design", 4th Edition, Wiley, 2014.
6. Giles Colborne, Simple and Usable Web, Mobile, and Interaction Design, New Riders Press, 2nd Edition, 2018.
7. Donald A. Norman, "Design of Everyday Things", MIT Press, 2013.
8. Steven Hoober, Eric Berkman, "Designing Mobile Interfaces Patterns for Interaction Design", O'Reilly, 2011.
9. Bill Scott and Theresa Neil, "Designing Web Interfaces", First Edition, O"Reilly, 2009.
10. Cameron Banga, Josh Weinhold, "Essential Mobile Interaction Design: Perfecting Interface Design in Mobile Apps", Addison-Wesley Professional, 1st edition, 2014.

21EC1956	AUGMENTED REALITY/VIRTUAL REALITY	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To impart the fundamental aspects and principles of AR/VR Technologies.
- To know the internals of the hardware and software components involved in the development of AR/VR enabled applications.
- To learn about the graphical processing units and their architectures.
- To gain knowledge about AR/VR application development.
- To know the technologies involved in the development of AR/VR based applications

UNIT - I INTRODUCTION TO VIRTUAL REALITY AND AUGMENTED REALITY 9

Introduction to Virtual Reality and Augmented Reality – Definition – Introduction to Trajectories and Hybrid Space-Three I's of Virtual Reality – Virtual Reality Vs 3D Computer Graphics – Benefits of Virtual Reality – Components of VR System – Introduction to AR-AR Technologies-Input Devices – 3D Position Trackers – Types of Trackers – Navigation and Manipulation Interfaces – Gesture Interfaces – Types of Gesture Input Devices – Output Devices – Graphics Display – Human Visual System – Personal Graphics Displays – Large Volume Displays – Sound Displays – Human Auditory System.

UNIT - II VR MODELING 9

Modeling – Geometric Modeling – Virtual Object Shape – Object Visual Appearance – Kinematics Modeling – Transformation Matrices – Object Position – Transformation Invariants –Object Hierarchies – Viewing the 3D World – Physical Modeling – Collision Detection – Surface Deformation – Force Computation – Force Smoothing and Mapping – Behavior Modeling – Model Management.

UNIT - III VR PROGRAMMING 9

VR Programming – Toolkits and Scene Graphs – World ToolKit – Java 3D – Comparison of World ToolKit and Java 3Dman Factors in VR.

UNIT - IV APPLICATIONS 9

Hu – Methodology and Terminology – VR Health and Safety Issues – VR and Society-Medical Applications of VR – Education, Arts and Entertainment – Military VR Applications – Emerging Applications of VR – VR Applications in Manufacturing – Applications of VR in Robotics – Information Visualization – VR in Business – VR in Entertainment – VR in Education.

UNIT - V AUGMENTED REALITY 9

Introduction to Augmented Reality-Computer vision for AR-Interaction-Modelling and Annotation Navigation-Wearable devices.

TOTAL: 45 PERIODS

OUTCOMES:

On successful completion of the course student will be able to:

1. Understand the basic concepts of AR and VR.
2. Understand the tools related to AR/VR.
3. Understand the technologies related to AR/VR.
4. Know the working principle of AR/VR related Sensor devices.
5. Design of various models using modeling techniques.
6. Develop AR/VR applications in different domains.

TEXT BOOKS:

1. Charles Palmer, John Williamson, “Virtual Reality Blueprints: Create compelling VR experiences for mobile”, Packt Publisher, 2018.
2. Dieter Schmalstieg, Tobias Hollerer, “Augmented Reality: Principles & Practice”, Addison Wesley, 2016.

REFERENCES:

1. John Vince, “Introduction to Virtual Reality”, Springer-Verlag, 2004.
2. William R. Sherman, Alan B. Craig: Understanding Virtual Reality – Interface, Application, Design”, Morgan Kaufmann, 2003.

List of Open Electives I (V SEMESTER)

21EE1005	ENERGY CONSERVATION AND MANAGEMENT	L	T	P	C
		3	0	0	3

OBJECTIVES:

- Understand and analyse the energy data of industries
- Carryout energy accounting and balancing
- Conduct energy audit and suggest methodologies for energy savings
- Utilise 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

Pumps, 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.

TOTAL: 45 PERIODS

OUTCOMES:

On successful completion of the course student will be able to:

1. Remember the knowledge for Basic combustion and furnace design and selection of thermal and mechanical energy equipment.
2. Study the Importance of Stoichiometry relations, Theoretical air required for complete combustion.
3. Skills on combustion thermodynamics and kinetics
4. Apply calculation and design tube still heaters.
5. Studied different heat treatment furnace.
6. Practical and theoretical knowledge burner design.

TEXT BOOKS:

1. Energy Manager Training Manual (4 Volumes) available at www.energymanagertraining.com. a website administered by Bureau of Energy Efficiency (BEE), a statutory body under Ministry of Power, Government of India, 2004.

REFERENCES:

1. Witte. L.C., P.S. Schmidt, D.R. Brown, "Industrial Energy Management and Utilisation" Hemisphere Publ, Washington, 1988.
2. Callaghn, P.W. "Design and Management for Energy Conservation", Pergamon Press, Oxford, 1981
3. Dryden. I.G.C., "The Efficient Use of Energy" Butterworths, London, 1982
4. Turner. W.C., "Energy Management Hand book", Wiley, New York, 1982
5. Murphy. W.R. and G. Mc KAY, "Energy Management", Butterworths, London 1987

21CS1001	FUNDAMENTALS OF DATABASE MANAGEMENT SYSTEMS	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To understand the basic concepts and the applications of database systems.
- To understand the various data models
- To learn the relational database design principles.
- To know the basics of SQL and construct queries using SQL.
- To familiar with the basic issues of transaction processing and concurrency control.

UNIT - I DATABASE FUNDAMENTALS 9

Introduction: Database System Applications, Purpose of Database Systems, View of Data, components and structure, Database Users and Administrator, History of Database Systems.

UNIT - II DATA MODELS 9

ER model, Entities, Attributes and Entity sets, Relationships and Relationship sets, Additional features of ER Model, Conceptual Design with the ER Model, Enhanced E-R Model.

UNIT - III RELATIONAL DATABASE 9

Relational Data Model - Concept of relations, schema-instance distinction, keys, referential integrity and foreign keys, relational algebra operators, Normalization (1NF, 2NF, 3NF, BCNF).

UNIT - IV STRUCTURED QUERY LANGUAGE 9

Introduction, data definition in SQL, table, key and foreign key definitions, update behaviours. Querying in SQL, notion of aggregation, aggregation functions group by and having clauses, embedded SQL

UNIT - V TRANSACTION MANAGEMENT AND CONCURRENCY 9

Control Transaction management: ACID properties, serializability and concurrency control, Lock based concurrency control (2PL, Deadlocks), Time stamping methods, optimistic methods, database recovery management.

TOTAL: 45 PERIODS

OUTCOMES:

On successful completion of the course student will be able to:

1. Remember the Structure of a Database
2. Understand an Entity Relational Model for a database.
3. Apply Relational database concepts to design a database.
4. Analyze the importance of normalization and functional dependencies in database design
5. Understand transaction processing and concurrency control
6. Create a database design using Relational models

TEXT BOOKS:

1. Data base System Concepts, A. Silberschatz, Henry. F. Korth, S.Sudarshan, McGraw Hill India Private Limited, 7th edition.

REFERENCES:

1. Data base Management Systems, Raghu Ramakrishnan, Johannes Gehrke, McGraw Hill Education (India) Private Limited, 3rd Edition.

PANIMALAR ENGINEERING COLLEGE . CHENNAI. JAISAKTHI EDUCATIONAL TRUST

21CS1003	CLOUD COMPUTING	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To learn about the concept of cloud and utility computing.
- 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 TO CLOUD COMPUTING 9

Introduction to Cloud Computing – Roots of Cloud Computing – Desired Features of Cloud Computing – Challenges and Risks – Benefits and Disadvantages of Cloud Computing.

UNIT - II VIRTUALIZATION 9

Introduction to Virtualization Technology – Load Balancing and Virtualization – Understanding Hypervisor – Types of Virtualization – Server, Desktop, Application Virtualization.

UNIT - III CLOUD ARCHITECTURE, SERVICES AND STORAGE 9

NIST Cloud Computing Reference Architecture – Public, Private and Hybrid Clouds - IaaS – PaaS – SaaS – Architectural Design Challenges.

UNIT - IV RESOURCE MANAGEMENT AND SECURITY IN CLOUD 9

Inter Cloud Resource Management – Resource Provisioning Methods – Security Overview – Cloud Security Challenges – Data Security –Application Security – Virtual Machine Security.

UNIT - V CASE STUDIES 9

Google App Engine(GAE) – GAE Architecture – Functional Modules of GAE – Amazon Web Services(AWS) – GAE-Open Stack .

TOTAL: 45 PERIODS

OUTCOMES:

On successful completion of the course student will be able to:

1. Articulate the main concepts, key technologies, strengths and limitations of cloud computing.
2. Learn the key and enabling technologies that help in the development of cloud.
3. Develop the ability to understand and use the architecture of compute and storage cloud, service and delivery models.
4. Explain the core issues of cloud computing such as resource management and security.
5. Be able to install and use current cloud technologies.
6. Choose the appropriate technologies, algorithms and approaches for implementation and use of cloud.

