JERUSALEM COLLEGE OF ENGINEERING

(An Autonomous Institution)

(Approved by AICTE, Affiliated to Anna University,
Accredited by NBA and NAAC with 'A' Grade)
Velachery Main Road, Narayanapuram, Pallikaranai, Chennai - 600100

DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

VISION OF THE INSTITUTION

Jerusalem College of Engineering is committed in emerging as an international institution of excellence in imparting finest quality engineering, technology and management education rooted in ethical and societal values through various academic programmes, multi-disciplinary research, consultancy and entrepreneurship activities and hence to contribute towards social transformation and nation building.

MISSION OF THE INSTITUTION

- Generating abundant resources and making conducive policies, the management led by the Chief Executive Officer strives towards promoting globally competitive academic programmes augmented with value added courses, in-plant training activities, co-curricular activities and ambience that support intellectual growth and skill acquisition

- Promoting collaborative trans-border research programmes continuing education in synergy with academia, industries and research organizations leading to real time solutions and life-long learning

- Transforming young men and women into competent professionals and entrepreneurs motivated by a passion for professional excellence, driven by human values and proactively engage in the betterment of the society through innovative practices and academic excellence

- Facilitating effective interaction among faculty members and students and fostering network of alumni, industries, institutions and other stake-holders for successful career gain and placement

VISION OF THE DEPARTMENT

The Department of Electronics and Communication Engineering is committed to promote academic excellence and research to meet the needs of society and International Industrial requirements and standards.

MISSION OF THE DEPARTMENT

- To equip the graduates to be competent with excellent knowledge through innovative teaching methods.

- To promote relevant academic excellence through value added courses.

- To train the graduates in qualitative and quantitative skills in research to meet the International Industrial standards.

- To inculcate ethical values and social consciousness among the graduates to enrich themselves and also the community as a whole.

PROGRAM OUTCOMES (POs)

PO1: Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

PO2: Problem analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences

PO3: Design/development of solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

PO4: Conduct investigations of complex problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

PO5: Modern tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and communication tools including prediction and modelling to complex engineering activities by understanding the limitations.

PO6: The engineer and society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

PO7: Environment and sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

PO8: Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

PO9: Individual and team work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

PO10: Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

PO11: Project management and finance: Demonstrate knowledge and understanding of the engineering 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.

PO12: Life-long learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

PROGRAMME EDUCATIONAL OBJECTIVES (PEOs)

PEO1: To enable graduates to pursue research, or have a successful career in academia or industries associated with Electronics and Communication Engineering, or as entrepreneurs.

PEO2: To provide students with strong foundational concepts and also advanced techniques and tools in order to enable them to build solutions or systems of varying complexity.

PEO3: To prepare students to critically analyze existing literature in an area of specialization and ethically develop innovative and research-oriented methodologies to solve the problems identified.

PROGRAM SPECIFIC OBJECTIVES (PSOs)

PSO1: To analyse, design and develop solutions by applying foundational concepts of electronics and communication engineering.

PSO2: To apply design principles and best practices for developing quality products for scientific and business applications.

PSO3: To adapt to emerging information and communication technologies (ICT) to innovate ideas and solutions to existing/novel problems.

JERUSALEM COLLEGE OF ENGINEERING
(AN AUTONOMOUS INSTITUTION, AFFILIATED TO ANNA UNIVERSITY, CHENNAI)
B.E. ELECTRONICS AND COMMUNICATION ENGINEERING
REGULATION 2021
CHOICE BASED CREDIT SYSTEM
I TO VIII SEMESTERS CURRICULUM AND SYLLABI

SEMESTER 1

S.No	Course Code	Course Title	Category	Contact Periods	L	T	P	C
THEORY								
1	JHS1121	Communicative English and Soft Skills I	HS	4	2	0	2	3
2	JMA1101	Matrices and Calculus	BS	4	2	2	0	3
3	JPH1101	Engineering Physics	BS	3	3	0	0	3
4	JCY1101	Engineering Chemistry	BS	3	3	0	0	3
5	JGE1101	Engineering Basics	ES	3	3	0	0	3
6	JGE1102	Programming in C	ES	3	3	0	0	3
PRACTICALS								
7	JPC1111	Physics and Chemistry Laboratory	BS	2	0	0	2	1
8	JGE1111	Design Appreciation Laboratory	ES	4	0	0	4	2
9	JGE1112	Programming in C Laboratory	ES	4	0	0	4	2
TOTAL				**30**	**16**	**2**	**12**	**23**

SEMESTER 2

S. No	Course Code	Course Title	Category	Contact Periods	L	T	P	C
THEORY								
1	JHS1221	Technical English and Soft Skills II	HS	4	2	0	2	3
2	JMA1201	Vector Calculus and Complex Analysis	BS	4	2	2	0	3
3	JBE1223	Applied Science for Electronics and Information Engineering	BS	4	2	0	2	3
4	JGE1201	Python Programming	ES	3	3	0	0	3
5	JGE1203	Electric Circuits & Electronic Devices	ES	4	2	2	0	3
6	JGE1202	Engineering Graphics & Design	ES	5	1	0	4	3
7	JNC1261	Environmental Science	NCM	3	3	0	0	0
PRACTICALS								
8	JGE1211	Python Programming Laboratory	ES	4	0	0	4	2
9	JGE1213	Electric Circuits & Electronic Devices Laboratory	ES	4	0	0	4	2
TOTAL				**35**	**15**	**4**	**16**	**22**

SEMESTER 3

S. No	Course Code	Course Title	Category	Contact Periods	L	T	P	C
THEORY								
1	JMA1301	Transforms and Linear Algebra	BS	4	2	2	0	3
2	JEC1302	Electronic Circuits	PC	3	3	0	0	3
3	JEC1303	Digital Electronics	PC	3	3	0	0	3
4	JEC1304	Signals and Systems	PC	4	2	2	0	3
5	JNC1361	Essence of Indian Traditional Knowledge	NCM	2	2	0	0	0
PRACTICALS								
6	JPT1001	Soft Skills and Aptitude 1	EEC	2	0	0	2	*
7	JEC1312	Electronic Circuits and Simulation Laboratory	PC	4	0	0	4	2
8	JEC1313	Digital Logic Design Laboratory	PC	4	0	0	4	2
9	JEC1314	Electronics Design Practice Laboratory I	ES	4	0	0	4	2
TOTAL				**30**	**12**	**4**	**14**	**18**

* Only Internal Assessments will be conducted in the 3rd semester while the end semester examination will be conducted in the 4th semester.

SEMESTER 4

S. No	Course Code	Course Title	Category	Contact Periods	L	T	P	C
THEORY								
1	JMA1404	Applied Probability and Random Processes	BS	4	2	2	0	3
2	JEC1401	Analog and Digital Communication	PC	3	3	0	0	3
3	JEC1402	Linear Integrated Circuits	PC	3	3	0	0	3
4	JEC1403	Electromagnetic Field Theory	ES	4	2	2	0	3
5	-	Professional Elective 1	PE	3	3	0	0	3
6	-	Open Elective1	OE	3	3	0	0	3
PRACTICALS								
7	JPT1001	Soft Skills and Aptitude II	EEC	2	0	0	2	1
8	JEC1411	Analog and Digital Communications Laboratory	PC	4	0	0	4	2
9	JEC1412	Linear Integrated Circuits Laboratory	PC	4	0	0	4	2
TOTAL				**30**	**16**	**4**	**10**	**23**

SEMESTER 5

S. No	Course Code	Course Title	Category	Contact Periods	L	T	P	C
THEORY								
1	JEE1501	Microprocessors and Microcontrollers (Integrated)	ES	4	2	0	2	3
2	JEC1501	Discrete Time Signal Processing	PC	4	2	2	0	3
3	JEC1502	Transmission Lines and RF Systems	PC	3	3	0	0	3
4	-	Professional Elective 2	PE	3	3	0	0	3
5	-	Open Elective 2	OE	3	3	0	0	3
PRACTICALS								
6	JPT1002	Technical Skills and Aptitude I	HS	2	0	0	2	*
7	JHS1511	Professional Communication	HS	2	0	0	2	1
8	JEC1511	Discrete Time Signal Processing Laboratory	PC	4	0	0	4	2
9	JEC1512	Electronics Design Practice Laboratory II	ES	2	0	0	2	1
10	JEC1521	Mini Project	EEC	2	0	0	2	1
TOTAL				**29**	**13**	**2**	**14**	**20**

* Only Internal Assessments will be conducted in the 5th semester while the end semester examination will be conducted in the 6th semester.

SEMESTER 6

S. No	Course Code	Course Title	Category	Contact Periods	L	T	P	C
THEORY								
1	JEC1601	Communication Networks	PC	3	3	0	0	3
2	JEC1602	VLSI Design	PC	3	3	0	0	3
3	JEC1603	Antennas and Microwave Engineering	PC	3	3	0	0	3
4	-	Professional Elective 3	PE	3	3	0	0	3
5	-	Open Elective 3	OE	3	3	0	0	3
PRACTICALS								
6	JPT1002	Technical Skills and Aptitude II	HS	2	0	0	2	1
7	JEC1611	Communication Networks Laboratory	PC	4	0	0	4	2
8	JEC1612	VLSI Design Laboratory	PC	4	0	0	4	2
9	JEC1641	Internship/In-plant training	EEC	-	-	-	2**	1
TOTAL				**25**	**15**	**0**	**10**	**21**

** Internship of two weeks must be undertaken in Industries through semesters 3,4,5 leading of 1 credit in Semester 6

SEMESTER 7

S. No	Course Code	Course Title	Category	Contact Periods	L	T	P	C
THEORY								
1	JEC1701	Optical Communication and Optical Sensors	PC	3	3	0	0	3
2	JEC1702	Embedded Systems and Product Design	PC	3	3	0	0	3
3	-	Professional Elective 4	PE	3	3	0	0	3
4	-	Professional Elective 5	PE	3	3	0	0	3
5	-	Open Elective 4	OE	3	3	0	0	3
PRACTICALS								
6	JBA1711	Entrepreneurship for Engineers	EEC	2	0	0	2	1
7	JEC1711	Optical and Microwave Laboratory	PC	4	0	0	4	2
8	JEC1712	Embedded System Design Laboratory	PC	4	0	0	4	2
9	JEC1731	Project Work - Phase – 1	EEC	6	0	0	6	3
TOTAL				**31**	**15**	**0**	**16**	**23**

SEMESTER 8

S. No	Course Code	Course Title	Category	Contact Periods	L	T	P	C
THEORY								
1	JNC1861	Indian Constitution	NCM	2	2	0	0	0
PRACTICALS								
2	JEC1832	Project Work – Phase -2	EEC	18	0	0	18	9
3	JEC1811	Comprehension & Technical Seminar	EEC	2	0	0	2	1
TOTAL				**22**	**2**	**0**	**20**	**10**

OPEN ELECTIVES

S. No	Course Code	Course Title	Category	Contact Periods	L	T	P	C
Semester - 4								
1	JEC9001	Communication Systems	OE	3	3	0	0	3
2	JEC9002	Introduction to Embedded Systems	OE	3	3	0	0	3
3	JEC9003	Simulation Tools in Electronics	OE	3	3	0	0	3
Semester - 5								
1	JEC9004	Basics of Signals and its Processing	OE	3	3	0	0	3
2	JEC9005	Basics of RF Circuits	OE	3	3	0	0	3
3	JEC9006	Embedded Systems Applications	OE	3	3	0	0	3
Semester - 6								
1	JEC9007	Introduction to Mobile Communication	OE	3	3	0	0	3
2	JEC9008	Telecommunication Switching Networks	OE	3	3	0	0	3
3	JEC9009	Verilog HDL for Digital Circuit Design	OE	3	3	0	0	3
Semester - 7								
1	JEC9010	Introduction to Satellite Communication	OE	3	3	0	0	3
2	JEC9011	Sensors, Actuators and Interface Electronics	OE	3	3	0	0	3
3	JEC9012	Tools for Computing and Design Platform	OE	3	3	0	0	3

S. No.	SUBJECT AREA	CREDITS AS PER SEMESTER								CREDITS TOTAL	PERCENTAGE
		I	II	III	IV	V	VI	VII	VIII		
1	HS	3	3	-	-	1	1	-	-	8	5
2	BS	10	6	3	3	-	-	-	-	22	13.750
3	ES	10	13	2	3	4	-	-	-	32	20.000
4	PC	-	-	13	10	8	13	10	-	54	33.750
5	PE	-	-	-	3	3	3	6	-	15	9.375
6	OE	-	-	-	3	3	3	3	-	12	7.500
7	EEC	-	-	-	1	1	1	4	10	17	10.625
Total		23	22	18	23	20	21	23	10	160	100.000
Non Credit/ Mandatory			1 paper	1 paper					1 paper		-

SEMESTER I

JHS1121	COMMUNICATIVE ENGLISH & SOFT SKILLS I (Common to all B.E. / B. Tech Programmes)	L	T	P	C
		2	0	2	3

COURSE OBJECTIVES:

- To enable the students of Engineering and Technology to develop their listening skill by learning the key techniques for comprehending information
- To facilitate the learners to speak effectively while exchanging ideas in academic and social domains
- To develop their skills in reading and understanding texts through practice
- To expose them to the correct usage of language to develop their writing skill
- To train the students to use appropriate vocabulary in academic and technical writings

UNIT I BASIC GRAMMAR I AND READING FOR INFORMATION 9

Parts of speech - Sentence patterns – Tenses - Wh- questions - Yes/no questions - Countable and Uncountable nouns - Affixation – word formation; Reading short comprehension passages - practice in skimming and scanning for specific information and note-making, Critical reading - finding key information in a given text - shifting facts from opinions and paraphrasing

SOFT SKILLS LAB 3

Listening to documentaries, inspiring speeches of great leaders, news bulletins, Ted talks, telephonic conversations

UNIT II BASIC GRAMMAR II AND SHARING INFORMATION 9

Pronouns - Adjectives - Adverbs - Imperatives - Direct and indirect questions - Compound words - Guessing meaning of words in contexts – one word substitutes; Autobiographical writing (writing about one's leisure time activities, hometown, favourite place and school life) – Biographical writing (place, people), Letter writing (informal letters)

SOFT SKILLS LAB 3

Self-introduction, peer introduction, picture description, JAM

UNIT III BASIC GRAMMAR III AND FREE WRITING I 9

Conjunctions – Prepositions - Articles - Degrees of comparison – Discourse markers - Reference words; Process description, Coherence and cohesion in writing cause and effect / compare & contrast / narrative / analytical paragraphs

SOFT SKILLS LAB 3

Language functions: Giving reasons, talking about future plans, comparing and contrasting, making suggestions

UNIT IV BASIC GRAMMAR IV AND LANGUAGE DEVELOPMENT 9

Subject-verb agreement - Modal verbs - Phrasal verbs - Single word substitutes - Use of abbreviations & acronyms - Cloze reading - Interpreting visual material, Jumbled sentences

SOFT SKILLS LAB 3

Interpersonal Skills: role play, group discussion, debate, conduct of meeting

UNIT V BASIC GRAMMAR V AND FREE WRITING II 6

Clause - Direct and indirect speech – Correction of errors - Word association (connotations) - Lexical items (fixed / semi fixed expressions) - Essay writing – different types of essays, dialogue writing

SOFT SKILLS LAB 3

Creative writing and speaking skills: Poster making and description, project proposals

TOTAL: 60 PERIODS

COURSE OUTCOMES:

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

- Listen to different talks and lectures and understand them easily
- Communicate their thoughts confidently using communicative strategies
- Read and grasp different genres of texts effortlessly
- Write grammatically correct academic, business and technical texts
- Apply the language skills efficiently in all forms of communication

TEXTBOOKS:

1. Board of Editors, Department of English, Anna University, Chennai. Using English: A Course Book for Undergraduate Engineers and Technologists, Orient Black Swan: Chennai, 2017.
2. Dhanavel, S.P. English and Communication Skills for Students of Science and Engineering. Orient Black Swan Publications, Chennai, 2011.
3. Raman, Meenakshi & Sangeetha Sharma, Technical Communication: English Skills for Engineers. Oxford University Press, New Delhi. 2011.

REFERENCE BOOKS:

1. Regional Institute of English. English for Engineers. Cambridge University Press, New Delhi. 2006
2. Rizvi M, Ashraf. Effective Technical Communication. Tata McGraw-Hill Publishing Company Limited, New Delhi, 2007.
3. Rutherford, Andrea J. Basic Communication Skills for Technology. Pearson Edition (II Edition), New Delhi, 2001.
4. Mandel, Steve. Effective Presentation Skills. New Delhi: Viva Books Pvt. Ltd., 2004.
5. Writing Cover Letters-Kilmet, Stephen. "Cover Letter," and "Enclosures and Attachments." In Writing for Design Professionals. New York.

WEBSITE REFERENCES:

1. https://www.perfect-english-grammar.com
2. https://edu.gcfglobal.org/en/grammar
3. https://www.talkenglish.com/grammar/grammar.aspx
4. https://learnenglish.britishcouncil.org/skills
5. https://www.myenglishlanguage.com

EXTENSIVE READING:

Kalam, Abdul. The Wings of Fire, Universities Press, Hyderabad. 1999

CO-PO MAPPING

COcC	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	-	-	-	-	-	-	-	1	2	3	-	2
CO2	-	-	-	-	-	-	-	1	2	3	-	2
CO3	-	-	-	-	-	-	-	1	2	3	-	2
CO4	-	-	-	-	-	-	-	1	2	3	-	2
CO5	-	-	-	-	-	-	-	1	2	3	-	2
AVG	-	-	-	-	-	-	-	1	2	3	-	2

JMA1101	MATRICES AND CALCULUS (Common to all B.E. / B. Tech Programmes)	L	T	P	C
		2	2	0	3

COURSE OBJECTIVES:

- To equip students with the knowledge of matrices required for applications in engineering.
- To enable students to understand the concepts of multivariable functions and its calculus.
- To familiarize students on concepts of differential calculus and its applications.
- To introduce concepts of integral calculus as tools required for applications in engineering.
- To introduce ordinary differential equations which is widely used in problem solving and engineering applications.

UNIT I MATRICES 12

Eigenvalues and Eigenvectors of a real matrix – Characteristic equation – Properties of Eigenvalues and Eigenvectors – Cayley-Hamilton theorem – Diagonalization of matrices by similarity and orthogonal transformations – Reduction of a quadratic form to canonical form – Nature of quadratic forms.

UNIT II FUNCTIONS OF SEVERAL VARIABLES 12

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

UNIT III APPLICATIONS OF DIFFERENTIAL CALCULUS 12

Curvature and radius of curvature – Circle of curvature – Evolutes – Envelopes – Evolute as envelope of normals.

UNIT IV APPLICATIONS OF INTEGRAL CALCULUS 12

Multiple integrals: Double integrals – Change of order of integration – Change of variables – Area enclosed by plane curves – Triple integrals – Volume of solids.
Improper integrals: Beta and Gamma Integrals – Definitions and properties – Simple problems.

UNIT V ORDINARY DIFFERENTIAL EQUATIONS 12

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

TOTAL: 60 PERIODS

COURSE OUTCOMES:

At the end of the course, students will be able:

- To understand applications of matrix theory in quadratic forms
- To use calculus for problems and applications dealing with functions of several variables
- To apply differential calculus in practical problem solving in the area of geometry
- To gain insight on the applications of multiple integrals in area and volume problems
- To solve ordinary differential equations that occur in many physical and engineering applications

TEXT BOOKS:

1. Grewal B.S., "Higher Engineering Mathematics", Khanna Publishers, New Delhi, 43rd Edition, 2014.
2. Kreyszig Erwin, "Advanced Engineering Mathematics", John Wiley and Sons, 10th Edition, New Delhi, 2016.
3. P.Anuradha and V.Sudhakar, "Matrices and Calculus", Scitech Publications, 1st Edition, Chennai, 2019.

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, New Delhi, 3rd Edition, 2007.
3. Srimantha Pal and Bhunia, S.C, "Engineering Mathematics" Oxford University Press, 2015.
4. Weir, M.D and Joel Hass, "Thomas Calculus", 12th Edition, Pearson India, 2016.

WEBSITE REFERENCES:

1. https://nptel.ac.in/courses/111/108/111108157/
2. https://nptel.ac.in/courses/111/107/111107108/
3. https://nptel.ac.in/courses/111/104/111104144/
4. https://nptel.ac.in/courses/111/105/111105122/
5. https://nptel.ac.in/courses/111/107/111107111/

CO - PO MAPPING

CO\PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	2	2	-	-	-	-	2	-	-	2
CO2	3	3	2	2	-	-	-	-	2	-	-	2
CO3	3	3	2	2	-	-	-	-	2	-	-	2
CO4	3	3	2	2	-	-	-	-	2	-	-	2
CO5	3	3	2	2	-	-	-	-	2	-	-	2
AVG	3	3	2	2	-	-	-	-	2	-	-	2

JPH1101	ENGINEERING PHYSICS (Common to all B.E. / B. Tech Programmes)	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To enable the students to understand the basics of the latest advancements in Physics
- To introduce the principles of quantum mechanics
- To impart knowledge of laser and fiber optic communication

UNIT I CRYSTAL PHYSICS 9

Single crystal, Polycrystal and Amorphous materials – Single Crystals: Unit cell, Crystal systems, Bravais lattices, Directions and Planes in a crystal, Miller indices – Inter planar distances – Coordination number and Packing factor for SC, BCC, FCC, HCP and Diamond structures - Crystal imperfections: Point defects, Line defects – Burgers vector, Stacking faults.

UNIT II PROPERTIES OF MATTER 9

Elasticity – Stress-strain diagram and its uses - factors affecting elastic moduli and tensile strength – torsional stress and deformations – twisting couple - torsion pendulum: theory and experiment - bending of beams - stress due to bending in beams - bending moment – cantilever: theory and experiment – uniform and non-uniform bending: theory and experiment.

UNIT III ULTRASONICS 9

Production of ultrasound by Magnetostriction effect and Piezo electric effect Detection of ultrasonic wave – Properties of ultrasonic wave – Acoustic grating - Industrial applications – Drilling, Welding, Soldering and Cleaning – SONAR - Non Destructive Testing – Pulse echo system through Transmission and Reflection modes- A, B and C–scan displays.

UNIT IV PHOTONICS AND FIBRE OPTICS 9

Spontaneous and stimulated emission-Population inversion -Einstein's A and B coefficients derivation – Laser Principle - Semiconductor lasers (homojunction & heterojunction)-Industrial and Medical Applications – Optical Fiber: types (material, refractive index, mode) - Propagation of light in optical fibers – Numerical aperture and Acceptance angle –attenuation, dispersion, bending -Fiber Optical Communication system (Block diagram) -Active and passive fiber sensors-Endoscope.

UNIT V QUANTUM PHYSICS 9

Black body radiation –Planck's theory (derivation) –Deduction of Wien's displacement law and Rayleigh –Jeans' Law from Planck's theory –Compton effect: theory –Properties of Matter waves –G.P Thomson experiment -Schrödinger's wave equation –Time independent and time dependent equations –Physical significance of wave function –Particle in a one dimensional box -Scanning electron microscope -Transmission electron microscope

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of the course, students will be able:

- To enhance knowledge on properties of matter
- To assess the properties of ultrasonics and imaging devices
- To understand and to compute problems in Quantum Physics.
- To learn the use of modern optical fiber communication systems and tools in real life applications.
- To gain more insight on the functioning of optical materials for optoelectronics.

TEXT BOOKS:

1. Bhattacharya, D.K. & Poonam, T. “Engineering Physics”. Oxford University Press, 2015.
2. Gaur, R.K. & Gupta, S.L. “Engineering Physics”. Dhanpat Rai Publishers, 2012.
3. Dr.Beula Shanthi John, Dr.P.mani,” Engineering Physics”,Dhanam Publications, First Edition, 2019.

REFERENCES:

1. Halliday, D., Resnick, R. & Walker, J. “Principles of Physics”. Wiley, 2015.
2. Serway, R.A. & Jewett, J.W. “Physics for Scientists and Engineers”. Cengage Learning,2010.
3. Tipler, P.A. & Mosca, G. “Physics for Scientists and Engineers with Modern Physics’. W.H.Freeman, 2007
4. Rajendran V, "Engineering Physics", Tata McGraw Hill, 2009.
5. John D.Cutnell, “Cutnell and Johnson Physics”, Willey Publications, 2018.

WEB SITE REFERENCES:

1. https://nptel.ac.in/courses/115/104/115104109/
2. https://nptel.ac.in/noc/courses/noc18/SEM2/noc18-ce18/
3. https://onlinecourses.nptel.ac.in/noc21_bt50/preview
4. https://nptel.ac.in/courses/115/104/115104096/
5. https://nptel.ac.in/courses/108/104/108104113/

CO - PO MAPPING

CO\PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	1	1	-	-	1	-	-	1	-	1	-
CO2	2	1	1	-	-	1	-	-	1	-	1	-
CO3	2	1	1	-	-	1	-	-	1	-	1	-
CO4	2	1	1	-	-	1	-	-	1	-	1	-
CO5	2	1	1	-	-	1	-	-	1	-	1	-
AVG	2	1	1	--	-	1	-	-	1	-	1	-

JCY1101	ENGINEERING CHEMISTRY (Common to all B.E. / B. Tech Programmes)	L	T	P	C
		3	0	0	3

OBJECTIVE:

- To acquaint the student with concepts of photochemistry and analytical techniques.
- To make the students conversant with boiler feed water and water treatment techniques.
- To make the students acquire sound knowledge in corrosion of materials.
- To understand polymer chemistry and the principle of energy in batteries.
- To impart knowledge on the basics of nano materials and engineering materials.

UNIT I PHOTOCHEMISTRY AND ANALYTICAL TECHNIQUES 9

Photochemistry- Laws of photochemistry - Grotthuss–Draper law, Stark–Einstein law and Lambert-Beer Law (problems). Photo processes - Internal Conversion, Inter-system crossing, Fluorescence and its applications in medicine – Phosphorescence-Chemiluminescence and Photo-sensitization.

Analytical Techniques – UV-visible spectroscopy – principles – instrumentation (block diagram only) – Colorimetry- Principle-Instrumentation, estimation of iron by colorimetry – Flame photometry – principle – Instrumentation – estimation of sodium by Flame photometry.

UNIT II WATER TECHNOLOGY 9

Hardness-Units of Hardness- Temporary hardness-Permanent hardness- Estimation hardness by EDTA method- Alkalinity – Types- water quality parameters (pH, EC, TDS, DO, BOD, COD) - Boiler feed water-requirements- boiler troubles (scale and sludge- caustic embrittlement-boiler corrosion-priming and foaming) - softening of hard water -external treatment (zeolite and demineralization) - internal treatment (phosphate, calgon, carbonate, colloidal) - desalination of brackish water –reverse osmosis.

UNIT III ELECTROCHEMISTRY AND CORROSION 9

Electrochemistry- Electrochemistry- Electrochemical cell - redox reaction, electrode potential-oxidation potential- reduction potential, measurement and applications - electrochemical series and its significance - Nernst equation (derivation and problems).

Corrosion- causes- types-chemical, electrochemical corrosion- galvanic corrosion-differential aeration corrosion (pitting, waterline, wire fence, pipeline, crevice, stress corrosion), Factors influencing the rate of corrosion- corrosion control - material selection and design aspects – cathodic protection methods (sacrificial anode and impressed current cathodic methods)- Electroplating of Copper and electroless plating of nickel-corrosion inhibitors (anodic and cathodic inhibitors).

UNIT IV POLYMER, COMPOSITES AND ENERGY STORAGE DEVICES 9

Introduction- Classification of polymers – Natural and synthetic; Thermoplastic and Thermosetting. Functionality – Degree of polymerization. Bio degradable polymer- Types- synthetic methods – applications of biodegradable polymers. Polymer composites and its application.

Energy Storage Devices - Batteries and fuel cells: Types of batteries – primary battery (dry cell) secondary battery (lead acid battery, nickel-cadmium battery, lithium-ion-battery). Fuel cell – H_2-O_2 fuel cell- solid oxide fuel cell - polymer electrolyte membrane fuel cell (PEMFC) applications.

UNIT V ENGINEERING MATERIALS AND NANO CHEMISTRY 9

Engineering Materials- Refractories – classification – acidic, basic and neutral refractories – properties (refractoriness, refractoriness under load, dimensional stability, porosity, thermal spalling) – manufacture of alumina, magnesite and zirconia bricks. cement- manufacture and properties - setting and hardening of cement, special cement- waterproof and white cement–properties and uses.

Nanochemistry – Introduction – distinction between molecules, nanoparticles and bulk materials; Synthesis: precipitation, thermolysis, hydrothermal, solvothermal, electrodeposition, chemical vapour deposition, laser ablation; Properties and applications.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

- Understand laws of photochemistry and principles of instrumentation and their applications in various fields.
- To understand the basic principle of water treatment and techniques involved in the purification process for future learning.
- Apply electrochemical reactions on the process of corrosion and its prevention methods.
- Gain knowledge on biodegradable polymers and understand the principle of batteries for development of new energy resources.
- Gain knowledge on engineering materials and understand the unique behavior of nano materials.

TEXT BOOKS:

1. Jain P.C. and Monica Jain, "Engineering Chemistry", Dhanpat Rai Publishing Company (P) Ltd., New Delhi, 2010.
2. R.Gopalan, D.Venkapayya, Sulochna Nagarajan,Text book of Engineering Chemsitry, Vikas publishing pvt ltd, 4th edition, 2013.
3. Dr.N.John Jebarathinam Dr.R.Vaidyanathan Ms.A.U.Ajisha Dr.A.Ravikrishnan, Engineering Chemistry, Sri Krishna Publications, First edition 2019.

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1. O.G.Palanna, Engineering Chemistry, Mc Graw Hill, 2017
2. Dara S.S, Umare S.S, "Engineering Chemistry", S. Chand & Company Ltd., New Delhi 2013.
3. Gowariker V.R., Viswanathan N.V. and Jayadev Sreedhar, "Polymer Science", New Age International P (Ltd.,), Chennai, 2006.
4. Ozin G. A. and Arsenault A. C., "Nanochemistry: A Chemical Approach to Nanomaterials", RSC Publishing, 2005.
5. B.R.Puri, L.R.Sharma, Madan S.Pathana, Principle of physical chemistry, 47th edition, Vishal publishing Co, 2017.

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1. https://nptel.ac.in/content/storage2/courses/103108100/module2/module2.pdf
2. https://www.samcotech.com/what-is-a-boiler-feed-water-treatment-system-how-does-it-work/
3. https://nptel.ac.in/courses/113/101/113101098/
4. https://nptel.ac.in/courses/112/107/112107221/
5. https://nptel.ac.in/courses/113/106/113106093/

CO - PO MAPPING

CO\PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	1	1	1	1	1	1	-	-	-	1	1
CO2	1	1	1	1	1	1	1	-	1	1	1	-
CO3	1	1	1	1	1	1	1	-	1	1	1	-
CO4	1	1	1	1	1	1	1	1	1	1	1	1
CO5	1	1	1	1	1	1	1	-	1	1	1	1
AVG	1	1	1	1	1	1	1	1	1	1	1	1

JGE1101	ENGINEERING BASICS (Common to all B.E. / B. Tech Programmes)	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To impart knowledge on the basics of Civil Engineering to the students.
- To impart knowledge on the basics of Mechanical Engineering to the students.
- To impart knowledge on the electric circuits and working principles of Electrical Machines.
- To impart knowledge on the Principles and characteristics of various electronic devices.
- To impart knowledge on the basics of various measuring instruments.

UNIT I BASICS OF CIVIL ENGINEERING 11

Introduction to Civil Engineering, Types of buildings, Components of a residential building, Building Materials, Types of slabs, beam, column, lintel, floor and foundation - Types of roofs.

Surveying and Levelling - Linear and Angular Measurements - Introduction to transport system, role of transportation in society - Green Highway.

Sources of water, Hydrological cycle, Irrigation Engineering, Rain water harvesting, Environmental pollution, Greenhouse gas emission, Ozone depletion, Global warming - Green building concepts.

UNIT II BASICS OF MECHANICAL ENGINEERING 11

Introduction to Concept of Mechanization and Automation, Robotics; Manufacturing methods- casting, machining, forming operations. Introduction to IC Engine- working principle of Petrol and diesel engine; Types of Power plants- Hydel power plant and thermal power plant; Steam generators-Fire tube boiler and water tube boiler; Thermal systems-Heat exchangers, Radiator and oil cooler; Design of ingenious Mechanisms-Parts feeding mechanism.

UNIT III ELECTRIC CIRCUITS AND ELECTRICAL MACHINES 7

Basic circuit components – Ohms Law – Kirchhoff's Law-Introduction to AC circuits – waveforms and RMS value – power and power factor-Principles of operation of DC machines-Transformers-three phase and single-phase induction motors.

UNIT IV ELECTRONIC DEVICES & CIRCUITS 7

Types of Materials - Silicon & Germanium - N type and P type materials - Construction and Characteristics: PN Junction diode - Zener Diode - Bipolar Junction Transistor - Field effect Transistors - IGBT - Introduction to operational amplifier - Inverting Amplifier - Non-inverting Amplifier.

UNIT V MEASUREMENTS & INSTRUMENTATION 9

Elements of generalized measurement system – Basic terminologies: Accuracy, precision, resolution, sensitivity, linearity, span and range – Errors in measurement – Standards of measurement - calibration – Operating forces: Deflection force, controlling force, damping force-Classification of instruments.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of the course, students will be able:

- Gain knowledge on the various fields of Civil Engineering.
- Know the fundamentals of Mechanical Engineering.
- Understand the basic concepts of electric circuits and working principles of electrical machines.
- Gain knowledge on the basics of electronics and apply them in practical situations.
- Choose appropriate instruments for electrical measurement for a specific application.

TEXTBOOKS

1. Shanmugam G and Palanichamy MS, "Basic Civil and Mechanical Engineering", Tata McGraw Hill publishing Co., 2016
2. Venugopal K. and Prahu Raja V., Basic Mechanical Engineering, Anuradha Publishers, Kumbakonam,2000.
3. D P Kothari and I.J Nagarath, Electrical Machines - Basic Electrical and Electronics Engineering, McGraw Hill Education (India) Private Limited, Third Reprint, 2016.

REFERENCES:

1. Palanikumar, K. Basic Mechanical Engineering, ARS Publications, 2010.
2. Ramamrutham S.,Basic Civil Engineering, Dhanpat Rai Publishing Co.(P) Ltd.1999.
3. Thereja .B.L., Fundamentals of Electrical Engineering and Electronics , S. Chand & Co. Ltd., 2008.
4. A.K.Sawhney,ACourseinElectrical &ElectronicMeasurements & Instrumentation, Dhanpat Rai and Co, New Delhi, 2010.
5. H.S. Kalsi, Electronic Instrumentation, Tata McGraw-Hill, New Delhi, 2010.

WEBSITE REFERENCES:

1. https://www.eit.edu.au/
2. https://nptel.ac.in/courses/105/102/105102088/
3. https://nptel.ac.in/courses/108/105/108105155/
4. https://nptel.ac.in/courses/117/103/117103063/
5. https://nptel.ac.in/courses/108/105/108105153/

CO - PO MAPPING

CO\PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	1	1	1	1	-	-	-	-	-	-	-
CO2	1	1	1	1	1	-	-	-	-	-	-	-
CO3	1	1	1	1	1	-	-	-	-	-	-	-
CO4	1	1	1	1	1	-	-	-	-	-	-	-
CO5	1	1	1	1	1	-	-	-	-	-	-	-
AVG	1	1	1	1	1	-	-	-	-	-	-	-

JGE1102	PROGRAMMING IN C	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To learn Fundamentals of Computing
- To be able to use file operations in C
- To implement programs using basic features of C
- To learn to use C pointers and dynamically allocated memory techniques
- To learn advanced features of the C programming language

UNIT I INTRODUCTION TO PROBLEM SOLVING 9

Simple model of a Computer – Hardware – Software – Data Representation, Problem Solving Techniques – Bottom up design and top down design - applications, Introduction to Algorithms and Flow Chart - Notion of memory, addresses, variables, instructions, execution of instructions. Operating system commands, file editing, compiling, linking, executing a program.

UNIT II C PROGRAMMING 9

Introduction to 'C' programming – structure of a 'C' program – compilation and linking processes. Conversion of simple algorithm to program-Constants, Variables – Data Types – Expressions using operators in 'C' – Managing Input and Output operations – Decision Making and Branching – Looping statements – solving simple scientific and statistical problems.

UNIT III ARRAYS AND STRINGS 9

Arrays – Initialization – Declaration – One dimensional and two dimensional arrays - String- String operations –Arrays of strings.

UNIT IV FUNCTIONS AND USER DEFINED DATA TYPES 9

Function – definition of function – Declaration of function – Pass by value - Pass by reference– Command Line Argument in C-- Recursion - Enumerators - Structures - Unions.

UNIT V POINTERS AND FILES 9

Macros - storage classes - Pointers- Definition – Initialization – Pointers arithmetic – Double Pointers, Basic file operations-Example problems.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

- Design and represent solutions to problems as algorithm and flow chart
- Write simple C Programs using loops and conditional statements
- Write simple C Programs using arrays
- Write simple C Programs using functions
- Write simple C codes using pointers, structures and union

TEXT BOOKS:

1. PradipDey, ManasGhosh, "Programming in C", First Edition, Oxford University Press, 2018
2. Byron S Gottfried, "Programming with C", Schaum's Outlines, Third Edition, McGraw-Hill,2010.

REFERENCES:

1. Kernighan,B.W and Ritchie,D.M, “The C Programming language”, Second Edition, Pearson Education,2015.
2. Yashavant P. Kanetkar. “Let Us C”, BPB Publications,2011.
3. Paul J Deitel, Dr.Harvey M.Deitel, "C How to Program", Seventh Edition, Pearson Education,2016.
4. E. Balagurusamy, “Computing Fundamentals and C Programming”, McGraw-Hill Publishing Company Limited, (2008).
5. Brian W. Kernighan and Rob Pike, “The Practice of Programming” (Chap 1), Pearson Education,2008

WEBSITE REFERENCES:

1. https://www.javatpoint.com/computer-fundamentals-tutorial
2. https://www.geeksforgeeks.org/basics-file-handling-c/
3. https://www.studytonight.com/c/string-and-character-array.php
4. https://www.tutorialspoint.com/cprogramming/c_functions.htm
5. https://www.guru99.com/c-pointers.html

CO-PO MAPPING

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	3	-	-	-	-	3	3	3	-	3
CO2	3	3	3	-	-	-	-	3	3	3	-	3
CO3	3	3	3	-	-	-	-	3	3	3	-	3
CO4	3	3	3	-	-	-	-	3	3	3	-	3
CO5	3	3	3	-	-	-	-	3	3	3	-	3
AVG	3	3	3	-	-	-	-	3	3	3	-	3

JPC1111	PHYSICS AND CHEMISTRY LABORATORY (Common to all B.E /B.Tech Programmes)	L	T	P	C
		0	0	2	1

COURSE OBJECTIVES:

- To provide students the first hand experience of verifying various concepts learnt in theory courses.

LIST OF EXPERIMENTS: Physics

1. Determination of Young’s modulus for the given uniform bar by uniform bending method
2. Determination of wavelength of the diode laser and hence determine the size of the coated powder particle
3. Determination of velocity of Ultrasound using Ultrasonic interferometer and also find the compressibility of the given liquid
4. Determination of moment of inertia of the given circular disc and rigidity modulus of the metal wire using torsional pendulum
5. Determination of Planck’ constant using different color filters
6. Determination of Wavelength of spectral lines in mercury spectrum using spectrometer
7. Analysis of I-V Characterization of Solar cell

TOTAL: 15 PERIODS

LIST OF EXPERIMENTS: Chemistry

1. Estimation of HCl using Na_2CO_3 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 in brass by Iodometry.
6. Determination of molecular weight of polyvinyl alcohol using Ostwald viscometer.

TOTAL: 15 PERIODS

COURSE OUTCOMES:

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

1. Acquire experience in analyzing the elastic materials.
2. Understand the acoustic properties of various liquids.
3. Acquire knowledge in optical properties of solids.
4. Make the student to acquire practical skills in the determination of water quality parameters through volumetric and instrumental analysis.
5. Acquaint the students with the determination of molecular weight of a polymer by viscometry

REFERENCES:

1. Practical Fiber Optics, D. Bailey and E. Wright, 2003
2. J.Mendham, RC Denney, JD Barnes, MJK Thomas, Text book of quantitative chemical analysis, Vogel’s, 2008.
3. Fretter W.B. -Introduction to Experimental Physics, Blackiee
4. J.Mendham, RC Denney, JD Barnes, MJK Thomas, Text book of quantitative chemical analysis, Vogel’s, 2008.

WEBSITE REFERENCES:

1. http://www.digimat.in/nptel/courses/video/105107176/L31.html
2. https://www.canterbury.ac.nz/media/documents/science-outreach/chloride_mohr.pdf
3. http://www.mgcub.ac.in/pdf/material/20200428101433e562a8b8e8.pd
4. http://depthome.brooklyn.cuny.edu/physics/lab/phy2/newlabs/Diffraction-grating-ver-2.pdf
5. http://web.physics.ucsb.edu/~phys128/experiments/interferometry/measuring_wavelength.pdf

CO - PO MAPPING

CO\PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	1	1	-	1	1	-	-	1	-	1	1
CO2	2	1	1	-	1	1	-	-	1	-	1	1
CO3	2	1	1	-	1	1	-	-	1	-	1	1
CO4	2	1	1	-	1	1	-	-	1	-	1	1
CO5	2	1	1	-	1	1	-	-	1	-	1	1
AVG	2	1	1	-	1	1	-	-	1	-	1	1

JGE1111	DESIGN APPRECIATION LABORATORY (Common to all B.E /B.Tech Programmes)	L	T	P	C
		0	0	4	2

COURSE OBJECTIVES

- To provide exposure to the students with hands on experience on various
- Basic engineering practices in Civil, Mechanical, Electrical and Electronics Engineering.
- To kindle own creativity, ideation and realize the importance of team working.
- To gain knowledge through experience in handling of engineering aggregates.
- To appreciate the use of various mechanisms involved in engineering products.
- To understand the interactions between its subsystems and their functionality.

GROUP A (CIVIL & MECHANICAL)

I CIVIL ENGINEERING PRACTICE 13

BUILDINGS:

- Study of plumbing and carpentry components of residential and industrial buildings. Safety aspects.

PLUMBING WORKS:

a) Study of pipeline joints, its location and functions: valves, taps, couplings, unions, reducers, elbows in household fittings.
b) Study of pipe connections requirements for pumps and turbines.
c) Preparation of plumbing line sketches for water supply and sewage works.
d) Hands-on-exercise: Basic pipe connections – Mixed pipe material connection – Pipe connections with different joining components.
e) Demonstration of plumbing requirements of high-rise buildings.

CARPENTRY USING POWER TOOLS ONLY:

a) Study of the joints in roofs, doors, windows and furniture.
b) Hands-on-exercise: Wood work, joints by sawing, planning and cutting.

II MECHANICAL ENGINEERING PRACTICE 18

WELDING:

a) Preparation of butt joints, lap joints and T- joints by Shielded metal arc welding.
b) Gas welding practice

BASIC MACHINING:

a) Simple Turning and Taper turning
b) Drilling Practice

SHEET METAL WORK:

a) Forming & Bending:
b) Model making – Trays and funnels.
c) Different type of joints.

MACHINE ASSEMBLY PRACTICE:

a) Study of centrifugal pump
b) Study of air conditioner

DEMONSTRATION ON:

a) Smithy operations, upsetting, swaging, setting down and bending. Example – Exercise – Production of hexagonal headed bolt.
b) Foundry operations like mould preparation for gear and step cone pulley.
c) Fitting – Exercises – Preparation of square fitting and V – fitting models.

GROUP B (ELECTRICAL & ELECTRONICS)

III ELECTRICAL ENGINEERING PRACTICE 13

1. Residential house wiring using switches, fuse, indicator, lamp and energy meter.
2. Fluorescent lamp wiring.
3. Stair case wiring
4. Measurement of electrical quantities – voltage, current, power & power factor in RLC circuit.
5. Measurement of energy using single phase energy meter.
6. Measurement of earth resistance for electrical equipment.

IV ELECTRONICS ENGINEERING PRACTICE 16

1. Study of Electronic components and equipments - Resistor, colour coding measurement of AC signal parameter (peak-peak, rms period, frequency) using CR.
2. Study of logic gates AND, OR, EX - OR and NOT.
3. Generation of Clock Signal.
4. Soldering practice - Components Devices and Circuits - Using general purpose PCB.
5. Measurement of ripple factor of HWR and FWR.