TEXT BOOKS:

1. Buyya R., Broberg J., Goscinski A., Cloud Computing: Principles and Paradigm, First Edition, John Wiley and Sons, 2011.
2. Kai Hwang, Geoffrey C. Fox, Jack G. Dongarra, "Distributed and Cloud Computing, From Parallel Processing to the Internet of Things", Morgan Kaufmann Publishers, 2012.
3. Rittinghouse, John W., and James F. Ransome, Cloud Computing: Implementation, Management, And Security, CRC Press, 2017.

REFERENCES:

1. RajkumarBuyya, 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.
3. George Reese, "Cloud Application Architectures: Building Applications and Infrastructure in the Cloud: Transactional Systems for EC2 and Beyond (Theory in Practice), OReilly, 2009.

21EC1003	BASIC OF BIOMEDICAL INSTRUMENTATION	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To study about the different biopotential and its propagation
- To understand the different types of electrodes and its placement for various recording
- To study the design of bioamplifier for various physiological recording
- To learn the different measurement techniques for non-physiological parameters.
- To familiarize the different biochemical measurements.

UNIT - I BIOPOTENTIAL GENERATION AND ELECTRODES TYPES 9

Origin of bio potential and its propagation.Types of electrodes -surface, needle and micro electrodes and their equivalent circuits. Recording problems - measurement with two electrodes.

UNIT - II BIOSIGNAL CHARACTERISTICS AND ELECTRODE CONFIGURATIONS 9

Biosignals characteristics frequency and amplitude ranges. ECG Einthoven's Triangle , standard 12 lead system. EEG –10-20 electrode system, unipolar, bipolar and average mode. EMG– unipolar and bipolar mode.

UNIT - III SIGNAL CONDITIONING CIRCUITS 9

Need for bio-amplifier - differential bio-amplifier, Impedance matching circuit, isolation amplifiers, Power line interference, Right leg driven ECG amplifier, Band pass filtering.

UNIT - IV MEASUREMENT OF NON-ELECTRICAL PARAMETERS 9

Temperature, respiration rate and pulse rate measurements. Blood Pressure: indirect methods - Auscultatory method, direct methods: electronic manometer, Systolic, diastolic pressure, Blood flow and cardiac output measurement: Indicator dilution, and dye dilution method, ultrasound blood flow measurement.

UNIT - V BIO-CHEMICAL MEASUREMENT 9

Blood gas analyzers and Non-Invasive monitoring, colorimeter, Sodium Potassium Analyser, spectrophotometer, blood cell counter, auto analyzer (simplified schematic description).

TOTAL: 45 PERIODS

OUTCOMES:

On successful completion of the course student will be able to:

1. Learn the different bio-potential and its propagation.
2. Get familiarize the different electrode placement for various physiological recording
3. Students will be able to design bio-amplifier for various physiological recording
4. Students will understand various technique on electrical physiogical measurements
5. Understand the different biochemical measurements

TEXT BOOKS:

1. Leslie Cromwell,"Biomedical Instrumentation and measurement", Prentice hall of India, New Delhi, 2012.
2. John G. Webster,"Medical Instrumentation Application and Design", John Wiley and sons, New York, 2014.

REFERENCES:

1. Myer Kutz, "Standard Handbook of Biomedical Engineering and Design", McGraw Hill Publisher, 2013.
2. Khandpur R.S, "Handbook of Biomedical Instrumentation", Tata McGraw-Hill, New Delhi, 2013.
3. Joseph J. Carr and John M. Brown, "Introduction to Biomedical Equipment Technology", Pearson Education, 2014.

21EE1006	INTELLIGENT AUTOMATION	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To identify potential areas for automation and justify need for automation.
- Study the concepts of Artificial Intelligence.
- Learn the methods of solving problems using Artificial Intelligence.
- Apply the concept of AI to attain industrial automation.

UNIT - I INTRODUCTION TO AUTOMATION (7+2 skill)9

Introduction to Industrial Automation - Automation in Production System- Principles and Strategies of Automation - Basic Elements of an Automated System- Advanced Automation Functions- Levels of Automations- Production Economics - Methods of Evaluating Investment Alternatives- Costs in Manufacturing- Break Even Analysis- Unit cost of production- Cost of Manufacturing Lead time and Work-in-process.

UNIT - II INTRODUCTION TO ARTIFICAL INTELLIGENCE (7+2 skill)9

Introduction to Artificial Intelligence -Introduction-Foundations of AI- History of AI- Intelligent agents: Agents and Environment- Reactive agent- deliberative- goal driven- utility driven and learning agents -Artificial Intelligence programming techniques. Introduction to ML and DL Concepts

UNIT - III KNOWLEDGE AND REASONING (7+2 skill)9

Knowledge Representation and Reasoning - Ontologies-foundations of knowledge representation and reasoning-representing and reasoning about objects- relations- events-actions- time- and space- predicate logic-situation calculus- description logics-reasoning with defaults-reasoning about knowledge-sample applications- Representing Knowledge and reasoning in an Uncertain Domain- Bayes rule- Bayesian networks-probabilistic inference sample applications- Planning: planning as search- partial order planning- construction and use of planning graphs.

UNIT - IV EXPERT SYSTEMS (7+2 skill)9

Expert systems -Expert systems – Architecture of expert systems, Roles of expert systems – Knowledge Acquisition – Meta knowledge- Heuristics. Typical expert systems – MYCIN – ART-XOON.

UNIT - V AI IN CONTROL SYSTEMS (7+2 skill)9

Industrial AI applications and Case studies - Applications of Industrial AI in Monitoring-optimization and control- AI applications in Industry Automation using - natural language processing-computer vision-speech recognition-computer vision.

TOTAL: 45 PERIODS

OUTCOMES:

On successful completion of the course student will be able to:

1. Understand the basics AI algorithms (L2).
2. Identify appropriate AI methods to solve a given problem (L1).
3. Illustrate about AI/ML/DL techniques in Industrial Automation (L3).
4. Summarize the levels of automation (L2).
5. Ability to apply AI concepts for industrial optimization and control. (L4).
6. Design the AI for various applications

TEXT BOOKS:

1. Rich and Knight, "Artificial Intelligence", 3rd Edition, Tata McGraw Hill, 2014.
2. M.P.Groover, "Automation, Production Systems and Computer Integrated Manufacturing", 5th edition, Pearson Education, 2009.

REFERENCES:

1. Anuradha Srinivasaraghavan, Vincy Joseph "Machine Learning", Wiley, 2019.
2. Stuart Russell and Peter Norvig, "Artificial Intelligence: A Modern Approach", 2nd Edition, Prentice Hall, 2003.
3. Rajiv Chopra, "Deep Learning", 1st Edition, Khanna Publishing House, 2018.

21CB1001	INTRODUCTION TO C PROGRAMMING	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To acquire knowledge to write an algorithm and flowchart for problems.
- To study and develop C programs using operators, expressions and control flow.
- To learn the concept for functions and pointers.
- To gather knowledge about structure and I/O.
- To learn about processing of files.

UNIT - I BASICS OF C PROGRAMMING 9

Introduction to programming paradigms, Art of Programming through Algorithms and Flowcharts.History and importance of C - Applications of C Language - Structure of C program – Basics: Data Types – Constants –Variables - Keywords – Operators: Precedence and Associativity - Expressions – Input / Output statements, Assignment statements – Decision-making statements - Switch statement - Looping statements – Pre-processor directives - Compilation process – Exercise Programs: Check whether the required amount can be withdrawn based on the available amount – Menu-driven program to find the area of different shapes – Find the sum of even numbers.

SUGGESTED ACTIVITIES:

Understanding the constructs of C Language.
Control the sequence of the program and give logical outputs.
Understanding the uses of pre-processors and various memory models.

SUGGESTED EVALUATION METHODS

Tutorial on conditionals and loops.
Assignments.

UNIT - II ARRAYS 9

Introduction to Arrays – One dimensional array: Declaration – Initialization - Accessing elements – Operations: Traversal, Insertion, Deletion, Searching - Two dimensional arrays: Declaration – Initialization - Accessing elements – Operations: Read – Print – Sum – Transpose – Multiplication- Exercise Programs: Print the number of positive and negative values present in the array – Sort the numbers using bubble sort - Find whether the given is matrix is diagonal or not.

SUGGESTED ACTIVITIES:

Understanding the purpose of array
Design and implement applications using arrays
Develop an application to perform matrix operations using multi-dimensional arrays

SUGGESTED EVALUATION METHODS

Pedagogical tools
Assignments.

UNIT - III STRINGS & POINTERS 9

Introduction to Strings - Reading and writing a string - String operations (without using built-in string functions): Length – Compare – Concatenate – Copy – Reverse – Substring – Insertion – Indexing – Deletion – Replacement – Array of strings – Pointers: Pointer operators – Pointer arithmetic - Exercise programs: To find the frequency of a character in a string - To find the number of vowels, consonants and white spaces in a given text - Sorting the names.

SUGGESTED ACTIVITIES:

Understanding the purpose of strings
Developing C programs using strings

SUGGESTED EVALUATION METHODS

Quizzes
Tabulate the different strings functions and its purpose

UNIT - IV FUNCTIONS 9

Introduction to Functions – Types: User-defined and built-in functions - Function prototype - Function definition - Function call - Parameter passing: Pass by value - Pass by reference - Built-in functions (string functions) – Recursive functions – Exercise programs: Calculate the total amount of power consumed by 'n' devices (passing an array to a function) – Menu-driven program to count the numbers which are divisible by 3, 5 and by both (passing an array to a function) – Replace the punctuations from a given sentence by the space character (passing an array to a function)

SUGGESTED ACTIVITIES:

Apply code reusability with functions and pointers
Develop and implement modular applications in C using functions.

SUGGESTED EVALUATION METHODS

Assignments
Pedagogical Techniques

UNIT - V STRUCTURES, UNIONS AND FILE MANAGEMENT 9

Introduction to structures – Declaration – Initialization – Accessing the members – Nested Structures – Array of Structures – Structures and functions – Passing an entire structure – typedef – Union - Storage classes and Visibility. Exercise programs: Compute the age of a person using structure and functions (passing a structure to a function) – Compute the number of days an employee came late to the office by considering his arrival time for 30 days (Use array of structures and functions) - Defining and opening a file, closing a file, Input/output and Error Handling on Files

SUGGESTED ACTIVITIES:

Demonstration of real-world applications using file operations.
Implementing applications using Unions, Enumerations and typedef.
Understanding the basics of file handling mechanisms

SUGGESTED EVALUATION METHODS

Quizzes
Assignment

TOTAL: 45 PERIODS

OUTCOMES:

On successful completion of the course student will be able to:

1. Ability to implement the algorithms and flow chart for solving mathematical and engineering problems
2. Develop C programs for real world/technical application using basic constructs
3. Implement C programs using control structures
4. Explore the usage of arrays, pointers and functions in C.
5. Implement Programs with structures and union in C.
6. Design applications using sequential and random access file processing

TEXT BOOKS:

1. ReemaThareja, "Programming in C", Oxford University Press, Second Edition, 2016.
2. Kernighan, B.W and Ritchie,D.M, "The C Programming language", Second Edition, Pearson Education, 2015.

REFERENCES:

1. Paul Deitel and Harvey Deitel, "C How to Program with an Introduction to C++", Eighth edition, Pearson Education, 2018.
2. Yashwant Kanetkar, Let us C, 17th Edition, BPB Publications, 2020.
3. Byron S. Gottfried, "Schaum's Outline of Theory and Problems of Programming with C", McGraw-Hill Education, 1996.
4. Pradip Dey, Manas Ghosh, "Computer Fundamentals and Programming in C", Second Edition, Oxford University Press, 2013.
5. Anita Goel and Ajay Mittal, "Computer Fundamentals and Programming in C", 1st Edition, Pearson Education, 2013.

21AM1001	DATA STRUCTURES AND ALGORITHMS	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To understand the concepts of ADTs
- To design linear data structures–lists, stacks, and queues
- To understand sorting algorithms
- To understand the concept of searching and hashing algorithms
- To apply Tree and Graph structures

UNIT - I LINEAR DATA STRUCTURES – LIST 9

Abstract Data Types (ADTs) – List ADT – array-based implementation – linked list implementation —–singly linked lists- circularly linked lists- doubly-linked lists – applications of lists –Polynomial Manipulation – All operations (Insertion, Deletion, Merge, Traversal).

SUGGESTED ACTIVITES:

Developing and application(student's choice using all the linear data structure

SUGGESTED EVALUATION METHODS:

Programs and Demonstration on applications of linear data structures.
Checking output of programs implemented.
Assignments.

UNIT - II LINEAR DATA STRUCTURES – STACKS, QUEUES 9

Stack ADT – Operations - Applications - Evaluating arithmetic expressions- Conversion of Infix to postfix expression - Queue ADT – Operations - Circular Queue Priority Queue – deQueue – applications of queues- Job Scheduling- Josephus problem.

SUGGESTED ACTIVITES:

Demonstrating stack for Towers of Hanoi application.

SUGGESTED EVALUATION METHODS:

Programs on applications of Stacks and Queues
Quiz on various topics of the unit
Assignments

UNIT - III NON LINEAR DATA STRUCTURES – TREES 9

Tree ADT - Representation of Trees- Binary Tree -Tree traversal- expression trees - applications of trees - binary search tree ADT -Threaded Binary Trees- AVL Trees - B-Tree B+ Tree -Trie - Heap - Applications of heap.

SUGGESTED ACTIVITES:

Solving expressions using expression trees by determining infix, prefix and postfix expressions.

Developing any application using trees.

SUGGESTED EVALUATION METHODS:

Programs using tree traversal and binary tree

Programs on binary search trees.

Programs and Demonstration using AVL tree applications.

Assignments

UNIT - IV NON LINEAR DATA STRUCTURES - GRAPHS 9

Definition - Representation of Graph - Types of graph - Breadth-first traversal - Depth- first traversal - Topological Sort - Bi-connectivity - Cut vertex - Euler circuits - Applications of graphs- Shortest path algorithms- Minimum spanning trees- Prims and Kruskal Algorithms Applications of BFS: Graph Coloring.

SUGGESTED ACTIVITES:

External learning- Applications of graphs.

Practical- To choose and apply a suitable graph algorithm for solving a real time pr /scenario such as Network Routing.

SUGGESTED EVALUATION METHODS:

Assignments on representation of graphs for a given problem

Quizzes on basics of graphs.

Programs and Demonstration using application of graph and topological sort

UNIT - V SEARCHING, SORTING AND HASHING TECHNIQUES 9

Searching- Linear Search - Binary Search. Sorting -Quick Sort - Bubble sort - Selection sort - Heap Sort -Merge Sort - Insertion sort - Bucket sort - Shell sort - Radix sort. Hashing- Hash Functions – Separate Chaining - Open Addressing - Rehashing - Extendible Hashing

SUGGESTED ACTIVITES:

External learning- Applications of graphs.

Practical-To choose and apply a suitable graph algorithm for solving a real time problem/scenario such as Network Routing.

SUGGESTED EVALUATION METHODS:

Tutorials on external sorting.

Tutorials on hashing.

Check output of programs implemented

TOTAL: 45 PERIODS

OUTCOMES:

On successful completion of the course student will be able to:

1. Implement abstract datatypes for linear data structures.
2. Apply the different linear data structures to problem solutions.
3. Model problems as Tree problems and implement efficient Tree algorithms to solve them.
4. Model problems as graph problems and implement efficient graph algorithms to solve them.
5. Critically analyze the various sorting algorithms.
6. Analyze the various searching and hashing algorithms

TEXT BOOKS:

1. Mark Allen Weiss, Data Structures and Algorithm Analysis in C, 2nd Edition, Pearson education, 2011.
2. Reema Thareja, ‘Data Structures Using C’, Second Edition , Oxford University Press, 2011.

REFERENCES:

1. Thomas H.Cormen, Charles E. Leiserson, Ronald L.Rivest, Clifford Stein, “Introduction to Algorithms”,Second Edition, McGraw Hill,2002.
2. Aho,HopcroftandUllman,“DataStructuresandAlgorithms”,PearsonEducation, 1983.
3. StephenG.Kochan,”ProgramminginC”,3rd edition, Pearson Education.
4. Ellis Horowitz, Sartaj Sahni, Susan Anderson-Freed, “Fundamentals of Data Structures in C”,Second Edition,University Press,2008.

ENGINEERING COLLEGE JAISAKTHI EDUCATIONAL TRUST

21IT1003	ETHICAL HACKING	L T P C 3 0 0 3

OBJECTIVES: To impart Knowledge on the following topics:

- To explore the concepts of security testing and the knowledge required to protect against hackers and attackers.
- To understand reconnaissance and the publicly available tools used to gather information on potential targets.
- To discover the scanning techniques used to identify network system open ports.
- To identify network system vulnerabilities and confirm their exploitability.
- To explore techniques for identifying web application vulnerabilities and attacks.

UNIT - I INTRODUCTION TO HACKING 9

Introduction to Hacking – Important Terminologies – Penetration Test – Vulnerability Assessments versus Penetration Test – Pre-Engagement – Rules of Engagement - Penetration Testing Methodologies – OSSTMM – NIST – OWASP – Categories of Penetration Test – Types of Penetration Tests – Vulnerability Assessment Summary -Reports.

SUGGESTEDACTIVITIES:

In-class activity to understand the penetration testing methodologies.
Practical – Use security tools in Kali Linux to assess the vulnerabilities.
Prepare Vulnerability Assessment summary reports.

SUGGESTEDEVALUATIONMETHODS:

Assignment on categories of penetration testing and vulnerability summary reports.
Quiz on penetration testing methodologies, OSSTMM and OWASP.

UNIT - II INFORMATION GATHERING AND SCANNING 9

Information Gathering Techniques – Active Information Gathering – Passive Information Gathering – Sources of Information Gathering – Tracing the Location – Traceroute – ICMP raceroute – TCP Traceroute – Usage – UDP Traceroute – Enumerating and Finger printing the Webservers – Google Hacking – DNS Enumeration – Enumerating SNMP – SMTP Enumeration
– Target Enumeration and Port Scanning Techniques – Advanced Firewall/IDS Evading Techniques.

SUGGESTED ACTIVITIES:

Explain different ways to gather information about a system in the network.

Demonstrate the network command tools to identify the system.

Understand the network protocols and port scanning techniques using Kali linux.

SUGGESTED EVALUATION METHODS:

Assignment problems on information gathering and traceroute of ICMP, DNS and SNMP.