TOTAL: 60 PERIODS

LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS:

CIVIL

1. Assorted components for plumbing consisting of metallic pipes, plastic pipes, flexible pipes, couplings, unions, elbows, plugs and other fittings. 15 Sets
2. Carpentry vice (fitted to work bench) 15 Nos
3. Standard woodworking tools 15 Sets
4. Models of industrial trusses, door joints, furniture joints 5 each
5. Power Tools:
    a. Rotary Hammer 2 Nos
    b. Demolition Hammer 2 Nos
    c. Circular Saw 2 Nos
    d. Planer 2 Nos
    e. Hand Drilling Machine 2 Nos
    f. Jigsaw 2 Nos

MECHANICAL

1. Arc welding transformer with cables and holders 5 Nos
2. Welding booth with exhaust facility 5 Nos
3. Welding accessories like welding shield, chipping hammer, wire brushetc. 5 Sets
4. Oxygen and acetylene gas cylinders, blow pipe and other welding outfit. 2 Nos
5. Centre lathe 2 Nos
6. Hearth furnace, anvil and smithy tools 2 Sets

7. Moulding table, foundry tools 2 Sets
8. Power Tool: Angle Grinder 2 Nos
9. Study-purpose items: centrifugal pump, air-conditioner 1 each

ELECTRICAL

1. Assorted electrical components for house wiring 15 Sets
2. Electrical measuring instruments 10 Sets
3. Study purpose items: Iron box, fan and regulator, emergency lamp 1 each
4. Megger (250V/500V) 1 No
5. Power Tools:
   a. Range Finder 2 Nos
   b. Digital Live-wire detector 2 Nos

ELECTRONICS

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

COURSE OUTCOMES:

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

- Fabricate carpentry components and pipe connections including plumbing works.
- Illustrate on centrifugal pump, Air conditioner, operations of smithy, foundry and fittings
- Carry out basic home electrical works and appliances
- Measure the electrical quantities
- Elaborate on the components, gates, soldering practices.

WEBSITE REFERENCES:

1. www.vikaspublishing.com/engineering-practices-lab
2. https://archieve.org/mechanicalengineeeringworkshoplaboratory

CO - PO MAPPING

CO\PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	1	1	1	1	1	1	-	1	-	1	1
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CO3	1	1	1	1	1	1	1	-	1	1	1	-
CO4	1	1	1	1	1	1	1	1	I	I	1	1
CO5	1	1	1	1	1	1	1	-	1	1	1	1
AVG	1	1	1	1	1	1	1	-	1	1	1	1

JGE1112	PROGRAMMING IN C LABORATORY	L	T	P	C
		0	0	4	2

COURSE OBJECTIVES:

The students should be made

- To be exposed to the syntax of C
- To be familiar with programming in C
- To learn to use arrays, strings, functions, pointers, structures and unions in C.
- To Learn the fundamentals of File Programming in C
- To solve simple problems using C

LIST OF PROGRAMS:

1. Usage of Basic Linux commands
2. C Programming using Simple statements and expressions
3. Scientific problem solving using decision making and looping.
4. Simple programming for one dimensional and two dimensional arrays.
5. Solving problems using Strings
6. C Programming using Pointers
7. C Programming using user defined functions (Pass by value and Pass by reference)
8. C Programming using Recursion
9. C Programming using structures and union
10. C Programming using enumerated data types
11. C Programming using macros and storage classes
12. C Programming using Files

TOTAL: 60 PERIODS

COURSE OUTCOMES

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

- Write simple C Programs
- Able to solve scientific problems using C
- Gain knowledge on the use of functions and arrays
- Use structures, pointers and files in C Programs
- Develop modularized applications in C

TEXT BOOKS:

1. PradipDey, ManasGhosh, "Programming in C - As per the latest AICTE syllabus", First Edition, Oxford University Press,2018

2. Byron S Gottfried, "Programming with C", Schaum's Outlines, Third Edition, McGraw-Hill,2010

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1. https://www.javatpoint.com/first-c-program
2. https://www.w3resource.com/c-programming-exercises/
3. https://www.javatpoint.com/functions-in-c
4. https://www.programiz.com/c-programming/c-structures-pointers
5. https://www.sitesbay.com/cprogramming/c-applications

CO-PO MAPPING

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
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CO4	3	3	3	3	-	-	-	3	3	3	-	3
CO5	3	3	3	3	-	-	-	3	3	3	-	3
AVG	3	3	3	3	-	-	-	3	3	3	-	3

SEMESTER II

JHS1221	TECHNICAL ENGLISH & SOFT SKILLS II (Common to all B.E /B.Tech Programmes)	L	T	P	C
		2	0	2	3

COURSE OBJECTIVES:

- To make the students of engineering and technology enhance their ability to read and comprehend different texts
- To improve their creative and critical thinking so as to use in demanding contexts
- To equip the learners with the skills of writing convincing job applications and effective reports
- To develop their speaking skills to make technical presentations and participate in group discussions
- To facilitate them to hone their soft skills

UNIT I TECHNICAL WRITING AND VISUAL CONVERSION 9

Definitions, Purpose statements, Technical vocabulary, regular and irregular verbs - Process Description and Interpretation of Graphs and Charts

SOFT SKILLS LAB 3

Skimming and scanning, understanding logic and sequencing in reading, inferring the exact meaning of text, making out meaning of pictorial and graphical representations

UNIT II TECHNICAL WRITING AND GUIDELINES PREPARATION 9

Conditional clauses, Numerical adjectives, Collocation, verbal analogies – Instructions, Recommendations, Checklist

SOFT SKILLS LAB 3

Comprehensive listening: Listening to telephonic conversations, listening to native accents, short and long conversations from different domains, listening to various pre-recorded conversations and speeches

UNIT III 12

SOFT SKILLS LAB

Listening and speaking practice based on BEC, IELTS and TOEFL

UNIT IV TECHNICAL WRITING AND BUSINESS LETTERS 9

Cause and effect, impersonal passive voice, idioms and phrases, words used as nouns and verbs - Letter writing – job application, business correspondence (letters) – calling for quotations, placing order, complaint letters, preparing a memo, notice and e-mail – itinerary

SOFT SKILLS LAB 3

Group Discussions - Process, Skills, Guidelines, Evaluation, Oral Presentation – Planning, Preparing, Organizing, Presenting

UNIT V TECHNICAL WRITING AND REPORT WRITING 9

Degrees of comparison, editing, Email etiquette, Misspelled words -- Report writing: survey, feasibility, industrial visit, reporting various incidents and accidents, Minutes of meeting

SOFT SKILLS LAB 3

Starting a Career – vision statement, preparing logo and tagline, making short term and long term goals, setting plans

TOTAL: 60 PERIODS

COURSE OUTCOMES:

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

- Read and understand general and technical texts
- Apply creative and critical thinking and communicate their ideas efficiently
- Participate in group discussions and deliver short speeches effectively
- Write effectively and persuasively in academic and workplace contexts
- Face the future challenges confidently and successfully

TEXTBOOKS:

1. Department of English, Anna University, Chennai. Mindscapes: English for Technologists and Engineers. Orient Black Swan, Chennai.
2. Dhanavel, S.P. English and Communication Skills for Students of Science and Engineering. Orient Black Swan Publications, Chennai, 2011.
3. Rizvi, M. Ashraf, “Effective Technical Communication”, Tata McGraw – Hill, 2006.

REFERENCE BOOKS:

1. Ibbotson, Mark, “Cambridge English for Engineering”, Cambridge University Reference Press, 2008
2. English, Laura M & Sarah Lynn, “Business Across Cultures: Effective Communication Strategies”, Addison Wesley, 1995.
3. Richard Johnson-Sheehan, “Technical Communication Today” 4th Edition Books Longman Publishing Group, 2011.
4. Porter, Patricia A., and Margaret Grant, “Communicating Effectively in English: Oral Communication for Non-Native Speakers”, 2nd Edition, Wadsworth, 1992.
5. Gopalaswamy, Ramesh & Ramesh Mahadevan. ACE of Soft Skills: Attitude, Communication and Etiquette for Success, New Delhi: Pearson, 2010.

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1. https://learnenglish.britishcouncil.org/business-english
2. https://www.thebalancecareers.com
3. https://www.deakin.edu.au/students/studying/study-support/academic-skills/report-writing
4. https://www.englishclub.com
5. https://www.ielts.org

EXTENSIVE READING:

- Wells, H.G. The Time Machine, Peacock, India, 2008.

CO - PO MAPPING

CO\PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	-	-	-	-	-	-	-	1	2	3	-	2
CO2	-	-	-	-	-	-	-	1	2	3	-	2
CO3	-	-	-	-	-	-	-	1	2	3	-	2
CO4	-	-	-	-	-	-	-	1	2	3	-	2
CO5	-	-	-	-	-	-	-	1	2	3	-	2
AVG	-	-	-	-	-	-	-	1	2	3	-	2

JMA1201	VECTOR CALCULUS AND COMPLEX ANALYSIS (Common to all B.E /B.Tech Programmes)	L	T	P	C
		2	2	0	3

COURSE OBJECTIVES:

- To familiarize students with concepts of vector calculus and its applications.
- To help students understand theory of analytic functions and problem solving.
- To provide knowledge of complex integration, series expansions, residue theorem and its applications.
- To build concepts of Laplace transforms and its properties with problem solving.
- To enable students to use Laplace transforms and its inverse in solving differential equations.

UNIT I VECTOR CALCULUS 12

Vector Differentiation: Gradient and directional derivative – Divergence and curl - Vector identities – Irrotational and Solenoidal vector fields

Vector Integration: Line and surface integrals - Green's theorem – Gauss and Stoke's theorems – Verification and evaluation in simple problems.

UNIT II ANALYTIC FUNCTIONS 12

Analytic functions – Zeros and Singularities - Necessary and sufficient conditions for analyticity in Cartesian and polar coordinates (without proof) - Properties – Harmonic conjugates – Construction of analytic functions - Conformal mappings – $w = z + c,\ w = cz,\ w = \frac{1}{z}$ – Bilinear transformation.

UNIT III COMPLEX INTEGRATION 12

Cauchy's integral theorem – Cauchy's integral formula – Taylor's and Laurent's series - Types of Singularities and residues – Cauchy's Residue theorem – Application of residue theorem for evaluation of real integrals (Circular contour and semi-circular contour only).

UNIT IV LAPLACE TRANSFORMS 12

Definition - Existence conditions – Transforms of elementary functions – Transforms of unit step function and unit impulse function – Properties with proof – Initial and final value theorems – Transform of periodic functions – Convolution theorem with proof – Problems.

UNIT V INVERSE LAPLACE TRANSFORMS 12

Definition - Evaluation of Inverse Laplace transforms by using properties, partial fractions, residues and convolution theorem - Applications to solution of linear second order ordinary differential equations with constant coefficients.

TOTAL: 60 PERIODS

COURSE OUTCOMES:

At the end of the course, students will be able:

- To understand concepts of vector calculus and evaluate line and surface integrals
- To understand analyticity of complex valued functions, bilinear transformation and conformal mappings
- To evaluate complex integrals using Cauchy's integral and Cauchy's residue theorems
- To find Laplace transforms of functions using definition and properties
- To apply Laplace transform method in solving differential equations

TEXT BOOKS:

1. Grewal B.S., "Higher Engineering Mathematics", Khanna Publishers, New Delhi, 43rd Edition, 2014.
2. Kreyszig Erwin, "Advanced Engineering Mathematics ", John Wiley and Sons, 10th Edition, New Delhi, 2016.
3. P.Anuradha and V.Sudhakar, "Vector Calculus and Complex Analysis", Scitech Publications, 1st Edition, Chennai, 2019.

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1. Bali N., Goyal M. and Watkins C., "Advanced Engineering Mathematics", Firewall Media (An imprint of Lakshmi Publications Pvt., Ltd.,), New Delhi, 7th Edition, 2009.
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 Learning Pvt. Ltd, 4th Edition, New Delhi, 2014.
5. Wylie, R.C. and Barrett, L.C., "Advanced Engineering Mathematics" Tata McGraw Hill Education Pvt. Ltd, 6th Edition, New Delhi, 2012.

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2. https://nptel.ac.in/courses/111/106/111106141/
3. https://nptel.ac.in/courses/111/107/111107056/
4. https://nptel.ac.in/courses/111/106/111106139/

CO - PO MAPPING

CO\PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	2	2	-	-	-	-	2	-	-	2
CO2	3	3	2	2	-	-	-	-	2	-	-	2
CO3	3	3	2	2	-	-	-	-	2	-	-	2
CO4	3	3	2	2	-	-	-	-	2	-	-	2
CO5	3	3	2	2	-	-	-	-	2	-	-	2
AVG	3	3	2	2	-	-	-	-	2	-	-	2

JBE1223	APPLIED SCIENCE FOR ELECTRONICS AND INFORMATION ENGINEERING	L	T	P	C
		2	0	2	3

COURSE OBJECTIVES:

- To understand the essential principles of semiconductor device and Electron transport properties.
- To understand the essential principles of magnetic properties of materials.
- To understand the essential principles of optical properties of materials.
- To compare the basic concepts of hybridization with chemical bonding.
- To understand about the principles in various analytical techniques.

UNIT I SEMICONDUCTING MATERIAL 7

Intrinsic semiconductor – Carrier concentration – Fermi level – Variation of Fermi level with temperature – Electrical conductivity – Band gap determination – Compound semiconductors -Direct and Indirect band gap- Carrier concentration in N-type and P-type semiconductor – Variation of Fermi level with temperature and Impurity concentration.

UNIT II MAGNETIC AND SUPERCONDUCTING MATERIALS 7

Origin of magnetic moment – Bohr magneton – comparison of Dia, Para and Ferro magnetism – Domain theory – Hysteresis – Soft and Hard magnetic materials – Antiferromagnetic materials – Ferrites and its applications - Superconductivity: properties – Type I and Type II superconductors – BCS theory of superconductivity (Qualitative) – High Tc superconductors.

UNIT III OPTICAL PROPERTIES OF MATERIALS 7

Classification of Optical materials - metals, insulators and semiconductors) – Carrier generation and Recombination processes - Absorption emission and Scattering of light (concepts only) - Photo current in a P-N diode – Solar cell - LED – Organic LED.

UNIT IV CHEMICAL BONDING AND CONDUCTIVITY IN SOLIDS 10

Band theory – Salient feature-Application of band theory **(c**onductor, semiconductor, insulator)- Semiconductor- Types (intrinsic and extrinsic) - Band energy levels for pure silicon crystal, band model of n-type and p-type semiconductance of silicon. Types -Nonelemental semiconductor, Defect semiconductor, Chalcogen semiconductor (definition, properties). Preparation of Germanium-Fractional distillation and crystal growth methods. Fullerenes-preparation, properties and applications. Conducting polymer-Types-mechanism of conduction (polyacetylene) -polyaniline - properties, applications.

UNIT V INSTRUMENTAL METHODS OF ANALYSIS 9

Thermal analysis techniques- Thermo gravimetric analysis and Differential thermal analysis- Principle, instrumentation and applications - Concept of chromatography – Principle, instrumentation and applications of Paper chromatography, Column chromatography, Thin layer chromatography and Gas chromatography. Principle and applications of Conductometric titrations, Potentiometric titrations and pH-metry.

PHYSICS LABORATORY

LIST OF EXPERIMENTS: (ANY 5)

1. Determination of dispersive power of the given solid prism using spectrometer
2. Determination of thickness of the given thin material by forming interference fringes using air-wedge setup
3. Analysis of I-V Characterization of Solar cell
4. Determination of energy gap of the given semiconductor by plotting the graph between current and temperature
5. Determination of acceptance angle of the given fiber cable.
6. Determination of Young's modulus for the given uniform bar by non uniform bending method

CHEMISTRY LABORATORY

LIST OF EXPERIMENTS: (ANY 5)

1. Determination of strength of hydrochloric acid using pH meter.
2. Determination of strength of acids in a mixture of acids using conductivity meter.
3. Conductometric titration of strong acid vs strong base.
4. Estimation of iron content using potentiometer.
5. Estimation of iron content of the water sample using spectrophotometer (thiocyanate method).
6. Estimation of sodium and potassium present in water using flame photometer.
7. Determination of SAP and FAV values of an oil.
8. Estimation of acetic acetic acid adsorbed on charcoal

TOTAL: 60 PERIODS

COURSE OUTCOMES:

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

- Acquire knowledge on basics of conductivity of solids, semiconductor physics and its applications in various devices,
- Get knowledge on magnetic properties of materials and their applications in data storage

- Have the necessary understanding on the functioning of optical materials for optoelectronics
- Acquainted with hands-on knowledge in the quantitative chemical analysis through instrumental analysis
- Acquire practical knowledge on interference pattern, semiconductor devices, solar cells and instrumental analysis of acids, bases and heavy metals.

TEXT BOOKS:

1. Kasap, S.O.- Principles of Electronic Materials and Devices, McGraw, Education, 2007.
2. Jasprit Singh, Semiconductor Devices: Basic Principles, Wiley 2012.
3. Kittel, C. Introduction to Solid State Physics. Wiley, 2005.
4. Umesh K Mishra &Jasprit Singh, "Semiconductor Device Physics and Design", Springer, 2008.
5. Jain P.C. and Monica Jain, "Engineering Chemistry", Dhanpat Rai Publishing Company (P) Ltd., New Delhi, 2010.

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1. Garcia, N. & Damask, A. "Physics for Computer Science Students". Springer-Verlag, 2012
2. Wahab, M.A. "Solid State Physics: Structure and Properties of Materials". Narosa Publishing House, 2009.
3. K.SeshaMaheswaramma, MridulaChugh, Engineering chemistry, Pearson, 2016.
4. O.G.Palanna, Engineering Chemistry, Mc Graw Hill, 2017.
5. Gurdeep R.Chatwal, Sham K. Anand, Instrumental methods of chemical analysis, Himalaya Publishing House, 2007.
6. Practical Fiber Optics, D. Bailey and E. Wright, 2003.
7. J.Mendham, RC Denney, JD Barnes, MJK Thomas, Text book of quantitative chemical analysis, Vogel's, 2008.
8. Quantitative and qualitative analysis, U.Alexeyer, MIR publication, Moscow (1979).
9. Analytical Chemistry, Gary D.Christian, Wiley, 2005.

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2. https://www.youtube.com/watch?v=6QUFuZpCgGw
3. http://tiny.cc/0vhjuz
4. https://nptel.ac.in/content/storage2/courses/103108100/module7/module7.pdf
5. https://nptel.ac.in/courses/108/108/108108122/

CO - PO MAPPINGS

CO\PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	1	1	-	-	1	-	-	1	-	1	-
CO2	2	1	1	-	-	1	-	-	1	-	1	-
CO3	2	1	1	-	-	1	-	-	1	-	1	-
CO4	2	1	1	-	-	1	-	-	1	-	1	-
CO5	2	1	1	-	-	1	-	-	1	-	1	-
AVG	2	1	1	-	-	1	-	-	1	-	1	-

JGE1201	PYTHON PROGRAMMING	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To provide an introduction to Python Programming Language.
- To understand the decision making and looping concepts.
- To understand functions, strings and list in Python.
- To understand tuples, dictionaries and files.
- To know the exception handling and 2D concepts.

UNIT I INTRODUCTION TO PYTHON 9

History of Python, Features, Installing Python, Running Python Program, Interactive mode programming, Script Mode Programming, Identifiers, Reserved Words, Indentation, Comments, Variables, Data Types, Data Type Conversion.

UNIT II DECISION MAKING AND LOOPING 9

Python Operators, Operator Precedence, Decision Making: if Statement, if else Statement, if elif else Statement, nested if Statement, Loops: while loop, for loop, nested loops; Loop Control Statements: continue Statement, break Statement, pass Statement: Iterator and Generator

UNIT III FUNCTIONS, STRING, LIST 9

Functions: Pre defined Functions, User defined Functions, Recursion, Lambda Function; String: Functions, methods, modules; Lists: Operations, pre-defined functions, advanced list processing; Packages.

UNIT IV TUPLES, DICTIONARY, FILES 9

Tuples: Tuple Operations and methods, Dictionary: Dictionary Operations and methods; Files: Text Files, Reading and writing Files; Format Operator, Command line argument.

UNIT V EXCEPTION HANDLING AND GRAPHICS 9

Date & Time Methods, Exception handling clauses, Raising an Exception, User Defined Exception; Simple graphics and image processing, simple 2d drawing - colors and shapes.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of the course, the student will be able

- To understand the evolution of Python and run basic python programs.
- To structure simple python programs for solving programs.
- To Decompose larger programs into functions.
- To Understand compound structures like list, tuple, dictionary.
- To Learn basic 2d graphics concepts in Python.

TEXT BOOKS:

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

REFERENCES:

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

WEBSITE REFERENCES:

1. https://www.w3schools.com/python/python_reference.asp
2. https://www.pythonforbeginners.com/basics/python-websites-tutorials
3. https://www.programiz.com/python-programming/methods/built-in/list
4. https://www.geeksforgeeks.org/python-convert-dictionary-to-list-of-tuples/
5. https://www.javatpoint.com/python-exception-handling

CO-PO MAPPINGS

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	3	-	-	-	-	-	-	-	-	-
CO2	3	3	3	-	-	-	-	-	-	-	-	-
CO3	3	3	3	-	-	-	-	-	-	-	-	-
CO4	3	3	3	-	-	-	-	-	-	-	-	-
CO5	3	3	3	-	-	-	-	-	-	-	-	-
AVG	3	3	3	-	-	-	-	-	-	-	-	-

JGE1203	ELECTRIC CIRCUITS AND ELECTRONIC DEVICES	L	T	P	C
		2	2	0	3

COURSE OBJECTIVES:

- To Impart knowledge in basic circuits, circuit reduction techniques and analysis
- To explain the passive component characteristics for the ac and dc source of power in electric circuits
- To acquaint the students with the in-depth knowledge of characteristics of electronic devices.
- To introduce the advantages and characteristics of FET, MOSFET and different modes.
- To understand the special electronic devices such as UJT, Tunnel diode and power devices such as SCR, TRIAC etc.

UNIT I BASIC CIRCUIT ANALYSIS 12

Passive and Active elements, Source transformation rules, Star-Delta conversion, Kirchhoff's laws, Mesh Analysis and Nodal Analysis, Introduction to coupled circuits, Resonance circuits.

UNIT II NETWORK THEOREMS & TRANSIENTS 12

Network Theorems for AC and DC circuits: Superposition Theorem, Thevenins and Norton Theorems –Maximum power transfer theorem – Reciprocity Theorem – Millman's theorem. Transient Analysis - Series and parallel RL, RC and RLC Circuits.

UNIT III PN JUNCTION DIODE AND BJT 12

PN junction diode-V-I Characteristics, Current equations, Diffusion and drift current densities, Transition and Diffusion Capacitances, Varactor diode, Switching Characteristics, Breakdown diodes, Applications. Bipolar Junction transistors- input and Output Characteristics, h-parameter model. CB, CE, CC configurations, Ebers-Moll Model.

UNIT IV FIELD EFFECT TRANSISTORS 12

Classifications of FET, JFETs – Drain and Transfer characteristics -Current equations -Pinch off voltage and its significance- MOSFET- Characteristics- Threshold voltage -Channel length modulation, Modes of MOSFET- V-I Characteristics and transfer characteristics.

UNIT V SPECIAL SEMICONDUCTOR DEVICES & POWER DEVICES 12

Schottky barrier diode- Tunnel diode- Gallium Arsenide device, LASER diode, LDR. UJT, SCR, Diac, Triac, IGBT, MCT, LED, LCD, Photo transistor, Opto Coupler, Photo Voltaic Cells, CCD.

TOTAL: 60 PERIODS

COURSE OUTCOMES:

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

- Analyze DC and AC circuits using mesh and nodal analysis.
- Apply circuit theorems to electronic circuits to obtain various parameters
- Explain the characteristics of semiconductor devices do small projects
- Explain the characteristics of special semiconductor devices and applications
- Understand the characteristics of various electronic components and power devices

TEXT BOOKS:

1. Jacob Millman, Christos C. Halkias and SatyabrataJit, Millmans Electronic Devices and Circuits, Fourth edition, McGraw Hill, 2015
2. William H. Hayt, Jack Kemmerly and Steven M. Durbin, Engineering Circuit Analysis, McGraw Hill, 2013.

REFERENCES:

1. Salivahanan. S and Suresh Kumar S. N, ―Electronic Devices and circuit, Fourth Edition, Tata McGraw- Hill, 2016.
2. R. S. Sedha, A Textbook of Electronic Devices and Circuits, Second Edition, S. Chand Publishing, 2008.
3. Sudhakar A and Shyam Mohan SP, “Circuits and Network Analysis and Synthesis”,McGraw Hill, 2015.

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3. https://nptel.ac.in/courses/117/103/117103063/
4. https://nptel.ac.in/courses/117/107/117107095/
5. https://digimat.in/nptel/courses/video/108108122/L01.html

CO - PO MAPPING

CO\PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	3	3	1	2	-	-	-	-	3	3
CO2	3	3	2	3	2	2	-	-	-	-	3	3
CO3	3	3	3	3	2	1	-	-	-	-	3	3
CO4	3	3	2	3	2	2	-	-	-	-	2	3
CO5	3	3	3	3	2	2	-	-	-	-	3	3
AVG	3	3	3	3	2	2	-	-	-	-	3	3

JGE1202	ENGINEERING GRAPHICS & DESIGN (Common to all B.E /B.Tech Programmes)	L	T	P	C
		1	0	4	3

COURSE OBJECTIVES:

- To understand the importance of graphics in engineering
- To develop skills in preparation of basic drawing
- To improve their technical communication skill in the form of communicative drawing
- To impart knowledge about standard principle of orthographic projection of objects.
- To improve their visualization skills for developing new products.

UNIT I PLANE CURVES AND ORTHOGRAPHIC PROJECTION 15

Conics – Construction of ellipse, Parabola and hyperbola by eccentricity method – Construction of cycloid – construction of involutes of squad and circle – Drawing of tangents and normal to the above curves. Free hand sketching: Representation of Three Dimensional objects – General principles of orthographic projection – Need for importance of multiple views and their placement – First angle projection – layout views – Developing visualization skills through free hand sketching of multiple views from pictorial views of objects.

UNIT II PROJECTION OF POINTS, LINES AND PLANE SURFACES 15

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

UNIT III PROJECTION OF SOLIDS 15

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

UNIT IV SECTION OF SOLIDS AND DEVELOPMENT OF SURFACES 15

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

UNIT V ISOMETRIC AND PRESPECTIVE PROJECTIONS 15

Principles of isometric projection – isometric scale – isometric projections of simple solids, truncated prisms, pyramids, cylinders and cones. Perspective projection of prisms, pyramids and cylinders by visual ray method

TOTAL: 75 PERIODS

COURSE OUTCOMES:

On successful completion of this course, the students will be able to

- Familiarize with the fundamental and standards of engineering graphics.
- Perform free hand sketching of basic geometrical constructions and multiple views of object.
- Project orthographic projections of lines and plane surfaces.
- Draw projection of solids and development of surfaces.
- Interpret isometric and perspective view of objects.

TEXT BOOKS:

1. Natrajan K.V., "A text book of Engineering Graphics", Dhanalakshmi Publishers, Chennai, 2009.
2. Venugopal K and Prabhu Raja V., "Engineering Graphics", New Age International (P) Limited,2008.
3. Bhatt N.D. and Panchal V.M., "Engineering Drawing", Charotar Publishing House, 50th Edition, 2010.

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1. Basant Agarwal and Agarwal C.M., "Engineering Drawing", Tata McGraw Hill Publishing Company Limited, New Delhi, 2008.
2. Gopalakrishna K.R., "Engineering Drawing" (Vol. I & II combined), Subhas Stores, Bangalore,2007.
3. Luzzader, Warren.J and Duff,John M., "Fundamentals of Engineering Drawing with an introduction to Interactive Computer Graphics for Design and Production", Eastern Economy Edition, Prentice Hall of India Pvt. Ltd, New Delhi, 2005.
4. N S Parthasarathy and Vela Murali, "Engineering Graphics", Oxford University, Press, New Delhi, 2015.
5. Shah M.B and Rana B.C., "Engineering Drawing", Pearson, 2nd Edition, 2009.

Publication of Bureau of Indian Standards:

1. IS 10711 - 2001: Technical products Documentation - Size and lay out of drawing sheets.
2. IS 9609 (Parts 0 & 1) - 2001: Technical products Documentation - Lettering.
3. IS 10714 (Part 20) - 2001 & SP 46 - 2003: Lines for technical drawings.
4. IS 11669 - 1986 & SP 46 - 2003: Dimensioning of Technical Drawings.
5. IS 15021 (Parts 1 to 4) - 2001: Technical drawings - Projection Methods.

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2. https://freevideolectures.com
3. https://nptel.ac.in/courses
4. https://nptel.ac.in/courses/105/104/105104148/
5. https://nptel.ac.in/courses/112/103/112103019/

CO-PO MAPPING

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	1	1	-	1	1	-	1	1	1	1	1
CO2	1	1	1	1	1	1	1	-	1	1	1	-
CO3	1	-	1	1	1	-	1	1	1	1	1	1
CO4	-	1	1	1	-	1	1	1	1	1	1	1
CO5	1	1	1	-	1	1	1	1	1	1	-	1
AVG	1	1	1	1	1	1	1	1	1	1	1	1

JNC1261	ENVIRONMENTAL SCIENCE	L	T	P	C
		3	0	0	0

COURSE OBJECTIVES:

- To study the interrelationship between living organism and environment.
- To finding and implementing scientific, technological to environmental problems due to pollution.
- To study about various natural resources and the individual responsibility to conserve it.
- To study on the social issues over environment.
- To get knowledge on population explosion, human rights and value education.

UNIT I ENVIRONMENT, ECOSYSTEMS AND BIODIVERSITY 9

Definition, scope and importance of environment – need for public awareness - concept of an ecosystem – structure and function of an ecosystem – energy flow in the ecosystem – ecological succession – food chains, food webs and ecological pyramids. Introduction, types, characteristic features, structure and function of the (a) forest ecosystem (b) aquatic ecosystems (ponds, streams, lakes, rivers, oceans, estuaries) – Introduction to biodiversity definition: genetic, species and ecosystem diversity – value of biodiversity- threats to biodiversity– conservation of biodiversity: In-situ and ex-situ conservation of biodiversity.

UNIT II ENVIRONMENTAL POLLUTION 9

Definition – causes, effects and control measures of: (a) Air pollution (b) Water pollution (c) Soil pollution (d) Marine pollution (e) Noise pollution (f) Thermal pollution (g) Nuclear hazards – solid waste management: causes, effects and control measures of municipal solid wastes – role of an individual in prevention of pollution.

UNIT III NATURAL RESOURCES 9

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- effects of modern agriculture, fertilizer-pesticide problems, water logging, salinity. Energy resources: renewable and non renewable energy sources, Land resources: Land as a resource, land degradation, man induced landslides, soil erosion and desertification – role of an individual in conservation of natural resources.

UNIT IV SOCIAL ISSUES AND THE ENVIRONMENT 9

Water conservation- watershed management – resettlement and rehabilitation of policy. – consumerism and waste products – environment production act – Air (Prevention and Control of Pollution) act – Water (Prevention and control of Pollution) act – Wildlife protection act – Forest conservation act – enforcement machinery involved in environmental legislation- central and state pollution control boards- Public awareness.

UNIT V HUMAN POPULATION AND THE ENVIRONMENT 9

Human 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.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

- Explain about ecosystem, their structure and function to conserve biodiversity.
- Recognize the level of environmental pollution and their control measures.
- Explain about the various types of natural resources and role of a human being in maintaining a clean sustainable environment for the future generations.
- Identify the social problems in the environment to reduce social issues.
- Understand environment and human health – human rights – value education, and the role of information technology in environment and human health.

TEXT BOOKS:

1. Benny Joseph, Environmental Science and Engineering, Tata McGraw-Hill, New Delhi, 2006.
2. 2 Gilbert M.Masters, Introduction to Environmental Engineering and Science‘, 2nd edition, Pearson Education, 2004.

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1. Dharmendra S. Sengar, Environmental law, Prentice Hall of India PVT Ltd, New Delhi, 2007.
2. Erach Bharucha, -Textbook of Environmental Studies, Universities Press (I) PVT, LTD, Hydrabad, 2015.
3. Rajagopalan, R, Environmental Studies-From Crisis to Cure, Oxford University Press, 2005.
4. G. Tyler Miller and Scott E. Spoolman, -Environmental Science, Cengage Learning India PVT, LTD, Delhi, 2014.

WEBSITE REFERENCES:

1.https://moef.gov.in/e-books/
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5.https://nptel.ac.in/courses/109/104/109104045/

CO-PO MAPPING

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	-	-	-	-	-	3	2	-	-	1	-
CO2	1	-	-	-	-	-	3	2	-	-	1	-
CO3	1	-	-	-	-	-	3	2	-	-	1	1
CO4	1	-	-	-	-	2	3	2	-	-	1	-
CO5	1	-	-	-	-	2	3	2	-	-	1	-
AVG	1	-	-	-	-	2	3	2	-	-	1	1

JGE1211	PYTHON PROGRAMMING LABORATORY	L	T	P	C
		0	0	4	2

COURSE OBJECTIVES:

- To write, test, and debug simple Python programs.
- To implement Python programs with conditionals and loops.
- Use functions for structuring Python programs.
- Represent compound data using Python lists, tuples, dictionaries.
- To implement basic 2D diagrams.

LIST OF PROGRAMS:

1. Compute the GCD of two numbers.
2. Find the square root of a number (Newton‘s method)
3. Exponentiation (power of a number)
4. Find the maximum of a list of numbers
5. Guess an integer number in a rang
6. Insert a card in a list of sorted cards.
7. Multiply matrices
8. Programs that take command line arguments (word count)
9. Find the most frequent words in a text read from a file
10. Create an User defined Exception
11. Draw a 2D circle and square

TOTAL: 60 PERIODS

PLATFORM NEEDED

Python 3 interpreter for Windows/Linux

COURSE OUTCOMES:

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

- Write, test, and debug simple Python programs.
- Implement Python programs with conditionals and loops.
- Develop Python programs step-wise by defining functions and calling them.
- Use Python lists, tuples, dictionaries for representing compound data.
- Draw 2D graphic diagrams in Python.

WEBSITE REFERENCE:

1. https://www.programiz.com/python-programming/examples
2. https://www.javatpoint.com/python-condition-and-loops-programs
3. https://realpython.com/python-lists-tuples/
4. https://www.tutorialsteacher.com/python/python-user-defined-function
5. https://www.cdslab.org/python/notes/visualization/2d/2d.html

CO-PO MAPPING

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	3	-	3	-	-	3	3	3	-	3
CO2	3	3	3	-	3	-	-	3	3	3	-	3
CO3	3	3	3	-	3	-	-	3	3	3	-	3
CO4	3	3	3	-	3	-	-	3	3	3	-	3
CO5	3	3	3	-	3	-	-	3	3	3	-	3
AVG	3	3	3	-	3	-	-	3	3	3	-	3

JGE1213	ELECTRIC CIRCUITS AND ELECTRONIC DEVICES LABORATORY	L	T	P	C
		0	0	4	2

COURSE OBJECTIVES:

- To understand the working of RL,RC and RLC circuits
- To gain hand on experience in Thevenin & Norton theorem, KVL & KCL, and Super Position Theorems
- To learn the characteristics of basic electronic devices such as Diode, BJT,FET, SCR

LIST OF EXPERIMENTS

1. Verification of KVL &KCL
2. Verification of Thevenin & Norton theorems
3. Verification of Super Position Theorem
4. Verification of maximum power transfer & reciprocity theorems
5. Determination Of resonant frequency of series & parallel RLC Circuits
6. Study of Transient analysis of RL and RC circuits
7. Study of characteristics of PN Junction Diode and its application: clipper, clamper and Full Wave Rectifier
8. Study of characteristics of Zener diode and its application as voltage regulator
9. Study of input-output characteristics of BJT in Common Emitter Common Base Configuration
10. Study of Characteristics of FET
11. Study of Characteristics of UJT
12. Study of Characteristics of SCR

TOTAL: 60 PERIODS

COURSE OUTCOMES:

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

- Verify KVL & KCL, Thevenin & Norton theorem and superposition theorems
- Understand the behaviour of RL, RC and RLC circuits
- Understand the characteristics of basic electronic devices

LABORATORY REQUIREMENTS:

1. BC 107, BC 148,2N2646, BFW10 - 25 each
2. 1N4007, Zener diodes - 25 each
3. Resistors, Capacitors, Inductors - sufficient quantities
4. Bread Boards - 15 Nos
5. CRO (30MHz) – 10 Nos.
6. Function Generators (3MHz) – 10 Nos.
7. Dual Regulated Power Supplies (0 – 30V) – 10 Nos.

WEBSITE REFERENCES:

1. https://nptel.ac.in/courses
2. www.electronicsforyou.com

CO - PO MAPPING

CO\PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	3	3	1	2	-	-	-	-	2	3
CO2	3	3	2	3	1	2	-	-	-	-	2	3
CO3	3	3	3	3	3	1	-	-	-	-	1	3
CO4	3	3	3	3	1	1	-	-	-	-	2	3
CO5	3	3	3	3	3	1	-	-	-	-	3	3
AVG	3	3	3	3	2	2	-	-	-	-	2	3

SEMESTER III

JMA1301	TRANSFORMS AND LINEAR ALGEBRA	L	T	P	C
		2	2	0	3

COURSE OBJECTIVES:

- To equip students with the knowledge of Fourier transforms which is used in signals and systems.
- To enable students to understand Z transforms and its applications in solving Difference equations.
- To familiarize students in the concepts of vector spaces, bases and dimension.
- To help understand concepts of linear transformation, Eigen values, Eigen vectors and Diagonalizability.
- To introduce inner product spaces, orthogonalization and least square approximations.

UNIT I FOURIER TRANSFORMS 12

Statement of Fourier integral theorem – Complex form of the Fourier integral - Fourier transform pair – Fourier sine and cosine transforms – Properties – Transforms of simple functions – Convolution theorem – Parseval's identity.

UNIT II Z - TRANSFORMS AND DIFFERENCE EQUATIONS 12

Z-transforms - Elementary properties – Inverse Z-transform (using partial fraction and residues) – Initial and final value theorems - Convolution theorem - Formation of difference equations – Solution of difference equations using Z - transform.

UNIT III VECTOR SPACES 12

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

UNIT IV LINEAR TRANSFORMATION AND DIAGONALIZATION 12

Linear transformation - Properties - Kernel and Image - One - to - One and Onto transformations - Dimension theorem - Matrix representation of a linear transformations - Eigenvalues and eigenvectors - Diagonalizability.

UNIT V INNER PRODUCT SPACES 12

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

TOTAL: 60 PERIODS

COURSE OUTCOMES:

At the end of the course, students will be able:

- To understand problems solving in Fourier transforms and Fourier integral representations.
- To use Z transforms as a tool for solving difference equations.
- To apply fundamentals concepts of advanced algebra in modern mathematics.
- To demonstrate efficient use of matrix representations and eigen value problems in linear transformations.
- To solve problems using orthogonalization process and use least square approximations in engineering applications.

TEXT BOOKS:

1. Grewal B.S., "Higher Engineering Mathematics", 43rd Edition, Khanna Publishers, New Delhi, 2014.
2. Kreyszig Erwin, "Advanced Engineering Mathematics", 10th Edition, John Wiley and Sons, New Delhi, 2016.
3. Friedberg, A.H., Insel, A.J. and Spence, L., "Linear Algebra, Prentice Hall of India", New Delhi, 2004.

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1. Burden, R.L. and Faires, J.D, "Numerical Analysis", 9th Edition, Cengage Learning, 2016.
2. James, G., "Advanced Modern Engineering Mathematics", Pearson Education, 2007.
3. Kolman, B. Hill, D.R., "Introductory Linear Algebra", Pearson Education, New Delhi, First Reprint, 2009.
4. Kumaresan, S., "Linear Algebra – A Geometric Approach", Prentice – Hall of India, New Delhi, Reprint, 2010.

5. Lay, D.C., “Linear Algebra and its Applications”, 5th Edition, Pearson Education, 2015.
6. O‘Neil, P.V., “Advanced Engineering Mathematics”, Cengage Learning, 2007.
7. Strang, G., “Linear Algebra and its applications”, Thomson (Brooks/Cole), New Delhi, 2005.
8. Sundarapandian, V. “Numerical Linear Algebra”, Prentice Hall of India, New Delhi, 2008.

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2. https://nptel.ac.in/courses/111/102/111102129/
3. https://nptel.ac.in/courses/108/104/108104174/
4. https://nptel.ac.in/courses/111/104/111104137/
5. https://nptel.ac.in/courses/111/106/111106135/

CO - PO MAPPINGS

CO\PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	2	2	-	-	-	-	2	-	-	2
CO2	3	3	2	2	-	-	-	-	2	-	-	2
CO3	3	3	2	2	-	-	-	-	2	-	-	2
CO4	3	3	2	2	-	-	-	-	2	-	-	2
CO5	3	3	2	2	-	-	-	-	2	-	-	2
AVG	3	3	2	2	-	-	-	-	2	-	-	2

JEC1302	ELECTRONIC CIRCUITS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To design and analyze the regulated DC power supplies & DC Converters.
- To understand the methods of biasing transistors.
- To study about feedback amplifiers and oscillator principles.
- To study about Power amplifiers.
- To understand the analysis and design of multi vibrators and wave shaping circuits.

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UNIT I POWER SUPPLIES & DC CONVERTERS 9

Review of PN Junction diode and Zener diode - Linear mode power supply - Rectifiers –Half Wave Rectifier, Full Wave Rectifier - Filters –C, L, LC, Π Filters - Voltage regulators – shunt, series- Switched mode power supply (SMPS) - DC/DC convertors – Buck, Boost, Buck-Boost analysis and design- Inverters-Single Phase, Three Phase.

UNIT II BIASING OF BJT& FET AMPLIFIERS 10

Review of BJT–Biasing and stabilization - DC Load Line and Bias Point - Various biasing methods of BJT-fixed, voltage divider, collector to base bias - Stability factors –Hybrid π equivalent circuit-Cascade, Cascode configurations - Differential amplifier - JFET-Source follower, Common gate amplifier.

UNIT III FEEDBACK AMPLIFIERS & OSCILLATORS 11

Feedback Concepts – gain with feedback – Effect of feedback on gain stability, distortion, bandwidth, input and output impedances; topologies of feedback: current series, current shunt, voltage series, voltage shunt - Barkhausen criterion for oscillation – RC phase shift, Wien bridge - Hartley & Colpitt's oscillators – crystal oscillators- Frequency stability of oscillators

UNIT IV POWER AMPLIFIERS 7

Power amplifiers- Class A, Transformer coupled class A, Class B-Class AB amplifier, Class C and Class D amplifiers, Amplifier distortion

UNIT V MULTIVIBRATOR & WAVE SHAPING CIRCUITS 8

Multivibrators–Astable, Monostable, Bistable Multivibrators - Schmitt Trigger- UJT Oscillator - RC integrator and differentiator circuits – diode clampers and clippers.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of the course, the students will be able:

- To design power amplifier and DC convertors.
- To apply knowledge of working principles, characteristics and applications of BJT and FET.
- To analyze the performance of feedback amplifiers and power amplifiers.
- To design and analyze oscillator circuits.
- To design wave shaping circuits and multivibrators.

TEXT BOOKS:

1. Salivahanan and N. Suresh Kumar, "Electronic Devices and Circuits", 4th Edition, McGraw Hill Education (India) Private Ltd., 2017.

REFERENCES:

1. R.S. Sedha, "A Textbook of Electronic Devices and Circuits", 2nd edition, S. Chand Publishing, 2008.
2. Donald. A. Neamen, "Electronic Circuits Analysis and Design", 3rd Edition, McGraw Hill Education (India) Private Ltd., 2010.
3. Robert L. Boylestad and Louis Nasheresky, "Electronic Devices and Circuit Theory", 11th Edition, Pearson Education, 2013.
4. Sedra and Smith, "Micro Electronic Circuits", Sixth Edition, Oxford University Press, 2011.

WEBSITE REFERENCES:

1. https://www.youtube.com/watch?v=bZLxYCwkvGQ, Power supply- Prof. B. G. Fernandes, IIT Bombay.
2. https://www.youtube.com/watch?v=mE8bO7fKe5U, BJT Biasing - Prof.T.S.Natarajan, IIT Madras
3. https://www.youtube.com/watch?v=_o8GXGLkBow, Feedback Amplifier and Oscillator- Prof. Joseph John, IIT Bombay
4. https://www.youtube.com/watch?v=nxoUuR7EAdA, Power Amplifier - Prof. Joseph John, IIT Bombay
5. https://www.youtube.com/watch?v=-NzNSAl8cRw,Multivibarator- Prof. T.S. Natarajan from IIT Madras

CO - PO MAPPINGS

CO\PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	2	2	1	2	2	-	-	-	1	3
CO2	3	3	2	2	1	2	1	-	-	-	2	3
CO3	3	2	2	2	1	2	2	-	-	-	2	3
CO4	3	2	2	2	1	2	1	-	-	-	2	2
CO5	3	2	2	2	2	3	2	-	-	-	2	2
AVG	3	2	2	2	1	2	2	-	-	-	2	3

CO -PSO MAPPING

CO\PSO	PSO1	PSO2	PSO3
CO1	3	2	2
CO2	3	2	2
CO3	3	2	2
CO4	3	2	2
CO5	3	2	2
AVG	3	2	2

JEC1303	DIGITAL ELECTRONICS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To acquire knowledge on number systems and Boolean algebra.
- To implement Combinational logic circuits
- To design Synchronous Sequential digital circuits
- To design Asynchronous Sequential digital circuits
- To realize combinational circuits using PLDs

UNIT I NUMBER SYSTEMS AND LOGIC REDUCTION 9

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

UNIT II COMBINATIONAL LOGIC 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, Parity Encoder. Introduction to HDL.

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 – Design of Counters- Ripple Counters, Ring Counters, Shift registers, Universal Shift Register-Design of sequential circuit using HDL.

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- Design using HDL

UNIT V MEMORY DEVICES AND DIGITAL INTEGRATED CIRCUITS 9

Basic memory structure – ROM -PROM – EPROM – EEPROM –EAPROM, RAM – Static and dynamic RAM -Programmable Logic Devices – Programmable Logic Array (PLA) - Programmable Array Logic (PAL) – Field Programmable Gate Arrays (FPGA) - Implementation of combinational logic circuits using PLA, PAL.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of the course, the students will be able:

- To apply knowledge on number systems and Boolean algebra
- To implement Combinational logic circuits
- To design Synchronous Sequential logic circuits
- To design Asynchronous digital circuits
- To apply knowledge on HDL programming

TEXT BOOKS:

1. M. Morris Mano and Michael D. Ciletti, “Digital Design”, 5th Edition, Pearson, 2014.
2. S.Salivahanan and S.Arivazhagan “Digital Electronics”, Ist Edition, Vikas Publishing House Pvt Ltd, 2012.

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. R. Ananda Natarajan, “Digital Design”, PHI Learning.
4. John. F. Wakerly, “Digital Design Principles and Practices”, 3rd Edition, Prentice Hall

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2. https://www.youtube.com/watch?v=mMKSKpF103A - Prof.D.Roychoudhury, Department of Computer Science and Engineering,IIT Kharagpur
3. https://www.youtube.com/watch?v=MiuMYEn3dpg - Prof. S. Srinivasan,Department of Electrical Engineering,IIT Madras
4. https://www.youtube.com/watch?v=QfIoAPio8oE – (Part-I, Part-II) – Prof IndranilSengupta Department of Computer Science and Engineering,IIT Kharagpur.

5. https://www.youtube.com/watch?v=PkFX7NjgEdA - Prof. S. Srinivasan,Department of Electrical Engineering,IIT Madras
6. www.nptel.ac.in
7. www.brainkart.com

CO - PO MAPPINGS

CO\PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	1	2	2	1	-	-	-	-	2	2
CO2	3	3	1	2	3	1	-	-	-	-	2	2
CO3	3	3	1	2	2	1	-	-	-	-	2	2
CO4	3	3	1	2	2	1	-	-	-	-	2	2
CO5	3	3	1	2	2	1	-	-	-	-	2	2
AVG	3	3	1	2	2	1	0	0	0	0	2	2

CO -PSO MAPPING

CO\PSO	PSO1	PSO2	PSO3
CO1	3	2	2
CO2	3	2	2
CO3	3	2	2
CO4	3	2	2
CO5	3	2	2
AVG	3	2	2

JEC1304	SIGNALS AND SYSTEMS	L	T	P	C
		2	2	0	3

COURSE OBJECTIVES:

- To understand the basic properties and classification of signals and systems.
- To analyze continuous time signals using Fourier and Laplace domain
- To analyze continuous time linear time invariant system in the Fourier and Laplace domain
- To analyze discrete time signals using Discrete time Fourier and Z transform domain
- To analyze discrete time linear time invariant system in Z domain.

UNIT I CLASSIFICATION OF SIGNALS AND SYSTEMS 12

Standard signals-Step, Ramp, Pulse, Impulse, Real and complex exponentials and Sinusoids-Classification of signals-operation on 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 CONTINOUS TIME SIGNALS 12

Fourier series of Periodic signals -Trigonometric, Cosine representation and exponential, Symmetry conditions-Fourier Transform and its properties -Laplace Transforms and its properties.

UNIT III LINEAR TIME INVARIANT CONTINUOUS TIME SYSTEMS 12

Impulse response - convolution integrals-Differential equation- Fourier and Laplace Transforms in Analysis CT - LTI systems- CT Systems connected in series and parallel.

UNIT IV ANALYSIS OF DISCRETE TIME SIGNALS 12

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

UNIT V LINEAR TIME INVARIANT DISCRETE TIME SYSTEMS 12

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

TOTAL: 60 PERIODS

COURSE OUTCOMES:

At the end of the course, the student will be able:

- To analyze the characteristics of signals and systems.
- To analyze and characterize CT signals using Fourier transform and Laplace transform.
- To investigate and characterize CT LTI systems using Fourier transform and Laplace transform.
- To analyze and characterize DT signals using Discrete Time Fourier transform and Z Transform.
- To investigate and characterize DT LTI systems using Discrete time Fourier transform and Z Transform

TEXT BOOKS:

1. Allan V.Oppenheim, S.Wilsky and S.H.Nawab, "Signals and Systems", 2nd Edn., Pearson, 2015.
2. P.Ramesh Babu and R.Ananda Natarajan,"Signals and Systems", 5th Edn Scitech 2017

REFERENCES:

1. H. P. Hsu, "Signals and Systems" Schaum'sOutline Series, McGraw Hill Professional, 3rd Edition, 2013.
2. A.Anandkumar,"Signals and Systems", 2nd Edn, PHI Learning 2012
3. B. P. Lathi, "Principles of Linear Systems and Signals", Second Edition, Oxford, 2009.
4. R.E.Zeimer, W.H.Tranter and R.D.Fannin, "Signals & Systems - Continuous and Discrete", Pearson, 2007.
5. John Alan Stuller, "An Introduction to Signals and Systems", Thomson, 2007.
6. Simon Haykin and Barry Van Veen "Signals and Systems",Wiley & Sons, 3rdEdition, 2012.
7. John G Proakis and Manolakis, "Digital Signal Processing Principles, Algorithms and Applications", Pearson Education, 4th Edition, 2014.

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2. https://www.youtube.com/watch?v=7Z3LE5uM-6Y&list=PLbMVogVj5nJQQZbah2uRZIRZ_9kfoqZyxProf. K.S. Venktesh, Department of Electrical Engineering, IIT Kanpur
3. https://www.academia.edu/34693866/Continuous_and_Discrete_Time_Signals and Systems
4. https://web.stanford.edu/~boyd/ee102/laplace.pdf

5. https://www.youtube.com/watch?v=WXwQ_fb7NEk- V.G.K.Murti, Department of Electrical Engineering, IIT Madras.
6. https://www.youtube.com/watch?v=IanYg7ujpo0 - Prof.S. C Dutta Roy, Department of Electrical Engineering, IIT Delhi

CO - PO MAPPINGS

CO\PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	3	2	2	1	-	-	-	-	2	2
CO2	3	3	3	2	2	1	-	-	-	-	2	2
CO3	3	3	3	2	2	1	-	-	-	-	2	2
CO4	3	3	3	2	2	1	-	-	-	-	2	2
CO5	3	3	3	2	2	1	-	-	-	-	2	2
AVG	3	3	3	2	2	1	0	0	0	0	2	2

CO -PSO MAPPING

CO\PSO	PSO1	PSO2	PSO3
CO1	2	1	1
CO2	2	1	1
CO3	3	1	1
CO4	3	2	1
CO5	3	3	3
AVG	2.6	1.6	1.4

JNC1361	ESSENCE OF INDIAN TRADITIONAL KNOWLEDGE	L	T	P	C
		2	0	0	0

COURSE OBJECTIVES:

- To facilitate the students with the concepts of Indian traditional knowledge and to make them understand the Importance of roots of knowledge system.

UNIT I INTRODUCTION TO TRADITIONAL KNOWLEDGE 6

Define traditional knowledge (TK), nature and characteristics, scope and importance, kinds of traditional knowledge, the physical and social contexts in which traditional knowledge develop, the historical impact of social change on traditional knowledge systems. Indigenous Knowledge (IK), characteristics, traditional knowledge vis-à-vis indigenous knowledge, traditional knowledge Vs western knowledge traditional knowledge vis-à-vis formal knowledge

UNIT II PROTECTION OF TRADITIONAL KNOWLEDGE 6

The need for protecting traditional knowledge Significance of TK Protection, value of TK in global economy, Role of Government to harness TK.

UNIT III LEGAL FRAME WORK AND TK 6

A: The Scheduled Tribes and Other Traditional Forest Dwellers (Recognition of Forest Rights) Act, 2006, Plant Varieties Protection and Farmer's Rights Act, 2001 (PPVFR Act);

B: The Biological Diversity Act 2002 and Rules 2004, the protection of traditional knowledge bill, 2016. Geographical indicators act 2003.

UNIT IV TRADITIONAL KNOWLEDGE AND INTELLECTUAL PROPERTY 6

Systems of traditional knowledge protection, Legal concepts for the protection of traditional knowledge, Certain non IPR mechanisms of traditional knowledge protection, Patents and traditional knowledge, Strategies to increase protection of traditional knowledge, global legal FORA for increasing protection of Indian Traditional Knowledge.

UNIT V TRADITIONAL KNOWLEDGE IN DIFFERENT SECTORS 6

Traditional knowledge and engineering, Traditional medicine system, TK and biotechnology, TK in agriculture, Traditional societies depend on it for their food and healthcare needs, Importance of conservation and sustainable development of environment, Management of biodiversity, Food security of the country and protection of TK.

TOTAL: 30 PERIODS

COURSE OUTCOMES:

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

1. To understand the concept of Traditional knowledge and its importance
2. To know the need and importance of protecting traditional knowledge.
3. To know the various enactments related to the protection of traditional knowledge.
4. To understand the concepts of Intellectual property to protect the traditional knowledge.
5. To know the applications of traditional knowledge in various fields.

REFERENCE BOOKS:

1. Amit Jha, “Traditional Knowledge System in India”, 2009.
2. Basanta Kumar Mohanta and Vipin Kumar Singh, “Traditional Knowledge System and Technology in India”, Pratibha Prakashan, 2012.
3. Amit Jha, “Traditional Knowledge System in India”, Atlantic publishers,2002
4. Kapil Kapoor, MichelDanino, “Knowledge Traditions and Practices of India”

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1. https://www.youtube.com/watch?v=LZP1StpYEPM
2. http://nptel.ac.in/courses/121106003/

CO - PO MAPPINGS

CO\PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	-	-	1	1	1	1	1	-	-	-	-	-
CO2	-	-	1	1	1	1	1	-	-	-	-	-
CO3	-	-	1	1	1	1	1	-	-	-	-	-
CO4	-	-	1	1	1	1	1	-	-	-	-	-
CO5	-	-	1	1	1	1	1	-	-	-	-	-
AVG	0	0	1	1	1	1	1	0	0	0	0	0

CO -PSO MAPPING

CO\PSO	PSO1	PSO2	PSO3
CO1	1	1	1
CO2	1	1	1
CO3	1	1	1
CO4	1	1	1
CO5	1	1	1
AVG	1	1	1

JPT1001	SOFT SKILLS AND APTITUDE I	L	T	P	C
		0	0	2	*

COURSE OBJECTIVES:

- To help students groom their personality and develop their skill of building social relationships
- To improve the personality traits of students and their creativity
- To help students gain knowledge in rational thinking and aptitude
- To make students think logically and judiciously
- To help student acquire technical skills in C programming language

UNIT I SOFT SKILLS AND APTITUDE- I 5

Self-Realization – Self Motivation – Relationship Building – Personality Enrichment – Personality Traits – Intra Personal Communication – Inter Personal Communication – Behavioral Based Perception – Attitude & Behavior – SWOT Analysis

UNIT II SOFT SKILLS AND APTITUDE –II 5

Dimensions of Personality – Self Confidence – Open Mindedness – Acceptance – Creativity - Strategies for developing creativity – Overcoming myths of creativity – Presence of Mind – Staying Focused – Self Acceptance – Self Growth

UNIT III QUANTITATIVE APTITUDE 6

Number system – Divisibility Rule – Simplification – Surds and Indices – Square root and Cube root – Averages - Percentage

UNIT IV LOGICAL REASONING 6

Number series – Alphabet series – Alphabet test – Word test – Letter Arrangement – Word Arrangement – Coding and Decoding – Analogy

UNIT V TECHNICAL APTITUDE IN C-I 8

Technical aptitude in C: Program Structure – Data types – Variables – Constants – Operators – Decision Making - Switch statement – Looping statements – Functions – Call by reference - Recursive Arrays, single dimensional, Multi-dimensional

TOTAL: 30 PERIODS

COURSE OUTCOMES:

At the end of the course, the student will be able to

- Build better relationship with all in their social settings
- Engage in creative activities focusing on their career
- Solve the real time and complex problems in aptitude
- Solve critical reasoning and real time application problems
- Apply their knowledge in the basics of C programming

TEXTBOOKS:

1. R.S Agrawal, "Quantitative Aptitude"
2. R. S. Agrawal, "Verbal Reasoning"
3. R.S. Agrawal "Non Verbal reasoning.
4. Pradip Dey, Manas Ghosh, "Fundamentals of Computing and Programming in C", First Edition, Oxford University Press, 2009.
5. Yashavant P. Kanetkar. "Let Us C", BPB Publications, 2011.

WEBSITE REFERENCES:

1. https://www.indiabix.com/aptitude/questions-and-answers/
2. https://m4maths.com/placement-puzzles.php
3. https://www.youtube.com › watch/average
4. https://www.youtube.com › watch/coding and decoding
5. https://www.youtube.com › watch/c programs
6. https://www.youtube.com › watch/self confidence
7. https://www.youtube.com › watch/motivation

CO - PO MAPPINGS

CO\PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	-	2	3	2	-	-	1	3	2	1	-	-
CO2	-	2	3	2	-	-	1	3	2	1	-	-
CO3	-	2	3	2	-	-	1	3	2	1	-	-
CO4	-	2	3	2	-	-	1	3	2	1	-	-
CO5	-	2	3	2	-	-	1	3	2	1	-	-
AVG	0	2	3	2	0	0	1	3	2	1	0	0

CO -PSO MAPPING

CO\PSO	PSO1	PSO2	PSO3
CO1	1	1	1
CO2	1	1	1
CO3	1	1	1
CO4	1	1	1
CO5	1	1	1
AVG	1	1	1

JEC1312	ELECTRONIC CIRCUITS AND SIMULATION LABORATORY	L	T	P	C
		0	0	4	2

COURSE OBJECTIVES:

- To Study the Frequency response of CE, CB, CC and CS Amplifier
- To learn about Darlington Amplifier and Differential Amplifiers
- To learn about feedback amplifiers.
- To learn the fundamental principles of oscillators.
- To learn simulation software used in circuit design.

LIST OF EXPERIMENTS:

1. Frequency Response of CE, CB, CC amplifiers.
2. Frequency Response of CS amplifiers.
3. Darlington Amplifier.
4. Differential Amplifiers - CMRR Measurement.
5. RC Integrator and Differentiator circuits.
6. Series feedback amplifiers-Frequency response.
7. Shunt feedback amplifiers-Frequency response.
8. RC Phase shift oscillator.
9. Hartley Oscillator.
10. Clippers and Clampers.

SIMULATION USING SPICE:

1. Analysis of Frequency Response of BJT.
2. Analysis of Frequency Response of FET.
3. Bistable Multivibrator.
4. Analysis of power amplifier.
5. Schmitt Trigger circuit with Predictable hysteresis.

TOTAL: 60 PERIODS

COURSE OUTCOMES:

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

- To analyze the Frequency response of CE, CB, CC and CS Amplifier.
- To design Darlington Amplifier and Differential Amplifiers.
- To design feedback amplifiers.
- To design and demonstrate oscillators.
- To design and simulate the circuits using PSpice.

LAB REQUIREMENT:

1. CRO (Min 30MHz) - 15 Nos
2. Signal Generator /Function Generators (2 MHz) – 15 Nos
3. Dual Regulated Power Supplies (0 – 30V) - 15 Nos
4. Digital Multimeter - 15 Nos
5. Digital LCR Meter - 2 Nos

6. Standalone desktops PC - 15 Nos
7. Transistor/FET (BJT-NPN-PNP and NMOS/PMOS) - 50 Nos

Components and Accessories:

Transistors, Resistors, Capacitors, Inductors, diodes, Zener Diodes, Bread Boards, Transformers. SPICE Circuit Simulation Software: (any public domain or commercial software)

WEBSITE REFERENCES:

1. https://www.youtube.com/watch?v=oGRWGzP5ZrE - CE Amplifier.
2. https://www.youtube.com/watch?v=8IRzGRqcNaA - Differential Amplifiers
3. https://www.youtube.com/watch?v=7GB6xZTRwe8 - Series feedback amplifiers
4. https://www.youtube.com/watch?v=AdRCrCWt7qI - RC Phase shift oscillator
5. www.electronicsforyou.com

CO - PO MAPPINGS

CO\PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	2	2	1	1	2	-	-	-	1	3
CO2	3	3	2	2	1	1	1	-	-	-	2	2
CO3	3	2	2	2	1	1	2	-	-	-	2	2
CO4	3	2	2	2	1	1	1	-	-	-	2	2
CO5	3	2	2	2	2	2	2	-	-	-	2	2
AVG	3	2	2	2	1	1	2	-	-	-	2	2

CO -PSO MAPPING

CO\PSO	PSO1	PSO2	PSO3
CO1	3	3	3
CO2	3	3	3
CO3	3	3	3
CO4	3	3	3
CO5	3	3	3
AVG	3	3	3

JEC1313	DIGITAL LOGIC DESIGN LABORATORY	L	T	P	C
		0	0	4	2

COURSE OBJECTIVES:

- To design and implement the code converters circuits logic gates.
- To implement Adder/ Subtractor, Mux, Encoder and Decoder.
- To implement Parity Generator and checker and Magnitude Comparator.
- To design and implement counters.
- To design and implement shift registers using Flip- flops

LIST OF EXPERIMENTS:

Design and implementation

1. Code converters using logic gates(i) BCD to excess-3 code and vice versa (ii) Binary to gray and vice-versa
2. Adder and Subtractor using logic gates.
3. 4 bit binary Adder/ Subtractor and BCD adder using IC 7483.
4. Multiplexer and De-multiplexer using logic gates
5. Encoder and Decoder using logic gates.
6. Parity Generator and checker.
7. 4-bit Magnitude Comparator
8. Verification of 4 bit ripple counter.
9. 3-bit synchronous up/down counter
10. Verification of Mod-10 / Mod-12 Ripple counters
11. SISO, SIPO, PISO and PIPO shift registers using Flip- flops

Simulation using Modelsim

12. Design of Combinational Circuits using Modelsim
13. Design of Sequential Circuits using Modelsim

TOTAL: 60 PERIODS

COURSE OUTCOMES:

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

- To design and test the Combinational circuits.
- To design and test the synchronous and asynchronous counter.
- To design and simulate digital circuits using Modelsim simulator.

LIST OF EQUIPMENTS AND COMPONENTS

1. Digital IC Tester -2 Nos
2. Power Supply- 10 5V DC
3. Multimeter- 10 Digital
4. Computer with HDL software

CONSUMABLES (MINIMUM OF 25 NOS. EACH)

1. IC7400, 2. IC7404, 3. IC74682, 4. IC7402, 5. IC7408, 6. IC7411, 7. IC7432, 8. IC7483, 9. IC7485, 10. IC7486, 11. IC74150, 12. IC74151, 13. IC74147, 14. IC7445, 15. IC7474, 16.IC7476, 17. IC7491, 18. IC7494, 19. IC7447, 20. IC74180, 21. Bread Board

WEBSITE REFERENCES:

1. https://www.youtube.com/watch?v=_VavngOCrgw
2. https://www.youtube.com/watch?v=9mpRF6bAY1g- simulation using modelsim
3. https://www.youtube.com/watch?v=7cFZIB46-iM – Implementation of code converters
4. https://www.youtube.com/watch?v=1zxXZ3qVpBM- Implementation of Shift registers
5. https://www.youtube.com/watch?v=QEFW4DcyOC0- Implementation of counters

CO - PO MAPPINGS

CO\PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	2	2	1	2	1	-	-	-	1	3
CO2	3	3	2	2	1	2	1	-	-	-	2	3
CO3	3	2	2	2	1	2	1	-	-	-	2	3
AVG	3	3	2	2	1	2	1	-	-	-	2	3

CO -PSO MAPPING

CO\PSO	PSO1	PSO2	PSO3
CO1	3	3	3
CO2	3	3	3
CO3	3	3	3
AVG	3	3	3

JEC1314	ELECTRONICS DESIGN PRACTICE LABORATORY I	L	T	P	C
		0	0	4	2

COURSE OBJECTIVES:

- To identify various electronic components and its appropriate use in electronic circuits
- To understand bread board, general purpose PCB, component assembly and soldering practice
- To provide hands on experience with micro & tiny projects
- To learn simulation of the projects using electronic work benches (open sources)
- To impart knowledge in overall enclosure integrating the boards and ports.

A mini or tiny project is to be completed at the end of the semester. The project work is evaluated based on the expected output obtained from the project work jointly by external and internal examiners constituted by the Head of the Department.

MINI/TINY PROJECT

Phase 1:

1. Understanding the characteristics and specifications of the electronic components and accessories – passive components, IC's, ports etc.
2. Analyzing the response of the circuits using measuring instruments and testing Equipments-voltmeter, ammeter, ohmmeter, multimeter and LCR meter. Test equipment - IC tester
3. Optimum choice of power supply equipments used for stimulus of the circuit under test.
4. Analyze the response of the circuit under test using graphic display equipments – CRO, DSO
5. Use of Signal generating devices - Function generator

Phase 2:

1. Assembling the circuit components in the bread board and observe the output.
2. Assembling the circuit components in the general purpose PCB and observe the output.
3. Fabrication of PCB, multilayer PCB.
4. Soldering and de-soldering practice.

Phase 3: Identification of micro and tiny projects on different themes to get hands on experience.

Phase 4: Simulation of the project using simulation tools /electronic work benches.

Phase 5: Assembling the PCB, power cable, ports in the enclosure as a product and achieving the expected output.

COURSE OUTCOMES:

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

- To identify the components, pin configuration, appropriate use in circuits
- To demonstrate PCB assembling of the components, soldering and testing the output
- To demonstrate micro and tiny projects
- To identify software tools and simulate the project
- To gain knowledge in assembly, package and enclosure

WEBSITE REFERENCES:

1. https://www.youtube.com/watch?v=gkeJzRrwe5k
2. https://www.youtube.com/watch?v=_QIVe7iFd4M
3. https://www.youtube.com/watch?v=4xOJwQx9_as
4. Electronics for you magazine-https://electronicsforu.com/
5. EE Times https://www.eetimes.com/
6. Electro-https://www.elektor.com/
7. https://www.electronicproducts.com/

CO - PO MAPPINGS

CO\PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	2	2	1	1	2	-	-	-	1	3
CO2	3	3	2	2	1	1	1	-	-	-	2	2
CO3	3	2	2	2	1	1	2	-	-	-	2	2
CO4	3	2	2	2	1	1	1	-	-	-	2	2
CO5	3	2	2	2	2	2	2	-	-	-	2	2
AVG	3	2	2	2	1	1	2	0	0	0	2	2

CO -PSO MAPPING

CO\PSO	PSO1	PSO2	PSO3
CO1	3	3	3
CO2	3	3	3
CO3	3	3	3
CO4	3	3	3
CO5	3	3	3
AVG	3	3	3

SEMESTER IV

JMA1404	APPLIED PROBABILITY AND RANDOM PROCESSES	L	T	P	C
		2	2	0	3

COURSE OBJECTIVES:

- To provide basic concepts of discrete, continuous random variables and standard distributions.
- To introduce two dimensional random variables, correlation and regression.
- To acquaint students with statistical testing of hypothesis and its applications.
- To familiarize students in the concepts of random processes and its applications.
- To enable students, understand correlation and spectral densities.

UNIT I RANDOM VARIABLES 12

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

UNIT II TWO - DIMENSIONAL RANDOM VARIABLES 12

Joint distributions – Marginal and conditional distributions – Covariance – Correlation and Regression – Transformation of random variables – Central limit theorem (for independent and identically distributed random variables).

UNIT III TESTING OF HYPOTHESIS 12

Statistical hypothesis - Large sample tests based on Normal distribution for single mean and difference of means -Tests based on t, Chi-square and F distributions for mean, variance and proportion - Contingency table - Goodness of fit.

UNIT IV RANDOM PROCESSES 12

Classification – Stationary process – Markov process – Markov chain - Poisson process – Random telegraph process – Binomial Process.

UNIT V CORRELATION AND SPECTRAL DENSITIES 12

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

TOTAL: 60 PERIODS

COURSE OUTCOMES:

At the end of the course, students will be able:

- To understand random variables and use standard distributions in solving real time problems.
- To use joint density functions to perform correlation and regression analysis.
- To apply hypothesis testing for making statistical inferences in large and small sample real life problems.
- To demonstrate efficient use of random processes in modeling engineering problems.
- To understand and apply concepts of correlation and spectral densities.

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", 4th Edition, Tata McGraw Hill, New Delhi, 2002.
3. Johnson, R.A., Miller, I and Freund J., "Miller and Freund's Probability and Statistics for Engineers", 8th Edition, Pearson Education, Asia, 2015.

REFERENCES:

1. Devore. J.L., "Probability and Statistics for Engineering and the Sciences", 8th Edition, Cengage Learning, New Delhi, 2014.
2. Spiegel. M.R., Schiller. J. and Srinivasan, R.A., "Schaum's Outline of Theory and Problems of Probability and Statistics", Tata McGraw Hill Edition, 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", 3rd Edition, Pearson Education, Asia, 2002.
5. Yates. R.D. and Goodman. D.J., "Probability and Stochastic Processes", 2nd Edition, Wiley India Pvt. Ltd., Bangalore, 2012.

WEB REFERENCES:

1. https://nptel.ac.in/courses/111/104/111104032/
2. https://nptel.ac.in/courses/103/106/103106120/
3. https://nptel.ac.in/courses/117/103/117103067/

CO - PO MAPPINGS

CO\PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	2	2	-	-	-	-	2	-	-	2
CO2	3	3	2	2	-	-	-	-	2	-	-	2
CO3	3	3	2	2	-	-	-	-	2	-	-	2
CO4	3	3	2	2	-	-	-	-	2	-	-	2
CO5	3	3	2	2	-	-	-	-	2	-	-	2
AVG	3	3	2	2	-	-	-	-	2	-	-	2

JEC1401	ANALOG AND DIGITAL COMMUNICATION	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To provide various Analog modulation systems
- To provide overview on baseband communication
- To provide various Digital modulation systems
- To understand the concepts of information theory
- To study some basic error control coding theorem

UNIT I ANALOG COMMUNICATION 9

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

UNIT II BASEBAND TRANSMISSION & RECEPTION 9

Low pass sampling - Aliasing - Signal Reconstruction, Quantization - Uniform & non-uniform quantization, quantization noise - PCM - TDM - DM - Line codes and its properties - ISI - Nyquist criterion for distortion less transmission - Equalizing Filters.

UNIT III DIGITAL MODULATION SCHEME 9

Generation, detection, power spectral density & bit error rate of coherent BFSK - BPSK - QPSK - QAM - Structure of non-coherent receivers - Principle of DPSK.

UNIT IV INFORMATION THEORY 9

Discrete Memoryless source, Information, Entropy, Mutual Information - Discrete Memoryless channels – Binary Symmetric Channel, Channel Capacity - Source coding theorem - Shannon - Fano & Huffman codes

UNIT V ERROR CONTROL CODING 9

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

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

- To design Analog communication systems
- To design base band communication systems
- To design Digital communication systems
- To analyze different source coding techniques
- To design error control coding schemes

TEXTBOOK:

1. J.G.Proakis, M.Salehi, “Fundamentals of Communication Systems”, Pearson Education 2014
2. S. Haykin, “Digital Communications”, John Wiley, 2005

REFERENCES:

1. H P Hsu, “Schaum’s Outline Series - Analog and Digital Communications”, TMH 2006
2. Simon Haykin, “Communication Systems”, 4th Edition, Wiley, 2014
3. B.P.Lathi, “Modern Digital and Analog Communication Systems”, 3rd Edition, Oxford University Press, 2007
4. D.Roody, J.Coolen, “Electronic Communications”, 4th edition PHI 2006
5. B.Sklar, “Digital Communications Fundamentals and Applications”, 2nd Edition Pearson Education 2007
6. J.G Proakis, “Digital Communication”, 4th Edition, Tata McGraw Hill Company, 2001

WEBSITE REFERENCES:

1. https://www.youtube.com/watch?v=S8Jod9AtpN4, Prof.Surendra Prasad, IIT Delhi
2. https://www.youtube.com/watch?v=gsUaHawPy-w, Prof.Surendra Prasad, IIT Delhi
3. https://nptel.ac.in/courses/117/101/117101051/, Prof. Bikash Kumar Dey, IIT Bombay

4. https://www.youtube.com/watch?v=ZW1glqkIgcw,Prof. Bikash Kumar Dey, IIT Bombay
5. https://nptel.ac.in/courses/117/101/117101051/,Prof. Bikash Kumar Dey, IIT Bombay

CO - PO MAPPINGS

CO\PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	2	2	3	2	-	1	1	-	3	-	-
CO2	3	3	1	3	2	-	2	1	-	3	-	-
CO3	3	2	2	2	2	-	-	2	-	3	-	-
CO4	3	2	2	2	1	-	-	1	-	3	-	-
CO5	3	2	2	3	2	-	-	1	-	3	-	-
AVG	3	2	2	3	2	0	1	1	0	3	0	0

CO -PSO MAPPING

CO\PSO	PSO1	PSO2	PSO3
CO1	2	2	2
CO2	3	3	3
CO3	3	3	3
CO4	3	3	3
CO5	3	3	3
AVG	2.8	2.8	2.8

JEC1402	LINEAR INTEGRATED CIRCUITS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To introduce the basic building blocks of linear 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 and introduce some special function ICs

UNIT I BASICS OF OPERATIONAL AMPLIFIERS 9

Operational Amplifier and its characteristics - General operational amplifier stages - Internal circuit diagram of IC 741 - DC and AC performance characteristics, slew rate, CMRR - Open and closed loop configurations-Sign Changer, Scale Changer, Voltage Follower.

UNIT II APPLICATIONS OF OPERATIONAL AMPLIFIERS 9

Phase Shift Circuits, V-to-I and I-to-V converters, adder, subtractor Amplifiers-Instrumentation amplifier, Integrator, Differentiator, Logarithmic amplifier, Antilogarithmic amplifier. Voltage level detectors - Comparators, Schmitt trigger, Precision rectifier, peak detector, clipper and clamper, Active Filters - Low-pass, high-pass and band-pass Butterworth filters.

UNIT III ANALOG MULTIPLIER AND PLL 9

Analog Multiplier - Emitter Coupled Transistor Pair, Gilbert Multiplier cell, analog multiplier ICs and their applications, PLL -Operation and Closed loop analysis, Voltage controlled oscillator**,** PLL Applications - AM detection, FM detection, FSK modulation and demodulation and Frequency synthesizing.

UNIT IV ANALOG TO DIGITAL AND DIGITAL TO ANALOG CONVERTER 9

Analog and Digital Data Conversions, D/A converters- specifications, weighted resistor type, R-2R Ladder type, Voltage Mode and Current-Mode R - 2R Ladder types. High speed sample-and-hold circuits, A/D Converters – specifications, Flash type, Successive Approximation type, Single Slope type, Dual Slope type, Data Acquisition (DAQ) device-components – Applications.

UNIT V WAVEFORM GENERATORS AND SPECIAL FUNCTION ICs 9

Waveform Generators: Sine-wave generators, Multivibrators and Triangular wave generator, Saw-tooth wave generator, Timer IC 555, **Special Function ICs**: Voltage regulators, IC 723 general purpose regulator - Monolithic switching regulator, Frequency to Voltage and Voltage to Frequency converters.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

- To design linear and non linear applications of OP – AMPS
- To design applications using analog multiplier and PLL
- To design ADC and DAC using OP – AMPS
- To demonstrate waveforms using OP – AMP Circuits
- To analyze special function ICs

TEXT BOOKS:

1. D.Roy Choudhry, Shail Jain, “Linear Integrated Circuits”, New Age International Pvt. Ltd., 2018, Fifth Edition.
2. Ramakant A. Gayakwad, “OP-AMP and Linear ICs”, 4th Edition, Prentice Hall / Pearson Education, 2015.

REFERENCES:

1. Robert F.Coughlin, Frederick F.Driscoll, “Operational Amplifiers and Linear Integrated Circuits”, Sixth Edition, PHI, 2001.
2. B.S.Sonde, “System design using Integrated Circuits”, 2nd Edition, New Age Pub, 2001
3. Sergio Franco, “Design with Operational Amplifiers and Analog Integrated Circuits”, 4th Edition, Tata McGraw-Hill, 2016
4. Gray and Meyer, “Analysis and Design of Analog Integrated Circuits”, Wiley International, 5th Edition, 2009

WEBSITE REFERENCES:

1. https://nptel.ac.in/courses/108/108/108108111/,Prof. HardikJeetendra Pandya, IISC Bangalore.
2. https://www.youtube.com/watch?v=Ad-XynW7qjo, Prof. K. Radhakrishna Rao, Prof (Retd), IIT Madras. Texas Instruments, India.
3. https://www.youtube.com/watch?v=yhYLt9aFqBM, Prof. K. Radhakrishna Rao, Prof (Retd), IIT Madras. Texas Instruments, India.
4. https://www.youtube.com/watch?v=wa7pIviT-do, Prof. A.N. Chandorkar, Department of Electronics & Communication Engineering, IIT Bombay.
5. https://www.youtube.com/watch?v=mB5nI_phvlQ, Prof. K. Radhakrishna Rao, Prof (Retd), IIT Madras. Texas Instruments, India.

CO - PO MAPPINGS

CO\PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	3	2	1	2	-	-	-	-	1	3
CO2	3	2	3	2	1	2	-	-	-	-	1	3
CO3	3	2	3	2	1	2	-	-	-	-	1	3
CO4	3	2	1	1	1	2	-	-	-	-	-	2
CO5	3	3	2	3	2	2	-	-	-	-	2	3
AVG	3	2	2	2	1	2	0	0	0	0	1	3

CO -PSO MAPPING

CO\PSO	PSO1	PSO2	PSO3
CO1	2	2	3
CO2	3	3	2
CO3	3	3	2
CO4	3	3	2
CO5	3	3	2
AVG	2.8	2.8	2.2

JEC1403	ELECTROMAGNETIC FIELD THEORY	L	T	P	C
		2	2	0	3

COURSE OBJECTIVES:

- To gain conceptual and basic mathematical understanding of coordinate systems
- To understand the concepts of electrostatics fields with help of mathematic equations
- To understand the concepts of static magnetic fields with help of mathematic equations
- To understand the coupling between electric and magnetic field through faradays law, displacement current and Maxwell's equations
- To understand wave propagation in lossless and in lossy media

UNIT I INTRODUCTION 12

Review of vector algebra, Rectangular, cylindrical and spherical coordinate systems, Gradient of a scalar field, Divergence of a vector field, Divergence theorem, Curl of a vector field, Stokes's theorem, Vector identities.

UNIT II ELECTROSTATICS 12

Electric field, Coulomb's law, Gauss's law and applications, Electric potential, Conductors in static electric field, Dielectrics in static electric field, Boundary conditions, Capacitance-Parallel, cylindrical and spherical capacitors. Electrostatic energy, Poisson's and Laplace's equations, Current density and Ohm's law, Equation of continuity

UNIT III MAGNETOSTATICS 12

Lorentz force equation, Ampere's law, Biot-Savart law and applications, Vector magnetic potential, behavior of magnetic materials, Boundary conditions, Inductance and mutual inductance.

UNIT IV TIME-VARYING FIELDS AND MAXWELL'S EQUATIONS 12

Faraday's law, Displacement current and Amperes law, Maxwell's equations, Potential functions, Electromagnetic boundary conditions, Wave equations and solutions, Time-harmonic fields, Applications of Maxwell equations in Matlab

UNIT V PLANE ELECTROMAGNETIC WAVES 12

Plane waves in lossless media, Plane waves in lossy media (low-loss dielectrics and good conductors), Group velocity, power and Poynting vector, Normal incidence at a plane conducting boundary, Normal incidence at a plane dielectric boundary, Visualization of signal propagation using Matlab.

TOTAL: 60 PERIODS

COURSE OUTCOMES:

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

- To explain the concept of different coordinate systems
- To apply the concept of electrostatic fields with the help of mathematics and apply them for practical applications.
- To apply the concept of static magnetic fields with the help of mathematics and apply them for practical applications.
- To explain the physical meaning of Maxwell's equations in integral, differential and phasor forms
- To explain electromagnetic wave propagation in lossy and in lossless media.

TEXT BOOK:

1. Matthew N.O Sadiku, "Principles of electromagnetic", 4th edition, Oxford University Press, 2009.

REFERENCES:

1. D.K. Cheng, "Field and wave electromagnetic", 2nd ed., Pearson (India), 1989(UNIT I, II,III IV,V)
2. W.H. Hayt and J.A. Buck, "Engineering Electromagnetics", 7th ed., McGraw-Hill (India), 2006(UNIT I-V)
3. V. V. Sarwate, "Electromagnetic Fields and Waves", New Age International Pvt Ltd Publishers, 2015

WEBSITE REFERENCES:

1. nptel.ac.in/courses/108/104/108104087. Prof. Pradeepkumar K
2. Vectoralgebra“https://www.youtube.com/watch?v=pGdr9WLto4A.Dr. HarisankarRamachandran.
3. Magnetic materials “https://www.youtube.com/watch?v=1xFRtdN5IJA by walterlewin.
4. Maxwell’s equations” https://www.youtube.com/watch?v=yINtzw63Knc.
5. Waveequations”https://www.youtube.com/watch?v=3gG6OlMvoOQ&index=34&t=0s&list=PLHtzy2FDe_eiPzJjohVJvV7P1IZlGGe3j.

CO - PO MAPPINGS

CO\PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	1	2	3	2	-	-	-	-	2	2
CO2	3	3	1	2	2	2	-	-	-	-	2	2
CO3	3	3	1	2	3	2	-	-	-	-	2	2
CO4	3	3	1	2	2	2	-	-	-	-	2	2
CO5	3	3	1	2	3	2	-	-	-	-	2	2
AVG	3	3	1	2	3	2	0	0	0	0	2	2

CO -PSO MAPPING

CO\PSO	PSO1	PSO2	PSO3
CO1	2	1	1
CO2	3	1	1
CO3	3	2	2
CO4	3	3	3
CO5	3	3	3
AVG	2.8	2	2

JPT1001	SOFT SKILLS AND APTITUDE II	L	T	P	C
		0	0	2	1

COURSE OBJECTIVES:

- To help students learn various forms of writing and develop content
- To help students acquire time and stress management skills
- To facilitate students to gain required knowledge to understand practical concepts in aptitude
- To develop the thinking and analytical skills of students
- To gain knowledge in concepts of C programming language

UNIT I SOFT SKILLS AND APTITUDE-III 5

Communication – on Specific topics – both oral and written – Content development – various forms of writing and specific writing – Brainstorming – Individual – Concept focusing – Public Speaking – Analytical writing.

UNIT II SOFT SKILLS AND APTITUDE-IV 5

Importance of Time – Time Management techniques – The art of prioritizing and scheduling – Stress – Positive and Negative Stress - Stress Management techniques – Concept of Goal setting – Importance of Goals – Dream vs Goal – Reasons for failure of Goals – SMART.

UNIT III QUANTITATIVE APTITUDE 6

Ratio and Proportions – Allegations and Mixtures – Problem on Ages – Profit and Loss and Discount.

UNIT IV LOGICAL REASONING 6

Odd man out series – Blood Relation – Seating Arrangement – Number Ranking

UNIT V TECHNICAL APTITUDE IN C-II 8

Strings - Storage Classes – Pointers – Preprocessor directives - Structures – Union. Type def – Input/Output – File I/O - Header Files – Type casting – Error handling – Command Line Arguments – Variable Arguments – Memory Management - Bitwise operators.

TOTAL PERIODS: 30

COURSE OUTCOMES:

At the end of the course, the student will be able to

- Develop different types of content using the skills learnt
- Manage time and stress competently
- Find answers to real time application problems
- Use logical reasoning skills to solve problems differently
- Apply C programming concepts for coding

TEXTBOOKS:

1. R.S Agrawal, “Quantitative Aptitude”
2. R. S. Agrawal, “Verbal Reasoning”
3. R.S. Agrawal “Non Verbal reasoning.
4. PradipDey, Manas Ghosh, “Fundamentals of Computing and Programming in C”, First Edition, Oxford University Press, 2009.
5. Yashavant P. Kanetkar. “Let Us C”, BPB Publications, 2011.

WEBSITE REFERENCES:

1. https://www.indiabix.com/aptitude/questions-and-answers/
2. https://m4maths.com/placement-puzzles.php
3. www.freshers world.com
4. https://www.youtube.com › watch>problems on ages
5. https://www.youtube.com › watch>blood relation
6. https://www.youtube.com › watch>content
7. https://www.youtube.com › watch>SMART
8. https://www.youtube.com › watch>strings in C

CO - PO MAPPINGS

CO\PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	1	1	-	3	-	-	1	2	2	3
CO2	3	3	1	1	-	3	-	-	1	2	2	3
CO3	3	3	1	1	-	3	-	-	1	2	2	3
CO4	3	3	1	1	-	3	-	-	1	2	2	3
CO5	3	3	1	1	-	3	-	-	1	2	2	3
AVG	3	3	1	1	0	3	0	0	1	2	2	3

CO -PSO MAPPING

CO\PSO	PSO1	PSO2	PSO3
CO1	1	1	1
CO2	1	1	1
CO3	1	1	1
CO4	1	1	1
CO5	1	1	1
AVG	1	1	1

JEC1411	ANALOG AND DIGITAL COMMUNICATIONS LABORATORY	L	T	P	C
		0	0	4	2

COURSE OBJECTIVES:

- To Implement AM & FM modulation and demodulation
- To Implement PAM, PWM & PDM Modulation and Demodulation
- To visualize the effects of sampling and TDM
- To implement PCM, DM, ASK, FSK and PSK To simulate Digital Modulation schemes
- To simulate Error control coding schemes

LIST OF EXPERIMENTS:

1. AM Modulator and Demodulator
1. FM Modulator and Demodulator
2. Analog Pulse Modulation and Demodulation.
3. Verification of sampling theorem.
4. Time Division Multiplexing and De multiplexing
5. Pulse Code Modulation and Demodulation
6. Delta Modulation and Demodulation
7. Line Coding Techniques
8. Digital Modulation: ASK, FSK, PSK
9. Simulation of ASK, FSK, and BPSK generation and detection schemes
10. Simulation of DPSK, QPSK and QAM generation schemes

11. Simulation of Linear Block and Cyclic error control coding schemes
12. Simulation of Convolutional coding scheme
13. Communication link simulation

TOTAL: 60 PERIODS

COURSE OUTCOMES:

At the end of the course, the students will be able:

- To simulate & validate various functional modules of a communication system
- To demonstrate base band signaling schemes through implementation of digital modulation schemes
- To apply various channel coding schemes & demonstrate the improvement of the noise performance of communication system
- To simulate end-to-end communication Link

LAB Requirements for a Batch of 30 students (3 students per experiment):

1. Kits for Signal Sampling, TDM, AM, FM, PCM, DM and Line Coding Schemes
2. CROs/DSOs – 15 Nos, Function Generators – 15 Nos.
3. MATLAB or equivalent software package for simulation experiments
4. PCs - 15 Nos

WEBSITE REFERENCES:

1. http://cyberspaceandtime.com/3PD93EHCi9Y.video+related
2. http://ecelabs.njit.edu/ece489v2/Lab1.php
3. https://www.youtube.com/watch?v=xlV1RHc0Rs4

CO - PO MAPPINGS

CO\PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	1	1	3	1	-	-	-	-	-	2
CO2	3	2	1	1	2	1	-	-	-	-	-	2
CO3	3	2	1	1	3	1	-	-	-	-	-	1
CO4	3	2	1	1	2	1	-	-	-	-	-	1
AVG	3	2	1	1	2.5	1	0	0	0	0	0	1.5

CO -PSO MAPPING

CO\PSO	PSO1	PSO2	PSO3
CO1	3	2	2
CO2	3	2	2
CO3	3	2	2
CO4	3	2	2
AVG	3	2	2

JEC1412	LINEAR INTEGRATED CIRCUITS LABORATORY	L	T	P	C
		0	0	4	2

COURSE OBJECTIVES:

- To understand the basics of linear integrated circuits and available ICs
- To understand the characteristics of the operational amplifier
- To apply operational amplifiers in linear and nonlinear applications.
- To acquire the basic knowledge of special function IC
- To use SPICE software for circuit design

LIST OF EXPERIMENTS

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 & 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 SPICE:

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

COURSE OUTCOMES:

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

- To design amplifiers, oscillators, D-A converters using operational amplifiers.
- To design filters using op-amp and performs an experiment on frequency response.
- To analyze the working of PLL and describe its application as a frequency multiplier.
- To design DC power supply using ICs
- To analyze the performance of filters, multivibrators, A/D converter and analog multiplier using SPICE.