Quizzes on enumeration, port scanning techniques and firewall/IDS evading techniques.

UNIT - III NETWORK ATTACKS 9

Vulnerability Data Resources – Exploit Databases – Network Sniffing – Types of Sniffing – Promiscuous versus Nonpromiscuous Mode – MITM Attacks – ARP Attacks – Denial of Service Attacks –Hijacking Session with MITM Attack – SSL Strip: Stripping HTTPS Traffic – DNS Spoofing – ARP Spoofing Attack Manipulating the DNS Records – DHCP Spoofing – Remote Exploitation – Attacking Network Remote Services – Overview of Brute Force Attacks – Traditional Brute Force – Attacking SMTP – Attacking SQL Servers – Testing for
Weak Authentication.

SUGGESTED ACTIVITIES:

Familiarizing with different types of attacks such as sniffing, spoofing etc.

Demonstrating the MITM attack using ARP Poisoning using Kali Linux.

Teaching with case studies: SSL Stripping, SQL Injection, Brute Force attacks.

SUGGESTEDEVALUATIONMETHODS:

Assignment on denial of service (DoS) attack and hijacking session with MITMattack.

Quizzes on SSL stripping, ARP spoofing and weak authentication

UNIT - IV EXPLOITATION 9

Introduction to Metasploit – Reconnaissance with Metasploit – Port Scanning with Metasploit – Compromising a Windows Host with Metasploit – Client Side Exploitation Methods – E-Mails with Malicious Attachments – Creating a Custom Executable – Creating a Backdoor with SET – PDF Hacking – Social Engineering Toolkit – Browser Exploitation – Post–Exploitation – Acquiring Situation Awareness – Hashing Algorithms – Windows Hashing Methods – Cracking the Hashes – Brute force Dictionary Attacks – Password Salts –Rainbow Tables – John the Ripper – Gathering OS Information – Harvesting Stored Credentials.

SUGGESTED ACTIVITIES:

Case studies: Understand the Metasploit and Exploitations.
Demonstrating email with malicious attachment and cracking the hashes.
Practical - Implementing hashing algorithms and cracking the hashes

SUGGESTED EVALUATION METHODS:

Assignments on social engineering toolkit and browser exploitation.
Quizzes on reconnaissance with Metasploit and client–side exploitation methods.

UNIT - V WIRELESS AND WEB HACKING 9

Wireless Hacking – Introducing Aircrack– Cracking the WEP – Cracking a WPA/WPA2 Wireless Network Using Aircrack-ng – Evil Twin Attack – Causing Denial of Service on the Original AP – Web Hacking – Attacking the Authentication – Brute Force and Dictionary Attacks – Types of Authentications – Log-In Protection Mechanisms – Captcha Validation Flaw
– Captcha RESET Flaw – Manipulating User-Agents to Bypass Captcha and Other Protection – Authentication Bypass Attacks – Testing for the Vulnerability – Automating Itwith Burp Suite – Session Attacks – SQL Injection Attacks – XSS (Cross-Site Scripting) –Types of Cross-Site Scripting – Cross-Site Request Forgery (CSRF) – SSRF Attacks - penetration testing

SUGGESTED ACTIVITIES:

Cracking the WEP and WPA/WPA2 passphrase using Cracking tool in Kali Linux.
Design a web application with different authentication mechanism.
Understand the protection mechanism to prevent against various server attacks.

SUGGESTED EVALUATION METHODS:

Assignment on evil twin attack and denial of service attack on access point in WLAN.
Quizzes on types of authentication and vulnerabilities in a web application.

TOTAL: 45 PERIODS

OUTCOMES:

On successful completion of the course student will be able to:

1. Use various security tools to assess the computing system.
2. Predict the vulnerabilities across any computing system using penetration testing.
3. Identify prediction mechanism to prevent any kind of attacks.
4. Protect the system from malicious software and worms.
5. Evaluate the wireless network flaws and able to apply security patches
6. Analyze the risk and support the organization for effective security measures.

TEXT BOOKS:

1. Rafay Baloch, “Ethical Hacking and Penetration Testing Guide”, CRC Press, 2014.

REFERENCES:

1. Kevin Beaver, “Ethical Hacking for Dummies”, Sixth Edition, Wiley, 2018.
2. Jon Erickson , “Hacking: The Art of Exploitation”, Second Edition, Rogunix, 2007.

21EC1005	PRODUCT DESIGN AND DEVELOPMENT	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To facilitate the knowledge about product design.
- To know about engineering and functions in product design.
- To explore the tools and product manufacturing using case studies.

UNIT - I INTRODUCTION 9

Introduction to course, Product life-cycle, Product policy of an organization. Selection of a profitable product, Product design process, Product analysis.

UNIT - II ENGINEERING IN PRODUCT DESIGN 9

Value engineering in product design; Advantages, Applications in product design, Problem identification and selection.

UNIT - III FUNCTIONS IN PRODUCT DESIGN 9

Analysis of functions, Anatomy of function. Primary versus secondary versus tertiary/unnecessary functions, Functional analysis: Functional Analysis System Technique (FAST), Case studies.

UNIT - IV PRODUCT DESIGN TOOLS 9

Introduction to product design tools, QFD, Computer Aided Design, Robust design, DFX, DFM, DFA,Ergonomics in product design.

UNIT - V PRODUCT MANUFACTURING AND PROTOTYPE 9

DFMA guidelines, Product design for manual assembly, Design guidelines for metallic and nonmetallic products to be manufactured by different processes such as casting, machining, injection molding etc., Rapid prototyping, needs, advantages, working principle of SLA, LOM and SLS.

TOTAL: 45 PERIODS

OUTCOMES:

On successful completion of the course student will be able to:

1. Discuss the need for product life cycle.
2. Discuss the engineering and functions in the design of product.
3. Learn the significance of Engineering in product design
4. Explain the various tools used for design of a product.
5. Analyze the guidelines for manufacturing and prototype of a product.
6. Apply knowledge about various products in the present day scenario.

TEXT BOOKS:

1. Karl T. Ulrich, "Product Design and Development" Mc Graw -Hill International, 6th Edition.

REFERENCES:

1. Ulrich, Karl T., Eppinger, Steve D., and Yang, Maria C., Product Design and Development. 7th ed., McGraw-Hill Education, 2020.
2. Regalla, Srinivasa Prakash, "Product design and manufacturing", New Age International (P) Ltd.

21ME1004 INDUSTRIAL POLLUTION AND PREVENTION

L	T	P	C
3	0	0	3

OBJECTIVES: To impart Knowledge on the following topics:

- This course is designed to learn a variety of chemical, physical, biological treatment processes related to industrial pollution control.
- This course is to make pollution profiles of the industries, categorization, control methodologies and technologies, system design, ethic concepts and solving of the engineering problems on industrial systems.

UNIT - I TYPES OF POLLUTION 9

Types of emissions from chemical industries and effects of environment, environment legislation, Type of pollution, sources of wastewater, Effluent guidelines and standards

UNIT - II CHARACTERISTICS OF POLLUTANTS 9

Characterization of effluent streams, oxygen demands and their determination (BOD, COD, and TOC), Oxygen sag curve, BOD curve mathematical, controlling of BOD curve, self purification of running streams, sources and characteristics of pollutants in fertilizer, paper and pulp industry. General methods of control and removal of sulfur dioxide, oxides of nitrogen and organic vapors from gaseous effluent, treatment of liquid and gaseous effluent in fertilizer industry.

UNIT - III CONTROL OF POLLUTION 9

General methods of control and removal of sulfur dioxide, oxides of nitrogen and organic vapors from gaseous effluent, treatment of liquid and gaseous effluent in fertilizer industry.

UNIT - IV POLLUTION MEASUREMENTS 9

Air pollution sampling and measurement: Types of pollutant and sampling and measurement, ambient air sampling: collection of gaseous air pollutants, collection of particulate air pollutants. Stack sampling: sampling system, particulate sampling, and gaseous sampling. Analysis of air pollutants: Sulphur dioxide, nitrogen oxides, carbon monoxide, oxidants and Ozone, hydrocarbons, particulate matter.

UNIT - V **EMISSION CONTROL TECHNIQUES** **9**

Air pollution control methods and equipments: Source collection methods: raw material changes, process changes, and equipment modification. Cleaning of gaseous equipments particulate emission control: collection efficiency, control equipment like gravitational settling chambers, Cyclone separators, fabric filters, scrubbers, packed beds and plate columns, venturi scrubbers, their design aspects. Control of gaseous emissions: absorption by liquids, absorption equipments, adsorption by solids.

TOTAL: 45 PERIODS

OUTCOMES:

On successful completion of the course student will be able to:

1. Understanding of air/water pollution regulations and their scientific basis.
2. Apply knowledge for the protection and improvement of the environment.
3. Understanding the sources and characteristics of the pollutants.
4. Ability to monitor and design the air and water pollution control systems.
5. Ability to select and use suitable waste treatment technique

TEXT BOOKS:

1. Environmental pollution and control engineering, Rao C. S. - Wiley Eastern Limited, India, 1993.
2. Pollution control in process industries by S.P. Mahajan TMH.,1985.