LAB REQUIREMENT EQUIPMENTS

1. CRO/DSO (Min 30MHz) -- 15 Nos
2. Signal Generator /Function Generators (2 MHz) – 15 Nos
3. Dual Regulated Power Supplies (0 – 30V) -- 15 Nos
4. Digital Multimeter -- 15 Nos
5. IC Tester -- 5 Nos
6. Standalone desktops PC -- 15 Nos
7. Components and Accessories – 50 Nos

COMPONENTS AND ACCESSORIES:

Transistors, Resistors, Capacitors, diodes, Zener diodes, Bread Boards, Transformers, wires, Power transistors, Potentiometer, A/D and D/A convertors, LEDs.

Note: Op-Amps uA741, LM 301, LM311, LM 324, LM317, LM723, 7805, 7812, 2N3524, 2N3525, 2N3391, AD 633, LM 555, LM 565 may be used.

WEBSITE REFERENCES:

1. https://www.youtube.com/watch?v=jLr-eBKzLp4, Prof.Jayanta Mukherjee, Department of EE, IIT BOMBAY
2. https://www.youtube.com/watch?v=y5s4bQnmV-g, Prof.K.Radhakrishna Rao, Department of Electrical Engineering,IIT Madras
3. https://www.youtube.com/watch?v=02cdB3Y2M0o,Prof. K.Radhakrishna Rao, Department of Electrical Engineering,IIT Madras
4. https://www.youtube.com/watch?v=xki9taCqsWY, Prof. T.S.Natarajan, Department of physics, IIT Madras.
5. https://www.youtube.com/watch?v=mB5nI_phvlQ,Prof.K.Radhakrishna Rao, Department of Electrical Engineering, IIT Madras

CO - PO MAPPINGS

CO\PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	2	3	1	2	-	-	-	-	3	3
CO2	3	2	2	3	1	2	-	-	-	-	3	3
CO3	3	3	2	3	3	3	-	-	-	-	3	3
CO4	3	2	3	3	3	2	-	-	-	-	3	3
CO5	3	3	2	3	3	3	-	-	-	-	3	3
AVG	3	2	2	3	2	2	0	0	0	0	3	3

CO -PSO MAPPING

CO\PSO	PSO1	PSO2	PSO3
CO1	2	2	3
CO2	3	3	2
CO3	3	3	2
CO4	3	3	2
CO5	3	3	2
AVG	2.8	2.8	2.2

SEMESTER V

JEE1501	MICROPROCESSORS AND MICROCONTROLLERS (INTEGRATED)	L	T	P	C
		2	0	2	3

COURSE OBJECTIVES:

- To impart knowledge on architecture and interrupt structure of 8085 microprocessor
- To impart knowledge on addressing modes and ALP of 8085
- To study the architecture and programming of 8051 microcontroller.
- To acquire knowledge about the features and functionalities of the peripheral devices and interfacing
- To understand the concepts of developing microcontroller-based systems for various applications.

UNIT I THE 8085 MICROPROCESSOR 6

Hardware Architecture – Functional Building Blocks of Processor – Memory organization – I/O ports and data transfer concepts– Timing Diagram – Interrupts

UNIT II PROGRAMMING OF 8085 PROCESSOR 6

Instruction -format and addressing modes – Assembly language format – Data transfer, data manipulation & control instructions – Programming: Loop structure with counting & Indexing – Subroutine instructions – stack- Introduction to 16-bit microprocessor.

UNIT III 8051 MICROCONTROLLERS 6

Architecture of 8051 – Special Function Registers (SFRs) - Interrupts –Timer and counter - Instruction set - Addressing modes - Simple assembly language programming

UNIT IV PERIPHERAL INTERFACING 6

Programmable Peripheral Interface (8255) - Keyboard/Display Controller (8279) -Programmable Timer/ Counter (8254) - Programmable Interrupt Controller (8259) - DMA Controller (8257) - Serial Communication Interface (8251)

UNIT V MICROCONTROLLER PROGRAMMING AND APPLICATIONS 6

Simple programming exercises- key board and display interface –Control of servo motor-stepper motor control-Traffic Light control - ADC/DAC & Sensor Interfacing - Waveform generation.

TOTAL: 30 PERIODS

LIST OF EXPERIMENTS:

8085 Programs using kits

- Basic arithmetic and Logical operations
- Move a data block
- Programming with control instructions:
  - (i) Ascending / Descending order, Maximum / Minimum of numbers.
  - (ii) Programs using Rotate instructions.
  - (iii) Code conversion, decimal arithmetic and matrix operations.
- Floating point operations, string manipulations, sorting and searching

8051 Experiments using kits

- Basic arithmetic and logical operations
- conditional jumps & looping
- Code conversion & calling subroutines

Peripherals and Interfacing

- Traffic light control
- Stepper motor control
- Key board and Display
- Serial interface and Parallel interface
- A/D and D/A interface and Waveform Generation

8086 Demonstration using software package

30 PERIODS
TOTAL 60 PERIODS

COURSE OUTCOMES:

At the end of the course, the students will be able:

- To understand about the architecture of 8085 microprocessor.
- To acquire knowledge in Addressing modes & instruction set of 8085 and write the assembly language programme.
- To realize the architecture and programming of 8051 microcontroller.
- To gain knowledge about the features and functionalities of the peripheral devices and Interfacing.
- To understand the concepts of developing microcontroller based systems for various applications.

TEXT BOOKS:

1. Sunil Mathur & Jeebananda Panda, "Microprocessor and Microcontrollers", PHI Learning Pvt. Ltd, 2016.
2. R.S. Gaonkar, "Microprocessor Architecture Programming and Application", with 8085, Wiley Eastern Ltd., New Delhi, 2013.
3. Krishna Kant, "Microprocessor and Microcontrollers, Architecture, Programming and System Design 8085, 8086, 8051", Second Edition, PHI Learning Private Limited, 2014.
4. Mohamed Ali Mazidi, Janice Gillispie Mazidi, Rolin McKinlay, "The 8051 Microcontroller and Embedded Systems: Using Assembly and C", Second Edition, Pearson education, 2011.
5. Rajkamal, "Microcontrollers - Architecture, Programming, Interfacing and System design, 2nd edition, Pearson, 2012.

REFERENCES:

1. Krishna Kant, "Microprocessor and Microcontrollers", Eastern Company Edition, Prentice Hall of India, New Delhi, 2007.
2. B.RAM, "Computer Fundamentals Architecture and Organization" New age International Private Limited, Fifth edition, 2017.
3. Doughlas V.Hall, "Microprocessors and Interfacing, Programming and Hardware", TMH,2016.
4. Kenneth J Ayala "The 8051 Microcontroller, Architecture, Programming and Applications" 2nd edition Penram International Publishing, 1996.
5. Muhammad H. Rashid, "The 8051 Microcontroller and Embedded Systems, Volume 1" Prentice Hall, 2000.

6. Barry B Brey, "The Intel Microprocessor Architecture Programming and Interfacing", Pearson Education, 4th Edition, 2006.
7. Soumitra Kumar Mandal, Microprocessor & Microcontroller Architecture, Programming & Interfacing using 8085,8086,8051, McGraw Hill Edu,2013

WEBSITE REFERENCES:

1. https://www.digimat.in/nptel/courses/video/108105102/L01.html
2. http:// freevideolectures.com/courses/3018/microprocessors-and-microcontrollers
3. http://www.digimat.in/nptel/courses/video/108105102/L31.html
4. https:// youtu.be/myw7ycAgJYM
5. https://nptel.ac.in/courses/108107029/
6. https://www.iitk.ac.in/new/microprocessor-and-microcontroller-laboratory
7. http://209.211.220.205/vlabiitece/mi/labsMI.php

LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS:

S. No.	Description of Equipment	Quantity required
1.	8085 Microprocessor Trainer with Power Supply	15
2.	8051 Micro Controller Trainer Kit with power supply	15
3.	8255 Interface boards	5
4.	8251 Interface boards	5
5.	8259 Interface boards	5
6.	8279 Keyboard / Display Interface boards	5
7.	8254 timer/ counters	5
8.	ADC and DAC cards	5
9.	AC & DC motor with Controller s	5
10.	Traffic Light Control Systems	5

CO -PO MAPPING

CO\PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	3	3	1	-	-	-	-	-	1	2
CO2	3	2	3	3	1	-	-	-	-	-	1	2
CO3	3	2	3	3	1	-	-	-	-	-	1	2
CO4	3	2	3	3	1	-	-	-	-	-	1	2
CO5	3	2	3	3	1	-	-	-	-	-	1	2
AVG	3	2	3	3	1	0	0	0	0	0	1	2

CO -PSO MAPPING

CO\PSO	PSO1	PSO2	PSO3
CO1	3	3	1
CO2	3	3	1
CO3	3	3	1
CO4	3	3	1
CO5	3	3	1
AVG	3	3	1

JEC1501	DISCRETE TIME SIGNAL PROCESSING	L	T	P	C
		2	2	0	3

COURSE OBJECTIVES:

- To learn discrete Fourier transform, 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 and design 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 of multi rate signal processing and its applications communication and biomedical engineering

UNIT I INTRODUCTION TO DISCRETE FOURIER TRANSFORM 12

Introduction to Discrete Fourier transform (DFT) - Computation of DFT - Properties of DFT - Linear filtering using DFT- Filtering long data sequences - overlap save and overlap add method- Fast Fourier transform (FFT Radix-2) - Decimation-in-time and Decimation-in-frequency.

UNIT II INFINITE IMPULSE RESPONSE FILTERS 12

Design of analog filters - Butterworth filter -Design of digital IIR filters from analog filters (LPF, HPF, BPF) - Impulse invariance method, Bilinear transformation- Introduction to Chebyshev Filters - Structure of IIR filter - direct form I, direct form II, Cascade, parallel realizations.

UNIT III FINITE IMPULSE RESPONSE FILTERS 12

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

UNIT IV FINITE WORD LENGTH EFFECTS 12

Fixed point and floating point number representation - ADC - quantization - truncation and rounding - quantization noise – input quantization error - coefficient quantization error - product quantization error - overflow error - limit cycle oscillations – signal scaling.

UNIT V MULTI RATE SIGNAL PROCESSING 12

Introduction to Multirate signal processing- Interpolation and Decimation, Decimation by an integer factor - Interpolation by an integer factor - Sampling rate conversion by a rational factor - Multistage implementation of sampling rate conversion - Applications of Multirate signal processing and adaptive filtering - narrowband filtering of fetal ECG.

TOTAL: 60 PERIODS

COURSE OUTCOMES:

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

- Apply DFT for the analysis of digital signals and systems
- Design IIR and FIR filters
- Design FIR filters
- Characterize the effects of finite precision representation on digital filters
- Design multirate filters and apply adaptive filters appropriately for communication and biomedical systems

TEXT BOOKS:

1. John G. Proakis & Dimitris G.Manolakis, "Digital Signal Processing – Principles, Algorithms & Applications", Fourth Edition, Pearson Education / Prentice Hall, 2007.
2. V. Oppenheim, R.W. Schafer and J.R. Buck, "Discrete-Time Signal Processing", 8th Indian Reprint, Pearson, 2010.

REFERENCES

1. Emmanuel C. Ifeachor & Barrie. W. Jervis, "Digital Signal Processing", Second Edition, Pearson Education / Prentice Hall, Reprint ,2011.
2. Sanjit K. Mitra, "Digital Signal Processing – A Computer Based Approach", Fourth Edition, Tata McGraw Hill, 2013.
3. Andreas Antoniou, "Digital Signal Processing", Second Edition, Tata McGraw Hill, 2009.
4. M.H. Hayes, "Digital Signal Processing, Schaum's Outline Series", Second Edition McGraw-Hill, New York, 2011.

WEBSITE REFERENCES:

1. https://ocw.mit.edu/resources/res-6-008-digital-signal-processing-spring-2011/study-materials/
2. https://onlinecourses.nptel.ac.in/noc20_ee31/preview
3. https://nptel.ac.in/courses/117/105/117105134/, Prof. Mrityunjoy Chakraborty, IIT Kharagpur.
4. https://nptel.ac.in/courses/108/105/108105055/, Prof. T. K. Basu, IIT Kharagpur.
5. https://nptel.ac.in/courses/117/102/117102060/, Prof. S. C. Dutta Roy, IIT Delhi.

CO - PO MAPPING

CO\PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	3	3	2	1	-	-	-	-	3	2
CO2	3	3	3	3	3	1	-	-	-	-	2	3
CO3	3	3	3	3	3	1	-	-	-	-	3	3
CO4	3	3	3	3	3	1	-	-	-	-	2	3
CO5	3	3	3	3	3	1	-	-	-	-	3	2
AVG	3	3	3	3	2.8	1	0	0	0	0	2.6	2.6

CO - PSO MAPPING

CO\PSO	PSO1	PSO2	PSO3
CO1	3	3	1
CO2	3	3	1
CO3	2	3	1
CO4	3	3	1
CO5	3	3	1
AVG	3	3	1

JEC1502	TRANSMISSION LINES AND RF SYSTEMS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

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

UNIT I TRANSMISSION LINE THEORY 9

General theory of Transmission lines - general solution - The infinite line - Wavelength, velocity of propagation - Waveform distortion - the distortion-less line - Loading - Line not terminated in Z0 - Reflection coefficient - calculation of current, voltage, power delivered - Input and transfer impedance - reflection factor and reflection loss, TYNDP.

UNIT II HIGH FREQUENCY TRANSMISSION LINES 9

Transmission line equations at radio frequencies - Line of Zero dissipation - Voltage, current and Input Impedance of the dissipation-less line, Standing Waves, Standing Wave Ratio - Open and short-circuited lines - Power and impedance measurement on lines - Measurement of VSWR and wavelength.

UNIT III IMPEDANCE MATCHING IN HIGH FREQUENCY LINES 9

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

UNIT IV WAVEGUIDES 9

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

UNIT V RF SYSTEM DESIGN CONCEPTS 9

Active RF components: Semiconductor basics in RF, bipolar junction transistors, RF field effect transistors, High electron mobility transistors Basic concepts of RF design, Mixers, Low noise amplifiers, Power amplifiers, transducer power gain and stability considerations, Remodelling of R.F system design.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

- Explain the characteristics of transmission lines and its losses
- Write about the standing wave ratio and input impedance in high frequency transmission lines
- Analyze impedance matching by stubs using smith charts
- Analyze the characteristics of TE and TM waves
- Design a RF transceiver system for wireless communication

TEXT BOOKS:

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

REFERENCES:

1 Reinhold Ludwig and Powel Bretchko, RF Circuit Design – Theory and Applications, Pearson Education Asia, First Edition,2001.

2 D. K. Misra, ―Radio Frequency and Microwave Communication Circuits- Analysis and Design, John Wiley & Sons, 2004.

3 E.C.Jordan and K.G. Balmain, ―Electromagnetic Waves and Radiating Systems Prentice Hall of India, 2006.

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

WEBSITE REFERENCES:

1. www.allaboutcircuits.com
2. www.nature.com
3. www.onlinecourses-archieve.nptel.ac.in\transmission lines and EM waves
4. www.onlinecourses-archieve.nptel.ac.in\Microwave Engineering
5. www.onlinecourses-archieve.nptel.ac.in\Electromagnetic waves in guided and wireless media
6. www.ocw.mit.edu/Electromagnetic Fields, Forces and Motion

CO - PO MAPPING

CO\PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	3	3	2	2	1	-	-	-	-	3	2
CO2	3	2	3	3	3	1	-	-	-	-	2	3
CO3	2	3	2	2	3	2	-	-	-	-	3	2
CO4	3	3	3	3	2	1	-	-	-	-	2	2
CO5	3	2	3	2	3	1	-	-	-	-	3	2
AVG	2.6	2.6	2.8	2.4	2.6	1.2	-	-	-	-	2.6	2.2

CO - PSO MAPPING

CO\PSO	PSO1	PSO2	PSO3
CO1	3	2	1
CO2	3	2	1
CO3	3	2	1
CO4	3	2	1
CO5	3	2	1
AVG	3	2	1

JPT1002	TECHNICAL SKILLS AND APTITUDE I	L	T	P	C
		0	0	2	*

COURSE OBJECTIVES:

- To make students analyze and solve problems in technical as well as quantitative aptitude.
- To enhance the technical skills and basics of programming language
- To make students understand how to apply the practical knowledge with real time applications.
- To make students think and draw a conclusion from different scenarios.
- To help students understand python programming concepts

UNIT I OOPS CONCEPTS 6

What is object oriented programming? Const and classes -Arrays and string arrays fundamentals. Arrays of object, string, the standard C++ String class - Operator overloading: Overloading unary operations. Concept of inheritance. Derived class and based class. Derived class constructors, member function, Virtual Function

UNIT II PYTHON I 6

Python interpreter and interactive mode; values and types: int, float, boolean, string, and list; variables, expressions, statements, tuple assignment, modules and functions.

UNIT III PYTHON II 6

Lists: list operations, list slices, list methods, list loop, mutability, aliasing, list parameters; Tuples: tuple assignment, Dictionaries: operations and methods; advanced list processing – list comprehension

UNIT IV QUANTITATIVE APTITUDE 6

Boats and streams – Time and work – Pipes and Cistern – Time and Distance – Problems on Trains

UNIT V LOGICAL REASONING 6

Syllogism – Statement and Conclusion – Inequalities – Non Verbal Reasoning – Figure Analogy – Mirror and Water images – Paper cutting and Folding – Cubes and Dices – Pattern completion.

TOTAL: 30 PERIODS

COURSE OUTCOMES:

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

- Apply OOPS concepts in applications
- To enhance knowledge in python programming.
- Gain knowledge in coding using the python programming.
- Solve complex arithmetic problems practically with real time applications.
- Think logically in solving problems, enhance decision making, for difficult situations.

TEXTBOOKS:

1. Dr.E. Balagurusamy, "Programming in C++" complete reference 8th Edition.
2. "THE COMPLETE REFERENCE PYTHON", Herbert schildt., McGraw Hill Education, 2011.
3. Python: The Complete Reference by Martin Brown and Martin C.Brown Published in 2014.
4. Python in a nutshell by Alex Martelli Revised in March 2013.
5. Dr. R.S Agrawal, "Quantitative Aptitude" and Non Verbal Reasoning published in 2000.

WEBSITE REFERENCES:

1. https://www.indiabix.com/aptitude/questions-and-answers/
2. https://m4maths.com/placement-puzzles.php
3. www.freshers world.com
4. www.careerride.com
5. www.youtube.com/watch/python
6. www.youtube.com/watch/concepts of python
7. https://stackoverflow.com/
8. https://www.w3schools.com/
9. https://www.geeksforgeeks.org/

CO - PO MAPPING

CO\PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	-	-	-	-	1	-	1	-	-	1	-	1
CO2	-	-	-	-	1	-	1	-	-	1	-	1
CO3	-	-	-	-	1	-	1	-	-	1	-	1
CO4	-	-	-	-	1	-	1	-	-	1	-	1
CO5	-	-	-	-	1	-	1	-	-	1	-	1
AVG	0	0	0	0	1	0	1	0	0	1	0	1

JHS1511	PROFESSIONAL COMMUNICATION (Common to all B.E / B.Tech Programmes)	L	T	P	C
		0	0	2	1

COURSE OBJECTIVES:

- To enable students to acquire a specialized knowledge of the essential professional skills
- To train them to make effective presentations on a variety of topics
- To help them participate in group discussions displaying teamwork skills
- To build their confidence and help them attend interviews winningly
- To groom them to become successful professionals

UNIT I EXPOSURE TO PROFESSIONAL SKILLS 6

Introduction to Skills: hard skills and soft skills – communication skills – interpersonal skills –employability and career skills – planning and prioritizing work – time management – stress management– emotional intelligence – SWOT analysis

UNIT II PREPARING AND PRESENTING INSPIRING TALKS 6

Key elements of effective presentation – nonverbal communication – impressive self-introduction and shortindividual presentation – preparing outline – structuring and organising content – presenting – introducing topic – developing points – concluding – answering questions

UNIT III MEASURES TO CRACK GROUP DISCUSSION 6

Group discussion skills – team building – using key strategies – etiquette – content preparation –brainstorming – out of box thinking – mind mapping – turn taking and turn giving – speaking persuasively– questioning and clarifying

UNIT IV INTERVIEW SKILL TO GET HIRED 6

Interview skills – etiquette – body language – confidence – preparedness – types of interview – FrequentlyAsked Questions (FAQs) – mock interview – job application and resume writing

UNIT V LANGUAGE SKILLS AND CAREER MAPPING 6

Listening skills – understanding different accents – reading skills – verbal ability – email writing – professional grooming – leadership qualities – fundamentals of entrepreneurship – career planning – goal setting – future challenges

TOTAL: 30 PERIODS

COURSE OUTCOMES:

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

- Have sufficient knowledge of the skills required for professional development
- Give formal and effective presentations
- Participate actively in group discussions
- Attend job interviews and answer questions confidently and effortlessly
- Emerge as professionals ready for placement

RECOMMENDED SOFTWARE:

1. Globearena
2. Win English

TEXTBOOKS:

1. Interact English Lab Manual for Undergraduate Students, 2016, Hyderabad: OrientBlackSwan.

REFERENCES:

1. Alex, K, 2019, Soft Skills: Know Yourself and Know the World, New Delhi: S. Chand &Company Limited.
2. Butterfield, Jeff, 2015, Soft Skills for Everyone. New Delhi: Cengage Learning.
3. Kumar, Suresh E et al, 2015, Communication for Professional Success, Hyderabad: OrientBlackSwan.

4. Mitra, Barun K, 2016, Personality Development and Soft Skills, New Delhi: Oxford University Press.
5. Raman, Meenakshi and Sangeeta Sharma, 2014, Professional Communication, Oxford: OxfordUniversity Press.
6. Rizvi, Ashraf, M, 2018, Effective Technical Communication, Chennai: McGraw-Hill Education.

WEBSITE REFERENCES:

1. https://www.britishcouncil.in/english/online/resources-websites/moocs
2. https://alison.com/courses/communications
3. https://in.topresume.com/career-advice/15-free-resources-to-improve-your-presentation-and-speaking-skills
4. http://www.washington.edu/doit/TeamN/present_tips.html
5. https://www.softwaretestinghelp.com/how-to-crack-the-gd/
6. http://www.oxforddictionaries.com/words/writing-job-applications
7. http://www.mindtools.com/pages/article/newCDV_34.htm
8. https://myinterviewpractice.com/

CO-PO MAPPING

CO\PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	-	-	-	-	1	-	1	-	-	1	-	1
CO2	-	-	-	-	1	-	1	-	-	1	-	1
CO3	-	-	-	-	1	-	1	-	-	1	-	1
CO4	-	-	-	-	1	-	1	-	-	1	-	1
CO5	-	-	-	-	1	-	1	-	-	1	-	1
AVG	0	0	0	0	1	0	1	0	0	1	0	1

CO - PSO MAPPING

CO\PSO	PSO1	PSO2	PSO3
CO1	3	2	1
CO2	3	2	1
CO3	3	2	1
CO4	3	2	1
CO5	3	2	1
AVG	3	2	1

JEC1511	DISCRETE TIME SIGNAL PROCESSING LABORATORY	L	T	P	C
		0	0	4	2

COURSE OBJECTIVES:

- To perform basic signal processing operations such as Linear Convolution, Circular Convolution, Auto Correlation, Cross Correlation and Frequency analysis in MATLAB
- To perform MATLAB based implementation of various DSP systems
- To implement FIR and IIR filters in MATLAB and DSP Processor
- To study the architecture of DSP processor
- To design a DSP system to demonstrate the Multi-rate and Adaptive signal processing concepts.

LIST OF EXPERIMENTS:

MATLAB / EQUIVALENT SOFTWARE PACKAGE

1. Generation of elementary Discrete-Time sequences
2. Basic operations on signals
3. Linear and Circular convolutions
4. Auto correlation and Cross Correlation
5. Sampling and effect of aliasing
6. Frequency Analysis using DFT
7. Design of FIR filters (LPF/HPF/BPF/BSF) and demonstrates the filtering operation
8. Design of Butterworth 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 (sawtooth, square, triangular waveforms)
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

COURSE OUTCOMES:

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

- Carryout basic signal processing operations
- Demonstrate their abilities towards MATLAB based implementation of various DSP systems
- Analyze the architecture of a DSP Processor
- Design and Implement the FIR and IIR Filters in DSP Processor for performing filtering operation over real-time signals
- Design a DSP system for various applications of DSP

LAB Requirements for a Batch of 30 students (3 students per experiment):

- MATLAB software package for simulation experiments
- PCs - 15 Nos
- Kits - DSP Processor/ADC Kit-15 Nos.
- CROs - 15 Nos,
- Function Generators – 15 Nos.

WEBSITE REFERENCES:

1. https://www.vlab.co.in/participating-institute-iit-kharagpur, Prof. C.S. Kumar, IIT Kharagpur
2. http://vlabs.iitkgp.ernet.in › dsp
3. https://www.iitk.ac.in › new › digital-signal-processing

CO - PO MAPPING

CO /PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	3	2	2	1	-	-	-	-	3	2
CO2	3	3	3	3	3	1	-	-	-	-	2	3
CO3	2	3	3	3	3	1	-	-	-	-	3	3
CO4	3	3	3	3	3	1	-	-	-	-	2	3
CO5	3	3	3	2	3	1	-	-	-	-	3	2
AVG	3	3	3	2.6	2.8	1	-	-	-	-	2.6	2.6

CO - PSO MAPPING

CO\PSO	PSO1	PSO2	PSO3
CO1	3	3	1
CO2	3	3	1
CO3	3	3	1
CO4	3	3	1
CO5	3	3	1
AVG	3	3	1

JEC1512	ELECTRONICS DESIGN PRACTICE LABORATORY II	L	T	P	C
		0	0	2	1

COURSE OBJECTIVES:

- Learn the creation of electronic circuits in breadboard and PCB
- Understand the basics of electronic circuit assembly using TINKERCAD
- To understand circuit assembly and simulation through Or CAD PSpice
- To learn MATLAB basics and Simulink tools/SCILAB
- Mini Projects using Tinker cad/Or CAD PSpice/MATLAB

Phase 1: TINKERCAD

Create a breadboard circuit, Circuit build, Virtual circuit design, programming, simulation, Arduino electronic circuits, Programme your Arduino, Test your Arduino circuit and code.

Phase 2: OrCAD PSpice

Create electronic schematics, Analog circuit and digital logic simulation circuit simulation and verification, electronic prints for manufacturing printed circuit boards.

Phase 3: SCILAB/ MATLAB

Matrix manipulations, plotting of functions and data, implementation of algorithms, creation of user interfaces, graphical multi-domain simulation, Simulink

TOTAL: 60 PERIODS

COURSE OUTCOMES:

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

- Build an electronic circuit in breadboard and PCB and do manual testing
- Explain the fundamentals electronic circuit build, Arduino board programming and simulation
- Design electronic circuits and simulate using PSpice
- Understand the MATLAB Functionalities/open source SCILAB
- Do mini projects using the concepts of TinkerCAD/PSpice/MATLAB

WEBSITE REFERENCES:

1. https://www.tinkercad.com/ - TinkerCAD
2. https://www.orcad.com/products/orcad-pspice-designer/overview
3. https://www.orcad.com/orcad-free-trial
4. https://www.scilab.org/tutorials
5. https://in.mathworks.com/support/learn-with-matlab-tutorials.html?requestedDomain=
6. http://www.ni.com

CO - PO MAPPING

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	3	3	3	2	1	-	-	1	1	1
CO2	3	3	3	3	3	2	2	1	-	1	2	3
CO3	3	3	3	3	3	3	2	1	-	1	2	3
CO4	3	3	3	3	3	3	2	1	-	1	2	3
CO5	3	3	3	3	3	3	2	1	-	3	2	3
AVG	3	3	3	3	3	2.6	1.8	0.8	-	1.4	1.8	2.6

CO - PSO MAPPING

CO\PSO	PSO1	PSO2	PSO3
CO1	2	1	1
CO2	2	2	1
CO3	2	2	1
CO4	2	2	2
CO5	3	3	2
AVG	2.2	2	1.4

JEC1521	MINI PROJECT	L	T	P	C
		0	0	2	1

COURSE OBJECTIVES

- To develop skills to formulate a technical project and prepare technical report of the project.
- To estimate the ability of the student in transforming the theoretical knowledge studied so far into a working model of an Electronics and Communication system.
- To teach use of new tools, algorithms and techniques required to carry out the projects.
- To give guidance on the various procedures for validation of the product and analyze the cost effectiveness.
- For enabling the students to gain experience in organization and implementation of a small project and thus acquire the necessary confidence to carry out main project in the final year.

COURSE GUIDELINES

- The students are required to search / gather the material / information on a specific a topic comprehend it and present via ppt, prototype model, video etc., to the panel for further discussion and approval.
- The students in a group of 3 to 4 works on the approved topic should make a hardware/software model which shall be a working model or simulated output. The progress of the project should be presented and get evaluated by a reviewer committee constituted by the head of the department.
- The student's batch should prepare a comprehensive mini project report after completing the work to the satisfaction of the reviewer committee. The mini project work is evaluated based on oral presentation and the mini project report jointly by external and internal examiners constituted by the Head of the Department.

TOTAL: 30 PERIODS

COURSE OUTCOMES:

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

- Formulate a real world problem, identify the requirement and develop the design solutions.
- Express the technical ideas, strategies and methodologies.
- Utilize the new tools, algorithms, techniques that contribute to obtain the solution of the project.
- Test and validate through conformance of the developed prototype and analysis the cost effectiveness.
- Prepare report and present the oral demonstrations.

CO - PO MAPPING

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	1	3	3	1	2	-	-	-	2	1	2
CO2	3	3	3	3	3	2	-	-	-	1	2	3
CO3	3	2	3	1	3	3	-	-	-	2	2	3
CO4	3	3	3	3	3	3	-	-	-	1	2	3
CO5	3	2	3	3	2	3	-	-	-	3	2	2
AVG	3	2.2	3	2.6	2.4	2.6	0	0	0	1.8	1.8	2.6

CO - PSO MAPPING

CO\PSO	PSO1	PSO2	PSO3
CO1	1	3	2
CO2	2	2	1
CO3	2	2	3
CO4	1	2	2
CO5	2	3	3
AVG	1.6	2.4	2.2

SEMESTER VI

JEC1601	COMMUNICATION NETWORKS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- Understand the division of network functionalities into layers.
- Be familiar with the components required to build different types of networks
- Be exposed to the required functionality at each layer
- Learn the flow control and congestion control algorithms
- Learn about wireless sensor networks

UNIT I FUNDAMENTALS & LINK LAYER 9

Overview of Data Communications- Networks – Building Network and its types– Overview of Internet - Protocol Layering - OSI Mode – Physical Layer – Overview of Data and Signals - introduction to Data Link Layer - Link layer Addressing- Error Detection and Correction.

UNIT II MEDIA ACCESS &INTERNETWORKING 9

Overview of Data link Control and Media access control – Ethernet IEEE 802.3 - Wireless LANs – Available Protocols – Bluetooth– WiFi –Zigbee - Network layer services – Packet Switching – IPV4 Address – Network layer protocols IP, ICMP, Mobile IP.

UNIT III ROUTING 9

Types of Routing - Unicast Routing: Link State Routing, Distance Vector Routing, Protocols – Multicast Routing: Protocol Independent Multicast (PIM), Intra domain and inter domain protocols – Overview of IPv6 Addressing, Transition from IPv4 to IPv6.

UNIT IV TRANSPORT LAYER 9

Introduction to Transport layer –Protocols- User Datagram Protocols (UDP) and Transmission Control Protocols (TCP) –Services – Features – TCP Connection – State Transition Diagram – Flow, Error and Congestion Control - Congestion avoidance (DECbit, RED) –QoS – Security, Application requirements.

UNIT V APPLICATION LAYER 9

Application Layer Paradigms – Client Server Programming – World Wide Web and HTTP – DNS-Electronic Mail (SMTP, POP3, IMAP, MIME) – Introduction to Peer to Peer Networks – Need for Cryptography and Network Security – Firewalls, FTAM, MOTIS, MMSC.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

- Identify the components required to build different types of networks
- Choose the required functionality at each layer for given application
- Identify solution for each functionality at each layer
- Trace the flow of information from one node to another node in the network
- Describe wireless sensor networks

TEXT BOOKS:

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

REFERENCES:

1. James F. Kurose, Keith W. Ross, ―Computer Networking - A Top-Down Approach Featuring the Internet‖, Seventh Edition, Pearson Education, 2016.
2. Nader. F. Mir, Computer and Communication Networks‖, Pearson Prentice Hall Publishers, 2nd Edition, 2014.
3. WaltenegusDargie, Christian Poellabauer, ―Fundamentals of Wireless Sensor Networks Theory and Practice, John Wiley and Sons, 2010

WEBSITE REFERENCES:

1. https://www.youtube.com/watch?v=jMvA9mSIwtk,Prof.Soumyakantigosh,IITKaragpur
2. https://www.youtube.com/watch?v=pVl1L1jrbFE,Prof.S.Ghosh,Department of Computer Science & Engineering, I.I.T.,Kharagpur
3. https://www.youtube.com/watch?v=u0BTdiqhVRI, Prof.A. Pal, Department of Computer Science Engineering,IITKharagpur
4. https://www.youtube.com/watch?v=bKHRbqwkMkg, Prof.SandeepChakraborthy, Department of Computer Science & Engineering, I.I.T.,Kharagpur
5. https://freevideolectures.com/course/4469/nptel-structural-health-monitoring/55,Prof Dr. Srinivasan Chandrasekaran of IIT Madras

CO - PO MAPPING

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	1	2	2	3	1	-	-	-	-	1	2
CO2	1	3	2	3	2	1	-	-	-	-	1	2
CO3	2	3	3	3	3	1	-	-	-	-	1	2
CO4	1	3	2	3	2	1	-	-	-	-	1	2
CO5	3	3	3	3	3	1	-	-	-	-	1	2
AVG	1.6	2.6	2.4	2.8	2.6	1	0	0	0	0	1	2

CO - PSO MAPPING

CO\PSO	PSO1	PSO2	PSO3
CO1	3	3	2
CO2	3	2	3
CO3	3	3	3
CO4	2	2	3
CO5	3	3	3
AVG	2.8	2.6	2.8

JEC1602	VLSI DESIGN	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- Study the fundamentals of CMOS circuits and its characteristics.
- Learn the design and realization of combinational & sequential digital circuits.
- Learn the architecture of arithmetic building blocks and memory units.
- Learn the different FPGA architectures and testing schemes of VLSI circuits
- Understand the importance of HDL and design of CMOS circuits.

UNIT I INTRODUCTION TO MOS TRANSISTOR 9

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

UNIT II COMBINATIONAL AND SEQUENTIAL CIRCUIT DESIGN 9

Combinational Circuits: Static CMOS, Ratioed Circuits, Dynamic Circuits, Transmission Gates, Domino, Dynamic Power, Static Power, Low Power Architecture
Sequential Circuits: Static latches and Registers, Dynamic latches and Registers, Pipelining, Timing Issues.

UNIT III DESIGN OF ARITHMETIC BUILDING BLOCKS AND SUBSYSTEM 9

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

UNIT IV IMPLEMENTATION STRATEGIES AND TESTING 9

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

UNIT V VERILOG HDL AND TEST BENCHES 9

Importance of HDL, Design Methodologies, Modeling - Data Types – Verilog Operators - Modules and Ports - Verilog Test Benches – Design examples using HDL.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

- Realize the concepts of digital building blocks using MOS transistor.
- Design combinational and Sequential MOS circuits.
- Design arithmetic building blocks and memory subsystems.
- Apply and implement FPGA design flow and testing.
- Design CMOS circuits using Verilog HDL.

TEXT BOOKS:

1. Jan M. Rabaey, Anantha Chandrakasan, Borivoje. Nikolic, "Digital Integrated Circuits: A Design perspective", Second Edition, Pearson, 2016.
2. Neil H.E. Weste, David Money Harris ―CMOS VLSI Design: A Circuits and Systems Perspective‖, 4th Edition, Pearson, 2017
3. Nripendra N Biswas "Logic Design Theory" Prentice Hall of India,2001.

REFERENCES:

1. M.J. Smith, "Application Specific Integrated Circuits", Addisson Wesley, 1997
2. Sung-Mo kang, Yusuf leblebici, Chulwoo Kim "CMOS Digital Integrated Circuits: Analysis & Design",4th edition McGraw Hill Education,2013
3. Wayne Wolf, "Modern VLSI Design: System On Chip", Pearson Education, 2007
4. R.Jacob Baker, Harry W.LI., David E.Boyee, "CMOS Circuit Design, Layout and Simulation", Prentice Hall of India 2005.

WEB SITE REFERENCES:

1. www.nptel.ac.in
2. https://www.tutorialspoint.com/vlsi_design/vlsi_design_digital_system.htm
3. https://www.javatpoint.com/verilog
4. http://www.faadooengineers.com/online-study/branch/ece

CO - PO MAPPING

CO\PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	2	1	2	2	1	-	-	-	-	2	2
CO2	2	2	2	2	2	1	-	-	-	-	2	3
CO3	2	2	2	2	2	1	-	-	-	-	2	3
CO4	2	2	3	3	2	2	-	-	-	-	3	3
CO5	3	3	3	2	3	2	-	-	-	-	3	3
AVG	2	2.2	2.2	2.2	2.2	1.4	-	-	-	-	2.4	2.8

CO - PSO MAPPING

CO\PSO	PSO1	PSO2	PSO3
CO1	2	1	2
CO2	2	2	2
CO3	3	2	2
CO4	3	3	3
CO5	3	3	3
AVG	2.6	2.2	2.4

JEC1603	ANTENNAS AND MICROWAVE ENGINEERING	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To enable the student to understand the basic principles in antenna and microwave system design
- To enhance the student knowledge in the area of various antenna designs.
- To enhance the student knowledge in the area of microwave components and antenna for practical applications
- To understand the basics of microwave passive and active devices.
- To design RF amplifiers and mixers

UNIT I INTRODUCTION TO MICROWAVE SYSTEMS AND ANTENNAS 9

Microwave frequency bands, Physical concept of radiation, Near- and far-field regions, Fields and Power Radiated by an Antenna, Antenna Pattern Characteristics, Antenna Gain and Efficiency, Aperture Efficiency and Effective Area, Antenna Noise Temperature and G/T, Impedance matching, Friis transmission equation, Link budget and link margin analysis.

UNIT II RADIATION MECHANISMS AND DESIGN ASPECTS 9

Radiation Mechanisms of Linear Wire and Loop antennas, Aperture antennas, Reflector antennas, Microstrip antennas and Frequency independent antennas, Design considerations and applications, Slot antenna.

UNIT III ANTENNA ARRAYS AND APPLICATIONS 9

Two-element array, Array factor, Pattern multiplication, Uniformly spaced arrays with uniform and non-uniform excitation amplitudes, Smart antennas-MIMO antenna, Reconfigurable antennas, phased array antennas.

UNIT IV PASSIVE AND ACTIVE MICROWAVE DEVICES 9

Microwave Passive components: Directional Coupler, Power Divider, Magic Tee, attenuator, Principles of Microwave Semiconductor Devices: Gunn Diodes, IMPATT diodes, Schottky Barrier diodes, PIN diodes, Varactor diodes, Microwave tubes: Two cavity Klystron, Reflex Klystron, Cylindrical Magnetron, MMIC.

UNIT V MICROWAVE DESIGN PRINCIPLES 9

Impedance transformation, Impedance Matching, Microwave Filter Design, RF and Microwave Amplifier Design, Microwave Power amplifier Design, Low Noise Amplifier Design, Microwave Mixer Design, Microwave Oscillator Design, MEMS.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

- Apply the basic principles and evaluate antenna parameters and link power budgets
- Design and assess the performance of various antennas
- Understand the design concepts of array antennas and smart antennas
- Explain the working principles of microwave devices
- Design a microwave system given the application specifications

TEXTBOOKS:

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

REFERENCES:

1. Constantine A.Balanis, ―Antenna Theory Analysis and Design‖, Third edition, John Wiley India Pvt Ltd., 2005.
2. R.E.Collin, "Foundations for Microwave Engineering", Second edition, IEEE Press, 2001.
3. Annapurna Dass, "Microwave engineering", Tata Mcgraw-Hill publishing company, New Delhi.

WEBSITE REFERENCES:

1 www.microwaves101.com
2 www.onlinecourses-archieve.nptel.ac.in\Antennas and Wave Propagation
3 www.onlinecourses-archieve.nptel.ac.in\Microwave Engineering
4 www.ocw.mit.edu\Electromagnetics and applications
5 www.ocw.mit.edu\Micro and nano processing technology

CO - PO MAPPING

CO\PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	3	2	3	1	-	-	-	-	3	2
CO2	2	3	2	2	3	1	-	-	-	-	2	3
CO3	3	2	3	2	3	1	-	-	-	-	3	3
CO4	2	2	3	3	2	1	-	-	-	-	3	3
CO5	3	3	3	2	2	2	-	-	-	-	2	2
AVG	2.6	2.6	2.8	2.4	2.6	1.2	-	-	-	-	2.6	2.6

CO - PSO MAPPING

CO\PSO	**PSO1**	**PSO2**	**PSO3**
CO1	2	2	1
CO2	2	2	2
CO3	2	2	2
CO4	1	2	3
CO5	3	1	1
AVG	2	1.8	1.8

JPT1002	TECHNICAL SKILLS AND APTITUDE II	L	T	P	C
		0	0	2	1

COURSE OBJECTIVES

- To make students analyze and solve problems in technical as well as quantitative aptitude. Enhance the technical skills and basics of programming language
- To make the students understand how to apply the practical knowledge in real time applications.
- To make the students think and draw conclusions from different scenarios.
- To help the students understand JAVA programming concepts
- To help the students understand concepts and develop new applications in JAVA

UNIT I JAVA FUNDAMENTALS 6

OOP in Java – Characteristics of Java – Java Source-File -Structure – Compilation. Fundamental Programming Structures in Java.

UNIT II ADVANCED JAVA PROGRAMMING 6

Defining classes in Java – constructors, methods -access specifiers – static members - Data Types, Variables, Operators, Control Flow, Arrays, Inheritance – Super classes- sub classes –Protected members – constructors in sub classes- Interfaces –Strings.

UNIT III MATHEMATICAL AND ARITHMATIC PROBLEM SOLVING 6

Crpto arithmatic Problem Solving, Logarithms, Trigonometry, Mensuration, Probability, Permutations and Combinations.

UNIT IV LOGICAL REASONING - COGNITIVE THINKING 6

Numerical Ability, English Ability, Gaming, Arrangements, Visual Reasoning, Flowcharts – Visual Reasoning – DI.

UNIT V LOGICAL REASONING - CRITICAL THINKING 6

Logical Sequence, Inferred Meaning, Agree Disagree Psychometric, Statement & Conclusions, Cubes and Cuboids.

TOTAL: 30 PERIODS

COURSE OUTCOMES:

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

- Enhance their knowledge in JAVA concepts and Java Programming.
- Gain knowledge in coding using JAVA programming.
- Solve complex arithmetic problems practically with real time applications.
- Think logically in solving problems, enhance decision making, for difficult situations

TEXT BOOKS:

1. Herbert Schildt, “Java The complete reference”, 8th Edition, McGraw Hill Education, 2011.
2. Cay S. Horstmann, Gary cornell, “Core Java Volume –I Fundamentals”, 9th Edition, Prentice Hall, 2013.

3. Dr. R.S Agrawal, “Quantitative Aptitude” and Non Verbal Reasoning published in 2000.
4. S.Chand – A Modern Approach to Logical Reasoning Published in 2000.

WEBSITE REFERENCES:

1. https://www.indiabix.com/aptitude/questions-and-answers/
2. https://m4maths.com/placement-puzzles.php
3. www.freshers world.com
4. www.careerride.com
5. www.youtube.com/watch/python
6. www.youtube.com/watch/concepts of python
7. https://stackoverflow.com/
8. https://www.w3schools.com/
9. https://www.geeksforgeeks.org/

CO-PO MAPPING

CO\PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	-	-	-	-	1	-	1	-	-	1	-	1
CO2	-	-	-	-	1	-	1	-	-	1	-	1
CO3	-	-	-	-	1	-	1	-	-	1	-	1
CO4	-	-	-	-	1	-	1	-	-	1	-	1
CO5	-	-	-	-	1	-	1	-	-	1	-	1
AVG	0	0	0	0	1	0	1	0	0	1	0	1

JEC1611	COMMUNICATION NETWORKS LABORATORY	L	T	P	C
		0	0	4	2

COURSE OBJECTIVES:

- Learn to communicate between two desktop computers.
- Learn to implement the different protocols
- Be familiar with the various routing algorithms
- Be familiar with socket programming.
- Be familiar with simulation tools.

LIST OF EXPERIMENTS:

1. Implementation of Error Detection / Error Correction Techniques.
2. Implementation of Stop and Wait Protocol.
3. Implementation and study of Goback-N and selective repeat protocols.
4. Encryption and Decryption.
5. To create scenario and study the performance of network with CSMA / CA protocol and compare with CSMA/CD protocols.
6. Implementation of Distance vector routing algorithm.
7. Implementation of Link state routing algorithm.
8. Study of Socket Programming with Client – Server model.
9. Write a Socket Program for Echo/Ping/Talk commands.
10. Study of Network Simulator (NS).
11. Simulation of Congestion Control Algorithms using NS.
12. Network Topology - Star, Bus and Ring using NS2.

TOTAL: 60 PERIODS

COURSE OUTCOMES:

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

- Communicate between two desktop computers.
- Implement the different protocols
- Implement and compare the various routing algorithms
- Program using sockets.
- Use simulation tool.

LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS SOFTWARE

C / C++ / Java / Equivalent Compiler
Network simulator like NS2/ NS3 /ViRtsim/Glomosim/OPNET/ Equivalent-30

HARDWARE: Standalone desktops-30 Nos

WEB SITE REFERENCES:

1. https://www.youtube.com/watch?v=jMvA9mSIwtk,Prof.Soumyakantigosh, IITKaragpur
2. https://www.youtube.com/watch?v=pVl1L1jrbFE, Prof. S.Ghosh, Department of Computer Science & Engineering, I.I.T.,Kharagpur
3. https://www.youtube.com/watch?v=u0BTdiqhVRI, Prof.A. Pal, Department of Computer Science Engineering, IITKharagpur
4. https://www.youtube.com/watch?v=bKHRbqwkMkg, Prof.SandeepChakraborthy, Department of Computer Science & Engineering, I.I.T.,Kharagpur
5. https://freevideolectures.com/course/4469/nptel-structural-health-monitoring/55, Prof Dr. Srinivasan Chandrasekaran of IIT Madras

CO - PO MAPPING

CO / PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	3	2	3	1	-	-	-	-	1	2
CO2	3	3	2	1	2	1	-	-	-	-	2	2
CO3	3	3	3	2	3	1	-	-	-	-	1	2
CO4	3	3	2	1	2	1	-	-	-	-	1	2
CO5	3	3	2	1	2	1	-	-	-	-	2	2
AVG	3	3	2.4	1.4	2.4	1	0	0	0	0	1.4	2

CO - PSO MAPPING

CO\PSO	**PSO1**	**PSO2**	**PSO3**
CO1	3	2	3
CO2	3	2	3
CO3	3	2	3
CO4	3	2	3
CO5	3	2	3
AVG	3	2	3

JEC1612	VLSI DESIGN LABORATORY	L	T	P	C
		0	0	4	2

COURSE OBJECTIVES:

- To learn Hardware Descriptive Language (Verilog/VHDL)
- To learn the fundamental principles of VLSI circuit design in digital and analog domain
- To familiarize fusing of logical modules on FPGAs
- To provide hands on design experience with professional design (EDA) platforms
- To learn CMOS Circuits

LIST OF EXPERIMENTS:

PART I: DIGITAL SYSTEM DESIGN USING HDL & FPGA (24 Periods)

1. Design an Adder (Min 8 Bit) using HDL. Simulate it using Xilinx/Altera Software and implement by Xilinx/Altera FPGA
2. Design a Multiplier (4 Bit Min) using HDL. Simulate it using Xilinx/Altera Software and implement by Xilinx/Altera FPGA
3. Design 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.

PART-II DIGITAL CIRCUIT DESIGN (24 Periods)

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

PART-III ANALOG CIRCUIT DESIGN (12 Periods)

10. Design and Simulate a CMOS Inverting Amplifier.
11. Design and Simulate basic Common Source, Common Gate and Common Drain Amplifiers.
12. Design and simulate simple 5 transistor differential amplifier. Analyze Gain, Bandwidth and CMRR by performing Schematic Simulations.

Requirements: Cadence/Synopsis/ Mentor Graphics/Tanner/equivalent EDA Tools

TOTAL: 60 PERIODS

COURSE OUTCOMES:

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

- Write HDL code for basic as well as advanced digital integrated circuit
- Import the logic modules into FPGA Boards
- Synthesize Place and Route the digital IPs
- Design, Simulate and Extract the layouts of Digital & Analog IC Blocks using EDA Tools.
- Design and simulate CMOS related circuits.

Requirements: Xilinx ISE/Altera Quartus/ equivalent EDA along with Xilinx/ Altera/ equivalent FPGA Boards

LIST OF EQUIPMENTS FOR A BATCH OF 30 STUDENTS

S. No	EQUIPMENT	REQUIRED
1	Xilinx ISE/Altera Quartus/ equivalent EDA Tools	10 User License
2	Xilinx/Altera/equivalent FPGA Boards	10 Nos.
3	Cadence/Synopsis/Mentor Graphics/Tanner/equivalent EDA Tools	10 User License
4	Personal Computer	30 Nos.

WEBSITE REFERENCES:

1. https://nptel.ac.in/courses/106/103/106103116/ Dr. Santosh Biswas, Department of Computer Science and Engineering, IIT Guwahati.
2. https://nptel.ac.in/courses/117/106/117106093/ Dr.Nandita Dasgupta, IIT-Madras.
3. https://nptel.ac.in/courses/117/101/117101004/Prof. SachinPatkar , IIT-Bombay.

CO - PO MAPPING

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	1	2	1	3	2	-	-	-	-	1	1
CO2	2	2	2	3	3	1	-	-	-	-	1	3
CO3	2	2	2	3	3	2	-	-	-	-	1	1
CO4	1	2	2	1	3	1	-	-	-	-	1	3
CO5	1	2	2	3	3	1	-	-	-	-	1	1
AVG	1.4	1.8	2	2.2	3	1.4	0	0	0	0	1	1.8

CO - PSO MAPPING

CO\PSO	PSO1	PSO2	PSO3
CO1	2	2	1
CO2	2	2	2
CO3	1	2	2
CO4	3	3	1
CO5	3	1	3
AVG	2.2	2	1.8

SEMESTER VII

JEC1701	OPTICAL COMMUNICATION AND OPTICAL SENSORS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To study about the various optical fiber modes and configuration
- To understand the transmission characteristics of optical fibers
- To learn about the various optical sources
- To know about optical detector and receiver systems
- To learn about various optical sensors

UNIT I INTRODUCTION TO OPTICAL FIBERS 9

Overview of 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, fiber fabrication techniques, fiber optic cables, classification of optical fiber, single mode fiber, multimode fiber.

UNIT II TRANSMISSION CHARACTERISTIC OF OPTICAL FIBER 9

Attenuation, absorption, scattering losses, bending losses, core and cladding losses, signal dispersion, inter symbol interference, intermodal dispersion, intra model dispersion, material dispersion, waveguide dispersion, polarization mode dispersion, dispersion optimization of single mode fiber, dispersion calculation, MFD,Case Study:Optical Fiber Splicing.

UNIT III OPTICAL SOURCES 9

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, Case Study: OLED.

UNIT IV OPTICAL DETECTORS AND RECEIVER 9

Detectors: PIN photo detector, Avalanche photo diodes, Photo detector noise, noise sources, SNR, detector response time, comparisons of photo detectors.**Receivers:** Fundamental receiver operation, preamplifiers, digital signal transmission, error sources, Front end amplifiers, digital receiver performance, Probability of error, receiver sensitivity, Case Study: Quantum Teleportation.

UNIT V FIBER OPTIC SENSORS 9

Grating Sensors, Multimode Grating and Polarization Sensors, Distributed and Magnetic Sensors, Faraday Effect Sensors, Magnetostrictive, Lorentz Force Sensors, Chemical and Biosensor, Humidity Sensor, Ph-Sensor, Hydrogen Sensor, Oxygen Sensor, Case Study: PSPR and LSPR.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

- Realize basic elements in optical fibers, different modes and configurations.
- Analyze the transmission characteristics associated with dispersion and polarization techniques.
- Design optical sources with their use in advanced communication system.
- Construct fiber optic detector and receiver systems.
- Familiarize about fiber optic sensor technology.

TEXT BOOKS:

1. John M.Senior, “Optical Fiber Communication”, Pearson Education, Third edition, 2015.
2. GerdKeiser,"Optical Fiber Communication”, McGraw Hill Education Private Limited, Fifth Edition, 2013.

REFERENCES:

1. P.Chakrabarti, "Optical Fiber Communication”, McGraw Hill Education Private Limited**,** 2016.
2. J.Gower, “Optical Communication System”, Prentice Hall of India, 2001.
3. David A. Krohn, “Fiber optic sensors: fundamentals and applications”, ISA Publishing, 2000.
4. Bhagavanadasa Gupta, Banshi Das Gupta, “Fiber Optic Sensors: Principles and Applications”, New India Publishing, 2006.

WEBSITE REFERENCES:

1. https://onlinecourses.nptel.ac.in/noc22_ph01/preview
2. http://www.olsontech.com/mr_fiber/fiber101.htm
3. http://courses.washington.edu/me557/sensor/
4. https://www.coursera.org/specializations/optical-engineering
5. https://www.sydney.edu.au/units/ELEC5516

CO - PO MAPPING

CO\PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	3	2	1	-	1	-	-	-	-	1	1
CO2	2	3	2	1	-	1	-	-	-	-	1	1
CO3	2	2	2	1	-	1	-	-	-	-	1	1
CO4	2	3	2	1	-	1	-	-	-	-	1	1
CO5	2	2	2	1	-	2	-	-	-	-	1	1
AVG	**2**	**2.6**	**2**	**1**	**-**	**1.2**	**-**	**-**	**-**	**-**	**1**	**1**

CO -PSO MAPPING

CO\PSO	PSO1	PSO2	PSO3
CO1	3	3	2
CO2	2	2	2
CO3	2	2	2
CO4	2	2	2
CO5	3	2	3
AVG	**2.4**	**2.2**	**2.2**

JEC1702	EMBEDDED SYSTEMS AND PRODUCT DESIGN	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To learn the architecture and programming of ARM processor.
- To be familiar with the embedded computing platform design and analysis.
- To gain knowledge on the basic concepts of real time Operating system.
- To learn the system design techniques and networks for embedded systems
- To familiarize about design technology platform and concepts.

UNITI INTRODUCTION TO EMBEDDED COMPUTING AND ARM PROCESSORS 9

Complex systems and microprocessors– Embedded system design process – Instruction sets preliminaries - ARM Processor – supervisor mode, exceptions and traps – Co-processors- Memory system mechanisms.

UNIT II EMBEDDED COMPUTING PLATFORM DESIGN 9

The CPU Bus-Memory devices and systems–Designing with computing platforms – consumer electronics architecture – platform-level performance analysis - Components for embedded programs- Models of programs- Assembly, linking and loading – compilation techniques- Program validation and testing.

UNITIII PROCESSES AND OPERATING SYSTEMS 9

Introduction – Multiple tasks and multiple processes – Multirate systems- Preemptive real-time operating systems- Priority based scheduling - Interprocess communication mechanisms – Example Real time operating systems-RTEMS, Wind River systems

UNIT IV SYSTEM DESIGN TECHNIQUES AND NETWORKS 9

Design methodologies- Design flows - Requirement Analysis – Specifications-System analysis and architecture design - Distributed embedded systems – MPSoCs and shared memory multiprocessors. Design Examples- Personal Digital Assistant- Engine Control Unit- Software Modem

UNITV DESIGN TECHNOLOGY 9

Automation : Synthesis - Logic and Behavioral Synthesis Verification- Hardware / Software Co simulation- Reuse- Design Process Models

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

- Analyze the architecture and programming of ARM processor.
- Outline the concepts of embedded systems
- Analyze the basic concepts of real time Operating system design.
- Use the system design techniques for analyzing embedded systems
- Analyze real-time design technology concepts.

TEXT BOOKS:

1. Marilyn Wolf, “Computers as Components - Principles of Embedded Computing System Design”, Third Edition “Morgan Kaufmann Publisher (An imprint from Elsevier), 2012. (Unit I to IV)
2. Frank Vahid and Tony Givargis "Embedded system Design-A unified Hardware/Software Approach" 1999 Edition (Unit V)

REFERENCES:

1. Jonathan W.Valvano, "Embedded Microcomputer Systems Real Time Interfacing", Third Edition Cengage Learning,2012.
2. David. E. Simon, "An Embedded Software Primer", 1st Edition, Fifth Impression, Addison-Wesley Professional,2007.
3. Raymond J.A. Buhr, Donald L.Bailey, "An Introduction to Real-Time Systems- From Design to Networking with C/C++", Prentice Hall, 1999.
4. C.M. Krishna, Kang G. Shin, "Real-Time Systems", International Editions, Mc Graw Hill1997
5. K.V.K.K.Prasad, "Embedded Real-Time Systems: Concepts, Design & Programming", Dream Tech Press,2005.
6. Sriram V Iyer, Pankaj Gupta, "Embedded Real Time Systems Programming", Tata Mc Graw Hill, 2004.

WEBSITE REFERENCES:

1. https://nptel.ac.in/courses/108102045/
2. E Book Embedded system Designhttp://esd.cs.ucr.edu/
3. https://resources.pcb.cadence.com/blog/embedded-systems-design-functionality-and-processes
4. https://nptel.ac.in/courses/108102169
5. https://nptel.ac.in/courses/106103182

CO - PO MAPPING

CO\PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	2	2	2	2	2	-	-	-	-	1	1
CO2	3	3	3	3	2	2	-	-	-	-	1	1
CO3	3	3	3	3	3	2	-	-	-	-	1	1
CO4	2	2	2	2	2	2	-	-	-	-	1	1
CO5	3	3	3	3	3	3	-	-	-	-	1	1
AVG	**2.6**	**2.6**	**2.6**	**2.6**	**2.4**	**2.2**	**0**	**0**	**0**	**0**	**1**	**1**

CO -PSO MAPPING

CO\PSO	PSO1	PSO2	PSO3
CO1	3	3	2
CO2	2	2	2
CO3	2	2	2
CO4	2	2	2
CO5	3	2	3
AVG	**2.4**	**2.2**	**2.2**

JEC1711	OPTICAL AND MICROWAVE LABORATORY	L	T	P	C
		0	0	4	2

COURSE OBJECTIVES:

- To understand the working principle of optical and microwave components
- To understanding of basic optical communication link
- To learn about the characteristics and measurements in optical fiber
- To know about the behavior of microwave components
- To measure S-parameters of microwave devices

LIST OF OPTICAL EXPERIMENTS

1. DC Characteristics of LED and PIN Photodiode
2. Measurement of Connector and Bending Losses
3. Fiber Optic Analog and Digital Link
4. Numerical Aperture Determination for Fibers
5. Attenuation Measurement in Fibers

LIST OF MICROWAVE EXPERIMENTS

1. Reflex Klystron – Mode Characteristics
2. Gunn Diode – VI Characteristics
3. VSWR, Frequency and Wave Length Measurement
4. Directional Coupler – Directivity, Coupling Coefficient and S–Parameter measurement
5. Isolator and Circulator – S–Parameter measurement
6. S- Matrix Characterization of E–Plane Tee, H–Plane Tee and Magic Tee
7. Radiation Pattern of Horn Antenna
8. Antenna Gain Measurement

TOTAL: 60 PERIODS

COURSE OUTCOMES:

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

- Analyze the performance of fiber optical active and passive devices.
- Analyze and measure the numerical aperture and losses of optical fibers.
- Analyze the characteristics of microwave active devices.
- Measure the S-parameters of microwave passive devices.
- Analyze the radiation pattern and gain of horn antenna.

LIST OF EQUIPMENTS FOR A BATCH OF 30 STUDENTS (3 students per batch)

1. Trainer kit for carrying out LED and PIN diode characteristics, Digital multi meter, optical power meter – 2 Nos.
2. Trainer kit for analyzing Analog and Digital link performance, 2 Mbps PRBS Data source, 10 MHz signal generator, 20 MHz Digital storage Oscilloscope – 2 Nos.
3. Trainer Kit for measuring Numerical aperture and losses of optical fiber - 2 Nos.
4. MM/SM Glass and plastic fiber patch chords with ST/SC/E2000 connectors - 2 set.
5. LEDs with ST / SC / E2000 receptacles – 650 / 850 nm - 2 set.

6. PIN PDs with ST / SC / E2000 receptacles – 650 / 850 nm - 2 set.
7. Microwave test Bench at X band to determine Directional coupler characteristics. - 2 Nos.
8. Microwave test Bench at X band and Antenna turn table to measure Radiation pattern of Horn antenna, 2 Horn antennas. – 2 Nos.
9. Microwave test Bench at X band to determine VSWR for Isolator and Circulator, VSWR meter, Isolator, Circulator, E Plane Tee, H plane Tee. - 2 Nos.
10. Microwave test Bench at X band, Variable attenuator, Detector and 20 MHz Digital Analog Oscilloscope – 2 Nos.

WEBSITE REFERENCES:

1. https://nptel.ac.in/courses/108103141
2. https://nptel.ac.in/courses/117101002/
3. https://onlinecourses.nptel.ac.in/noc20_ee20/preview
4. http://www.olsontech.com/mr_fiber/fiber101.htm
5. https://cemelearning.co.in/course/info.php?id=523

CO - PO MAPPING

CO - PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	2	2	2	2	2	-	-	-	-	1	1
CO2	2	2	2	2	1	2	-	-	-	-	1	1
CO3	2	2	2	2	1	1	-	-	-	-	1	1
CO4	3	2	2	2	2	1	-	-	-	-	1	1
CO5	2	2	1	2	2	2	-	-	-	-	1	1
Average	**2.2**	**2**	**1.8**	**2**	**1.6**	**1.6**	-	-	-	-	**1**	**1**

CO -PSO MAPPING

CO\PSO	PSO1	PSO2	PSO3
CO1	3	3	2
CO2	2	2	2
CO3	2	2	2
CO4	2	2	2
CO5	3	2	3
AVG	**2.4**	**2.2**	**2.2**

JEC1712	EMBEDDED SYSTEM DESIGN LABORATORY	L	T	P	C
		0	0	4	2

COURSE OBJECTIVES:

- To learn the working of ARM processor
- To understand the interfacing with Embedded Systems
- To learn the concept of memory map and memory interface
- To write programs to interface memory, I/Os with processor
- To learn about interfacing of wireless modules

LIST OF EXPERIMENTS

1. Study of ARM evaluation system
2. Interfacing ADC
3. Interfacing LED and PWM.
4. Interfacing real time clock and serial port.
5. Interfacing keyboard and LCD.
6. Interfacing EPROM and interrupt.
7. Interrupt performance characteristics of ARM and FPGA.
8. Flashing of LEDS
9. Interfacing stepper motor and temperature sensor.
10. Implementing zigbee protocol with ARM.

TOTAL: 60 PERIODS

COURSE OUTCOMES:

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

- Write programs in ARM for a specific Application
- Interface memory, A/D convertor with ARM system
- Analyze the performance of interrupt
- Write program for interfacing keyboard, display, motor and sensor.
- Analyze the interfacing of wireless modules

LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS (3 students per batch)

- Embedded trainer kits with ARM board 10 Nos
- Embedded trainer kits suitable for communication 10 Nos

WEBSITE REFERENCES:

1. https://community.arm.com/arm-community-blogs/b/embedded-blog/posts/embedded-c-programming-with-arm-cortex-m-video-course
2. https://www.digimat.in/nptel/courses/video/106105193/L04.html

CO -PO MAPPING

CO\PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	2	2	2	2	2	-	-	-	-	1	1
CO2	3	3	3	3	2	2	-	-	-	-	1	1
CO3	3	3	3	3	3	2	-	-	-	-	1	1
CO4	2	2	2	2	2	2	-	-	-	-	1	1
CO5	3	3	3	3	3	3	-	-	-	-	1	1
AVG	**2.6**	**2.6**	**2.6**	**2.6**	**2.4**	**2.2**	**0**	**0**	**0**	**0**	**1**	**1**

CO - PSO MAPPING

CO\PSO	PSO1	PSO2	PSO3
CO1	3	3	2
CO2	2	2	2
CO3	2	2	2
CO4	2	2	2
CO5	3	2	3
AVG	**2.4**	**2.2**	**2.2**

JEC1731	PROJECT WORK - PHASE - 1	L	T	P	C
		0	0	6	3

COURSE OBJECTIVES:

- To identify a specific problem for the present need of the society and collecting information related to the same through detailed literature survey.
- To develop the methodology to solve the identified problem.
- To design, analyze and simulate the chosen problem using the software package.
- To train the students in preparing project reports and to face reviews and viva-voce examination.

METHOD OF EVALUATION:

The students in a group of 3 to 4 work on a topic approved by the Head of the Department under the guidance of a faculty member, prepare a comprehensive project report after completing the work to the satisfaction of the supervisor. The progress of the project is evaluated based on a minimum of three reviews. The review committee is constituted by the Head of the Department. The project work is evaluated based on oral presentation and the project report, jointly by external and internal examiners.

TOTAL: 90 PERIODS

COURSE OUTCOMES:

On completion of the phase - 1 project work, the students will be able to

- Analyze and formulate the problem
- Identify the methodology needed to solve the problem.
- Identify the tools and techniques required to solve the problem.
- Work with team mates to acquire the required material needed to find solutions to the chosen problem.
- Effectively communicate the outcomes of the findings.

CO -PO MAPPING

CO\PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	2	2	3	2	3	-	-	-	-	2	2
CO2	2	2	3	3	2	3	-	-	-	-	2	2
CO3	3	3	3	3	3	3	-	-	-	-	3	3
CO4	3	3	3	3	3	3	-	-	-	-	3	3
CO5	3	3	3	3	3	3	-	-	-	-	3	3
AVG	2.6	2.6	2.8	3	2.6	3	**0**	**0**	**0**	**0**	**2.6**	**2.6**

CO - PSO MAPPING

CO\PSO	PSO1	PSO2	PSO3
CO1	2	2	2
CO2	3	3	3
CO3	3	3	3
CO4	3	3	3
CO5	3	3	3
AVG	**2.8**	**2.8**	**2.8**

SEMESTER VIII

JNC1861	INDIAN CONSTITUTION	L	T	P	C
		2	0	0	0

COURSE OBJECTIVES:

- To understand the importance of Indian constitution, Administration, Concept and Development of Human Rights, election commission.

UNIT I INTRODUCTION TO INDIAN CONSTITUTION 6

Constitution' meaning of the term, Indian Constitution- Sources and constitutional history, Features- Citizenship, Preamble, Fundamental Rights and Duties, Directive Principles of State Policy

UNIT II UNION GOVERNMENT AND ITS ADMINISTRATION 6

Structure of the Indian Union: Federalism, Centre- State relationship, President: Role, power and position, PM and Council of ministers, Cabinet and Central Secretariat, Lok Sabha, Rajya Sabha, The Supreme Court and High Court: Powers and Functions; **State Government and its Administration** Governor: Role and Position, CM and Council of ministers, State Secretariat: Organization, Structure and Functions

UNIT III LOCAL ADMINISTRATION 6

A: Local Administration District's Administration head: Role and Importance, Municipalities: Introduction, Mayor and role of Elected Representative, CEO of Municipal Corporation,

B: Pachayati raj: Introduction, PRI: Zila Pachayat, Elected officials and their roles, CEO Zila Pachayat: Position and role, Block level: Organizational Hierarchy (Different departments), Village level: Role of Elected and Appointed officials, Importance of grass root democracy

UNIT IV CONCEPT AND DEVELOPMENT OF HUMAN RIGHTS 6

Meaning Scope and Development of Human Rights, United Nations and Human Rights – UNHCR, UDHR 1948, ICCPR 1996 and ICESCR 1966, Human Rights in India: Protection of Human Rights Act,1993 (NHRC and SHRC), First, Second and Third Generation Human Rights, Judicial Activism and Human Rights.

UNIT V ELECTION COMMISSION 6

Election Commission- Role and Functioning, Chief Election Commissioner and Election Commissioners, State Election Commission: Role and Functioning, Institute and Bodies for the welfare of SC/ST/OBC and women.

TOTAL:30PERIODS

COURSE OUTCOMES:

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

- Know the sources, features and principles of Indian Constitution.
- Learn about Union Government, State government and its administration.
- Get acquainted with Local administration and Pachayati Raj.
- Be aware of basic concepts and developments of Human Rights.
- Gain knowledge on roles and functioning of Election Commission.

CO - PO MAPPINGS

CO\PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	-	-	1	1	1	1	1	-	-	-	-	-
CO2	-	-	1	1	1	1	1	-	-	-	-	-
CO3	-	-	1	1	1	1	1	-	-	-	-	-
CO4	-	-	1	1	1	1	1	-	-	-	-	-
CO5	-	-	1	1	1	1	1	-	-	-	-	-
AVG	0	0	1	1	1	1	1	0	0	0	0	0

REFERENCES:

1. Durga Das Basu, Introduction to the Constitution of India, Prentice – Hall of India Pvt. Ltd. NewDelhi
2. SubashKashyap, Indian Constitution, National BookTrust
3. J.A. Siwach, Dynamics of Indian Government &Politics
4. D.C. Gupta, Indian Government and Politics
5. H.M.Sreevai, Constitutional Law of India, 4th edition in 3 volumes (Universal Law Publication)
6. J.C. Johari, Indian Government and Politics Hans
7. J. Raj Indian Government and Politics
8. M.V. Pylee, Indian Constitution Durga Das Basu, Human Rights in Constitutional Law, Prentice – Hall of India Pvt. Ltd. NewDelhi
9. Noorani, A.G., (South Asia Human Rights Documentation Centre), Challenges to Civil Right), Challenges to Civil Rights Guarantees in India, Oxford University Press 2012

WEBSITE REFERENCES:

1. nptel.ac.in/courses/109104074/8
2. nptel.ac.in/courses/109104045/
3. nptel.ac.in/courses/101104065/
4. www.hss.iitb.ac.in/en/lecture-details
5. www.iitb.ac.in/en/event/2nd-lecture-institute-lecture-series-indian-constitution.

JEC1832	PROJECT WORK - PHASE - 2	L	T	P	C
		0	0	18	9

COURSE OBJECTIVES:

- To develop the ability to solve a specific problem related to their subject expertise.
- To develop the methodology to solve the identified problem.
- To design, analyze and implement the chosen problem using the hardware components.
- To validate the simulation, hardware results with the theoretical results.
- To train the students in preparing project reports and to face reviews and viva-voce examination.

METHOD OF EVALUATION:

The students in a group of 3 to 4 work on a topic approved by the Head of the Department under the guidance of a faculty member, prepare a comprehensive project report after completing the work to the satisfaction of the supervisor. The progress of the project is evaluated based on a minimum of three reviews. The review committee is constituted by the Head of the Department. The project work is evaluated based on oral presentation and the project report, jointly by external and internal examiners.

TOTAL: 270 PERIODS

COURSE OUTCOMES:

On Completion of the project work, the student will be able to

- Apply the technical knowledge acquired for solving real world problems.
- Develop skills such as self learning, critical thinking, problem solving, project management and finance.
- Apply modern tools and techniques.
- Work with team mates and collectively work towards the success of the project.
- Communicate effectively to present the outcomes of the project both in written and oral forms.

CO -PO MAPPING

CO\PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	2	2	3	2	3	-	-	-	-	2	2
CO2	2	2	3	3	2	3	-	-	-	-	2	2
CO3	3	3	3	3	3	3	-	-	-	-	3	3
CO4	3	3	3	3	3	3	-	-	-	-	3	3
CO5	3	3	3	3	3	3	-	-	-	-	3	3
AVG	**2.6**	**2.6**	**2.8**	**3**	**2.6**	**3**	**0**	**0**	**0**	**0**	**2.6**	**2.6**

CO - PSO MAPPING

CO\PSO	PSO1	PSO2	PSO3
CO1	2	2	2
CO2	3	3	3
CO3	3	3	3
CO4	3	3	3
CO5	3	3	3
AVG	**2.8**	**2.8**	**2.8**

JEC1851	COMPREHENSION & TECHNICAL SEMINAR	L	T	P	C
		0	0	2	1

COURSE OBJECTIVES:

- To revamp the knowledge gained in the semester and prepare the students to face interview both at the academic and the Industrial Sector
- To encourage the students to study about the recent developments in the field
- To prepare and present technical reports
- To encourage the students to use various teaching aids such as Power point presentation and Demonstrative models

METHOD OF EVALUATION:

COMPREHENSION:

One period is allotted for comprehension. During this period, a test with objective type questions from competitive exams is conducted in identified technical courses. The evaluation is purely internal. Average of all the test marks shall be calculated, a weightage of 50 marks is awarded to the comprehension component.

TECHNICAL SEMINAR:

Three periods are allotted for the technical seminar. During the seminar session each student is expected to prepare and present a technical topic for duration of 10 minutes.
Each student is expected to make presentation at least twice during the semester and the student is evaluated based on various parameters such as topic chosen, content delivery, communication skills and presentation. A faculty guide is allotted who shall guide and monitor the progress and attendance of all the students. Equal weightage is considered for the two seminar sessions for a total weightage of 50 marks.

The total mark awarded for the course shall be the sum of marks scored out of 50 each for the two components. Evaluation is purely internal.

TOTAL: 30 PERIODS

COURSE OUTCOMES:

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

- Consolidate all the engineering concepts acquired in the course of study.
- Enrich their technical knowledge.
- Prepare and present technological developments.
- Communicate effectively the concepts related to the various topics.
- Face the interviews with confidence during the placement drives.

CO - PO MAPPING

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	1	2	1	3	2	2	2	2	2	1	1
CO2	2	2	2	3	3	1	1	1	1	1	1	3
CO3	2	2	2	3	3	2	2	2	2	2	1	1
CO4	1	2	2	1	3	1	1	1	1	1	1	3
CO5	1	2	2	3	3	1	1	1	1	1	1	1
AVG	**1.4**	**1.8**	**2**	**2.2**	**3**	**1.4**	**1.4**	**1.4**	**1.4**	**1.4**	**1**	**1.8**

CO - PSO MAPPING

CO\PSO	**PSO1**	**PSO2**	**PSO3**
CO1	2	2	1
CO2	2	2	2
CO3	1	2	2
CO4	2	3	1
CO5	2	1	3
AVG	**2.2**	**2**	**1.8**

JERUSALEM COLLEGE OF ENGINEERING

(An Autonomous Institution, Affiliated to Anna University)
NAAC ACCREDITED INSTITUTION
VELACHERY MAIN ROAD, NARAYANAPURAM
PALLIKKARANAI, CHENNAI - 600100

B.E. ELECTRONICS AND COMMUNICATION ENGINEERING

REGULATION – 2021

PROFESSIONAL ELECTIVES

DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

R2021

PROFESSIONAL ELECTIVE COURSES: VERTICALS

Vertical I Smart Automation	Vertical II Sensors and IoT	Vertical III Signal Processing	Vertical IV High Speed Communication	Vertical V Semiconductor Design and Testing	Vertical VI RF Technologies	Vertical VII Underwater and Space Technologies
JEC1003 - Control Systems Engineering	JEC1007 – Sensors and Actuators	**JEC1038 - Bio Signal Processing**	JEC1009 - Information Theory & Coding	**JEC1044 - Fundamentals of Nanoelectronics**	JEC1014 - Electromagnetic Interference and Compatibility	**JEC1052 - Radar Technologies**
JEC1005 - Measurements and Instrumentation	**JEC1031 - RF and Microwave Sensors**	**JEC1039 - Speech Processing**	JEC1016 - Statistical Theory of Communication	JEC1020 - CMOS Analog IC Design	JEC1021 – Software Defined Radio	**JEC1053 - Positioning and Navigational Systems**
JEC1001 - Medical Electronics	**JEC1032 - Flexible and Wearable Sensors**	JEC1008 - Digital Audio Engineering	JEC1012 - Multimedia Compression and Communication	JEC1025 - Low Power VLSI Design	JEC1022 – RF Integrated Circuits	**JEC1054 - Avionics Systems**
JEC1006 - Industrial Electronics	**JEC1033 - IoT Fundamentals and Architecture**	**JEC1040 - Statistical Signal Processing**	JEC1024 - Wireless Communication & Sensor Networks	**JEC1045 - ASIC Design**	JEC1015 – Radar and Navigational Aids	**JEC1055 - Remote Sensing**
JEC1023 - MEMS	**JEC1034 - IoT Based System Design**	JBM1701 – Digital Image Processing	JEC1010 - Mobile Communication	**JEC1046 - Mixed Signal IC Design**	**JEC1049 - RFID System Design & Testing**	**JEC1056 - Underwater Instrumentation System**
JEC1011 - Robotics and Automation	**JEC1035 - Flying IoT**	**JEC1041 - Computer Vision**	JEC1017 – High Performance Communication Networks	**JEC1047 - Validation and Testing Technology**	JEC1013 – Satellite Communication	**JEC1057 - Underwater Imaging Systems**
JEC1029 - Industrial Automation and Control	**JEC1036 - Embedded IoT**	JEC1019 - Soft Computing	**JEC1042 - 4G/5G Communication Networks**	JEC1028 – VLSI for Wireless Communication	**JEC1050 - Microwave Integrated Circuits**	**JEC1058 - Underwater Navigation Systems**
JEC1030 - Industrial IoT and Industry 4.0	**JEC1037 - Cloud Computing**	JEC1026 - Pattern Recognition	**JEC1043 - Information and Network Security**	**JEC1048 - Reconfigurable Computing with FPGA**	**JEC1051 - mm Wave Communication**	**JEC1059 - Underwater Communication**

Academic Coordinator **HOD-ECE**

JEC1003	CONTROL SYSTEMS ENGINEERING	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To introduce the components and their representation of control systems
- To learn various methods for analyzing the time response
- To learn various methods for analyzing the frequency response
- To analyze the -stability of the systems.
- To learn the various approach for the state variable analysis.

UNIT I SYSTEMS COMPONENTS AND THEIR REPRESENTATION 9

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-DC and AC servo Systems-Synchronous -Multivariable control system

UNIT II TIME RESPONSE ANALYSIS 9

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

UNIT III FREQUENCY RESPONSE AND SYSTEM ANALYSIS 9

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

UNIT IV CONCEPTS OF STABILITY ANALYSIS 9

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

UNIT V CONTROL SYSTEM ANALYSIS USING STATE VARIABLE METHODS 9

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.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

- To identify the various control system components and their representations.
- To analyze the various time domain parameters.
- To analysis the various frequency response plots and its system.
- To apply the concepts of various system stability criterions.
- To design various transfer functions of digital control system using state variable models.

TEXT BOOK:

1. M.Gopal, “Control System – Principles and Design”, 4th Edition, Tata McGraw Hill, 2012.

REFERENCES:

1. J.Nagrath and M.Gopal, "Control System Engineering", 5th Edition, New Age International Publishers, 2007.
2. K. Ogata, "Modern Control Engineering", 5th edition, PHI, 2012.
3. S.K.Bhattacharya, "Control System Engineering", 3rd Edition, Pearson, 2013.
4. Benjamin.C.Kuo, "Automatic control system", 7th Edition, Prentice Hall of India, 1995

WEBSITE REFERENCES:

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2. https://nptel.ac.in/courses/108/102/108102112/Prof.Shouribrata Chatterjee, IIT, Delhi
3. https://nptel.ac.in/courses/108/108/108108111/Prof.Hardik Jeetendra Pandya, IISc, Bangalore.
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5. https://nptel.ac.in/courses/112/105/112105267/Prof.Anandaroop Bhattacharya, IIT, Kharagpur
6. https://nptel.ac.in/courses/108107142/Prof. Sudeb Dasgupta, IIT, Roorkee.
7. https://nptel.ac.in/courses/108/102/108102112/Prof.Shouribrata Chatterjee, IIT, Delhi.

CO-PO MAPPING

CO\PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	3	3	3	2	-	-	-	-	2	2
CO2	3	3	3	3	3	2	-	-	-	-	2	2
CO3	3	3	3	3	3	2	-	-	-	-	2	2
CO4	3	3	3	3	3	2	-	-	-	-	3	2
CO5	3	3	2	3	3	2	-	-	-	-	2	3
AVG	3	3	3	3	3	2	-	-	-	-	2	2

CO - PSO MAPPING

CO\PSO	PSO1	PSO2	PSO3
CO1	2	2	2
CO2	2	2	2
CO3	3	2	2
CO4	3	3	3
CO5	3	3	3
AVG	2.6	2.4	2.4

JEC1005	MEASUREMENTS AND INSTRUMENTATION	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To introduce Characteristics of measurement systems.
- To introduce principles of various measurement techniques using analog and digital
- equipments.
- To teach Importance of signal generators and analyzers in measurements.
- To emphasize the need for data acquisition systems and optical domain measurements.
- To learn about display and recording systems

UNIT I SCIENCE OF MEASUREMENT 9

Measurement System – Instrumentation –Functional elements of an instrument –Characteristics of measurement systems – Static and Dynamic – Errors in Measurements – Calibration and Standards.

UNIT II TRANSDUCERS 9

Classification of Transducers – Variable Resistive transducers – Strain gauges, Thermistor, RTD Variable Inductive transducers- LVDT, RVDT, Variable Capacitive Transducers – Capacitor microphone- Photo electric transducers – Piezo electric transducers –Hall effect– Thermocouple – IC sensors - Fibre optic sensors – Smart/intelligent sensors –Thermal Imagers.

UNIT III SIGNAL CONDITIONING AND SIGNAL ANALYZERS 9

DC and AC bridges – Wheatstone, Kelvin, Maxwell, Hay and Schering. Pre-amplifier – Isolation amplifier – Filters – Data acquisition systems. Spectrum Analyzers – Network analyzer –Wave analyzers – Logic analyzers.

UNIT IV DIGITAL INSTRUMENTS 9

Digital Voltmeters – Millimeters – automation in Voltmeter – Accuracy and Resolution in DVM - Guarding techniques – Frequency counter- Data Loggers – Introduction to IEEE 488/GPIB Buses – Fiber optic measurements for power and system loss – optical time domains reflectometer.

UNIT V DATA DISPLAY AND RECORDING SYSTEMS 9

Dual trace CRO – Digital storage and Analog storage oscilloscope – Mixed signal oscilloscope. Analog and Digital Recorders and printers. Virtual Instrumentation - Block diagram and architecture – Applications in various fields. Measurement systems applied to Micro and Nanotechnology.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of the course the students will be able:

- To review about the principles of various measurement techniques.
- To analyze the transducers and its impact.
- To explain about the signal conditioning system and signal analyzers.
- To illustrate the digital measurement equipments.
- To emphasize the need for data acquisition, recording and display systems.

TEXT BOOKS:

1. Albert D.Helfrick and William D. Cooper, “Modern Electronic Instrumentation and Measurement Techniques”, Prentice Hall of India, 2007.
2. Ernest O.Doebelin and dhanesh N manik, “Measurement systems”,5th edition, McGraw-Hill, 2007.

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1. Joseph J.Carr, “Elements of Electronics Instrumentation and Measurement”, Pearson Education, 2003.
2. Alan. S. Morris, “Principles of Measurements and Instrumentation”, 2nd Edition, Prentice Hall of India, 2003.
3. David A. Bell, “Electronic Instrumentation and measurements”, Prentice Hall of India Pvt Ltd, 2003.
4. B.C. Nakra and K.K. Choudhry, “Instrumentation, Measurement and Analysis”, 2nd Edition, TMH, 2004.
5. James W. Dally, William F. Riley, Kenneth G. McConnell, “Instrumentation for Engineering Measurements”, 2nd Edition, John Wiley, 2003.

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2. https://nptel.ac.in/courses/108/105/108105153/
3. http://www.nptelvideos.in/2012/11/industrial-instrumentation.html
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CO -PO MAPPING

CO\PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	2	2	2	3	-	-	-	-	3	3
CO2	3	3	3	2	2	2	-	-	-	-	2	3
CO3	3	3	3	2	2	3	-	-	-	-	3	3
CO4	3	2	3	3	3	3	-	-	-	-	2	3
CO5	3	2	2	2	2	2	-	-	-	-	3	2
AVG	3	3	2	2	2	3	-	-	-	-	3	3

CO - PSO MAPPING

CO\PSO	PSO1	PSO2	PSO3
CO1	3	1	2
CO2	3	2	2
CO3	3	3	2
CO4	3	3	3
CO5	3	3	3
AVG	3	2.4	2.4

JEC1001	MEDICAL ELECTRONICS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

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

UNIT I ELECTRO-PHYSIOLOGY AND BIO-POTENTIAL RECORDING 9

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

UNIT II BIO-CHEMICAL AND NON ELECTRICAL PARAMETER MEASUREMENT 9

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

UNIT III ASSIST DEVICES 9

Cardiac pacemakers, DC Defibrillator, Dialyser, Ventilators, Magnetic Resonance Imaging Systems, Ultrasonic Imaging Systems, Nuclear medical Imaging Systems.

UNIT IV PHYSICAL MEDICINE AND BIOTELEMETRY 9

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

UNIT V RECENT TRENDS IN MEDICAL INSTRUMENTATION 9

Radio pill, Endomicroscopy, Brain machine interface, Lab on a chip, Automated Drug Delivery Systems – Insulin pumps, Foetal Monitoring Instruments.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of the course the students will be able:

- To review human body electro- physiological parameters and recording of bio-potentials
- To comprehend the non-electrical physiological parameters and their measurement – body temperature, blood pressure, pulse, blood cell count, blood flow meter etc.
- To interpret the various assist devices used in the hospitals viz. pacemakers, defibrillators, dialyzers and ventilators
- To comprehend physical medicine methods eg.ultrasonic, shortwave, microwave surgical diathermies , and bio-telemetry principles and methods
- To review about recent trends in medical instrumentation

TEXT BOOKS:

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

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1. John G.Webster, “Medical Instrumentation Application and Design”, 3rd Edition, Wiley India Edition, 2007.
2. Joseph J.Carr and John M.Brown, “Introduction to Biomedical Equipment Technology”, John Wiley and Sons, New York, 2004.
3. Carr Joseph J., Carr, “Introduction to Biomedical Equipment Technology”, 4th edition, Pearson Education,2008.
4. David Prutchi, Michael Norris, “Design and Development of Medical Electronic Instrumentation”, John Wiley & Sons, Inc., Hoboken, New Jersey, 2005.

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3. https://nptel.ac.in/courses/108/105/108105091/, Prof. Debdoot Sheet, IIT Kharagpur
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5. https://www.youtube.com/watch?v=NuQqDFkhIlU, Prof.Alok Barua, IIT Kharagpur

CO-PO MAPPING

CO\PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	2	2	2	2	-	-	-	-	1	3
CO2	3	3	3	2	3	2	-	-	-	-	1	3
CO3	3	3	3	2	3	2	-	-	-	-	2	3
CO4	3	3	3	2	3	2	-	-	-	-	2	3
CO5	3	3	3	3	3	3	-	-	-	-	3	3
AVG	3	3	3	2	3	2	0	0	0	0	2	3

CO - PSO MAPPING

CO\PSO	PSO1	PSO2	PSO3
CO1	2	1	2
CO2	2	2	2
CO3	3	2	2
CO4	3	3	3
CO5	3	3	3
AVG	2.6	2.2	2.4

JEC1006	INDUSTRIAL ELECTRONICS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- Design basic electronic circuits
- Learn about the latest electronic devices available in industry
- Gain some experience with operational amplifiers
- Learn about industrial control devices
- Be able to understand the functions of transducer

UNIT I BASIC ELECTRONIC CIRCUITS 9

Need for DC amplifiers, DC amplifiers – Drift, Causes, Darlington Emitter Follower, Cascode amplifier, Differential amplifiers, Voltage regulation - Fixed and Adjustable IC Voltage regulators, Introduction to Industrial Internet of Things, Industrial Automation, Industrial IoT: Sensors and Devices, IIOT Networks and Protocols, Consumer IOT

UNIT II SWITCHES AND RELAYS 9

Discrete Control Input and Output Devices, Introduction to discrete control, Mechanical and Electrical Switch Classifications, Mutually-Activated Electronic Circuit Switches -Mechanically-Activated Electronic Circuit Switches, Discrete Output Devices, Relays, Control Diagrams

UNIT III POWER DEVICES 9

SCR and Thyristor: Principles of operation and characteristics of SCR, Triggering of Thyristors, Commutation Techniques of Thyristors – Classes A, B, C, D, E and F, Ratings of SCR. Triacs - Triac Applications - Controlled Thyristor Switches

UNIT IV AUTOMATION, CONTROL DEVICES AND SENSORS 9

Introduction to Electronic Sensors -Non-contact Sensors, Sensor Output Interfaces, Analog Automation Sensors, Sensor Applications and Selection - Integrating Sensors into Power and Control Circuits

UNIT V SAFETY & DATA COMMUNICATION 9

Short Circuit, Over voltage and Thermal Protection, Safety - Introduction to Safety, Safety Standards, Presence Sensors, Interlock Devices, Developing a Safety Strategy Data Communication Between Intelligent Machines, Classification of Network Media, Enterprise Networks, Fieldbus Networks, Factory-Floor Data Network

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

- To explain about the operation of common linear components and latest electronic devices available in industry.
- To explain about the digital ICs and sensory electronic devices and Use tools/test equipment to analyze electronic components.
- To explain about industrial control devices, switches and relays.
- To assess fundamentals of power electronic circuits
- To explain Safety & Protection Techniques

TEXTBOOKS:

1. Rehg, James, A., Sartori, Glenn, "Industrial Electronics", 5th ed. Upper Saddle River: Prentice Hall. 2006
2. G. K. Mithal and Maneesha Gupta, "Industrial and Power Electronics", 19th Ed., Khanna Publishers, 2003.-

REFERENCES:

1. J. Millman and C.C Halkias, "Integrated Electronics", McGraw Hill, 1972.
2. Maloney, Timothy, "Modern Industrial Electronics", 5th ed. Upper Saddle River: Prentice Hall. 2004
3. Theodore. H. Bogart, "Electronic Devices and Circuits", 6th Edn., Pearson Education, 2003.
4. M. Rammurthy, "Thyristors and Applications", East-West Press, 1977.3.
5. Deboo and Burroughs, "Integrated Circuits and Semiconductor Devices", ISE

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2. https://www.powerelectronics.com/
3. https://www.sciencedirect.com/
4. https://meity.gov.in/content/industrial-applications
5. https://www.codrey.com/

CO -PO MAPPING

CO\PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	1	3	3	1	2	-	-	-	-	2	3
CO2	3	2	3	3	1	2	-	-	-	-	1	3
CO3	3	1	3	3	2	2	-	-	-	-	1	3
CO4	3	2	2	3	2	2	-	-	-	-	2	3
CO5	3	2	3	3	1	2	-	-	-	-	1	3
AVG	3	1	3	3	1	2	-	-	-	-	2	3

CO -PSO MAPPING

CO\PSO	PSO1	PSO2	PSO3
CO1	3	1	2
CO2	3	2	2
CO3	3	3	2
CO4	3	3	3
CO5	3	3	3
AVG	3	2.4	2.4

JEC1023	MEMS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To understand the basics of MEMS fabrication techniques
- To study about the thermal sensors and actuators
- To know about Electrostatic and Piezoelectric sensors and actuators
- To understand the Microfluidic Systems
- To learn about applications of MEMS

UNIT I MEMS AND MICROSYSTEMS 9

MEMS and Microsystems, Materials for MEMS – active substrate materials, Silicon compounds, Silicon piezoresistors, Gallium Arsenide, Quartz, Polymers,Microsystem Fabrication Process – Photolithography, Ion Implantation, Diffusion, Oxidation, Etching, CVD, bulk micromanufacturing, surface micromachining. Case Study: The LIGA process.