REFERENCES:

1. Waste water treatment by M.Narayana Rao and A.K.Datta,Oxford and IHB publ. New Delhi.
2. Air pollution control by P.Prathap mouli and N.Venkata subbayya. Divya Jyothi Prakashan, Jodhpur
3. "Industrial Pollution Control and Engineering." Swamy AVN, Galgotia publications, 2005.Hyderabad

List of Open Electives II (VI SEMESTER)

21ME1917	RENEWABLE ENERGY RESOURCES	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To get exposure on solar radiation and its environmental impact to power.
- To know about the various collectors used for storing solar energy.
- To know about the various applications in solar energy.
- To learn about the wind energy and biomass and its economic aspects.
- To know about geothermal energy with other energy sources.

UNIT - I PRINCIPLES OF SOLAR RADIATION 10

Role and potential of new and renewable source, the solar energy option, Environmental impact of solar power, physics of the sun, the solar constant, extraterrestrial and terrestrial solar radiation, solar radiation on titled surface, instruments for measuring solar radiation and sun shine, solar radiation data.

UNIT - II SOLAR ENERGY COLLECTION 8

Flat plate and concentrating collectors, classification of concentrating collectors, orientation and thermal analysis, advanced collectors.

UNIT - III SOLAR ENERGY STORAGE AND APPLICATIONS 7

Different methods, Sensible, latent heat and stratified storage, solar ponds. Solar Applications - solar heating/cooling technique, solar distillation and drying, photovoltaic energy conversion.

UNIT - IV WIND ENERGY AND BIO GAS 10

Sources and potentials, horizontal and vertical axis windmills, performance characteristics, Betz criteria BIO-MASS: Principles of Bio-Conversion, Anaerobic/aerobic digestion, types of Bio-gas digesters, gas yield, combustion characteristics of bio-gas, utilization for cooking, I.C-Engine operation and economic aspects.

UNIT - V GEOTHERMAL ENERGY 9

Resources, types of wells, methods of harnessing the energy, potential in India. OCEAN ENERGY: OTEC, Principles utilization, setting of OTEC plants, thermodynamic cycles. Tidal and wave energy: Potential and conversion techniques, mini-hydel power plants, and their economics. DIRECT ENERGY CONVERSION: Need for DEC, Carnot cycle, limitations, principles of DEC.

TOTAL: 45 PERIODS

OUTCOMES:

On successful completion of the course student will be able to:

1. Understand the renewable source, the solar energy option, Environmental impact of solar power physics of the sun the solar constant.
2. Apply the knowledge of Flat plate and concentrating collectors, classification of concentrating collectors.
3. Determine Sensible, latent heat and stratified storage, solar ponds photovoltaic energy conversion.
4. Determine horizontal and vertical axis windmills, performance characteristics combustion characteristics of bio-gas.
5. Methods of harnessing the energy, potential in India Principles utilization, setting of OTEC plants.
6. Determine the mini-Hydel power plants and their economics Carnot cycle limitations principles of DEC.

TEXT BOOKS:

1. Rai G.D. , “Non-Conventional Energy Sources”, Khanna Publishers, 2011.
2. Ramesh R & Kumar K.U , “Renewable Energy Technologies”,Narosa Publishing House, 2004.

REFERENCES:

1. Tiwari and Ghosal, “Renewable energy resources”, Narosa Publishing House, 2007.
2. Twidell&Wier, “Renewable Energy Resources”, CRC Press (Taylor & Francis), 2011.
3. Mittal K M, “Non-Conventional Energy Systems”, Wheeler Publishing Co. Ltd, New Delhi, 2003.
4. Kothari D.P, Singhal., K.C., “Renewable energy sources and emerging technologies”, P.H.I, New Delhi.

21ME1937	INDUSTRIAL SAFETY AND MAINTENANCE	L	T	P	C
		3	0	0	3

OBJECTIVES:

- Identify unsafe conditions and recognize unsafe alerts.
- Interpret the rules and regulations for safety operations.
- Capable of solving problem of accidents.
- Capable of solving the present for criticizing the present for improved safety.
- Collaborate and modify processes / procedures for safety.

UNIT - I INTRODUCTION 9

Evolution of modern safety concepts – Fire prevention – Mechanical hazards – Boilers, Pressure vessels, Electrical Exposure.

UNIT - II CHEMICAL HAZARDS 9

Chemical exposure – Toxic materials – Radiation Ionizing and Non-ionizing Radiation - Industrial Hygiene – Industrial Toxicology.

UNIT - III ENVIRONMENTAL CONTROL 9

Industrial Health Hazards – Environmental Control – Industrial Noise - Noise measuring instruments, Control of Noise, Vibration, - Personal Protection.

UNIT - IV HAZARD ANALYSIS 9

System Safety Analysis –Techniques – Fault Tree Analysis (FTA), Failure Modes and Effects Analysis (FMEA), HAZOP analysis and Risk Assessment.

UNIT - V SAFETY REGULATIONS 9

Explosions – Disaster management – catastrophe control, hazard control , Factories Act, Safety regulations Product safety – case studies.

TOTAL: 45 PERIODS

OUTCOMES:

On successful completion of the course student will be able to:

1. Identify and prevent chemical, environmental mechanical, fire hazard.
2. Collect, analyze and interpret the accidents data based on various safety techniques.
3. Apply proper safety techniques on safety engineering and management.
4. Able to perform hazard analysis.
5. Aid to design the system with environmental consciousness by implementing safety regulation.

TEXT BOOKS:

1. John V.Grimaldi, “Safety Management”, AITB S Publishers, 2003.

REFERENCES:

1. David L.Goetsch, “Occupational Safety and Health for Technologists”, Engineers and Managers, Pearson Education Ltd. 5th Edition, 2005.
2. Deshmukh L M, “Industrial Safety Management”, Tata McGraw-Hill Publishing Company Ltd.,2005.
3. Safety Manual, “EDEL Engineering Consultancy”, 2000.

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21EC1011	TELEHEALTH TECHNOLOGY	L	T	P	C
		3	0	0	3

OBJECTIVES:

- Learn the key principles for telemedicine and health.
- Understand telemedical technology.
- Know telemedical standards, mobile telemedicine and it applications

UNIT - I TELEMEDICINE AND HEALTH 9

History and Evolution of telemedicine, Organs of telemedicine, Global and Indian scenario, Ethicaland legal aspects of Telemedicine - Confidentiality, Social and legal issues, Safety and regulatory issues, Advances in Telemedicine.

UNIT - II TELEMEDICALTECHNOLOGY 9

Principles of Multimedia - Text, Audio, Video, data, Data communications and networks, PSTN,POTS, ANT, ISDN, Internet, Air/ wireless communications Communication infrastructure for telemedicine – LAN and WAN technology. Satellite communication, Mobile communication.

UNIT - III TELEMEDICAL STANDARDS 9

Data Security and Standards: Encryption, Cryptography, Mechanisms of encryption, phases of Encryption. Protocols: TCP/IP, ISO-OSI, Standards to followed DICOM, HL7, H. 320 series Video Conferencing, Security and confidentiality of medical records, Cyber laws related to telemedicine

UNIT - IV MOBILE TELEMEDICINE 9

Tele radiology: Image Acquisition system Display system, Tele pathology, Medical information storage and management for telemedicine- patient information, medical history, test reports, medical images, Hospital information system.

UNIT - V TELE MEDICAL APPLICATIONS 9

Telemedicine – health education and self care. · Introduction to robotics surgery, Telesurger, Telecardiology, Teleoncology, Telemedicine in neurosciences, Business aspects-Project planning and costing, Usage of telemedicine.

TOTAL: 45 PERIODS

OUTCOMES:

On successful completion of the course student will be able to:

1. Describe principles used for telemedicine and telehealth
2. Apply multimedia technologies in telemedicine.
3. Explain Protocols behind encryption techniques for secure transmission of data.
4. Explain various telemedical standards
5. Analyse patient information in hospital
6. Apply telehealth in healthcare.

TEXT BOOKS:

1. Norris, A.C. “Essentials of Telemedicine and Telecare”,Wiley,2012.

REFERENCES:

1. Wootton,R.,Craig,J.,Patterson,V.(Eds.),“IntroductiontoTelemedicine.RoyalSociety of Medicine” Press Ltd, Taylor & Francis 2016
2. O'Carroll, P.W., Yasnoff, W.A.,Ward,E., Ripp,L.H., Martin, E.L.(Eds), “Public Health Informatics and Information Systems”, Springer, 2013.
3. Simpson, W. Video over IP. A practical guide to technology and applications. Focal Press Elsevier, 2006
4. Bemmel, J.H. van, Musen, M.A. (Eds.) Handbook of Medical Informatics. Heidelberg, Germany: Springer, 1997 MohanBansa l, “MedicalInformatics”, TataMcGraw-Hill,2014.

21CS1002	SOFTWARE ENGINEERING	L T P C
		3 0 0 3

OBJECTIVES:

- To understand the phases in a software project
- To understand fundamental concepts of requirements engineering and Analysis Modeling.
- To understand the various software design methodologies, software testing, software process models
- To learn various testing and maintenance measures
- To understand the working knowledge of the techniques for estimation, design, testing and quality management of large software development projects

UNIT - I SOFTWARE PROCESS MODELS 9

Introduction to Software Engineering, Software Process, Perspective and Specialized Process Models – Waterfall model – Spiral Model – V shaped model – RAD model – Iterative Model – Prototype model. Introduction to Agility : Extreme programming.