UNIT II MECHANICAL AND THERMAL SENSORS AND ACTUATORS 9

Mechanics for MEMs design-static bending of thin plates, mechanical vibration, thermomechanics, fracture and thin film mechanics. Mechanical sensors and actuators – beam and cantilever – microplates, strain, pressure and flow measurements, Thermal sensors and actuators- actuator based on thermal expansion, thermal couples, thermal resistor, Case Study: Inertia sensor, flow sensor.

UNIT III ELECTROSTATIC AND PIEZOELECTRIC SENSORS AND ACTUATORS 9

Parallel plate capacitor, pull in effect, Electrostatic sensors and actuators- Inertia sensor, Pressure sensor, flow sensor, tactile sensor, comb drive. Properties of piezoelectric materials, Piezoelectric sensor and actuator – inchworm motor, inertia sensor, flow sensor.

UNIT IV MICROFLUID IC SYSTEMS 9

Fluid dynamics, continuity equation, momentum equation, equation of motion, laminar flow in circular conduits, fluid flow in microconduits, in submicrometer and nanoscale. Microscale fluid, expression for liquid flow in a channel, fluid actuation methods, dielectrophoresis, microfluid dispenser, microneedle, Case Study: micromixers.

UNIT V APPLICATION OF MEMS 9

CAD for MEMS, Drug delivery, micro total analysis systems (MicroTAS) detection and measurement methods, microsystem approaches to polymerase chain reaction (PCR), DNA hybridization, Electronic nose, Case Study: Bio Chip.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

- Fabricate the MEMS structures
- Design the thermal sensors and actuators
- Design the Electrostatic and Piezoelectric sensors and actuators
- Understand the Microfluidic Systems
- Apply the knowledge of CAD tools for MEMS design

TEXTBOOKS:

1. Tai Ran Hsu, "MEMS and Microsystems design and manufacture" , Tata McGraw Hill PublishingCompany, New Delhi, 2002
2. Chang Liu, " Foundations of MEMS", Pearson Education International, New Jersey, USA, 2006

REFERENCES:

1. Marc J. Madou, "Fundamentals of Microfabrication: the science of miniaturization", CRC Press, 2002.
2. NadimMaluf, Kirt Williams. "An introduction to Microelectromechancial Systems Engineering", Second Edition, Artech House Inc, 2004.
3. NitaigourPremch and Mahalik, "MEMS", Tata McGraw Hill Publishing Company, New Delhi, 2007
4. Yang, Victor C., Ngo, That T, "Biosensors and Their Applications", Springer, 2000.

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3. https://extension.ucsd.edu/courses-and-programs/rf-circuit-design
4. https://www.microwaves101.com/
5. https://www.udemy.com/course/introduction-to-radio-frequency-integrated-circuit-design/

CO - PO MAPPING:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	3	2	2	1	1	-	-	-	-	1	1
CO2	3	3	2	2	1	1	-	-	-	-	1	1
CO3	3	3	3	2	2	1	-	-	-	-	1	1
CO4	3	3	3	2	2	1	-	-	-	-	1	1
CO5	3	3	2	2	2	3	-	-	-	-	1	2
AVG	2.8	3	2.4	2	1.6	1.4	-	-	-	-	1	1.2

CO-PSO MAPPING:

CO\PSO	PSO1	PSO2	PSO3
CO1	2	1	2
CO2	2	2	2
CO3	3	2	3
CO4	3	3	3
CO5	3	3	3
AVG	2.6	2.2	2.6

JEC1011	ROBOTICS AND AUTOMATION	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To understand the basic concepts associated with the design, functioning, applications of robots
- To learn about analyzing robot kinematics, dynamics through different methodologies and study various design aspects of robot arm manipulator and end-effector
- To study about sensors and actuators used in robotics for various applications
- To learn about various motion planning techniques and the associated control architecture
- To understand the implications of AI and other trending concepts of robotics

UNIT I INTRODUCTION TO ROBOTICS 9

Introduction to robotics, Robot anatomy -Definition, law of robotics, History and Terminology of Robotics-Accuracy and repeatability of Robots-Automation and robots - robot classifications - robot specifications - robot configurations - applications of robots.

UNIT II KINEMATICS, DYNAMICS AND DESIGN OF ROBOTS & END EFFECTORS 9

Robot kinematics - Geometric approach for 2R, 3R manipulators, homogenous transformation using D-H representation, kinematics of WMR, Lagrangian formulation for 2R robot dynamics; Mechanical design aspects of a 2R manipulator, WMR; End-effector, common types

UNIT III ROBOTIC SENSORS AND VISION 9

Sensors in robotics, classification, tactile, proximity and range sensors, sensors based systems; Introduction to machine vision, the sensing and digitizing function in machine vision, image processing and analysis, training the vision system, robot programming and languages.

UNIT IV NAVIGATION, PATH PLANNING AND CONTROL ARCHITECTURE 9

Mapping & Navigation – SLAM, Path planning for serial manipulators; types of control architectures - Cartesian control, Force control and hybrid position/force control, Behaviour based control, programming methodologies of a robot.

UNIT V AI AND OTHER RESEARCH TRENDS IN ROBOTICS 9

Application of Machine learning - AI, Expert systems; Tele-robotics and Virtual Reality, Micro & Nano robots, Unmanned vehicles, Cognitive robotics, Evolutionary robotics, Humanoids, Robotics and Automation for Industry 4.0.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

- Explain the concepts of robots in terms of classification, specifications and coordinate systems, along with the need and application of robots & automation
- Design a 2R robot & an end-effector and solve the kinematics and dynamics of motion for robots.
- Examine different sensors and actuators for applications
- Explain navigation and path planning techniques along with the control architectures adopted for robot motion planning.
- Describe the impact and progress in AI and other research trends in the field of robotics

TEXT BOOKS:

1. Saeed. B. Niku, Introduction to Robotics, Analysis, system, Applications, Pearson educations, 2002
2. S.R. Deb, Robotics Technology and flexible automation, 2nd Edition, Tata McGraw-Hill Education, 2017.

REFERENCES:

1. Richard David Klafter, Thomas A. Chmielewski, Michael Negin, Robotic engineering: an integrated approach, Prentice Hall, 1989.
2. Craig, J. J., Introduction to Robotics: Mechanics and Control, 2nd Edition, Addison-Wesley, 1989.
3. R.K.Mittal and I.J.Nagrath, Robotics and Control, Tata McGraw Hill, New Delhi,4th Reprint, 2005. 2.
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2. https://nptel.ac.in/courses/112/101/112101099/Prof.C.Amarnath, Mechanical Engineering, IIT-Madras.
3. https://nptel.ac.in/courses/112/107/112107289/ PROF. N. Sukavanam Department of Mathematics IIT Roorkee, Prof.M. Felix Orlando, Department of Electrical Engineering, IIT-Roorkee.
4. https://nptel.ac.in/courses/112/107/112107289/ PROF. N. Sukavanam Department of Mathematics IIT Roorkee, Prof.M. Felix Orlando, Department of Electrical Engineering, IIT-Roorkee
5. https://nptel.ac.in/courses/112/107/112107289/ PROF. N. Sukavanam Department of Mathematics IIT Roorkee, Prof.M. Felix Orlando, Department of Electrical Engineering, IIT-Roorkee

CO - PO MAPPING

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	2	2	2	1	1	-	-	-	1	1	2
CO2	3	3	1	3	3	-	-	-	-	1	1	1
CO3	3	2	2	3	2	-	-	-	-	-	2	3
CO4	2	3	3	2	3	-	-	-	1	-	2	2
CO5	3	3	1	3	2	-	-	1	-	-	2	1
AVG	2.6	2.6	1.8	2.6	2.2	1	-	1	1	1	1.6	1.8

CO - PSO MAPPING

CO\PSO	PSO1	PSO2	PSO3
CO1	2	2	2
CO2	3	2	2
CO3	3	3	3
CO4	2	2	2
CO5	3	3	3
AVG	2.6	2.4	2.4

JEC1029	INDUSTRIAL AUTOMATION AND CONTROL	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To make understand the fundamentals of automation
- To familiarize with PLC and programming of PLC
- To make students understand the applications of PLC
- To explain about the concepts of SCADA
- To make students understand about Human-machine interface

UNIT I FUNDAMENTALS OF AUTOMATION 9

Automation overview - Requirement of automation systems - Architecture of Industrial Automation system Introduction of PLC- HMI and Supervisory control and data acquisition (SCADA). Industrial bus systems: Modbus & Profibus. Role of computers in measurement and control.

UNIT II PLC FUNDAMENTALS AND PROGRAMMING 9

Introduction to computer based industrial automation - Programmable Logic Controller (PLC) - Block diagram of PLC- Programming languages of PLC- Basic instruction sets- PLC programming- Ladder diagram- Sequential flow chart- Design of alarm and interlocks- Networking of PLC- Overview of the safety of PLC with case studies.

UNIT III APPLICATIONS OF PLC IN PROCESS INDUSTRIES 9

PLC Communication and networking- PLC selection - PLC Installation - Advantage of using PLC for Industrial automation- Application of PLC to process control industries- Process Safety Automation- Levels of process safety through use of PLCs - Application of international standards in process safety control.

UNIT IV SUPERVISORY CONTROL AND DATA ACQUISITION SYSTEM 9

Introduction to SCADA- Architecture of SCADA –Various editors of SCADA-Interfacing SCADA system with PLC – Object linking and embedding for process control (OPC) architecture- Steps in creating SCADA screen for simple objects, - Steps for linking SCADA object with PLC ladder program using OPC-Applications of SCADA.

UNIT V HUMAN MACHINE INTERFACE 9

Different Types of Operator Interfaces- Textual, Graphical- Wiring Practice of HMI- Data Handling With HMI- Configuration and Interfacing to PLC and PC- Communication Standards- DF1- Ethernet-DH45- RS232- RS485-Profibus.

TOTAL PERIODS: 45

COURSE OUTCOMES:

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

- Explain the need for automation process in industry
- Program PLC for application
- Analyse some applications of PLC
- Explain interface in SCADA with PLC
- Elaborate about interfacing Human with machines

TEXTBOOK:

1. Industrial Instrumentation and Control By. S.K. Singh, The McGraw Hill Companies, 3rd Edition, 2009
2. Process Control Instrumentation Technology By. C.D. Johnson, PHI,8th Edition, 2016
3. Programmable logic controller by Frank D. Petrusella, Tata McGraw-Hill 2005
4. PLCs & SCADA - Theory and Practice by Rajesh Mehra, Vikrant Vij 2019

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1. Programmable logic controller, Dunning, Delmar
2. SCADA: Beginner's Guide by Francis G.L 2015
3. Introduction to programmable logic controller by Gary dunning, Thomson Asia Pte Ltd 2005

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CO-PO/PSO MAPPING:

CO\PO,PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	1	2	2	3	1	-	-	-	-	1	2	3	3	2
CO2	1	3	2	3	2	1	-	-	-	-	1	2	3	2	3
CO3	2	3	3	3	3	1	-	-	-	-	1	2	3	3	3
CO4	1	3	2	3	2	1	-	-	-	-	1	2	2	2	3
CO5	3	3	3	3	3	1	-	-	-	-	1	2	3	3	3
AVG	**1.6**	**2.6**	**2.4**	**2.8**	**2.6**	**1**	**0**	**0**	**0**	**0**	**1**	**2**	**2.8**	**2.6**	**2.8**

JEC1030	INDUSTRIAL IoT AND INDUSTRY 4.0	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To make students understand the fundamentals of internet of things
- To explain the usefulness of IoT technology in the manufacturing process of Industry.
- To provide an overview of the evolution of the industrial revolution and its impact on the industrial process.
- To introduce the new technology digital twin in industry.
- To provide fundamental knowledge on simulation and modeling of industrial process.

UNIT I FUNDAMENTALS OF IoT 9

IoT levels and deployment, Domain specific IoT, IoT and M2M, IoT architecture – IETF, OGC, Reference model. IoT protocols – Protocol standardization, M2M, WSN, SCADA, RFID, IEEE 802.15.4, BACnet, Modbus, Zigbee, 6LowPAN, CoAP. Security issues in IoT.

UNIT II INDUSTRIAL IoT 9

Introduction to Industrial IoT, Business model and reference architecture, IIoT layers – Sensing, networking, communication. IIoT Analytics – Big data and software defined networks, introduction machine learning, data science, Security and Fog computing, IIoT Application domains.

UNIT III INDUSTRY 4.0 9

Industrial Revolution, Industrial Revolution – From Industry 1.0 to Industry 4.0, Transformation of Industrial process – Sensors and actuation, Lean Production Systems, Cyber Physical Systems, Product life cycle management. Applications driving industry 4.0, I4.0 opportunities in manufacturing and other industries.

UNIT IV INTRODUCTION TO DIGITAL TWIN 9

Definitions- Digital thread, digital shadow and digital twin. Digital twin building blocks – Discrete digital twin, composite digital design, Hierarchical building blocks, Associated building blocks, Peer building blocks

UNIT V DIGITAL TWIN DESIGN 9

Interpretation of data, technical aspects. Digital twin tools – Sensors, Modeling, Simulation, Analytics. Digital Twin Simulation and Modeling – Types of simulation, Simulation models digital twin and model, 2D and 3D modeling. Digital Twin in Industry, Implementation of Digital twin – Challenges and opportunities.

TOTAL PERIODS: 45

COURSE OUTCOMES:

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

- Explain the concepts of IoT, architecture and protocols.
- Apply and implement IoT concepts in industry.
- Comprehend the technical transformation in industry in all sectors.
- Explain the new technique of digital twin in industry 4.0
- Apply the digital twin in any industrial sectors by proper modelling and data analysis.

TEXT BOOKS:

1. Mayr Ramgir, “Internet of Things”, Pearson Education, First Edition, 2020.
2. Alasdair Gilchrist, “Industry 4.0 – the industrial internet of things”, Apress, 2017

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1. Elena G.Popkova, Yulia V Ragulina, and Aleksei V Bogoviz, “Industry 4.0: Industrial Revolution of the 21st century”, Springer, 2019.
2. Elaine Durtsche. “Digital Twin Technology: Twins Digital Technology And Industries”, Kindle edition, 2012.
3. Anand Iyer, “Digital Twin: Possibilities of the new digital twin technology”, Kindle edition, 2017.

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4. https://www.researchgate.net/profile/Sudeep-Tanwar/ publication/ 334836077
5. https://www.ncda.org

CO-PO/PSO MAPPING:

CO\PO,PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	2	3	3	2	-	-	-	-	2	3	3	3	3
CO2	3	2	3	3	3	2	-	-	-	-	2	2	3	2	2
CO3	3	2	2	2	3	2	-	-	-	-	1	3	3	2	2
CO4	3	2	2	3	3	2	-	-	-	-	2	3	3	2	3
CO5	3	2	1	2	3	3	-	-	-	-	2	3	3	3	3
AVG	**3**	**2**	**2**	**2.6**	**3**	**2.2**	-	-	-	-	**2**	**2.8**	**3**	**2.4**	**2.4**

JEC1007	SENSORS AND ACTUATORS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To understand static and dynamic characteristics of measurement systems.
- To study various types of sensors.
- To study State-of-the-art digital sensors and measurement of parameters using various types of sensors.
- To study different types of actuators and its types
- To study micro sensors and micro actuators

UNIT I INTRODUCTION TO MEASUREMENT SYSTEMS 9

General concepts and terminology – Measurement systems– Sensor classification – General input-output configuration– Methods of correction– Performance characteristics: Static characteristics of measurement systems - Dynamic characteristics of measurement systems.

UNIT II RESISTIVE REACTIVE AND MAGTENIC SENSORS 9

Resistive sensors: Wheat stone bridges -Strain gauges – Capacitive sensors: Displacement sensor - Proximity sensor – Inductive sensors: LVDT- Proximity sensors – Magnetostrictive ultrasonic transducers –Hall effect sensor

UNIT III MEASUREMENT OF PARAMETERS USING SENSORS 9

Digital sensors: Sensors for measuring humidity and gas –Reflective optical and ultrasonic sensors– Thermocouples- Thermistors - Resistance Temperature Detector- Infrared Thermography- Photoresistors - Photodiodes – Phototranistors. Fiber optic sensors – Piezoelectric sensors

UNIT IV ACTUATORS 9

Actuators – Types of Actuators- Characteristics of Actuators - Electric Motor Actuators - Brushless DC Motors - Stepper Motors -Actuators in motor vehicles, power switches-Electrical rotary and linear actuators- - Electro-pneumatic and electro-hydraulic actuators.

UNIT V MICRO SENSORS AND MICRO ACTUATOR 9

Micro Sensors: – Principle -Force and pressure micro sensors, - Position and speed micro sensors– acceleration micro sensors– biosensors and temperature micro sensors. Micro Actuators: Principle– shape memory effects-one way– two way-Electrostatic, Magnetic, Fluidic– Inverse piezo effect.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

- Describe the fundamentals of Measurement system
- Explain about types and characteristics of sensors
- Identify types of sensors for different parameter measurement
- Explain about types and characteristics of actuators
- Acquire knowledge in micro sensors and actuators

TEXT BOOKS:

1. Jacob Fraden, “Hand Book of Modern Sensors: physics, Designs and Applications”, Third Edition, Springer, New York 2015.

2. Clarence W. de Silva Author. “Sensors and Actuators: Engineering System Instrumentation”, Second Edition, CRC Press ,2015.
3. Jon. S. Wilson, “Sensor Technology Hand Book”, First Edition, Elsevier, Netherland 2011.

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3. https://nptel.ac.in/content/storage2/courses/112108092/module1/lec04.pdf G.K. Ananthasuresh Professor, Mechanical Engineering Indian Institute of Science Bangalore, 560012, India
4. https://nptel.ac.in/content/syllabus_pdf/108108147.pdf Prof Hardik J Pandya Department of Electrical & Electronic Engineering IISc Bangalore.
5. http://www.ieec.uned.es/investigacion/Dipseil/PAC/archivos/More%20on%20Transducers%20Sensors%20and%20Actuators.pdf

CO - PO MAPPING

CO\PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	3	3	2	1	-	-	-	-	3	2
CO2	3	3	3	3	3	1	-	-	-	-	2	3
CO3	2	3	3	3	3	1	-	-	-	-	3	3
CO4	3	3	3	3	3	1	-	-	-	-	2	3
CO5	3	3	3	3	3	1	-	-	-	-	3	2
AVG	3	3	3	3	2.8	1	-	-	-	-	2.6	2.6

CO - PSO MAPPING

CO\PSO	PSO1	PSO2	PSO3
CO1	3	2	1
CO2	3	2	1
CO3	2	2	1
CO4	3	2	1
CO5	3	2	1
AVG	3	2	1

JEC1031	RF AND MICROWAVE SENSORS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To provide an overview of RF antennas and RF link fading concepts
- To explain the application of radiometric system
- To describe the concepts of Space borne radar sensors
- To make understand the functions of power sensor and thermocouple sensors
- To explain the application of sensors in personal area communication

UNIT I ANTENNAS AND RF LINK 9

RF Antennas- Resonant Antennas- Traveling-Wave Antennas -RF link- Multipath and Path Loss- Fresnel Zones- Rayleigh Fading- Radio Link Reciprocity- Propagation Model- Radio Link Interference- Radar Systems- Radiometer System.

UNIT II PASSIVE MICROWAVE SENSORS 9

Passive versus active microwave sensing-Airborne Versus Spaceborne Sensing-Spaceborne Microwave Sensors-Passive Systems (Radiometers)- Earth Observing Spaceborne Radiometer Systems-Historical Radiometers-SMMR-Contemporary Radiometers-SSM/I-MSU-AMSU- TRMM -Microwave Imager (TMI)- Microwave Scanning Radiometer (MSR).

UNIT III ACTIVE MICROWAVE SENSORS 9

Introduction- Radar Fundamentals- Real-aperture Radars- Radar Altimetry- Radar Scatterometry- Side-Looking Airborne Radar- Synthetic Aperture Radar- Spaceborne Radar Systems- Contemporary Space borne Radar Sensors- Future Radar Sensors

UNIT IV MICROWAVE POWER SENSORS 9

Diode Sensors: Diode detector principles-dynamic range average power sensors- signal waveform effects on the measurement uncertainty of diode sensors. Thermocouple Sensors: Principles of Thermocouple sensor, power meters for thermocouple sensors.

UNIT V ANTENNAS FOR PERSONAL AREA COMMUNICATION 9

Printed Antennas, Broadband Microstrip Patch Antennas, Antennas for Wearable Devices, Design Requirements, Modeling and Characterization of Wearable Antennas, WBAN Radio Channel Characterization and Effect of Wearable Antennas, Domains of Operation, Sources on the Human Body, Compact Wearable Antenna for different applications.

TOTAL PERIODS: 45

COURSE OUTCOMES:

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

- Identify types of antennas to be used in various RF spectral regions
- Explain the functions of different radiometers for passive microwave sensing
- Classify and illustrate the principles of Altimetry, Scatterometry using Radar sensors
- Apply the basic knowledge of sensors in the measurement of RF radiation
- Describe the design of printed and wearable antenna sensors

TEXTBOOKS:

1. Michael Steer, "Microwave and RF Design- A Systems Approach" 2010 by SciTech Publishing.
2. David G Long , “Manual of Remote Sensing-Chapter 6-Microwave Sensors Active and Passive ", Brigham Young University Center for Remote Sensing 2008.

REFERENCES:

1. B. Hoffman - Wellenhof, H.Lichtenegger and J.Collins, "GPS: Theory and Practice ", 5th edition, Springer, New York, 2012.
2. Lillesand & Kiefer, “Remote Sensing and Image Interpretation”, 2011, 6th edition, John Wiley and Sons, New Jersey.
3. Finkenzeuer Klaus, “RFID Handbook”, 2011, 3rd edition, John Wiley and Sons, New Jersey.
4. Constantine A. Balanis, “Antenna Theory Analysis and Design”, 2016, 4th edition, John Wiley and Sons, New Jersey.

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1. https://www.mdpi.com/1424-8220/19/5/1013
2. https://blog.minicircuits.com/a-short-primer-on-rf-microwave-power-sensors/
3. https://techatronic.com/interfacing-rcwl-0516-microwave-sensor-with-arduino/
4. https://techatronic.com/automatic-light-microwave-motion-sensor-microwave-motion-detector/
5. https://www.raypcb.com/microwave-motion-sensors/

CO-PO/PSO MAPPING:

CO\ PO ,PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	2	2	2	-	-	-	-	-	2	2	2	2	2
CO2	3	2	2	2	2	-	-	-	-	-	3	3	3	3	3
CO3	3	2	2	3	3	-	-	-	-	-	3	3	3	3	3
CO4	2	2	3	3	3	-	-	-	-	-	3	3	3	3	3
CO5	2	3	3	3	3	-	-	-	-	-	3	3	3	3	3
AVG	**2.6**	**2.2**	**2.4**	**2.6**	**2.4**	**-**	**-**	**-**	**-**	**-**	**2.8**	**2.8**	**2.8**	**2.8**	**2.8**

JEC1032	FLEXIBLE AND WEARABLE SENSORS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To provide an overview of flexible electronics technology and the issues of processing thin film electronics.
- To expose the students to the materials selection and patterning methods for thin film electronics development.
- To describe the process involved in transferring the flexible electronics, challenges, opportunities and future of wearable devices.
- To expose the students to understand the challenges of wearable sensors employed for sensing the physical and biological parameters
- To describe the process involved in the conversion of conducting and semiconducting fibers to smart textiles

UNIT I FLEXIBLE ELECTRONICS TECHNOLOGY 9

Introduction - degrees of flexibility, substrates, backplane electronics, front plane technologies - Fabrication technology for flexible electronics - Fabrication on sheets by batch processing, Roll to Roll processing - Additive printing- semiconductors employed in flexible electronics - Plastic electronics for smart textiles - Improvements and limitations.

UNIT II NANOCRYSTALLINE SILICON THIN FILM TRANSISTORS 9

Fundamental issues for low temperature processing - amorphous and nanocrystalline silicon - characteristics of low temperature dielectric thin film deposition - low temperature silicon nitride and silicon oxide characteristics - Device structures and materials processing - Device performance - Contacts for the device - Device stability.

UNIT III PATTERNING METHODS FOR FLEXIBLE ELECTRONICS 9

Materials considerations for flexible electronics: Overview, Inorganics semiconductors and dielectrics, organic semiconductors and dielectrics, conductors - Print processing options for device fabrication: Overview, control of feature sizes of jet printed liquids, jet printing for etch mask patterning, methods for minimizing feature size, printing active materials.

UNIT IV WEARABLE FUNDAMENTALS 9

Attributes of wearables - Textiles and clothing: The meta wearable - Challenges and opportunities - Future of wearables - Need for wearable haptic devices - Categories of wearable haptic and tactile display.

UNIT V WEARABLE BIO, CHEMICAL AND INERTIAL SENSORS 9

Systems design - Challenges in chemical and biochemical sensing - Application areas - Wearable inertial sensors - obtained parameters from inertial sensors - Applications for wearable motion sensors - Application in clinical practice and future scope - Textile sensors for physiological state monitoring - Noninvasive sweat monitoring by textile sensors.

TOTAL PERIODS: 45

COURSE OUTCOMES:

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

- Explain the technology developments in flexible electronics technology.
- Describe the suitable materials and its processing for the development of thin film electronics
- Explain the pattern and develop with suitable patterning methods.
- Describe the process involved in the transformation of electronics from foils to textiles
- Explain the design process for developing wearable sensors for physical and chemical parameters

TEXT BOOKS:

1. William S. Wong, Alberto Salleo, Flexible Electronics: Materials and Applications, , 1st Edition, Springer, New York, 2011
2. Edward Sazonov, Michael R. Newman, "Wearable Sensors: Fundamentals, Implementation and Applications", 1st Edition, Academic Press, Cambridge, 2014,

REFERENCES:

1. Michael J. McGrath, Cliodhna Ni Scanaill, Dawn Nafus, "Sensor Technologies: Healthcare, Wellness and Environmental Applications", 1st Edition , Apress Media LLC, New York, 2001.
2. Kate Hartman, "Make: Wearable Electronics: Design, prototype, and wear your own interactive garments", 1st Edition, Marker Media, Netherlands, 2014.
3. Guozhen Shen, Zhiyong Fan, "Flexible Electronics: From Materials to Devices", 1st Edition, World Scientific Publishing Co, Singapore, 2015.
4. Yugang Sun, John A. Rogers, "Semiconductor Nanomaterials for Flexible Technologies: From Photovoltaics and Electronics to Sensors and Energy Storage (Micro and Nano Technologies)", 1st Edition, William Andrew, New York, 2011.

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2. https://www.frontiersin.org/articles/10.3389/felec.2021.668619/full
3. https://pubs.rsc.org/en/content/articlelanding/2018/lc/c7lc00914c
4. https://www.mdpi.com/1424-8220/22/14/5137

CO-PO/PSO MAPPING:

CO\PO, PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	2	2	2	3	-	-	-	-	2	2	2	2	2
CO2	3	2	2	2	2	3	-	-	-	-	3	3	3	3	3
CO3	3	2	2	3	3	3	-	-	-	-	3	3	3	3	3
CO4	2	2	3	3	3	3	-	-	-	-	3	3	3	3	3
CO5	2	3	3	3	3	3	-	-	-	-	3	3	3	3	3
AVG	**2.6**	**2.2**	**2.4**	**2.6**	**2.4**	**3**	**-**	**-**	**-**	**-**	**2.8**	**2.8**	**2.8**	**2.8**	**2.8**

		L	T	P	C
JEC1033	**IOT FUNDAMENTALS AND ARCHITECTURE**	**3**	**0**	**0**	**3**

COURSE OBJECTIVES:

- To understand the fundamentals of Internet of Things
- To gain knowledge on the various hardware platforms
- To familiarize the Architecture of IoT
- To learn about the basics of IoT protocols
- To know about simple IoT applications in real time

UNIT I EVOLUTION OF IOT 9

Definition and characteristics of IoT - Physical and Logical Design of IoT- IoT Enabling Technologies - IoT Levels & Deployment Templates - Domain Specific IoTs – Challenges in IoT - IoT System Management with NETCONF-YANG- IoT Platforms Design Methodology

UNIT II COMPONENTS OF IOT 9

IoT and M2M - Sensors for IoT Applications - Characteristics of IoT Sensor Nodes - Edge Computer- Cloud and Peripheral Cloud - Single Board Computers - Open-Source Hardware - Examples of IoT Infrastructure

UNIT III ARCHITECTURE OF IoT 9

M2M high-level ETSI architecture - IETF architecture for IoT - OGC architecture - IoT reference model- Domain model - information model - functional model - communication model - IoT reference architecture, 5G in IoT Middleware

UNIT IV IoT PROTOCOLS 9

Protocol Standardization for IoT – Efforts – M2M and WSN Protocols – SCADA and RFID Protocols – Unified Data Standards – Protocols – IEEE 802.15.4 – BACNet Protocol – Modbus– Zigbee Architecture – Network layer – 6LowPAN – CoAP.

UNIT V CASE STUDY AND SECURITY CONSIDERATIONS 9

Industrial IOT- Application Domains: Oil, chemical and pharmaceutical industry, Applications of UAVs in Industries - Real case studies: Milk Processing and Packaging Industries, Manufacturing Industries. Security in deployment of IoT, Security Challenges in 5G-Based IoT Middleware Systems

TOTAL PERIODS: 45

COURSE OUTCOMES:

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

- Articulate the main concepts, key technologies, strength and limitations of IoT
- Understand various hardware platform
- Understand the architecture, infrastructure models of IoT
- Implement various protocols and software
- Analyze applications of IoT in real time scenario

TEXT BOOKS:

1. Arshdeep Bahga and Vijai Madisetti: A Hands-on Approach "Internet of Things", Universities Press 2015.
2. Oliver Hersent, David Boswarthick and Omar Elloumi "The Internet of Things", Wiley,2016.
3. Samuel Greengard, "he Internet of Things", The MIT press, 2015.
4. Peter Waher, "Learning Internet of Things", Packt Publishing, 2015
5. Samuel Greengard, "The Internet of Things", The MIT press, 2015.

REFERENCES:

1. Alessandro Bassi, Martin Bauer, Martin Fiedler, Thorsten Kramp, Rob van Kranenburg, Sebastian Lange, Stefan Meissner, - "Enabling things to talk – Designing IoT solutions with the IoT Architecture Reference Model", Springer Open, 2016.
2. Jan Holler, VlasiosTsiatsis, Catherine Mulligan, Stamatis Karnouskos, Stefan Avesand, David Boyle, "From Machine to Machine to Internet of Things", Elsevier Publications, 2014.
3. Adrian McEwen and Hakim Cassimally, "Designing the Internet of Things "Wiley,2014.
4. LuYan, Yan Zhang, Laurence T. Yang, Huansheng Ning, "The Internet of Things: From RFID to the Next-Generation Pervasive Network", Aurbach publications, March, 2008.

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2. **http://www.cse.wustl.edu/~jain/cse570-15/ftp/iot_prot/index.html.**
3. **https://iotdunia.com/difference-iot-m2m-communication/ IOT VS M2M**
4. **https://docplayer.net/9841295-Architecting-the-internet-of-things.html**
5. **https://www.codemag.com/Article/1607071/Introduction-to-IoT-Using-the-Raspberry-Pi**
6. **https://www.elprocus.com/building-the-internet-of-things-using-raspberry-pi/**
7. **https://docplayer.net/9841295-Architecting-the-internet-of-things.html**

CO-PO/PSO MAPPING:

CO\PO, PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	2	2	2	3	-	-	-	-	2	2	2	2	2
CO2	3	2	2	2	2	3	-	-	-	-	3	3	3	3	3
CO3	3	2	2	3	3	3	-	-	-	-	3	3	3	3	3
CO4	2	2	3	3	3	3	-	-	-	-	3	3	3	3	3
CO5	2	3	3	3	3	3	-	-	-	-	3	3	3	3	3
AVG	**2.6**	**2.2**	**2.4**	**2.6**	**2.4**	**3**	**-**	**-**	**-**	**-**	**2.8**	**2.8**	**2.8**	**2.8**	**2.8**

JEC1034	IoT BASED SYSTEM DESIGN	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To provide an overview of the fundamentals of Internet of Things
- To explain the components and node structure for designing
- To describe a small low cost Embedded system using Raspberry Pi.
- To introduce the concept of Internet of Things in the real world scenario
- To provide an idea of some application areas where IoT can be used.

UNIT I INTRODUCTION 9

Introduction- Fundamental Element of IoT - Building blocks of IoT system - IoT data and Information Processing – Challenges of Design of IoT system

UNIT II DESIGN CONSIDERATIONS FOR IoT NODE 9

Introduction- Sensors-Interfacing Electronics Circuits, Embedded System-Wireless Transceivers-IoT Communication Protocol-IoT Security, Access Control, Data storage and Data analytics

UNIT III PROGRAMMING RASPBERRY PI AND ARDUINO FOR IOT SYSTEM 9

Single Board Computers (SBCs) – Setup and Installation, Programming in Python-Fundamentals of Python Programming, Implementation of Python Programming with Camera on IDE and GPIO on IDE- Microcontroller-Function definition and configurations-Interfacing Sensors, bilding a unique library to configure PIR Sensors

UNIT IV APPLICATIONS AND CASE STUDIES 9

Home automations - Smart cities, Smart cities - Environment – Energy – Retail – Logistics – Agriculture – Industry - Health and life style – Case study - Data Analytics for IoT – Software & Management Tools for IoT Cloud Storage Models & Communication APIs - Cloud for IoT -Amazon Web Services for IoT.

UNIT V PROJECTS ON IoT SYSTEMS 9

Wireless Sensor Node for Precision Agriculture, Vision- a guide for the visually impaired-IMU-Satellite Tracker

TOTAL PERIODS: 45

COURSE OUTCOMES:

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

- Explain the fundamentals required for IoT.
- Illustrate the designing and interfacing of the IoT nodes.
- Describe portable IoT using Raspberry Pi
- Analyze applications of IoT in real time scenario
- Describe applications of a system using IoT

TEXTBOOKS:

1. Alice James, Avishkar Seth, Subhas Chandra Mukhopadhyay – "IoT System Design-Project Based Approach" · 2021
2. Alessandro Bassi, Martin Bauer, Martin Fiedler, Thorsten Kramp, Rob van Kranenburg, Sebastian Lange, Stefan Meissner, - "Enabling things to talk – Designing IoT solutions with the IoT Architecture Reference Model", Springer Open, 2016.
3. Jan Holler, VlasiosTsiatsis, Catherine Mulligan, Stamatis Karnouskos, Stefan Avesand, David Boyle, - "From Machine to Machine to Internet of Things", Elsevier Publications, 2014.

REFERENCES:

1. LuYan, Yan Zhang, Laurence T. Yang, Huansheng Ning, "The Internet of Things: From RFID to the Next-Generation Pervasive Network", Aurbach publications, March, 2008.
2. Vijay Madisetti, Arshdeep Bahga, Adrian McEwen (Author), Hakim Cassimally "Internet of Things A Hands-on-Approach" Arshdeep Bahga& Vijay Madisetti, 2014.
3. Asoke K Talukder and Roopa R Yavagal, "Mobile Computing," Tata McGraw Hill, 2010.
4. Barrie Sosinsky, "Cloud Computing Bible", Wiley-India, 2010.
5. RonaldL. Krutz, Russell Dean Vines,"Cloud Security: A Comprehensive Guide to Secure Cloud Computing",Wiley-India, 2010

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2. https://docplayer.net/9841295-Architecting-the-internet-of-things.html
3. https://www.codemag.com/Article/1607071/Introduction-to-IoT-Using-the-Raspberry-Pi
4. https://www.elprocus.com/building-the-internet-of-things-using-raspberry-pi/
5. https://docplayer.net/9841295-Architecting-the-internet-of-things.html

CO-PO/PSO MAPPING:

CO\PO,PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	2	2	2	3	-	-	-	-	2	2	2	2	2
CO2	3	2	2	2	2	3	-	-	-	-	3	3	3	3	3
CO3	3	2	2	3	3	3	-	-	-	-	3	3	3	3	3
CO4	2	2	3	3	3	3	-	-	-	-	3	3	3	3	3
CO5	2	3	3	3	3	3	-	-	-	-	3	3	3	3	3
AVG	**2.6**	**2.2**	**2.4**	**2.6**	**2.4**	**3**	**-**	**-**	**-**	**-**	**2.8**	**2.8**	**2.8**	**2.8**	**2.8**

JEC1035	FLYING IoT	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To introduce the fundamentals of unmanned aerial vehicle
- To elaborate various payloads for unmanned aerial vehicle
- To explain learn about the basics of navigation and guidance system
- To describe the fabrication and flying of unmanned aerial vehicle category aircraft
- To provide in-depth skill set on design and fabrication techniques of unmanned aerial vehicle.

UNIT I INTRODUCTION TO UAV 9

Difference between Aircraft and UAV - History of UAV's, Types of Drones, Parts and functions of Fixed, Rotorcraft and flapping wing UAV, Characteristics of Multi rotor vehicle, Fixed Wing vehicle, Flapping wing Vehicles, Applications and Uses.

UNIT II PAYLOADS FOR UAV 9

Payloads - Classification of Payloads - camera - sensors - radars - various measuring devices - classification of payload based on applications - Hyper spectral sensors - laser detection and range- synthetic aperture radar - thermal cameras - ultra sonic detectors .

UNIT III NAVIGATION AND GUIDANCE SYSTEM 9

Flight Control System –Path planning- Way point Navigation system-GPS – GCS-Telemetry – Transmitter & Receiver.

UNIT IV SOFTWARE TOOLS AND TELEMETRY 9

Introduction to ArduPilot, System components, peripheral hardware, Mission planner, MavProxy. Wireless communication modules and topology, Zig-bee, Bluetooth, LORA, Zero power devices, Energy Harvesting technology.

UNIT V HEALTH MONITORING AND TECHNOLOGIES FOR FARMING 9

Measurement of leaf health, chlorophyll detection, ripeness level, crop mapping, fertilizing, Drone technology for soil field analysis and assistive operations. Water quality monitoring, micro-irrigation system, solar pump and lighting system, Fencing, Android based automation, Agricultural Robots, Standards for agriculture

TOTAL PERIODS: 45

COURSE OUTCOMES:

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

- Explain the fundamental concepts of Aerodynamics, Propulsion & Structures of Model Aircrafts
- Classify the payloads, sensors and measuring devices using in UAV.
- Describe the concept of Navigation and Guidance System of Aerial Robot
- Explain the design process of drones and software tools
- Explain the drone application for Plant health monitoring and soil field analysis

TEXT BOOKS:

1. Andey Lennon "Basics of R/C model Aircraft design" Model airplane news publication October 1996.
2. Alessandro Bassi, Martin Bauer, Martin Fiedler, Thorsten Kramp, Rob van Kranenburg, Sebastian Lange, Stefan Meissner, - "Enabling things to talk – Designing IoT solutions with the IoT Architecture Reference Model", Springer Open, 2016.
3. Jan Holler, VlasiosTsiatsis, Catherine Mulligan, Stamatis Karnouskos, Stefan Avesand, David Boyle, - "From Machine to Machine to Internet of Things", Elsevier Publications, 2014.

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1. Smart Agriculture: An Approach towards Better Agriculture Management: Editor: Prof. Dr. Aqeel-ur-Rehman, OMICS.
2. Daniel Tal, Jon Altschuld "Group. Drone Technology in Architecture, Engineering and Construction: A Strategic Guide to Unmanned Aerial Vehicle Operation and Implementation" February 2021.
3. LuYan, Yan Zhang, Laurence T. Yang, Huansheng Ning, "The Internet of Things: From RFID to the Next-Generation Pervasive Network", Aurbach publications, March, 2008.
4. Vijay Madisetti, Arshdeep Bahga, Adrian McEwen (Author), Hakim Cassimally "Internet of Things A Hands-on-Approach" Arshdeep Bahga& Vijay Madisetti, 2014.

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4. https://www.routledge.com/Internet-of-Things-Robotic-and-Drone-Technology/Goyal-Sharma-Rana-Tripathi/p/book/9780367754532
5. https://iotdunia.com/difference-iot-m2m-communication/

CO-PO/PSO MAPPING:

CO\PO,PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	2	2	2	3	-	-	-	-	2	2	2	2	2
CO2	3	2	2	2	2	3	-	-	-	-	3	3	3	3	3
CO3	3	2	2	3	3	3	-	-	-	-	3	3	3	3	3
CO4	2	2	3	3	3	3	-	-	-	-	3	3	3	3	3
CO5	2	3	3	3	3	3	-	-	-	-	3	3	3	3	3
AVG	**2.6**	**2.2**	**2.4**	**2.6**	**2.4**	**3**	**-**	**-**	**-**	**-**	**2.8**	**2.8**	**2.8**	**2.8**	**2.8**

JEC1036	EMBEDDED IoT	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To explain the various concept of the IoT.
- To familiarize to develop the IoT application
- To familiarize IoT protocols.
- To provide basic principles of cloud computing.
- To familiarize IoT applications into cloud environment.

UNIT I OVERVIEW OF EMBEDDED IoT 9

Introduction to Internet of Things (IoT)– Functional Characteristics – Recent Trends in the Adoption of IoT – Societal Benefits of IoT, Health Care — Machine to Machine (M2M) - Smart Transportation – Smart Living – Smart Cities- Smart Grid, Industry.

UNIT II ARDUINO UNO AND RASPBERRY PI 3 9

Arduino introduction, architecture, instruction set, input and output ports, interrupts, peripherals programming and board configuration, overview of ESP8266.

Raspberry Pi 3: Architecture, instruction set, input and output ports, interrupts, peripherals programming, and board configuration.

UNIT III PRINCIPLES OF COMMUNICATION 9

Protocol Standardization for IoT, Machine to machine (M2M) and WSN Protocols, Basics of RFID, Protocols- IEEE 802.15.4, ZigBee, IPv6 technologies for IOT.

UNIT IV COMMUNICATION INTERFACES AND SECURITY 9

IEEE 802.11 Wireless Networks Attacks: Basic Types, WEP Key Recovery Attacks, Keystream Recovery Attacks against WEP – RFID Security – Security Issues in ZigBEE: Eavesdropping Attacks, Encryption Attacks – Bluetooth Security: Threats To Bluetooth Devices and Networks.

UNIT V CLOUD ANALYSIS FOR IOT APPLICATION 9

Evolution of Cloud Computation, Commercial clouds and their features, open source IoT platforms, cloud dashboards, big data analytics and Hadoop. Interfacing and data logging with cloud: Thing speak, Blync platform.