UNIT - II REQUIREMENTS ANALYSIS AND SPECIFICATION 9

Software Requirements: Functional and Non-Functional, User requirements, System requirements, Software Requirements Document – Requirement Engineering Process: Feasibility Studies, Requirements elicitation and analysis, requirements validation, requirements management-Classical analysis: Structured system Analysis.

UNIT - III SOFTWARE DESIGN 9

Design process – Design Concepts-Design Model– Design Heuristic – Architectural Design - Architectural styles, Architectural Design, Architectural Mapping using Data Flow- User Interface Design: Interface analysis, Interface Design –Component level Design: Designing Class based components, traditional Components.

UNIT - IV TESTING AND MAINTENANCE 9

Software testing fundamentals-Internal and external views of Testing-white box testing - basis path testing-control structure testing-black box testing- Regression Testing – Unit Testing – Integration Testing – Validation Testing – System Testing And Debugging – Software Implementation Techniques: Coding practices-Refactoring-Maintenance and Reengineering-BPR model-Reengineering process model-Reverse and Forward Engineering.

UNIT - V **PROJECT MANAGEMENT** **9**

Software Project Management: Estimation – LOC, FP Based Estimation, Make/Buy Decision COCOMO I & II Model – Project Scheduling – Scheduling, Earned Value Analysis Planning– Project Plan, Planning Process, RFP Risk Management – Identification, Projection - Risk Management-Risk Identification-RMMM Plan-CASE TOOLS.

TOTAL: 45 PERIODS

OUTCOMES:

On successful completion of the course student will be able to:

1. Decompose the given project in various phases of a lifecycle.
2. Choose appropriate process model depending on the user requirements.
3. Perform various life cycle activities like Analysis, Design, Implementation, Testing and Maintenance.
4. Know various processes used in all the phases of the product.
5. Apply the knowledge, techniques, and skills in the development of a software product.
6. Estimate the size of the software product.

TEXT BOOKS:

1. Roger S. Pressman, Bruce R.Maxim-Software Engineering - A Practitioner's Approach, Eight Edition, McGraw-Hill International Edition, 2015.
2. IanSommerville,-Software Engineering, 9th Edition, Pearson Education Asia, 2011.

REFERENCES:

1. Rajib Mall,Fundamentals of Software Engineering, Third Edition, PHI Learning PrivateLimited,2009.
2. PankajJalote, Software Engineering, A Precise Approach, Wiley India, 2010.
3. Kelkar S.A., Software Engineering, Prentice Hall of India Pvt Ltd, 2007.
4. Stephen R.Schach, Software Engineering, Tata McGraw-Hill Publishing Company Limited,2007.
5. http://nptel.ac.in

21EE1003	LOGIC AND DISTRIBUTED CONTROL SYSTEM	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To give an overview of the automation technologies such as PLCs, SCADA and DCS used in industries
- To provide a fundamental understanding of the different languages used for PLC Programming
- To provide insight into some of the advanced principles those are evolving for present and future automation.

UNIT - I PLC & SCADA 9

PLC: Evolutions of PLCs – Programmable Controllers – Architecture, I/O modules – Comparative study of Industrial PLCs. SCADA: Remote terminal units- Master station - Communication architectures.

UNIT - II BASICS OF PLC PROGRAMMING(LADDER) 9

Basics of PLC programming – Ladder Logic – Relay type instructions – Timer/Counter instructions – Program control instructions – Data manipulation and math instructions – Programming Examples

UNIT - III PLC PROGRAMMING (OTHER LANGUAGES) 9

Functional block programming - Sequential function chart – Instruction list – Structured text programming – PLC controlled sequential Process Examples.

UNIT - IV DISTRIBUTED CONTROL SYSTEM 9

DCS: Evolution & types – Hardware architecture – Field control station – Interfacing of conventional and smart field devices (HART and FF enabled) with DCS Controller – Communication modules – Operator and Engineering Human interface stations – Study of any one DCS available in market.

UNIT - V ADVANCED TOPICS IN AUTOMATION 9

Introduction to Networked Control systems – Plant wide control – Internet of things – Cloud based Automation – OLE for Process Control – Safety PLC – Case studies: PLC - SCADA - DCS.

TOTAL: 45 PERIODS

OUTCOMES:

On successful completion of the course student will be able to:

1. Ability to understand all the important components such as PLC, SCADA, DCS,I/O modules and field devices of an industrial automation system
2. Ability to develop PLC program in different languages for industrial sequential applications.
3. Able to select and use most appropriate automation technologies for a given application.
4. Ability to gain knowledge on the recent developments in industrial automation.

TEXT BOOKS:

1. F.D. Petruzella, Programmable Logic Controllers, Tata Mc-Graw Hill, Third edition, 2010
2. Michael P. Lukas, Distributed Control Systems: Their Evaluation and Design, Van Nostrand Reinhold Co., 1986
3. D. Popovic and V.P.Bhatkar,' Distributed computer control for industrial Automation' Marcel Dekker, Inc., Newyork ,1990.

REFERENCES:

1. Clarke, G., Reynders, D. and Wright, E., "Practical Modern SCADA Protocols: DNP3,4. 60870.5 and Related Systems", Newnes, 1^{st} Edition, 2004.
2. Hughes, T.A., "Programmable Logic Controllers: Resources for Measurements and Control Series", 3rd Edition, ISA Press, 2004.
3. McMillan, G.K., "Process/Industrial Instrument and Controls Handbook", 5^{th} Edition, McGraw- Hill handbook, New York, 1999.
4. NPTEL Notes on, "Programmable Logic Control System" by Department of Electrical Engg., IIT Kharagpur.

21EC1008	ROBOTICS AND AUTOMATION	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To introduce basic robotic terminologies.
- To study about the sensors of robot.
- To understand the kinematics of robot.
- To illustrate about robotic vision.
- To apply robot based concepts in AI

UNIT - I INTRODUCTION TO ROBOTS 9

Introduction – Robotics -Definition and origin of robotics –components and structure of robots- different types of robot – various generations of robots – degrees of freedom – Robot classifications and specifications – Asimov's laws of robotics.

UNIT - II POWER SOURCES, SENSORS AND ACTUATORS 9

Hydraulic, pneumatic and electric drives: Design and control issues – determination of HP of motor and gearing ratio – variable speed arrangements – path determination – micro machines in robotics- machine vision – ranging – laser – acoustic – magnetic, fiber optic and tactile sensors.

UNIT - III KINEMATICS OF ROBOTS 9

Link Description - Link-Connection Description - Convention for Affixing Frames to Links - Manipulator Kinematics- Actuator Space-Joint Space and Cartesian Space Case Studies: Kinematics Of Two Industrial Robots - frames with standard names- computational considerations.

UNIT - IV ROBOTIC VISION 9

Industrial application of vision controlled robotic system-process of imaging-architecture of robotics vision system-image acquisition-description of other components of vision systems-image representation - image processing.

UNIT - V AI ROBOTICS 9

Intelligent systems- elements of artificial intelligence- system architecture-applications of advanced robot-fuzzy logic control-advanced concept and procedures-future development-impact on employment.

TOTAL: 45 PERIODS

OUTCOMES:

On successful completion of the course student will be able to:

1. Understand the evolution of robot technology and mathematically represent different types of robot.
2. Familiarize various electrical drive systems and sensors used in robotics for various applications.
3. Understand the kinematics of robotic device.
4. Understand the vision controlled robotic system.
5. Realize the description of components of vision systems.
6. Understand the applications of robotics in AI.

TEXT BOOKS:

1. Introduction to Robotics: Mechanics and control : J. Craig , Pearson,2008.
2. R.K.Mittal and I.J.Nagrath, Robotics and Control, Tata McGraw Hill, New Delhi, 4th Reprint, 2005.
3. James G. Keramas , Robot Technology Fundamendals India Edition.

REFERENCES:

1. Robotics Engineering : R. Klafter, PHI learning, 2009.
2. John M. Holland, "Designing Autonomous Mobile Robots-Inside the mind of an Intelligent Machine", Newnes Publication, 2004.
3. Robot : Dynamics and Control, Spong&Vidyasagar, McGraw Hill 2008.
4. Matthew T. Mason , Mechanics of Robotic Manipulation (Intelligent Robotics and Autonomous Agents) , MIT press 2022.
5. Groover, M.P., Weiss, M., Nagel, R.N., & Odrey, N.G. Industrial robotics - technology, programming, and applications.
6. Robotics and Control , Mittal R K & Nagrath I J , TMH.

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21IT1001 **WEB DESIGN AND MANAGEMENT**

L	T	P	C
3	0	0	3

OBJECTIVES:

- To Learn the basic concepts in HTML, CSS, JavaScript.
- To Understand the responsive design and development.
- To highlight the web frameworks in Web 2.0.
- To Design a Website with HTML, JS, CSS / CMS - Word press.
- To implement the project using CSS and open source.

UNIT - I WEB DESIGN - HTML MARKUP FORSTRUCTURE AND CSS 9

Working of Web - HTML Markup for Structure - Creating simple page - Marking up text - Addi Links -Adding Images - Table Markup - Forms - HTML5, CSS - Formatting text - Colours a Background - Padding, Borders and Margins - Floating andpositioning - Page Layout with CSS Transition, Transforms and Animation – Javascript - Using JavaScript

SUGGESTED ACTIVITIES:

Create HTML web page using CSS and JS
Create colorful web page design using CSS box model

SUGGESTED EVALUATION METHODS:

Quiz on HTML basic tags and CSS layout
Assignment submission on creating web page for different application.