TOTAL PERIODS: 45

COURSE OUTCOMES:

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

- Describe the various concept of the IoT and their technologies.
- Develop the IoT application using hardware platforms.
- Explain IoT Protocols.
- Discuss the basic principles of cloud computing.
- Discuss IoT applications into the cloud space.

TEXTBOOKS:

1. Ioana Culic, Alexandru Radovici, Cristian Rusu, “Commercial and Industrial Internet of Things Applications with the Raspberry Pi”, Apress Publishers, 2020.
2. Rajesh Singh, Anita Gehlot, Lovi Raj Gupta, Bhupendra Singh, and Mahendra Swain, “Internet of Things with Raspberry Pi and Arduino”, CRC Press, 2020.
3. Honbo Zhou, “The Internet of Things in the Cloud:A Middleware Perspective”, CRC Press 2012.

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1. Marco Schwartz, “Internet of Things with the Arduino Yun”, Packt Publishing, 2014
2. Peter Waher, 'Learning Internet of Things', Packt Publishing, 2015
3. Francis daCosta, “Rethinking the Internet of Things: A Scalable Approach to Connecting Everything”, 1st Edition, Apress Publications, 2013

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2. https://www.javatpoint.com/arduino-uno
3. https://www.raspberrypi.com/documentation/
4. https://www.ncsc.gov.uk/guidance/secure-communication-principles
5. https://dgtlinfra.com/cloud-internet-of-things-iot/

CO-PO/PSO MAPPING:

CO\ PO, PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2	2	2	2	2	-	-	-	-	1	1	3	3	2
CO2	3	3	3	3	2	2	-	-	-	-	1	1	2	2	2
CO3	3	3	3	3	3	2	-	-	-	-	1	1	2	2	2
CO4	2	2	2	2	2	2	-	-	-	-	1	1	2	2	2
CO5	3	3	3	3	3	3	-	-	-	-	1	1	3	2	3
AVG	**2.6**	**2.6**	**2.6**	**2.6**	**2.4**	**2.2**	**0**	**0**	**0**	**0**	**1**	**1**	**2.4**	**2.2**	**2.2**

JEC1037	CLOUD COMPUTING	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To make understand the concept of cloud computing.
- To explain the evolution of cloud from the existing technologies.
- To provide knowledge on the various issues in cloud computing.
- To describe storage architectures, processes, components and how they relate to virtualization.
- To introduce the key aspects of developing applications using a framework.

UNIT I INTRODUCTION TO CLOUD COMPUTING 9

Introduction to Cloud – Definition and Evolution of Cloud – Underlying Principles of Parallel and Distributed Computing – Cloud Characteristics – Elasticity in Cloud – Features of Today's Cloud, On-demand Provisioning.

UNIT-II CLOUD ENABLING TECHNOLOGIES 9

Service Oriented Architecture – REST and Systems of Systems – Web Services – Publish Subscribe Model – Virtualization Platforms & Techniques - Basics and types of Virtualization – Implementation Levels of Virtualization – Virtualization Structures – Tools and Mechanisms – Virtualization of CPU – Memory – I/O Devices –Virtualization Support.

UNIT-III CLOUD ARCHITECTURE, SERVICES AND STORAGE 9

Layered Cloud Architecture Design – NIST Cloud Computing Reference Architecture – Public, Private and Hybrid Clouds - laaS – PaaS – SaaS – Architectural Design Challenges – Cloud Storage – Storage-as-a-Service – Advantages of Cloud Storage – Cloud Storage Providers – Google Cloud, Amazon S3, Windows Azure, IBM Cloud.

UNIT-IV RESOURCE MANAGEMENT AND SECURITY IN CLOUD 9

Inter Cloud Resource Management – Resource Provisioning and Resource Provisioning Methods – Global Exchange of Cloud Resources – Technical and Legal Issues in Cloud Computing - Security Overview – Cloud Security Challenges – Software-as-a-Service Security – Security Governance – Virtual Machine Security – IAM – Security Standards.

UNIT-V CLOUD TECHNOLOGIES AND ADVANCEMENTS 9

Hadoop – MapReduce in Google Cloud Platform– Virtual Box -- Google App Engine – Programming Environment for Google App Engine – Cloud Computing Development Tools– Open Stack, SaltStack , AWS Cloud Development Kit (AWS CDK) , Windows Azure SDK – Federation in the Cloud – Four Levels of Federation – Federated Services and Applications.

TOTAL PERIODS: 45

COURSE OUTCOMES:

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

- Describe the main concepts, technologies, strengths of cloud computing.
- Classify the key and enabling technologies that help in the development of cloud.
- Explain the architecture of compute and storage cloud, service and delivery models.
- Explain the core issues of cloud computing such as resource management and security.

- Describe various Cloud Technologies and Advancements

TEXTBOOKS:

1. Kai Hwang, Geoffrey C. Fox, Jack G. Dongarra, "Distributed and Cloud Computing, From Parallel Processing to the Internet of Things", Morgan Kaufmann Publishers, 2012.
2. Sunil Kumar Manvi, Gopal K. Shyam, "Cloud Computing: Concepts and Technologies", CRC Press, Taylor & Francis Publishers, 2021.

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1. Rajiv Misra, Yashwant Singh Patel ,"Cloud and Distributed Computing: Algorithms and Systems", WILEY Publishers, 2020.
2. Rittinghouse, John W., and James F. Ransome, ―Cloud Computing: Implementation, Management and Security, CRC Press, 2017.
3. Rajkumar Buyya, Christian Vecchiola, S. ThamaraiSelvi, ―Mastering Cloud Computing‖, Tata Mcgraw Hill, 2013.
4. Toby Velte, Anthony Velte, Robert Elsenpeter, "Cloud Computing - A Practical Approach‖, Tata Mcgraw Hill, 2009.
5. George Reese, "Cloud Application Architectures: Building Applications and Infrastructure in the Cloud: Transactional Systems for EC2 and Beyond (Theory in Practice), O'Reilly, 2009.

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2. https://www.coursera.org/learn/introduction-to-cloud
3. https://www.ibm.com/in-en/cloud/learn/soa
4. https://www.geeksforgeeks.org/rest-api-architectural-constraints/
5. https://aws.amazon.com/pub-sub-messaging/

CO-PO/PSO MAPPING:

CO\ PO, PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	-	2	3	-	-	-	-	-	2	3	2	-
CO2	3	3	2	-	2	3	-	-	-	-	-	2	3	2	-
CO3	3	3	3	-	3	3	-	-	-	-	-	3	3	2	-
CO4	3	3	3	-	3	3	-	-	-	-	-	3	3	1	-
CO5	2	2	3	3	3	2	-	-	-	-	-	3	3	1	-
AVG	**2.8**	**2.8**	**2.6**	**3**	**2.6**	**2.6**	**-**	**-**	**-**	**-**	**-**	**2.6**	**3**	**1.6**	**-**

JEC1038	BIOSIGNAL PROCESSING	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To describe the time and frequency domain fundamentals of biomedical signals and systems.
- To explain time series analysis and spectrum estimation techniques.
- To describe the biomedical applications of adaptive filters and wavelets.
- To provide knowledge on neural network approaches in classification and recognition.
- To make students understand time, frequency representations and data compression.

UNIT I SIGNAL, SYSTEM AND SPECTRUM 9

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

UNIT II TIME SERIES ANALYSIS AND SPECTRAL ESTIMATION 9

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

UNIT III ADAPTIVE FILTERING AND WAVELET DETECTION 9

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

UNIT IV BIOSIGNAL CLASSIFICATION AND RECOGNITION 9

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

UNIT V TIME FREQUENCY AND MULTIVARIATE ANALYSIS 9

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

TOTAL PERIODS: 45

COURSE OUTCOMES:

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

- Describe the time and frequency domain fundamentals of biomedical signals and systems.
- Explain the time series analysis and spectrum estimation techniques with respect to bio signals.
- Illustrate the biomedical applications of adaptive filters and wavelets.
- Apply neural network approaches in classification and recognition.
- Comprehend time, frequency representations of bio signals and compression techniques.

TEXTBOOKS:

1. Willis J. Tompkins, Biomedical Digital Signal Processing, Prentice Hall of India, New Delhi, 2003.
2. Rangaraj M. Rangayyan, 2nd edition „Biomedical Signal Analysis-A case study approach", Wiley, IEEE Press, 2015.

REFERENCES:

1. Arnon Cohen, Bio-Medical Signal Processing Vol I and Vol II, CRC Press Inc., Boca Rato, Florida 1999.
2. Emmanuel C. Ifeachor, Barrie W.Jervis, second edition „Digital Signal processing- A Practical Approach" Pearson education Ltd., 2002
3. P.Ramesh Babu, ―Digital Signal Processing‖, Sixth Edition, Scitech publications, Chennai, 2014.
4. Raghuveer M. Rao and AjithS.Bopardikar, Wavelets transform – Introduction to theory and its applications, Pearson Education, India 2000

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2. https://www.youtube.com/watch?v=b0430f_W0mo
3. https://www.youtube.com/watch?v=IKolNjJPcM8
4. https://www.youtube.com/watch?v=h6YLvBux9PE
5. https://archive.nptel.ac.in/noc/courses/noc17/SEM1/noc17-ee09/

CO-PO/PSO MAPPING:

CO\PO, PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	2	2	3	-	-	-	-	-	1	2	3	3
CO2	3	3	3	2	2	3	-	-	-	-	-	2	3	2	2
CO3	3	3	3	2	2	3	-	-	-	-	-	2	2	2	1
CO4	3	3	2	2	2	2	-	-	-	-	-	2	2	2	2
CO5	3	3	3	2	1	1	-	-	-	-	-	1	3	3	1
AVG	**3**	**3**	**3**	2	2	2	-	-	-	-	-	**2**	**3**	**2**	**2**

JEC1039 SPEECH PROCESSING L T P C
3 0 0 3

COUSE OBJECTIVES:

- To introduce the basic concepts of speech signals and its representation.
- To describe Mathematical Modelling for Speech signal Processing.
- To explain the different Speech Recognition Systems
- To make students learn methods of Automatic Speech Recognition
- To provide knowledge about applications of Speech Synthesis

UNIT I BASIC CONCEPTS OF SPEECH SIGNAL 9

The process of speech production, acoustic theory of speech production, Digital models for speech signals, representing speech in the Time and Frequency Domains, Speech sounds and features.

UNIT II MATHEMATICAL MODELLING 9

Features and Pattern Comparison Techniques: Speech distortion measures – mathematical and perceptual – Log Spectral Distance-Dynamic Time Warping-Multiple Time – Alignment Paths

UNIT III SPEECH RECOGNITION 9

Parameterisation of the speech signal- dynamic time warping- distance measures- Speech Recognition- Speech Features – The Auditory System as a Filter Bank - The Cepstrum as a Spectral Analyzer-Linear Prediction.

UNIT IV AUTOMATIC SPEECH RECOGNITION 9

Automatic Speech Recognition- Feature Extraction for ASR- Deterministic Sequence Recognition for ASR- Statistical Sequence Recognition.

UNIT V EVALUATION OF SPEECH RECOGNITION SYSTEM 9

Performance and evaluation of speech recognition systems, Case Study – Gender Identification using Pitch Frequency calculation using MATLAB, Isolated word recognition.

TOTAL PERIODS:45

COURSE OUTCOMES:

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

- Analyse the basics of speech signals and its representation.
- Identify Mathematical Modelling for Speech signal Processing.
- Explain different Speech Recognition Systems.
- Implement Automatic Speech Recognition.
- Explore applications in Speech Synthesis.

TEXTBOOK:

1. Lawrence Rabiner and Biing-Hwang Juang, “Fundamentals of Speech Recognition”, 1st edition, Pearson Education, 2008.
2. L.R. Rabiner and S. W. Schafer, “Digital Processing of Speech Signals”, Pearson Education, 2007.

REFERENCES

1. Thomas F Quatieri, “Discrete-Time Speech Signal Processing – Principles and Practice”, PearsonEducation, 2006
2. Frederick Jelinek, “Statistical Methods of Speech Recognition”, MIT Press, 1998
3. Daniel Jurafsky and James H Martin, “Speech and Language Processing - An Introductionto Natural Language Processing, Computational Linguistics, and Speech Recognition”, 2ndedition, Pearson Education, 2002
4. Ben Gold and Nelson Morgan, Speech and Audio Signal Processing, John Wiley and Sons Inc., Singapore, 2004.

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1. NOC | Digital speech processing (nptel.ac.in).
2. NPTEL: NOC: Digital Speech Processing (Electronics and Communication Engineering) (nitttrc.edu.in)
3. Free Online Course: Speech Recognition Systems from edX | Class Central
4. Automatic Speech Recognition (nplt.in)

CO-PO/PSO MAPPING:

CO\PO, PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	2	3	1	-	-	-	-	1	2	3	3	2
CO2	3	3	2	3	2	1	-	-	-	-	1	2	3	2	3
CO3	2	3	2	3	3	1	-	-	-	-	1	2	3	3	3
CO4	1	3	2	3	2	1	-	-	-	-	1	2	2	2	3
CO5	3	3	2	3	3	1	-	-	-	-	1	2	3	3	3
AVG	**2.4**	**3**	**2**	**2.8**	**2.6**	**1**	-	-	-	-	**1**	**2**	**2.8**	**2.6**	**2.8**

JEC1008	DIGITAL AUDIO ENGINEERING	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To understand the classification of audio and its measurement
- To understand the concepts of filters
- To understand the audio compression techniques
- To know the speaker recognition and text to speech synthesis techniques
- To know the audio processing systems

UNIT I AUDIO SIGNAL CHARACTERISTICS 9

Nature of Audio signal – Discrete time modelling of Audio production – Classification of sounds – Phones – Phonemes – Phonetic and Phonemic alphabets – Perpectual Measurement.

UNIT II FILTER BANKS 10

Filter Banks for Audio Coding: Design Considerations - Quadrature Mirror and Conjugate Quadrature Filters - Tree-Structured QMF and CQF M-band Banks - Cosine Modulated "Pseudo QMF" M-band Banks -Cosine Modulated Perfect Reconstruction (PR) M-band Banks and the Modified Discrete Cosine Transform (MDCT).

UNIT III AUDIO COMPRESSION 8

Perpectual coding- coding tools-Lossless Audio Coding-Lossy Audio Coding- MPEG-1A, 2A, 2A Advanced, 4 Audio Coding - Optimum Coding in the Frequency Domain.

UNIT IV DIGITAL AUDIO RESTORATION 9

Modelling of Audio Signal- Click Detection- Replacement of corrupted samples- Correlated Noise pulse removal-Background Noise reduction- Reduction of Non-Linear Amplitude Distortion, Software for Audio Restoration.

UNIT V AUDIO PROCESSING SYSTEMS 9

Digital Signal Processors-Fixed point DSP- Floating point DSP-Audio Interfaces-Single Processor System-Multi Processor System-Serial, parallel links-scalable Audio System.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

- Explain the classification of audio and its measurement
- Analyse the concepts of filters
- Describe the audio compression techniques
- Explain the speaker recognition and text to speech synthesis techniques
- Describe the audio processing systems

TEXT BOOKS:

1. B.Gold and N.Morgan, "Speech and Audio Signal Processing", Wiley and Sons, 2000.
2. John Watkinson, An Introduction to Digital Audio, Focal Press, Second edition. 2013

REFERENCES:

1. Mark Kahrs, Karlheinz Brandenburg, Kluwer "Applications of Digital Signal Processing to Audio And Acoustics" Academic Publishers New York, Boston, Dordrecht, London, Moscow, 2002.
2. Udo Zolzer, "Digital Audio Signal Processing", Second Edition, A John Wiley& sons Ltd Publications, 2008.
3. Ken C. Pohalmann, "Principles of Digital Audio", Tata McGraw Hill Publications, Fourth Edition, 2000.

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2. https://www.ee.iitb.ac.in/student/~daplab/publications/chapter9-prao.pdf
3. https://www.sciencedirect.com/topics/computer-science/audio-compression
4. https://www.dspguide.com/ch1/3.htm

CO - PO MAPPING

CO\PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	2	1	3	3	2	-	-	-	-	2	2
CO2	2	2	2	3	3	2	-	-	-	-	2	3
CO3	2	2	2	3	3	2	-	-	-	-	2	3
CO4	2	2	3	3	3	2	-	-	-	-	3	3
CO5	3	3	3	3	3	2	-	-	-	-	3	3
AVG	2	2.2	2.2	3	3	2	-	-	-	-	2.4	2.8

CO - PSO MAPPING

CO\PSO	PSO1	PSO2	PSO3
CO1	2	1	1
CO2	2	2	2
CO3	3	2	2
CO4	3	2	2
CO5	3	3	3
AVG	2.6	2	2

JEC1040	STATISTICAL SIGNAL PROCESSING	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To explain about multirate signal processing and its applications
- To introduce the concepts of discrete time random signal processes
- To describe the concept of prediction theory and filtering
- To provide knowledge on concepts of adaptive filtering
- To make students understand the spectrum estimation techniques

UNIT I MULTIRATE SIGNAL PROCESSING 9

Review of Convolution, DFT and Z Transform, Multirate Signal Processing - Decimation, Interpolation, Sampling Rate Conversion by a rational factor – Digital filter banks, Sub band coding, Quadrature Mirror Filter.

UNIT II DISCRETE TIME RANDOM PROCESSES 9

Stationary random processes, Autocorrelation, Rational Power Spectra, Filters for generating random Processes from white noise and inverse filter – AR, MA and ARMA processes – relationship between autocorrelation and the filter parameters.

UNIT III LINEAR PREDICTION AND FILTERING 9

Linear Prediction – Forward and Backward - Wiener filters for filtering and prediction – FIR Wiener Filter – IIR Wiener Filter – Kalman Filter.

UNIT IV ADAPTIVE FILTERING 9

FIR adaptive filters – adaptive filters based on steepest descent method – LMS algorithm – Variants of LMS algorithm – adaptive echo cancellation – adaptive channel equalization – RLS Algorithm.

UNIT V SPECTRUM ESTIMATION 9

Estimation of power spectra from finite duration observations of signals – Non parametric methods of spectrum estimation – the Bartlett and the Welch method – Parametric spectrum estimation – AR, MA and ARMA.

TOTAL PERIODS: 45

COURSE OUTCOMES:
At the end of the course, the students will be able to:

- Comprehend multirate signal processing and demonstrate its applications
- Explain the concept of power spectral density and apply it to discrete random signals and systems
- Apply linear prediction and filtering techniques to discrete random signals for signal detection and estimation.
- Analyze adaptive filtering problems and demonstrate its application
- Apply power spectrum estimation techniques to random signals.

TEXTBOOKS:

1. John G. Proakis & Dimitris G.Manolakis, ―Digital Signal Processing – Principles, Algorithms & Applications, Fourth Edition, Pearson Education / Prentice Hall, 2007.
2. P. Vaidyanathan, "Multirate systems and filter banks", Prentice Hall Inc. 1993.

REFERENCES:

1. Monson H. Hayes, "Statistical digital signal processing and modeling", John Wiley and Sons Inc. New York, Indian reprint 2008.
2. Haykin, Adaptive Filter Theory, 4th Edition, Pearson Education, New Delhi, 2006.
3. Sophoncles J. Orfanidis, “Optimum Signal Processing “, McGraw Hill, 2000..

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CO-PO/PSO MAPPING:

CO\ PO, PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	2	2	3	-	-	-	-	-	1	2	3	3
CO2	3	3	3	2	2	3	-	-	-	-	-	2	3	2	2
CO3	3	3	3	2	2	3	-	-	-	-	-	2	2	2	1
CO4	3	3	2	2	2	2	-	-	-	-	-	2	2	2	2
CO5	3	3	3	2	1	1	-	-	-	-	-	1	3	3	1
AVG	**3**	**3**	**3**	2	2	2	-	-	-	-	-	**2**	**3**	**2**	**2**

JBM1701	DIGITAL IMAGE PROCESSING	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To become familiar with digital image fundamentals
- To get exposed to simple image enhancement techniques in Spatial and Frequency domain.
- To learn concepts of degradation function and restoration techniques.
- To study the image segmentation and representation techniques.
- To become familiar with image compression and recognition methods

UNIT I DIGITAL IMAGE FUNDAMENTALS 9

Steps in Digital Image Processing – Components – Elements of Visual Perception – Image Sensing and Acquisition – Image Sampling and Quantization – Relationships between pixels - Color image fundamentals - RGB, HSI models, Two-dimensional mathematical preliminaries, 2Dtransforms - DFT, DCT.

UNIT II IMAGE ENHANCEMENT 9

Spatial Domain: Gray level transformations – Histogram processing – Basics of Spatial Filtering– Spatial operations – directional smoothening and Sharpening Spatial Filtering, Frequency Domain: Introduction to Fourier Transform– Smoothing and Sharpening frequency domain filters – Ideal, Butterworth and Gaussian filters, Homomorphic filtering, Color image enhancement.

UNIT III IMAGE RESTORATION 9

Image Restoration - degradation model, Properties, Noise models – Mean Filters – Order Statistics – Adaptive filters – Band reject Filters – Band pass Filters – Notch Filters – Optimum Notch Filtering – Inverse Filtering – Wiener filtering

UNIT IV IMAGE SEGMENTATION 9

Edge detection, Edge linking via Hough transform – Thresholding - Region based segmentation – Region growing – Region splitting and merging – Morphological processing- erosion and dilation, Segmentation by morphological watersheds – basic concepts – Dam construction – Watershed segmentation algorithm

UNIT V IMAGE COMPRESSION AND RECOGNITION 9

Need for data compression, Huffman, Run Length Encoding, Shift codes, Arithmetic coding, JPEG standard, MPEG. Boundary representation, Boundary description, Fourier Descriptor, Regional Descriptors – Topological feature, Texture - Patterns and Pattern classes - Recognition based on matching.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

- Apply the basics and fundamentals of digital image processing, such as digitization, sampling, quantization, and 2D-transforms on images
- Operate on images using the techniques of smoothing, sharpening and enhancement.
- Discuss the restoration concepts and filtering techniques.
- Apply the basics of segmentation in a digital
- Use different compression method in a digital image

TEXT BOOKS:

1. Rafael C. Gonzalez, Richard E. Woods, "Digital Image Processing", Pearson Fourth Edition, 2018
2. Anil K. Jain, "Fundamentals of Digital Image Processing", Pearson,2015.

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,_ Multi dimensional Digital Signal Processing', PrenticeHall Professional Technical Reference, 1990.
4. J. Michael Fitzpatrick and Milan Sonka, "Handbook of Medical Imaging, Vol. 2, SPIE Press, 2000
5. Milan Sonka et al _Image processing, analysis and machine vision', Brookes/Cole, Vikas Publishing House, 2nd edition, 1999

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4. https://www.youtube.com/watch?v=7xKhYfPel9w
5. https://www.youtube.com/watch?v=5qxrzD6ODHc

CO-PO MAPPING:

CO\PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	1	1	-	-	-	-	-	1	2	-	1
CO2	3	1	1	-	-	-	-	-	1	2	-	2
CO3	3	2	1	-	-	-	-	-	1	2	-	2
CO4	3	3	1	-	-	-	-	-	1	2	-	2
CO5	3	3	1	-	-	-	-	-	1	2	-	2
AVG	3	2	1	-	-	-	-	-	1	2	-	1.8

CO-PSO MAPPING

CO\PSO	PSO1	PSO2	PSO3
CO1	2	2	2
CO2	2	2	2
CO3	3	2	2
CO4	3	3	3
CO5	3	3	3
AVG	2.6	2.4	2.4

JEC1041	COMPUTER VISION	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To provide basics of image processing techniques for computer vision.
- To make understand shape and region analysis.
- To describe Hough Transform and its applications to detect lines, circles, ellipses.
- To design three-dimensional image analysis techniques.
- To explain 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 – 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)

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.

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

TOTAL PERIODS: 45

COURSE OUTCOMES:

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

- Explain the fundamental image processing techniques required for computer vision.
- Describe shape analysis and implement boundary tracking techniques.
- Explain chain codes, Hough Transform for line, circle, and ellipse detections.

- Explain 3D vision and motion related techniques.
- Describe the applications using computer vision techniques.

TEXTBOOKS:

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.

REFERENCES:

1. Jan Erik Solem, ―Programming Computer Vision with Python: Tools and algorithms for analyzing images‖, O'Reilly Media, 2012.
2. Mark Nixon and Alberto S. Aquado, ―Feature Extraction & Image Processing for Computer Vision‖, Third Edition, Academic Press, 2012.
3. R. Szeliski, ―Computer Vision: Algorithms and Applications‖, Springer 2011.
4. Simon J. D. Prince, ―Computer Vision: Models, Learning, and Inference‖, Cambridge University Press, 2012.

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2. https://www.cs.ccu.edu.tw/~pahsiung/courses/soc/notes/soc01.pdf
3. https://si2.epfl.ch/~demichel/publications/archive/2000/TODAESvol5iss2Apr00pg115.pdf
4. https://youtu.be/3LaVxEX3F0o
5. https://www.youtube.com/watch?v=MUadR35FFqk

CO-PO/PSO MAPPING:

CO\PO,PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	2	2	2	3	-	-	-	-	2	2	2	2	2
CO2	3	2	2	2	2	3	-	-	-	-	3	3	3	3	3
CO3	3	2	2	3	3	3	-	-	-	-	3	3	3	3	3
CO4	2	2	3	3	3	3	-	-	-	-	3	3	3	3	3
CO5	2	3	3	3	3	3	-	-	-	-	3	3	3	3	3
AVG	**2.6**	**2.2**	**2.4**	**2.6**	**2.4**	**3**	**-**	**-**	**-**	**-**	**2.8**	**2.8**	**2.8**	**2.8**	**2.8**

JEC1019	SOFT COMPUTING	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To learn the basic concepts of Soft Computing
- To become familiar with neural networks,
- To become familiar with genetic algorithms
- To familiarize with fuzzy systems.
- To apply soft computing techniques to solve problems.

UNIT I INTRODUCTION TO SOFT COMPUTING 9

Introduction-Artificial Intelligence-Artificial Neural Networks-Fuzzy Systems-Genetic Algorithm and Evolutionary Programming-Swarm Intelligent Systems-Classification of ANNs-McCulloch and Pitts Neuron Model-Learning Rules: Hebbian and Delta- Perceptron Network-Adaline Network-Madaline Network.

UNIT II ARTIFICIAL NEURAL NETWORKS 9

Backpropagation Neural Networks - Kohonen Neural Network -Learning Vector Quantization - Hamming Neural Network - Hopfield Neural Network- Bi-directional Associative Memory -Adaptive Resonance Theory Neural Networks- Support Vector Machines - Spike Neuron Models.

UNIT III FUZZY SYSTEMS 9

Introduction to Fuzzy Logic, Classical Sets and Fuzzy Sets - Classical Relations and Fuzzy Relations - Membership Functions -Defuzzification - Fuzzy Arithmetic and Fuzzy Measures -Fuzzy Rule Base and Approximate Reasoning - Introduction to Fuzzy Decision Making.

UNIT IV GENETIC ALGORITHMS 9

Basic Concepts- Working Principles -Encoding- Fitness Function - Reproduction -Inheritance Operators - Cross Over - Inversion and Deletion -Mutation Operator - Bit-wise Operators -Convergence of Genetic Algorithm.

UNIT V HYBRID SYSTEMS 9

Hybrid Systems -Neural Networks, Fuzzy Logic and Genetic -GA Based Weight Determination - LR-Type Fuzzy Numbers - Fuzzy Neuron - Fuzzy BP Architecture - Learning in Fuzzy BP- Inference by Fuzzy BP - Fuzzy ArtMap: A Brief Introduction - Soft Computing Tools - GA in Fuzzy Logic Controller Design - Fuzzy Logic Controller

TOTAL PERIODS: 45

COURSE OUTCOMES:

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

- Learn the basic concepts of Soft Computing
- Be familiar with neural networks,
- Become familiar with genetic algorithms
- Understand fuzzy systems.
- Application of soft computing techniques to solve problems.

TEXTBOOKS:

1. N.P.Padhy,S.P.Simon, "Soft Computing with MATLAB Programming", Oxford University Press, 2015.
2. S.N.Sivanandam, S.N.Deepa, "Principles of Soft Computing", Wiley India Pvt.Ltd., 2nd Edition, 2011.
3. S.Rajasekaran, G.A.Vijayalakshmi Pai, "Neural Networks, Fuzzy Logic and Genetic Algorithm, Synthesis and Applications ", PHI Learning Pvt.Ltd., 2017.

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1. Jyh-Shing Roger Jang, Chuen-Tsai Sun, EijiMizutani, ―Neuro-Fuzzy and Soft Computing‖, Prentice-Hall of India, 2002.
2. Kwang H.Lee, ―First course on Fuzzy Theory and Applications‖, Springer, 2005.
3. George J. Klir and Bo Yuan, ―Fuzzy Sets and Fuzzy Logic-Theory and Applications‖, Prentice Hall, 1996.
4. James A. Freeman and David M. Skapura, ―Neural Networks Algorithms, Applications, and Programming Techniques‖, Addison Wesley, 2003.

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2. https://nptel.ac.in/courses/108104157
3. https://nptel.ac.in/courses/112105235

CO-PO MAPPING

CO\PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	2	1	2	2	1	-	-	-	-	2	2
CO2	2	2	2	2	2	2	-	-	-	-	2	3
CO3	2	2	2	2	2	2	-	-	-	-	2	3
CO4	2	2	3	3	3	2	-	-	-	-	3	3
CO5	3	2	3	3	3	2	-	-	-	-	3	3
AVG	**2**	**2**	**2.2**	**2.4**	**2.4**	**1.8**	**-**	**-**	**-**	**-**	**2.4**	**2.8**

CO-PSOMAPPING

CO\PSO	PSO1	PSO2	PSO3
CO1	2	2	2
CO2	2	2	2
CO3	3	2	2
CO4	3	3	3
CO5	3	3	3
AVG	2.6	2.4	2.4

JEC1026	PATTERN RECOGNITION	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To learn about supervised and unsupervised pattern classifiers.
- To understand Clustering concept.
- To familiarize about different feature extraction techniques.
- To explore the role of Hidden Marko model and SVM in pattern recognition.
- To understand the application of Fuzzy logic and genetic algorithms for pattern classifier

UNIT I PATTERN CLASSIFIER 9

Overview of Pattern recognition – Discriminant functions – Supervised learning –Parametric estimation – Maximum Likelihood Estimation – Bayesian parameter Estimation – Problems with Bayes approach– Pattern classification by distance functions – Minimum distance pattern classifier.

UNIT II CLUSTERING 9

Clustering for unsupervised learning and classification–Clustering concept – C Means algorithm – Hierarchical clustering – Graph theoretic approach to pattern Clustering – Validity of Clusters.

UNIT III FEATURE EXTRACTION AND STRUCTURAL PATTERN RECOGNITION 9

Principle component analysis, independent component analysis, Linear discriminant analysis, Feature selection through functional approximation – Elements of formal grammars, Syntactic description – Stochastic grammars – Structural Representation.

UNIT IV HIDDEN MARKOV MODELS AND SUPPORT VECTOR MACHINE 9

State Machines – Hidden Markov Models – Training – Classification – Support vector Machine – Feature Selection.

UNIT V RECENT ADVANCES 9

Fuzzy logic – Fuzzy Pattern Classifiers – Pattern Classification using Genetic Algorithms – Case Study Using Fuzzy Pattern Classifiers and Perception.

TOTAL: 45 PERIODS

COURSE OUTCOMES:
Upon completion of the course the student will be able to

- Differentiate between supervised and unsupervised classifiers
- Analyze Clustering concept.
- Classify the data and identify the patterns.
- Extract feature set and select the features from given data set.
- Apply fuzzy logic and genetic algorithms for classification problems

TEXTBOOKS:

1. Andrew Webb, “Statistical Pattern Recognition”, Arnold Publishers, London,1999.
2. C.M.Bishop, “Pattern Recognition and Machine Learning”, Springer, 2006.
3. M. Narasimha Murthy and V. Susheela Devi, “Pattern Recognition”, Springer 2011.

REFERENCES:

1. Menahem Friedman, Abraham Kandel, “Introduction to Pattern Recognition Statistical, Structural, Neural and Fuzzy Logic Approaches”, World Scientific Publishing Co. Ltd, 2000.
2. Robert J.Schalkoff, “Pattern Recognition Statistical, Structural and Neural Approaches”, John Wiley & Sons Inc., New York, 1992.
3. R.O.Duda, P.E.Hart and D.G.Stork, “Pattern Classification”, John Wiley, 2001.
4. S.Theodoridis and K.Koutroumbas, “Pattern Recognition”, 4th Ed., Academic Press. 2009.

WEBSITE REFERENCES:

1. Overview of Pattern Classifiers, Prof. P.S. Sastry, Department of Electronics & Communication Engineering, IISc Bangalore.
2. https://www.youtube.com/watch?v=9iaQg1vp4wE
3. Introduction to Clustering, https://www.youtube.com/watch?v=CwjLMV52tzI
4. Introduction to Statistical Pattern Recognition, www.digimat.in/nptel
5. Support Vector Machine, https://www.youtube.com/watch?v=SRVswRH5Q7E

CO - PO MAPPING

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	3	3	2	1	3	1	-	-	1	-	2	3
CO2	3	3	2	1	3	1	-	-	1	-	2	3
CO3	3	3	2	1	3	1	-	-	1	-	2	3
CO4	3	3	2	1	3	1	-	-	1	-	2	3
CO5	3	2	2	1	3	1	-	-	1	-	2	3
AVG	**3**	**2.8**	**2**	**1**	**3**	**1**	**-**	**-**	**1**	**-**	**2**	**3**

CO -PSO MAPPING

CO\PSO	**PSO1**	**PSO2**	**PSO3**
CO1	2	2	2
CO2	2	2	2
CO3	3	3	3
CO4	3	3	3
CO5	3	3	3
AVG	**2.6**	**2.6**	**2.6**

JEC1009	INFORMATION THEORY & CODING	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- Understand fundamentals of information theory
- Comprehend encoding and decoding of digital data streams.
- Gain knowledge about information channels
- Be familiar with the methods of detecting and correcting errors
- Learn generation of other coding and decoding techniques

UNIT I INFORMATION ENTROPY FUNDAMENTALS 9

Introduction, Measure of information, Information content of message, Average Information content of symbols in Long Independent sequences, Average Information content of symbols in long dependent sequences, Markov Statistical Model of Information Sources.

UNIT II SOURCE CODING 9

Source coding theorem, Prefix Codes – Encoding of the Source Output, Shannon's Encoding Algorithm Shannon Fano Encoding Algorithm, Huffman codes, Extended Huffman coding, Arithmetic Coding, Lempel – Ziv Algorithm, Run Length Encoding.

UNIT III INFORMATION CHANNELS 9

Binary Communication Channels, Channel Models, Channel Matrix, Joint probability Matrix, Binary Symmetric Channel, System Entropies, Mutual Information, Channel Capacity, Channel Capacity of :Binary Symmetric Channel, Binary Erasure Channel.

UNIT IV ERROR CONTROL CODING 9

Methods of Controlling Errors, Types of Errors, types of Codes-Linear block codes – syndrome and error correction – Binary Cyclic Codes: Algebraic Structure of Cyclic Codes, Syndrome Calculation, Error Detection and Correction.

UNIT V CODING TECHNIQUES 9

Convolution codes – encoder – generator matrix – state diagram – distance properties - maximum likelihood decoding – Viterbi decoding – sequential decoding –Hadamard matrices and Hadamard codes – BCH codes – description, decoding – Reed Solomon code, Label encoding.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

- Describe the concepts of information theory
- Choose the necessary source coding technique for different application.
- Characterize different channels
- Detect and correct errors using different error controlling codes
- Acquire idea about other coding techniques

TEXT BOOKS:

1. Dr.Muralidhar Kulkarni &Dr. Shivaprakash K S "Information Theory and Coding" Wiley India: 2015
2. Ranjan Bose, "Information Theory, Coding, and Cryptography" – McGraw Hill, India – 2008 (2nd Edition)

REFERENCES:

1. Thomas M. Cover, Joy A. Thomas – Elements of Information Theory – Wiley, India – 2nd Edition.
2. S.Haykins, "Digital Communications" John Wiley 2005

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4. https://nptel.ac.in/courses/117/104/117104120/
5. https://nptel.ac.in/courses/117/102/117102059/

CO - PO MAPPING

CO\PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	3	3	2	2	1	-	-	-	-	3	2
CO2	3	2	3	3	3	1	-	-	-	-	2	3
CO3	2	3	2	2	3	2	-	-	-	-	3	2
CO4	3	3	3	3	2	1	-	-	-	-	2	2
CO5	3	2	3	2	3	1	-	-	-	-	3	2
AVG	2.6	2.6	2.8	2.4	2.6	1.2	-	-	-	-	2.6	2.2

CO - PSO MAPPING

CO\PSO	PSO1	PSO2	PSO3
CO1	3	2	1
CO2	3	2	1
CO3	3	2	1
CO4	3	2	1
CO5	3	2	1
AVG	3	2	1

JEC1016	STATISTICAL THEORY OF COMMUNICATION	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To understand the concept of information measure
- To understand the concepts of memory less channels
- To understand the linear filters
- To know the various testing of statistical hypothesis
- To understand the concept of parameter estimation

UNIT I INFORMATION MEASURE 9

Units of Information-Entropy and its types-Information rate- Noiseless coding-source coding theorem-construction of optimal codes.

UNIT II NOISY CODING 9

Memory less Channel- properties of discrete memory less channel-channel capacity- Shannon's theorem-Classification of channels-Rate of transmission- Trans information of Gaussian channel-Shannons Hartley Law-SNR tradeoff.

UNIT III OPTIMUM LINEAR SYSTEM 9

Optimum Linear filter-Matched filter response-spectral shaping-matched filter by pre-whitning technic-Wiener-filter estimation using Least Mean Square Error- Discrete Wiener filter.

UNIT IV TESTING OF STATISTICAL HYPOTHESIS 9

Likelyhood Ratio Test-Bayes Test- Probability of Error-Minmax test-Neyman-Pearson (NP) test-Receiver characteristics, Null hypothesis, Case Study: Statistical Hypothesis.

UNIT V PARAMETER ESTIMATION 9

Estimation of parameters-Estimation model-Baye's estimate-Maximum Likelihood Estimate-Mean Square Error Estimate-Pulsed RADAR System-Applications of Estimation Theory to Radar.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

- To explain the concept of information measure
- To explain the concepts of memory less channels
- To design the linear filters
- To describe the various testing of statistical hypothesis
- To analyse the concept of parameter estimation

TEXT BOOKS:

1. S.P. Eugene Xavier, "Statistical Theory of Communication", New Age International, 2007
2. Upamanyu Madhow, "Fundamentals of Digital Communication", Cambridge University Press, 2012.

REFERENCES:

1. Ravikumar, "Comprehensive Statistical Theory of Communication", Lakshmi Publications, 2001.
2. J.M. Wozencraft and I.M. Jacobs, Principles of Communication Engineering, New York: Wiley & Sons, 1965.
3. H.L. van Trees, Detection, Estimation, and Modulation Theory, vol. I, New York: Wiley & Sons, 1968.
4. J.G. Proakis, Digital Communications, 5th ed., New York: McGraw-Hill, 2007

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2. https://www.youtube.com/watch?v=14PQawp_rjk Testing of Hypothesis - IIT Kharagpur.
3. https://www.youtube.com/watch?v=gZRLaHu4lQc Parameter Estimation - IIT Madras.
4. https://nptel.ac.in/noc/courses/noc16/SEM1/noc16-ch03/
5. https://nptel.ac.in/courses/108/106/108106150/

CO - PO MAPPING

CO\PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	3	2	1	2	-	-	-	-	1	3
CO2	3	2	3	2	1	2	-	-	-	-	1	3
CO3	3	2	3	2	1	2	-	-	-	-	1	3
CO4	3	2	1	1	1	2	-	-	-	-	-	2
CO5	3	3	2	3	2	2	-	-	-	-	2	3
AVG	3	2	2	2	1	2	0	0	0	0	1	3

CO - PSO MAPPING

CO\PSO	PSO1	PSO2	PSO3
CO1	3	2	1
CO2	3	2	1
CO3	3	2	1
CO4	3	2	1
CO5	3	2	1
AVG	3	2	1

JEC1012	MULTIMEDIA COMPRESSION AND COMMUNICATION	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

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

UNIT I AUDIO COMPRESSION 9

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

UNIT II IMAGE AND VIDEO COMPRESSION 9

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

UNIT III TEXT COMPRESSION 7

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

UNIT IV GUARANTEED SERVICE MODEL 10

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

UNIT V MULTIMEDIA COMMUNICATION 10

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

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

- To design the compression schemes for voice
- To configure the compression schemes for image and video
- To configure the text compression techniques
- To select the suitable service model for specific application
- To configure multimedia communication network

TEXT BOOKS:

1. Fred Halsall, - Multimedia Communication - Applications, Networks, Protocols and Standards, Pearson Education, 2007.
2. R. Steimnetz, K. Nahrstedt, "Multimedia Communication Systems and Applications, Pearson Education, First Edition, 1995.

REFERENCES:

1. Tay Vaughan - Multimedia Making it work, McGraw - Hill Osborne Media, 2006.
2. K R.Roa, Z S. Bojkovic, D A Milovanovic, - Multimedia Communication Systems: Techniques, Standards and Networks, Pearson Education 2007.
3. Rao Kamisetty, Bojkovic Zoras and Dragorad, "Introduction To Multimedia Communications", Wiley, 1st Ed., 2006.

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2. https://www.youtube.com/watch?v=rC16fhvXZOo - Audio Video Compression by IIT Kharagpur
3. https://nptel.ac.in/courses/117/105/117105081/
4. http://www.nptelvideos.in/2012/11/data-communication.html

CO - PO MAPPING

CO\PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	3	3	2	2	1	-	-	-	-	3	2
CO2	3	2	3	3	3	1	-	-	-	-	2	3
CO3	2	3	2	2	3	2	-	-	-	-	3	2
CO4	3	3	3	3	2	1	-	-	-	-	2	2
CO5	3	2	3	2	3	1	-	-	-	-	3	2
AVG	2.6	2.6	2.8	2.4	2.6	1.2	-	-	-	-	2.6	2.2

CO - PSO MAPPING

CO\PSO	PSO1	PSO2	PSO3
CO1	2	2	2
CO2	3	2	2
CO3	3	3	3
CO4	2	2	2
CO5	3	3	3
AVG	2.6	2.4	2.4

JEC1024 WIRELESS COMMUNICATION & SENSOR NETWORKS	L	T	P	C
	3	0	0	3

COURSE OBJECTIVES:

- To understand the characteristic of wireless channels
- To learn the various cellular architectures and signaling schemes.
- To study about the various multipath mitigation techniques
- To study about Adhoc network and Sensor Network fundamentals
- To learn sensor network platforms and tools

UNIT I WIRELESS CHANNELS 9

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

UNIT II CELLULAR ARCHITECTURE AND DIGITAL SIGNALING 9

Multiple Access techniques, FDMA, TDMA, CDMA, MC-CDMA, Capacity calculations, Cellular concept- Frequency reuse, channel assignment, hand off- trunking and grade of service, Principles of Offset-QPSK, p/4-DQPSK, Minimum Shift Keying, Gaussian Minimum Shift Keying, OFDMA principles.

UNIT III MULTIPATH MITIGATION TECHNIQUES 9

Structure of a wireless communication link, Equalization, Adaptive equalization, Linear and Non-Linear equalization, Zero forcing and LMS Algorithms. Diversity – Micro-diversity and Macro-diversity.

UNIT IV INTRODUCTION TO SENSOR NETWORKS AND ITS 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, Optimization Goals and Figures of Merit, Case Study: Transceiver Design Considerations.

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, GNS3.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

- Characterize the wireless channels
- Design cellular system architecture and implement various signaling schemes for fading channels
- Compare multipath mitigation techniques and analyze their performance
- Analyse the basics of Adhoc networks and Wireless Sensor Networks
- Familiarise the Operating Systems used in Wireless Sensor Networks.

TEXTBOOKS:

1. Rappaport T.S, "Wireless Communications", Pearson Education, Second Edition, 2010.
2. C. Siva Ram Murthy and B. S. Manoj, "Ad Hoc Wireless Networks Architectures and Protocols", Prentice Hall, PTR, 2004.

REFERENCES:

1. David Tseand Pramod Viswanath, "Fundamentals of Wireless Communication", Cambridge University Press,2005.
2. Feng Zhao, Leonidas Guibas, "Wireless Sensor Networks: an information processing approach", Elsevier publication, 2004.
3. Van Nee, R. and Ramji Prasad, "OFDM for wireless multimedia communications", Artech House, 2000.