UNIT - II RESPONSIVE WEB DESIGN 9

Sass for Responsive Web Design - Marking Content with HTML5 - Mobile-First or Desktop- First –CSSGrids, CSS Frameworks, UI Kits, and Flexbox for RWD - Designing small UIs by Large Finger -Images and Videos in Responsive Web Design - Meaningful Typography for Responsive Web Design.

SUGGESTED ACTIVITIES:

Create a simple web design using /Java /any language
Design small UI

SUGGESTED EVALUATION METHODS:

Build a responsive SaaS web page design
Create a Code for responsive web design videos.

UNIT - III WEB FRAMEWORK 9

Django Template System - Interacting with a Database (Modules) - Django Administration Site, Form Processing, Advanced Views and Urlconfs, Generic Views - Extending the Template Engine - Generating Non-HTML Content, Sessions, Users, Registration, Caching, Other Contributed Sub Frameworks, Middleware, Integrating with Legacy Databases and Applications, Extending Django's Admin Interface, Internationalization, Security and Deploying Django. The Model Definition Reference, The Data Base API Reference, Generic Views Reference, Settings, Built-In Template Tags and Filters, The Django - Admin Utility and Request and Response Objects. – Web App - Ruby Language – Ruby on Rails – Framework – Action Controller and Action View - RDF, Rdfa, OWL and Jena.

SUGGESTED ACTIVITIES:

Use web application framework software like Django, Flask to design and support the web application. Build web application using Ruby language.

SUGGESTED EVALUATION METHODS:

Assignment on web framework tool.

UNIT - IV WEB PROJECT MANAGEMENT 9

Project Life Cycle - Project Definition - Discovery and Requirements - Project Schedule and Budgeting- Running the project - Technical Documentation - Development , Communication, Documentation – QAand testing -Deployment - Support and operations.

SUGGESTED ACTIVITIES:

Case studies on Technical documentation

Real world domain specific problems involving project life cycle.

SUGGESTED EVALUATION METHODS:

Student assignment on case studies related to healthcare, climate change, ecommerce, retail business, manufacturing etc.

UNIT - V PRODUCTION, MAINTENANCE AND EVALUATION 9

Design and Construction – Testing, Launch and Handover – Maintenance – Review and Evaluation – Case Study: Using the Skills and Concepts Learn with the ADOBE IMAGE READY,DREAM WEAVER, FLASH, and Scripts, Develop Portfolios in the Form of Web Pages which have to be uploaded in Free Public Domains.

SUGGESTED ACTIVITIES:

Case studies on applications involving concept of adobe image ready.

Demonstration of develop portfolio in form of web page.

SUGGESTED EVALUATION METHODS:

Quiz on Testing and develop portfolio.

TOTAL: 45 PERIODS

OUTCOMES:

On successful completion of the course student will be able to:

1. Design Website using HTML CSS and JS.
2. Design Responsive Sites.
3. Identify the suitable web framework to support the development of web applications.
4. Manage, Maintain and Support Web Apps.
5. Write and demonstrate simple web applications involving CSS.
6. Create and maintain responsive websites and employ strategies with user-centered design methodologies.

TEXT BOOKS:

1. Jennifer Niederst Robbins, "Learning Web Design", O'REILLY 4th Edition.
2. Ricardo Zea, "Mastering Responsive Web Design", PACKT Publishing, 2015.
3. Justin Emond, Chris Steins, "Pro Web Project Management", Apress,2011.

REFERENCES:

1. Jon Duckett, "HTML and CSS: Design and Build Websites", John Wiley and Sons, edition 2014.
2. Jon Duckett, Jack Moore,"JavaScript & JQuery: Interactive Front-End Web Development".
3. John Wiley and Sons, edition 2014.

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21CB1002	MOBILE APPLICATION DEVELOPMENT	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To demonstrate their understanding of the fundamentals of Android operating systems.
- To learn how to utilize rapid prototyping techniques to design and develop sophisticatedAndroid application.
- To understand the platform for developing mobile application.
- To show their ability to deploy software to mobile devices.
- To exhibit their ability to debug programs running on mobile devices.

UNIT - I INTRODUCTION TO ANDROID OPERATING SYSTEM 9

Introduction to Android Operating System: Android OS design and Features – Android development framework, SDK features, Installing and running applications on Android Studio, Creating AVDs, Types of Android applications, Best practices in Android programming, Android tools Android application components – Android Manifest file, Resources for different devices and languages, Runtime Configuration Changes Android Application Lifecycle – Activities, Activity lifecycle, activity states, monitoring state changes.

SUGGESTED ACTIVITIES:

- Understanding the Android OS
- Acquire knowledge on basic building blocks of Android programming required for Appdevelopment.

SUGGESTED EVALUATION METHODS

- Quizzes
- Assignments

UNIT - II CONTROLS AND USER INTERFACE 9

Measurements – Device and pixel density independent measuring units - Layouts – Linear, Relative, Grid and Table Layouts - User Interface (UI) Components – Editable and non-editable Text Views, Buttons, Radio and Toggle Buttons, Checkboxes, Spinners, Dialog and pickers -Event Handling – Handling clicks or changes of various UI components Fragments – Creating fragments, Lifecycle of fragments, Fragment states, Adding fragments to Activity, adding, removing and replacing fragments with fragment transactions, interfacing between fragments and Activities, Multi-screen Activities.

SUGGESTED ACTIVITIES:

- Acquire the knowledge on Android devices and Platform
- Understanding the UI components.

SUGGESTED EVALUATION METHODS

- Pedagogical tools

Assignments

UNIT - III INTENTS AND BROADCASTS 9

Intent – Using intents to launch Activities, Explicitly starting new Activity, Implicit Intents, Passing data to Intents, Getting results from Activities, Native Actions, using Intent to dial a number or to send SMS -Broadcast Receivers –Using Intent filters to service implicit Intents, Resolving Intent filters, finding and using Intents received within an Activity Notifications – Creating and Displaying notifications, Displaying Toasts- Accessing Databases.

SUGGESTED ACTIVITIES:

- Understanding the working principle of Android for app development.
- Develop and publish Android applications in to Android Market

SUGGESTED EVALUATION METHODS

- Quizzes
- Crossword puzzles

UNIT - IV INTRODUCTION TO iOS 9

Introduction to iPhone, MVC Architecture, View Controller - Building the UI and Event handling, Application life cycle, Tab Bars, Story Boards and Navigation Controllers, Table View, Push Notification, Database handling, Introduction to icloud, Webkit framework in iOS8, Deploying and publishing application.

SUGGESTED ACTIVITIES:

- Understand the concepts of iOs.
- Develop and publish applications using iOS

SUGGESTED EVALUATION METHODS

- Assignments
- Crossword puzzles

UNIT - V WINDOWS MOBILE APP DEVELOPMENT 9

Introduction to Windows Phone 8, Application Life cycle, UI Designing and events, Building, Files and Storage, Network Communication, Push Notification, Background Agents, Maps and Locations, Data Access and storage, Introduction to Silverlight and XAML, Data Binding, Deploying and Publishing.

SUGGESTED ACTIVITIES:

- Understand the windows phone concepts.
- To learn the concepts of data binding, deploying and publishing

SUGGESTED EVALUATION METHODS

- Assignments
- Quizzes

TOTAL: 45 PERIODS

OUTCOMES:

On successful completion of the course student will be able to:

1. Learn and understand the technology and business trends impacting mobile application.
2. Understand and remember the components of android, iOS, and windows mobile application.
3. Learning the techniques for developing mobile applications.
4. Create the mobile applications with compelling user interface and database connectivity forreal time applications.
5. Apply and develop mobile application with iOS platform.
6. Develop and deploy mobile applications using Silverlight.

TEXT BOOKS:

1. Reto Meier, “Professional Android Application Development”, Wrox, 2010.
2. David Mark, Jack Nutting and Jeff LaMarche, “Beginning iOS 6 Development Exploring theiOS SDK”, Apress, 2013.

REFERENCES:

1. Beginning Android 4 Application Development, Wei-Meng Lee, Wiley India (Wrox), 2013.
2. Baijian Yang, Pei Zheng, Lionel M. Ni, “Professional Microsoft Smartphone Programming”,Wrox Edition.

21EE1007	INTELLIGENT CONTROL OF ELECTRIC VEHICLES	L	T	P	C
		2	0	2	3

OBJECTIVES: To impart Knowledge on the following topics:

- To design and drive the mathematical model of a BLDC motor and its characteristics.
- To learn the different control schemes for BLDC motor.
- To study the basics of fuzzy logic.
- To study the FPGA & VHDL basics.
- To implement fuzzy logic control of BLDC motor in real time.

UNIT - I MATHEMATICAL MODEL AND CHARACTERISTICS ANALYSIS OF THE BLDC MOTOR 6

Structure and Drive Modes - Basic Structure, General Design Method, Drive Modes. Mathematical Model, Differential Equations, Transfer Functions, State-Space Equations. Characteristics Analysis, Starting Characteristics, Steady-State Operation, Dynamic Characteristics, Load Matching Commutation Transients

UNIT - II SPEED CONTROL FOR ELECTRIC DRIVES 6

Introduction -PID Control Principle, Anti windup Controller, Intelligent Controller. Vector Control. Control applied to BLDC motor.

UNIT - III FUZZY LOGIC 6

Membership functions: features, fuzzification, methods of membership value assignments Defuzzification: lambda cuts - methods - fuzzy arithmetic and fuzzy measures: fuzzy arithmetic - extension principle - fuzzy measures - measures of fuzziness -fuzzy integrals - fuzzy rule base and approximate reasoning : truth values and tables, fuzzy propositions, formation of rules decomposition of rules, aggregation of fuzzy rules, fuzzy reasoning-fuzzy inference systems, overview of fuzzy expert system-fuzzy decision making.

UNIT - IV FPGA AND VHDL BASICS 6

Introduction – FPGA Architecture-Advantages-Review of FPGA family processors-Spartan 3, Spartan 6 and Spartan 7. VHDL Basics- Fundamentals-Instruction set-data type-conditional statements- programs like arithmetic, sorting, PWM generation, Speed detection.

UNIT - V REAL TIME IMPLEMENTATION 6

Inverter design, identifying rotor position via hall effect sensors, open loop and fuzzy logic control of 48 V BLDC motor using FPGA.

TOTAL: 30 PERIODS

OUTCOMES:

On successful completion of the course student will be able to:

1. To design the mathematical model of a BLDC motor and to discuss about its characteristics.
2. To demonstrate the PID control, ant windup controller, Intelligent Controller and Vector Control. Control applied to BLDC motor.
3. To illustrate the basics of fuzzy logic system.
4. To describe the basics of VHDL & FPGA applied to control of EVs.
5. To design and implement of fuzzy logic control scheme for BLDC motor using FPGA in real time.
6. Design and simulate controllers for induction motors in EV for steady sate and transient conditions.

TEXT BOOKS:

1. Electric Powertrain Energy Systems, Power Electronics and Drives for Hybrid, Electric and Fuel Cell Vehicles, John G. Hayes, G. Abas Goodarzi, Wiley 1st Edition, 2018.
2. VHDL Primer, A (3rd Edition), Jayaram Bhasker, Prentice Hall, 1st Edition, 2015.

REFERENCES:

1. Iqbal Hussain, "Electric and Hybrid Vehicles: Design Fundamentals, Third Edition" CRC Press, Taylor & Francis Group, 2021, 1st Edition.
2. Chang-liang, Permanent Magnet Brushless DC Motor Drives and Controls, Xia Wiley, 2012, 1st Edition.
3. M.N. Cirstea, A. Dinu, J.G. Khor,M. McCormick, Neural and Fuzzy Logic Control of Drives and Power Systems, Newnes publications, 1st Edition, 2002.
4. Wei Liu, Hybrid Electric Vehicle System Modeling and Control, Wiley, 2017, 2nd Edition.
5. Electric and Plug-in Hybrid Vehicle Networks Optimization and Control, Emanuele
Crisostomi • Robert Shorten, Sonja Stüdli • Fabian Wirth, CRC Press, 1st Edition, 2018.

21ME1934	INDUSTRIAL ENGINEERING	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To understand the various components and functions of production planning and control such as product planning, process planning, production scheduling.
- To know the recent trends like manufacturing requirement Planning (MRP II) and Enterprise Resource Planning (ERP).
- To make cost estimation for various products after process planning and product planning along with manufacturing time calculations.

UNIT - I INTRODUCTION TO PRODUCTION AND OPERATIONS MANAGEMENT 9

Objectives and benefits of planning and control-Functions of production control-Types of production- job- batch and continuous-Product development and design-Marketing aspect-Functional aspects-Operational aspect-Durability and dependability aspect aesthetic aspect. Profit consideration- Standardization, Simplification & specialization- Break even analysis-Economics of a new design.

UNIT - II PRODUCT PLANNING AND PROCESS PLANNING 9

Product planning-Extending the original product information-Value Analysis-Problems in lack of product planning-Process planning and routing-Prerequisite information needed for process planning- Steps in process planning-Quantity determination in batch production-Machine capacity, balancing- Analysis of process capabilities in a multi-product system.

UNIT - III PRODUCTION SCHEDULING 9

Production Control Systems-Loading and scheduling-Master Scheduling-Scheduling rules-Gantt charts-Perpetual Loading-Basic scheduling problems - Line of balance – Flow production scheduling- Batch production scheduling-Product sequencing – Production Control systems- Periodic batch control-Material requirement planning, KANBAN – Dispatching-Progress reporting and expediting. Manufacturing lead time-Techniques for aligning completion times and due dates.

UNIT - IV COST ESTIMATION 9

Importance of costing and estimation- Types of estimates – Estimating procedure-Methods of costing-elements of cost estimation, Estimation labor cost, material cost-allocation of overhead charges- Calculation of depreciation cost, Estimation of Different Types of Jobs - Estimation of Sheet metal Shop, Forging Shop, Welding Shop and Foundry Shop.

UNIT - V **MACHINING TIME CALCULATION & RECENT TRENDS IN INDUSTRIAL ENGINEERING** **9**

Estimation of Machining Time - Importance of Machine Time Calculation- Calculation of Machining Time for Different Lathe Operations, Drilling and Boring - Machining Time Calculation for Milling, Shaping and Planning -Machining Time Calculation for Grinding. Introduction to computer integrated production planning systems- elements of JUST IN TIME SYSTEMS-Fundamentals of MRP II and ERP.

TOTAL: 45 PERIODS

OUTCOMES:

On successful completion of the course student will be able to:

1. Understand the basic concepts of production and operations management with cost considerations.
2. Understand the concepts of value analysis, process capabilities, balancing for product and process planning.
3. Understand fundamental concepts of scheduling theory by determining an optimal schedule for a flow shop and also to solve complex job shop problems, design and evaluate various feasible job shop schedules.
4. Enable both the costing and estimating procedures for all type of industry with overheads.
5. Understand the importance of machining time along with recent trends like JIT, MRP - II and ERP.

TEXT BOOKS:

1. Martand T Telsang, “Industrial Engineering and Production Management”, Third Revised edition, S. Chand and Company, 2018.
2. Narang GBS and Kumar V, Production and Costing, Khanna Publishers, 2014.

REFERENCES:

1. Panneerselvam. R, Production and operations Management, PHI, 3rd Edition, 2012.
2. James. B. Dilworth,” Operations management – Design, Planning and Control for manufacturing and services” McGraw Hill International edition 1992.
3. William J Stevenson, Operations Management, McGraw Hill,13th Edition,2018.
4. Chary. S.N., “Production and Operations Management”, Tata McGraw Hill, 6th Edition, 2019.
5. Banga T R and Sharma S C, Estimating and Costing, Khanna Publishers, 2001.

21ME1005 **HOSPITAL MANAGEMENT**

L	T	P	C
3	0	0	3

OBJECTIVES:

- To understand the fundamentals of hospital administration and management.
- To know the market related research process.
- To explore various information management systems and relative supportive services.
- To learn the quality and safety aspects in hospital.

UNIT - I OVERVIEW OF HOSPITAL ADMINISTRATION 9

Distinction between Hospital and Industry, Challenges in Hospital Administration – Hospital Planning- Equipment Planning – Functional Planning.

UNIT - II HUMAN RESOURCE MANAGEMENT IN HOSPITAL 9

Principles of HRM – Functions of HRM – Profile of HRD Manager –Human Resource Inventory – Manpower Planning.

UNIT - III RECRUITMENT AND TRAINING 9

Different Departments of Hospital, Recruitment, Selection, Training Guidelines – Methods of Training – Evaluation of Training – Leadership grooming and Training, Promotion – Transfer.

UNIT - IV SUPPORTIVE SERVICES 9

Medical Records Department – Central Sterilization and Supply Department – Pharmacy – Food Services - Laundry Services.

UNIT - V COMMUNICATION AND SAFETY ASPECTS IN HOSPITAL 9

Purposes – Planning of Communication, Modes of Communication – Telephone, ISDN, Public Address and Piped Music – CCTV. Security – Loss Prevention – Fire Safety – Alarm System – Safety Rules.

TOTAL: 45 PERIODS

OUTCOMES:

On successful completion of the course student will be able to:

1. Able to understand fundamentals of hospital administration and management and their importance in the globalized competitive world.
2. Able to understand the market related research process.
3. Able to explore various information management systems and relative supportive services.
4. Apply the quality and safety aspects in hospital.
5. Able to understand the communication and safety aspects in hospital.

TEXT BOOKS:

1. R.C.Goyal, “Hospital Administration and Human Resource Management”, PHI – Fourth Edition, 2006.
2. G.D.Kunders, “Hospitals – Facilities Planning and Management – TMH, New Delhi – Fifth Reprint 2007.

REFERENCES:

1. Cesar A.Caceres and Albert Zara, “The Practice of Clinical Engineering, Academic Press, New York, 1977.
2. Norman Metzger, “Handbook of Health Care Human Resources Management”, 2nd edition, Aspen Publication Inc. Rockville, Maryland, USA, 1990.
3. Peter Berman “Health Sector Reform in Developing Countries” - Harvard University Press, 1995.
4. William A. Reinke “Health Planning For Effective Management” - Oxford University Press.1988.
5. Blane, David, Brunner, “Health and SOCIAL Organization: Towards a Health Policy for the 21st Century”, Eric Calrendon Press 2002.
6. Arnold D. Kalcizony& Stephen M. Shortell, “Health Care Management”, 6th Edition Cengage Learning, 2011.