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3. https://www.coursera.org/learn/wireless-communications
4. https://online.stanford.edu/courses/ee359-wireless-communications
5. https://ocw.mit.edu/courses/6-452-principles-of-wireless-communications-spring-2006/

CO - PO MAPPING

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	2	2	1	1	-	-	-	-	1	1
CO2	2	3	2	2	2	2	-	-	-	-	1	1
CO3	3	2	2	2	2	2	-	-	-	-	1	1
CO4	2	3	2	2	1	2	-	-	-	-	1	1
CO5	2	3	2	2	3	2	-	-	-	-	1	1
AVG	2.4	2.8	2	2	1.8	1.8	-	-	-	-	1	1

-PSO MAPPING

CO\PSO	PSO1	PSO2	PSO3
CO1	1	2	2
CO2	2	2	2
CO3	3	2	3
CO4	3	3	3
CO5	3	3	3
AVG	**2.4**	**2.2**	**2.6**

JEC1010	MOBILE COMMUNICATON	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To understand the basics of wireless transmission systems
- To analyze the various wireless mobile networks
- To learn about mobile network and transport layers techniques and protocols.
- To study about fundamentals of GSM and 3G Services, its protocols and applications
- To learn about evolution of 4G Networks, its architecture and applications

UNIT I BASICS OF WIRELESS TRANSMISSION 9

Introduction, Frequencies for radio transmission, Signals, Antennas ranges, Signal propagation, Multiplexing, Modulation, Spread spectrum, Cellular systems. Accessing Techniques, applications of wireless communication.

UNIT II WIRELESS MOBILE NETWORKS 9

WLAN System and Protocol architecture, IEEE 802.11a, IEEE 802.11b, HIPERLAN - WATM, BRAN, HiperLAN2, Bluetooth architecture and protocols, WPAN-802.15.4, Wireless USB, Zigbee, 6LoWPAN, LoRaWAN, Case Study: WiMAX.

UNIT III MOBILE NETWORK AND TRANSPORT LAYER 9

Mobile IP- IP packet delivery, Agent discovery, Registration, Tunneling and encapsulation, Optimizations, IPv6, DHCP, Mobile ad-hoc networks - Destination sequence distance vector, Dynamic source routing, Traditional TCP, Classical TCP improvements, TCP over 2.5/3G wireless networks, IoT, Case Study: COAP.

UNIT IV GSM AND 3G COMMUNICATIONS SYSTEMS 9

GSM- Mobile services, System architecture, Radio interface, Protocols, Localization and calling, Handover, Security, New data services, DECT- System and Protocol architecture, TETRA, UMTS- UMTS system architecture, UMTS radio interface, UTRAN, Core network, LMDS, MMDS, Case Study: CDMA2000.

UNIT V 4G & BEYOND 9

4G cellular Network- Introduction, vision, features, challenges and applications, 4G Technologies: Multicarrier Modulation, Smart antenna techniques, OFDM-MIMO Systems, Software-Defined Radio, Cognitive Radio, IMS Architecture, LTE, advanced LTE, Case Study: ABWA, MVNO.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

- Explain wireless transmission techniques
- Describe various wireless mobile networking technologies
- Explain mobile network and transport layers techniques and protocols
- Describe fundamentals of GSM and 3G Services, its protocols and applications
- Explain the evolution of 4G Networks, its architecture and applications

TEXT BOOKS:

1. Jochen Schiller, “Mobile Communications”, Second Edition, Pearson Education, 2012.
2. Vijay Garg, “Wireless Communications and networking”, First Edition, Elsevier, 2007.

REFERENCES:

1. Rappaport,T.S., “Wirelesscommunications”,PearsonEducation,SecondEdition,2010.
2. Simon Haykin , Michael Moher, David Koilpillai, “Modern Wireless Communications”, Pearson Education, First Edition, 2013.
3. Erik Dahlman, Stefan Parkvall, Johan Skold and Per Beming, “3G Evolution HSPA and LTE for Mobile Broadband”, Academic Press, Second Edition, 2008.

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3. https://www.electronicsforu.com/technology-trends/mobile-communication-1g-4g
4. http://ee.sharif.edu/~pr.wireless.comm/references/Schwartz.pdf
5. https://www.tutorialspoint.com/umts/umts_history_of_mobile_communication.htm

CO - PSO MAPPING

CO / PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	2	1	1	2	1	-	-	-	-	1	1
CO2	3	3	2	2	2	1	-	-	-	-	1	1
CO3	2	2	2	2	2	1	-	-	-	-	1	1
CO4	3	3	2	2	2	1	-	-	-	-	1	1
CO5	2	3	2	2	2	2	-	-	-	-	1	2
AVG	2.4	2.6	1.8	1.8	2.0	1.2	-	-	-	-	1	1.2

CO - PSO MAPPING

CO\PSO	PSO1	PSO2	PSO3
CO1	1	1	2
CO2	3	2	1
CO3	2	1	2
CO4	1	2	2
CO5	2	3	2
AVG	1.8	1.8	1.8

JEC1017	HIGH PERFORMANCE COMMUNICATION NETWORKS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To ensure a comprehensive understanding of high speed computer network architectures
- To study architecture and network performance of ISDN and broadband ISDN.
- To study and learn the concepts involved in ATM and Frame Relay.
- To focus on current and emerging networking technologies
- To Gain insights into Network Security and Management.

UNIT I SWITCHING NETWORKS 9

Switching – Packet switching - Ethernet, Token Ring, FDDI, DQDB, Frame Relay, SMDS, Circuit Switched – SONET, DWDM, DSL, Intelligent Networks – CATV

UNIT II ISDN AND BROADBAND ISDN 9

ISDN - overview, interfaces and functions, Layers and services, Signaling System 7 (SS7) - Broadband ISDN architecture and Protocols

UNIT III ATM AND FRAME RELAY 9

ATM: Main features-addressing, signaling and routing, ATM header structure-adaptation layer, management and control, ATM switching and transmission. Frame Relay: Protocols and services, Congestion control

UNIT IV ADVANCED NETWORKS CONCEPTS 9

VPN-Remote-Access VPN, site-to-site VPN, Tunneling to PPP, Security in VPN.MPLS operation, Routing, Tunneling and use of FEC, Traffic Engineering, and MPLS based VPN, overlay networksP2P connections, Resource Reservation Protocol (RSVP), Differential services

UNIT V NETWORK SECURITY AND MANAGEMENT 9

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

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

- Explain principles of High performance Switching networks.
- Analyze Broadband ISDN architecture.
- Describe about the ATM switching and transmission.
- Compare the various methods of providing connection-oriented services over an advanced network with reference to MPLS, VPN, RSVP
- Explain principles of Network Security and Management

TEXT BOOKS:

1. William Stallings, "ISDN and Broadband ISDN with Frame Relay and ATM", 4th edition, Pearson education Asia, 2002.
2. Jean Walrand and Pravinvaraiya, "High Performance Communication networks", 2nd edition, Harcourt and Morgan Kauffman, London, 2000.

REFERENCES:

1. J.F. Kurose & K.W. Ross, "Computer Networking- A Top Down Approach Featuring the Internet", Pearson, 2nd Edition, 2003.
2. Fred Halsall and Lingana Gouda Kulkarni, "Computer Networking and the Internet", Fifth Edition, Pearson Education, 2012.
3. Larry L.Peterson& Bruce S.David, "Computer Networks: A System Approach"- Morgan Kaufmann Publisher, 1996.

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2. https://www.youtube.com/watch?v=IPuLZSOye4c, Prof. S. Ghosh,Department of Computer Science & Engineering, I.I.T.,Kharagpur.
3. https://www.youtube.com/watch?v=JtpYdefMHkg, Prof.Karandikar, Department of Electrical Engineering, IIT Bombay.
4. https://www.coursera.org/lecture/cybersecurity-foundation/video-network-security-devices-ii-BMJiX
5. https://www.youtube.com/watch?v=2aHkqB2-46k, ChristofPaar Ruhr university, Germany.

CO - PO MAPPING

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	1	2	2	3	1	-	-	-	-	1	2
CO2	1	3	2	3	2	1	-	-	-	-	1	2
CO3	2	3	3	3	3	1	-	-	-	-	1	2
CO4	1	3	2	3	2	1	-	-	-	-	1	2
CO5	3	3	3	3	3	1	-	-	-	-	1	2
AVG	1.6	2.6	2.4	2.8	2.6	1	0	0	0	0	1	2

CO - PSO MAPPING

CO\PSO	PSO1	PSO2	PSO3
CO1	3	3	2
CO2	3	2	3
CO3	3	3	3
CO4	2	2	3
CO5	3	3	3
AVG	2.8	2.6	2.8

JEC1042 4G/5G COMMUNICATION NETWORKS L T P C
3 0 0 3

COURSE OBJECTIVES:

- To introduce the concept and technologies of 4G networks.
- To explain the fundamentals of 5G and its channel access methods.
- To make the students understand the Radio Access Network for 5G communications.
- To provide knowledge on the various channel models for 5G networks.
- To describe the applications of 5G communication networks.

UNIT I OVERVIEW OF 4G NETWORKS 9

4G Vision, 4G features and challenges, Applications of 4G, 4G Technologies – Multi carrier modulation, Smart Antenna Techniques, OFDM-MIMO Systems, Adaptive Modulation and Coding with Time-Slot Scheduler, Bell Labs Layered Space Time (BLAST) System, Software-Defined Radio, Cognitive Radio. Case Study - LTE Advanced.

UNIT II INTRODUCTION TO 5G AND CHANNEL ACCESS METHODS 9

Introduction to 5G, Evolving LTE to 5G Capability, 5G NR and 5G core network, 5G Standardization, 3GPP and IMT2020, Spectrum for 5G, 5G deployment, Challenges and Applications. OFDM, OFDMA, MIMO OFDM, GFDM.

UNIT III RADIO ACCESS NETWORK FOR 5G 9

5G NR requirements, 5G Core Network Architecture, Radio Access Network (RAN), Radio Protocol Architecture, User Plane Protocols, Radio Link Control, Medium-Access Control, Physical Layer functions, Control Plane Protocols, Network Slicing, RAN virtualization, Case Study – Spectrum Management in 5G.

UNIT IV CHANNEL MODELS FOR 5G NR 9

Channel Hierarchy in 5G NR, Logical Channels and Transport Channels in 5G NR, Physical Layer Data Channels in 5G NR, Downlink Physical Channel and Uplink Physical Channels, Propagation Channel models for 5G.

UNIT V APPLICATIONS 9

Device-to-Device (D2D) Communication, 5G for Massive Machine Type Communication, Massive IoT, V2X Communication, Full Duplex and Green Communication, mmWave Communications, Massive MIMO, Beamforming Techniques.

TOTAL PERIODS: 45

COURSE OUTCOMES:

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

- Explain the technologies of 4G networks.
- Describe the concepts of 5G and its channel access methods.
- Explain the Radio Access Network for 5G communications.
- Describe the various channel models for 5G networks.
- Comprehend the applications of 5G communication networks.

TEXTBOOKS:

1. Vijay Garg, "Wireless Communications and networking", First Edition, Elsevier, 2007.
2. Saad Z. Asif, "5G Mobile Communications Concepts and Technologies, CRC Press, 1st Edition, 2019.
3. Erik Dahlman, Stefan Parkvall, Johan Skold "5G NR: The Next Generation Wireless Access Technology", Academic Press, 1st Edition, 2018.

REFERENCES:

1. Jonathan Rodriguez, "Fundamentals 5G Mobile Networks", John Wiley & Sons, 1st Edition, 2015.
2. Afif Osseiran, Jose.F.Monserrat, Patrick Marsch, "Fundamentals of 5G Mobile Networks", Cambridge University Press.
3. Robert W. Heath Jr., Angel Lozano, "Foundations of MIMO Communication", Cambridge University Press, 1st Edition, 2019.
4. R. Vannithamby and S. Talwar, "Towards 5G: Applications, Requirements and Candidate Technologies", John Willey & Sons, 1st Edition, 2017.

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1. https://www.javatpoint.com/4g-mobile-communication-technology#:~:text=4G%20network%20provides%20up%20to,any%20need%20for%20fixed%20wired.
2. https://www.coursera.org/lecture/5g-training-qualcomm/what-are-private-networks-mib8U
3. https://onlinecourses.nptel.ac.in/noc22_ee56/preview
4. https://www.youtube.com/live/aYJncUscfmk?feature=share
5. https://youtu.be/XC9Yx62vR9Q

CO-PO/PSO MAPPING:

CO\ PO, PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	2	2	3	2	-	-	-	-	1	1	2	2	2
CO2	3	2	2	2	2	2	-	-	-	-	1	1	3	3	3
CO3	3	2	3	3	3	2	-	-	-	-	1	1	3	3	3
CO4	3	2	3	2	3	2	-	-	-	-	1	1	3	3	3
CO5	2	2	2	2	3	2	-	-	-	-	1	1	3	3	3
AVG	**2.8**	**2**	**2.4**	**2.2**	**2.8**	**2**	**-**	**-**	**-**	**-**	**1**	**1**	**2.8**	**2.8**	**2.8**

JEC1043 INFORMATION AND NETWORK SECURITY

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- To introduce fundamental concepts of Information Security
- To introduce the fundamentals of Cryptography and its Algorithms
- To familiarize various User Authentication and Access control techniques
- To explain various program security errors and attacks
- To describe network security threats, security services, and countermeasures.

UNIT I INTRODUCTION TO INFORMATION SECURITY 9

Information Security: Characteristics -Attacks-Vulnerability-Security Goals-Security Services and mechanisms-Security Management: Classification Process -practices- Security Policy -Risk Management -Laws and Standards- IPR - Security Audit.

UNIT II CRYPTOGRAPHY 9

Public key Cryptography Principles, RSA algorithm, Key Management, Diffie-Hellman Key Exchange. Message authentication and Hash Functions, Authentication Requirements and Functions, Message Authentication, MACs Hash and MAC Algorithms SHA-512, HMAC

UNIT III USER AUTHENTICATION AND ACCESS CONTROL 9

Digital Signatures, Authentication Protocols, Digital signature Standard, Authentication Applications, Kerberos, X.509 Directory Authentication Service. Email Security: Pretty Good Privacy (PGP) and S/MIME.

UNIT IV PROGRAM SECURITY 9

Program Security: Non malicious Program errors – Buffer overflow, Incomplete mediation, Time-of-check to Time-of- use Errors, Viruses, Trapdoors, Salami attack, Man-in-the- middle attacks, Covert channels

UNIT V NETWORK SECURITY 9

Security in Networks: Threats in networks, Network Security Controls – Architecture, Encryption, Content Integrity, Wireless Security, Traffic flow security, Firewalls – Design and Types of Firewalls, Personal Firewalls, Email Security – PGP,S/MIME.

TOTAL PERIODS: 45

COURSE OUTCOMES:

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

- Explain the basic concepts of Information Security and management.
- Apply cryptography algorithms and protocols to achieve computer security.
- Illustrate the concepts of digital signature and digital certificates
- Describe the foundational theory behind program security
- Describe vulnerability analysis of network security

TEXTBOOKS:

1. Cryptography and Network Security (principles and approaches) by William Stallings Pearson Education, 5th Edition, 2011
2. Peltier, Thomas R. Information Security Fundamentals. 2nd ed. CRC Press. Boca Raton, FL: Auerbach Publications, 2014.

REFERENCES:

1. Behrouz A.Forouzan, "Cryptography & Network Security", Tata McGraw Hill, India, New Delhi, 2009.
2. Principles of Information Security, Whitman, Thomson. Cengage Learning, 2014
3. Network Security Essentials: Applications and Standards, by William Stallings. Prentice Hall.

WEBSITE REFERENCES:

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2. NETWORK SECURITY - HMAC ALGORITHM - Bing video https://eecs.ceas.uc.edu/~jonewb/DFTnew.pdf
3. https://www.youtube.com/watch?v=XICDWB06VG4
4. Buffer Overflow Exploits and Defenses - Bing video
5. Firewalls - CompTIA Security+ SY0-501 - 2.1 - Bing video

CO-PO/PSO MAPPING:

CO\PO,PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	1	2	2	2	-	-	-	-	2	2	2	2	2
CO2	3	2	2	2	2	2	-	-	-	-	2	3	2	2	3
CO3	3	2	2	2	2	2	-	-	-	-	2	3	3	3	3
CO4	3	2	3	3	2	2	-	-	-	-	3	3	3	3	3
CO5	3	3	3	2	3	2	-	-	-	-	3	3	3	3	3
AVG	**3**	**2.2**	**2.2**	**2.2**	**2.2**	**2**	**-**	**-**	**-**	**-**	**2.4**	**2.8**	**2.6**	**2.6**	**2.8**

JEC1044	FUNDAMENTALS OF NANO ELECTRONICS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To learn about the basics of nanomaterial science.
- To understand the general preparation methods.
- To know about the various nanomaterials.
- To understand the different characterization techniques.
- To understand the applications of nanoscience.

UNIT I INTRODUCTION 9

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

UNIT II GENERAL METHODS OF PREPARATION 9

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

UNIT III NANOMATERIALS 9

Nanoforms of Carbon - Buckminster fullerene- graphene and carbon nanotube, Single wall carbon Nanotubes (SWCNT) - methods of synthesis (arc growth, laser ablation, CVD routes, Plasma CVD), Nanometal oxides-ZnO, TiO_2, MgO, ZrO_2, NiO, Nano alumina, CaO, $AgTiO_2$, Ferrites, Nano clays-functionalization and applications-Quantum wires, Quantum dots-preparation, properties and applications.

UNIT IV CHARACTERIZATION TECHNIQUES 9

X-ray diffraction technique, Scanning Electron Microscopy - environmental techniques, Transmission Electron Microscopy including high-resolution imaging, Surface Analysis techniques - AFM, SPM, STM - Nanoindentation-thermogravimetric analysis of nanomaterials.

UNIT V APPLICATIONS 9

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

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of the course the students will be able:

- To review about science of nanomaterials
- To demonstrate the preparation methods of nanomaterials
- To analyze the characteristics of nanomaterials
- To analyze the characterization techniques
- To design various nanoscience applications

TEXT BOOKS:

1. A.S. Edelstein and R.C. Cammearata, eds., "Nanomaterials: Synthesis, Properties and Applications", Institute of Physics Publishing, Bristol and Philadelphia, 1996.
2. N John Dinardo, "Nanoscale Characterization of surfaces & Interfaces", 2nd edition, Weinheim Cambridge, Wiley-VCH, 2000.

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1. G Timp, "Nanotechnology", AIP press/Springer, 1999.
2. Akhlesh Lakhtakia, "The Hand Book of Nano Technology, Nanometer Structure, Theory, Modeling and Simulations", Prentice-Hall of India (P) Ltd, New Delhi, 2007.
3. Guozhong Cao, "Nanostructures and Nanomaterials", Imperial College press, 2004.
4. T Pradeep, "Nano: The Essentials", McGraw-Hill Education, 2007.

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2. https://nptel.ac.in/courses/118/102/118102003/# Prof. Ashok K Ganguli, IIT Delhi
3. https://nptel.ac.in/courses/118104008/ Dr. Kantesh Balani & Dr. Anandh Subramaniam, IIT Kanpur
4. https://www.youtube.com/watch?v=lFYs3XDu4fQ Dr. P. Gopinath, IIT Roorkee
5. https://nptel.ac.in/courses/108/108/108108113/ Prof. Hardik Jeetendra Pandya, IISC Bangalore.

CO -PO MAPPING

CO\PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	1	3	1	-	3	3	-	-	-	-	2
CO2	2	1	3	2	-	-	2	-	-	-	-	-
CO3	2	2	3	2	1	1	2	-	-	-	-	2
CO4	1	2	3	2	1	-	2	-	-	-	-	2
CO5	2	1	3	1	2	2	3	-	-	-	-	3
AVG	2	1	3	1	-	3	3	-	-	-	-	2

CO -PSO MAPPING

CO\PSO	PSO1	PSO2	PSO3
CO1	3	1	2
CO2	3	2	2
CO3	3	3	2
CO4	3	3	3
CO5	3	3	3
AVG	3	2.4	2.4

JEC1020	CMOS ANALOG IC DESIGN	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To study the fundamentals of analog circuits and MOS device models
- To gain knowledge on various configurations of MOS transistors and feedback concepts
- To study the characteristics of noise and frequency response of the amplifier
- To learn the concepts of Op-Amp frequency compensation
- To learn about PLLs

UNITI INTRODUCTION TO ANALOG IC DESIGN AND CURRENT MIRRORS 9

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

UNIT II AMPLIFIERS AND FEEDBACK 9

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

UNITIII FREQUENCY RESPONSE OF AMPLIFIERS AND NOISE 9

General considerations- Miller Effect and Association of Poles with Nodes, Common source stage- Source followers- Common gate stage- Cascode stage- Differential pair. Noise- Statistical characteristics of noise- Types of noise- Representation of noise in circuits- Noise in single-stage amplifiers- Noise in differential pairs- Noise Bandwidth.

UNIT IV OPERATIONAL AMPLIFIER STABILITY AND FREQUENCY COMPENSATION 9

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

UNITV SWITCHED CAPACITOR CIRCUITS AND PLLS 9

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

TOTAL:45 PERIODS

OUTCOMES:

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

- Realize the concepts of Analog MOS devices and current mirror circuits.
- Design different configurations of Amplifiers and feedback circuits.
- Analyze the characteristics of the frequency response of the amplifier and its noise.
- Analyze the performance of the stability and frequency compensation techniques of Op-Amp Circuits.
- Construct switched capacitor circuits and PLLs

TEXTBOOK:

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

REFERENCES:

1. Paul R. Gray, Paul J. Hurst, Stephen H. Lewis, Robert G. Meyer, Analysis and Design of Analog Integrated Circuits, 5th Edition, Wiley, 2009
2. Grebene, ―Bipolar and MOS Analog Integrated circuit design‖, John Wiley & sons, Inc., 2003.
3. Paul R. Gray, Paul J. Hurst, Stephen H. Lewis, Robert G. Meyer, Analysis and Design of Analog Integrated Circuits, 5th Edition, Wiley, 2009

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2. https://nptel.ac.in/courses/117107094
3. https://nptel.ac.in/courses/117101106
4. https://nptel.ac.in/courses/108108114
5. http://www.infocobuild.com/education/audio- videocourses/electronics/AnalogICDesign -IIT-Madras/lecture-45.html

CO-PO MAPPING

CO\PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	2	1	2	2	1	-	-	-	-	2	2
CO2	2	2	2	2	2	1	-	-	-	-	2	3
CO3	2	2	2	2	2	1	-	-	-	-	2	3
CO4	2	2	3	3	2	2	-	-	-	-	3	3
CO5	3	3	3	2	3	2	-	-	-	-	3	3
AVG	**2**	**2.2**	**2.2**	**2.2**	**2.2**	**1.4**	**-**	**-**	**-**	**-**	**2.4**	**2.8**

CO-PSOMAPPING

CO\PSO	PSO1	PSO2	PSO3
CO1	2	1	2
CO2	2	2	2
CO3	3	2	2
CO4	3	3	3
CO5	3	3	3
AVG	2.6	2.2	2.4

JEC1025	LOW POWER VLSI DESIGN	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

- To identify sources of power in an IC.
- To identify the power reduction techniques based on technology dependence
- To learn apower dissipation mechanism in various MOS logic style.
- To identify suitable techniques to reduce power dissipation.
- To design circuits with 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 - Transistor leakage mechanisms of deep submicron transistors.

UNIT II POWER OPTIMIZATION 9

Logic level power optimization – Circuit level low power design – circuit techniques for reducing power consumption in adders and multipliers.

UNIT III DESIGN OF LOW POWER CMOS CIRCUITS 9

Computer arithmetic techniques for low power system – reducing power consumption in memories – low power clock, inter connect and layout design – Advanced techniques – Special techniques – Adiabatic switching system

UNIT IV POWER ESTIMATION 9

Power Estimation techniques – logic power estimation – Simulation power analysis – Probabilistic power analysis-statistical techniques.

UNITV SYNTHESIS AND SOFTWARE DESIGN FOR LOW POWER 9

Synthesis for low power – Behavioral level transform – Logic level transform-circuit level-software design for low power-software power optimizations – Automated Low power code generation.

TOTAL:45 PERIODS

COURSE OUTCOMES:

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

- Analyze the basics of power dissipation in CMOS
- Analyze the different power optimization techniques
- Design low power CMOS circuits
- Analyze the power estimation in CMOS logic design
- Design and synthesize the low power CMOS circuits using software

TEXT BOOKS:

1. Kaushik Roy and S.C.Prasad, “Low power CMOS VLSI circuit design”, Wiley,2000.
2. A.P.Chandrasekaran and R.W.Broadersen, “Low power digital CMOS design”,Kluwer,1995.

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1. Dimitrios Soudris, Chirstian Pignet, Costas Goutis, “Designing CMOS Circuits for Low Power”, Kluwer,2002.
2. J.B.Kulo and J.H Lou, “Low voltage CMOS VLSI Circuits”, Wiley1999.
3. Gary Yeap, “Practical low power digital VLSI design”, Kluwer,1998.
4. Abdelatif Belaouar, Mohamed.I.Elmasry, “Low power digital VLSI design”, Kluwer,1995.
5. James B.Kulo, Shih-Chia Lin, “Low voltage SOI CMOS VLSI devices and Circuits”, John Wiley and sons, inc.2001.

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4. https://nptel.ac.in/courses/117101004
5. https://sites.cs.ucsb.edu/~ckrintz/racelab/rre/papers/roy96software.pdf

CO-PO/PSO MAPPING:

CO\ PO, PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2	2	2	2	1	-	-	-	-	2	2	1	2	2
CO2	2	2	2	2	2	2	-	-	-	-	2	3	2	2	2
CO3	2	2	2	2	2	2	-	-	-	-	3	3	3	2	3
CO4	2	2	3	3	2	2	-	-	-	-	3	3	3	3	3
CO5	3	3	3	2	3	2	-	-	-	-	3	3	3	3	3
AVG	**2.2**	**2.2**	**2.4**	**2.2**	**2.2**	**1.4**	**-**	**-**	**-**	**-**	**2.6**	**2.8**	**2.4**	**2.2**	**2.6**

JEC1045	ASIC DESIGN	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To describe the design flow of different types of ASIC.
- To familiarize the portioning and routing in ASIC.
- To familiarize the different synthesis, simulation and logical testing.
- To explain architecture design
- To make understand the SoC concepts.

UNIT I OVERVIEW OF ASIC 9

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

UNIT II PHYSICAL DESIGN IN ASIC 9

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

UNIT III SIMULATION, SYNTHESIS AND TESTING 9

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

UNIT IV ARCHITECTURE DESIGN 9

Register Transfer Design – Pipelining - High Level Synthesis- Architectures of Low power – GALS System – Architecture Testing - Design Methodologies – Multiprocessor System.

UNIT V EXPAND DESIGN 9

System-On-Chip Design - SoC Design Flow, Platform-based and IP based SoC Designs, Basic

Concepts of Bus-Based Communication Architectures. High performance algorithms for ASICs/ SoCs – case studies.

TOTAL PERIODS: 45

COURSE OUTCOMES:

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

- Discuss basic concepts of ASIC
- Analyze the physical design of ASIC
- Analyze the synthesis, Simulation and testing of systems.
- Discuss the architecture design.
- Explain the design issues of SOC.

TEXT BOOKS:

1. Modern VLSI Design-IP Based Design, Waney wolf, 4th Edition, Prentice Hall Modern Semiconductor Design Series, 2009
2. M. J. S. Smith, "Application Specific Integrated Circuits", Addison - Wesley Longman Inc., Eleventh Impression 2011.
3. Sudeep Pasricha and NikilDutt, On-Chip Communication Architectures System on

Chip Interconnect, Elsevier, 2008

REFERENCES:

1. David A.Hodges, Analysis and Design of Digital Integrated Circuits (3/e), MGH 2004
2. H.Gerez, Algorithms for VLSI Design Automation, John Wiley, 1999
3. Jan. M. Rabaey et al, Digital Integrated Circuit Design Perspective (2/e), PHI 2003
4. M.J.S. Smith: Application Specific Integrated Circuits, Pearson, 2003
5. J. Old Field, R.Dorf, Field Programmable Gate Arrays, John Wiley& Sons, Newyork.
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1. https://www.elprocus.com/application-specific-integrated-circuits/#:~:text=Modern%20ASIC%20generally%20includes%20a,levels%20of%20customization%20are%20developed.
2. https://personal.utdallas.edu/~zhoud/EE6306/lecture%20slides/ASIC%202012%20chapter%201%20introduction.pdf
3. https://www.xilinx.com/htmldocs/xilinx14_7/sim.pdf
4. https://www.sciencedirect.com/science/article/pii/S1571066106000272
5. https://www.cs.ccu.edu.tw/~pahsiung/courses/soc/notes/soc01.pdf

CO-PO/PSO MAPPING:

CO\ PO, PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	2	2	3	-	-	-	-	2	2	2	2	2
CO2	3	3	2	2	2	3	-	-	-	-	3	3	3	3	3
CO3	3	3	2	3	3	3	-	-	-	-	3	3	3	3	3
CO4	2	2	3	3	3	3	-	-	-	-	3	3	3	3	3
CO5	2	2	3	3	3	3	-	-	-	-	3	3	3	3	3
AVG	**2.6**	**2.6**	**2.4**	**2.6**	**2.6**	**3**	**-**	**-**	**-**	**-**	**2.8**	**2.8**	**2.8**	**2.8**	**2.8**

JEC1046	MIXED SIGNAL IC DESIGN	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To explain about basics of submicron technology
- To describe about various integrated filters and topologies
- To familiarize with data converter architectures
- To familiarize with modeling of data converters and signal to noise ratio
- To explain the working principle of oscillators and PLL

UNIT I SUBMICRON CMOS CIRCUIT DESIGN 9

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

UNIT II CMOS FILTERS 9

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

UNIT III DAC AND ADC ARCHITECTURE 9

DAC Architectures: 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 MODELING OF DAC and ADC 9

Sampling and Aliasing: Impulse sampling, sample and hold circuit, Quantization noise. Data converter SNR: Clock, Clock Jitter, Improving Signal to Noise Ratio, Decimating filter for ADCs, Interpolating filter for DACs, Band pass and High pass filters.

UNIT V OSCILLATORS AND PLL 9

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

TOTAL PERIODS: 45

COURSE OUTCOMES:

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

- Explain the basic concepts of submicron technology
- Design integrator filters and explain the topologies in filtering
- Explain the architecture of data converters
- Describe the data converters
- Analyze the design of Oscillators and PLL

TEXT BOOKS:

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

REFERENCES:

1. Gordon W.Roberts, Friedrich Taenzler, Mark Burns, "An Introduction to Mixed-signal IC Test and Measurement" Oxford University Press, Inc.2012
2. CMOS Mixed Signal Circuit Design by R.Jacob Baker, Wiley India, IEEE Press, reprint 2008.
3. M.L.Bushnell and V.D.Agrawal, "Essentials of Electronic Testing for Digital, Memory and Mixed-Signal VLSI Circuits", Kluwer Academic Publishers, 2002.

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1. https://ewh.ieee.org/r5/denver/sscs/Presentations/2004_12_Loke.pdf
2. https://hasler.ece.gatech.edu/Courses/ECE3400/Proj4/CMOSActiveFilters_Temes01.pdf
3. https://www.electronicdesign.com/technologies/analog/article/21165089/per-vices-corp-evaluating-adc-and-dac-performance-characteristics
4. https://www.swindonsilicon.com/adcs-in-asics-an-overview-for-system-designers/
5. https://www.ijitee.org/wp-content/uploads/papers/v9i5/E2636039520.pdf

CO-PO/PSO MAPPING:

CO\ PO, PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	2	2	2	3	-	-	-	-	2	2	2	2	2
CO2	3	2	2	2	2	3	-	-	-	-	3	3	3	3	3
CO3	3	2	2	3	3	3	-	-	-	-	3	3	3	3	3
CO4	2	2	3	3	3	3	-	-	-	-	3	3	3	3	3
CO5	2	2	3	3	3	3	-	-	-	-	3	3	3	3	3
AVG	**2**	**2**	**2.4**	**2.6**	**2.4**	**3**	**-**	**-**	**-**	**-**	**2.8**	**2.8**	**2.8**	**2.8**	**2.8**

JEC1047	VALIDATION AND TESTING TECHNOLOGY	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To help the students understand the basic concepts of testing
- To explain the concepts of faults and measure of testability
- To familiarize test patterns for combinational and sequential circuits
- To Familiarize the testability concepts
- To explain different fault models and diagnose the same

UNIT I FAULT MODELLING 9

Importance of Testing - Test Generation - Fault Models - Levels of Abstraction in Testing - Functional Versus Structural Testing - Levels of Fault Models - Fault Equivalence - Fault Dominance - Fault Collapsing - Check point Theorem - Delay Fault

UNIT II FAULT SIMULATION AND TESTABILITY MEASURES 9

Simulation for Design Verification and Test Evaluation – Modeling Circuits for Simulation – Algorithms for True Value and Fault Simulation – SCOPA Controllability and Observability

UNIT III TEST GENERATION FOR DIGITAL CIRCUITS 9

Algorithms and Representations – Redundancy Identification – Combinational ATPG Algorithms – Sequential ATPG Algorithms – Simulation Based ATPG – Genetic Algorithm Based ATPG

UNIT IV DESIGN FOR TESTABILITY 9

Design for Testability Basics – Testability Analysis - Scan Cell Designs – Scan Architecture – Builtin Self-Test – Random Logic Bist – DFT for Other Test Objectives.

UNIT V FAULT DIAGNOSIS 9

Introduction and Basic Definitions – Fault Models for Diagnosis – Generation of Vectors for Diagnosis – Combinational Logic Diagnosis - Scan Chain Diagnosis – Logic BIST Diagnosis.

TOTAL PERIODS: 45

COURSE OUTCOMES:

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

- Explain the basic concepts of testing
- Describe logical simulate Faults and analyze testability
- Generate test patterns for combinational and sequential circuits
- Make use of testability concepts
- Build different fault models and perform fault diagnosis

TEXTBOOKS:

1. Parag K. Lala, An Introduction to Logic Circuit Testing, Morgan & Claypool Publishers, 2008
2. Niraj K. Jha and Sandeep Gupta, “Testing of Digital Systems”, Cambridge University Press, 2003.

REFERENCES:

1. Laung-Terng Wang, Cheng-Wen Wu and Xiaoqing Wen, "VLSI Test Principles and Architectures", Elsevier, 2011
2. Z.Navabi, Digital System Test and Testable Design, Springer, 2011.

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2. https://www.youtube.com/watch?v=m86zSu8vbZE
3. https://digitalsystemdesign.in/atpg-for-sequential-circuits/
4. https://www.youtube.com/watch?v=t4h1Jb5aQxM
5. https://pld.ttu.ee/diagnostika/theory/faultdiagnosis.html

CO-PO/PSO MAPPING:

CO\PO,PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	2	1	2	2	2	-	-	-	-	2	2	2	2	2
CO2	2	2	2	2	2	2	-	-	-	-	2	3	2	2	3
CO3	2	2	2	2	2	2	-	-	-	-	2	3	3	3	3
CO4	2	2	3	3	2	2	-	-	-	-	3	3	3	3	3
CO5	3	3	3	2	3	2	-	-	-	-	3	3	3	3	3
AVG	**2**	**2.2**	**2.2**	**2.2**	**2.2**	**2**	**-**	**-**	**-**	**-**	**2.4**	**2.8**	**2.6**	**2.6**	**2.8**

JEC1028	VLSI FOR WIRELESS COMMUNICATION	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To understand basic communication components
- To understand the concepts of different mixers
- To understand the synthesizers
- To know the various subsystems
- To know the basics of hardware design for communication systems

UNIT I COMPONENTS AND DEVICES 9

Integrated inductors, resistors, MOSFET and BJT AMPLIFIER DESIGN: Low Noise Amplifier Design - Wideband LNA - Design Narrowband LNA - Impedance Matching - Automatic Gain Control Amplifiers – Power Amplifiers

UNIT II MIXERS 9

Balancing Mixer - Gilbert Mixer - Switching Mixer - Unbalanced Switching Mixer- Sampling Mixer - Single Ended Sampling Mixer: Conversion Gain, Distortion - Intrinsic Noise -Extrinsic Noise

UNIT III FREQUENCY SYNTHESIZERS 9

Phase Locked Loops - Voltage Controlled Oscillators - Phase Detector – Analog Phase Detectors– Digital Phase Detectors - Frequency Dividers - LC Oscillators - Ring Oscillators - Phase Noise -Applications

UNIT IV SUB SYSTEMS 9

Data converters in communications, adaptive Filters, equalizers and transceivers, Low Noise Amplifiers.

UNITV IMPLEMENTATIONS 9

VLSI architecture for Multitier Wireless System - Hardware Design Issues for CDMA System.

TOTAL:45 PERIODS

COURSE OUTCOMES:

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

- Analyze basic communication components
- Analyze the concepts of different mixers
- Analyze the synthesizers
- Analyze the various subsystems
- Familiarize the basics of hardware design for communication systems

TEXTBOOKS:

1. Bosco H Leung “VLSI for Wireless Communication”, Pearson Education, 2002.
2. I Emad N Farag and Mohamed I Elmasry, “Mixed Signal VLSI Wireless Design - Circuits and Systems”, Kluwer Academic Publishers, 2000.

REFERENCES:

1. Thomas H.Lee, "The Design of CMOS Radio –Frequency Integrated Circuits", Cambridge University Press,2003.
2. B.Razavi ," RF Microelectronics" , Prentice-Hall,1998
3. Behzad Razavi, "Design of Analog CMOS Integrated Circuits" McGraw-Hill, 1999.
4. J. Crols and M. Steyaert, "CMOS Wireless Transceiver Design," Boston, Kluwer Academic Pub., 1997

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5. https://nptel.ac.in/courses/108105157

CO-PO/PSO MAPPING:

CO\ PO, PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	1	2	2	2	2	-	-	-	-	2	2	2	2	2
CO2	2	2	2	2	2	2	-	-	-	-	2	3	2	2	2
CO3	2	2	2	2	2	2	-	-	-	-	3	3	3	3	3
CO4	3	2	3	3	2	2	-	-	-	-	3	3	3	3	3
CO5	3	3	3	2	3	2	-	-	-	-	3	3	3	3	3
AVG	**2.2**	**2.2**	**2.4**	**2.2**	**2.2**	**2**	**-**	**-**	**-**	**-**	**2.6**	**2.8**	**2.4**	**2.6**	**2.6**

JEC1048	RECONFIGURABLE COMPUTING WITH FPGA	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To familiarize the device architecture.
- To make students understand the computing systems with FPGA.
- To familiarize the concepts of reconfigurable management.
- To explain programming concepts in reconfigurable systems.
- To explain the programming in FPGA applications.

UNIT I DEVICE ARCHITECTURE 9

Computational Fabric- Interconnect structures and Programmability – Extended Logic Elements - Configuration – Xilinx Virtex II Pro - Reconfigurable Processing Fabric Architectures- Independent Reconfigurable Coprocessor

UNIT II RECONFIGURABLE COMPUTING SYSTEM 9

PAM, VCC, and Splash – PRISM, CAL and XC6200 – circuit emulation - Accelerating Technology - Reconfigurable Supercomputing – Non FPGA and other system issues - The Future of Reconfigurable Systems

UNIT III RECONFIGURATION MANAGEMENT 9

Configuration Architectures: Single context- multi context- Partially Reconfigurable - Managing the Reconfiguration Process – Grouping, caching, scheduling, reallocation and context switching - Configuration Transfer Time: Architectural Approaches, Compression and data reuse

UNIT IV PROGRAMMING RECONFIGURABLE SYSTEMS 9

Compute Models – Challenges, Dataflow, Sequential control, Data parallel, data centric, Multi thread. System Architectures: Streaming Dataflow, Sequential Control, parallelism, Cellular Automata, Multi-threaded, Hierarchical Composition.

UNIT V PROGRAMMING FPGA APPLICATIONS 9

VHDL Programming - Structural Description - RTL Description - Parametric Hardware Generation - Finite-state Machine Datapath - Hardware Compilation Flow. Overview of how C Runs on Spatial Hardware - Automatic Compilation

TOTAL PERIODS: 45

COURSE OUTCOMES:

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

- Explain the device architecture.
- Describe the computing systems with FPGA.
- Explain of reconfigurable management.
- Elucidate programming concepts in reconfigurable systems.
- Make use of FPGA programming in different applications.

TEXT BOOKS:

1. Reconfigurable Computing the Theory and Practice Offpga-Based computation, Edited by Scott Hauck and Andre DeHon, Elsevier, 2008

REFERENCES:

1. Pierre-Emmanuel Gaillardon, "Reconfigurable Logic Architecture, Tools, and Applications", CRC Press, 2016
2. Dirk Koch, "Partial Reconfiguration on FPGAs, Architestures, Tools and Applications", Springer Newyork, NY, 2014

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2. https://kmorrow.ece.wisc.edu/Publications/Compton_ReconfigIntro.pdf
3. https://www.researchgate.net/publication/220235881_Implementation_of_a_Partially_Reconfigurable_Multi-Context_FPGA_Based_on_Asynchronous_Architecture
4. https://www.youtube.com/watch?v=-GKWGg9adpY
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CO-PO/PSO MAPPING:

CO\ PO, PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2	2	2	2	2	-	-	-	-	1	1	3	3	2
CO2	3	3	3	3	2	2	-	-	-	-	1	1	2	2	2
CO3	3	3	3	3	3	2	-	-	-	-	1	1	2	2	2
CO4	2	2	2	2	2	2	-	-	-	-	1	1	2	2	2
CO5	3	3	3	3	3	3	-	-	-	-	1	1	3	2	3
AVG	**2.6**	**2.6**	**2.6**	**2.6**	**2.4**	**2.2**	**0**	**0**	**0**	**0**	**1**	**1**	**2.4**	**2.2**	**2.2**

JEC1014	ELECTROMAGNETIC INTERFERENCE AND COMPATIBILITY	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To introduce the basic concepts of Electromagnetic Interference and compatibility
- To explain Interference coupling mechanisms
- To teach the solution for EMI and EMC problems
- To explain different existing standards and regulations
- To learn testing methods and instrumentation

UNIT I BASIC THEORY 9

Introduction to EMI and EMC, Intra and inter system EMI, Elements of Interference, Sources and Victims of EMI, Conducted and Radiated EMI emission and susceptibility, Case Histories, Radiation hazards to humans, Various issues of EMC, EMC Testing, Specific Absorption rate

UNIT II COUPLING MECHANISM 9

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

UNIT III EMI MITIGATION TECHNIQUES 9

Working principle of Shielding and Murphy's Law, LF Magnetic shielding, Apertures and shielding effectiveness, Choice of Materials for H, E, and free space fields, Gasketting and sealing, PCB Level shielding, Principle of Grounding, Isolated grounds, Grounding strategies for Large systems, Grounding for mixed signal systems, Filter types and operation, Frequency Selective Surface

UNIT IV STANDARDS AND REGULATION 9

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

UNIT V EMI TEST METHODS AND INSTRUMENTATION 9

Fundamental considerations, EMI Shielding effectiveness tests, Open field test, Shielded chamber, EMI test receivers, Spectrum analyzer, EMI test wave simulators, EMI coupling networks, Feed through capacitors, Antennas, Current probes, MIL -STD test methods, Civilian STD test method, vector network analyzer, Applications-Space applications, Radar applications, Personal area communication, Body area communications

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

- Understand the basic concepts of Electromagnetic Interference and compatibility
- Identify the various types and mechanisms of Electromagnetic Interference
- Propose a suitable EMI mitigation technique
- Describe the various EMC Standards and regulations
- Describe the various EMC methods to measure them

TEXT BOOKS:

1. Clayton.R.Paul,"Introduction to Electromagnetic Compatibility", Second edition, Wiley indiapvt Ltd.
2. Henry W.Ott., Noise Reduction Techniques in Electronic Systems", A Wiley Inter Science Publications, John Wiley and Sons, Newyork, 1988.

REFERENCES:

1. V.P.Kodali, "Engineering EMC Principles, Measurements and Technologies", IEEE Press, Newyork, 1996.
2. Clayton.R.Paul, "Introduction to Electromagnetic Compatibility", Wiley Interscience, 2006.
3. Bemhard Keiser, "Principles of Electromagnetic Compatibility", 3rd Ed, Artech house, Norwood, 1986.
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2. https://nptel.ac.in/noc/courses/noc19/SEM1/noc19-ee17/
3. https://www.youtube.com/watch?v=55rgbgwFpck&list=PLyqSpQzTE6M8KHvPajlKmZDAPY_K3xb4Q
4. https://www.youtube.com/watch?v=cWo_sVDTszY&list=PL5kBRBfvqzbXCQXRcChr9-kFpGy9r7VZ9
5. https://freevideolectures.com/course/4203/nptel-electromagnetic-compatibility-emc/3

CO - PO MAPPING

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	2	2	3	2	-	-	-	-	3	2
CO2	3	2	2	3	2	1	-	-	-	-	2	1
CO3	3	3	3	3	2	1	-	-	-	-	2	1
CO4	3	3	2	2	2	1	-	-	-	-	2	1
CO5	2	3	2	3	3	1	-	-	-	-	2	1
AVG	2.8	2.8	2.2	2.6	2.4	1.2	-	-	-	-	2.2	1.2

CO - PSO MAPPING

CO\PSO	PSO1	PSO2	PSO3
CO1	3	2	1
CO2	1	2	1
CO3	1	1	2
CO4	2	2	1
CO5	3	2	3
AVG	2	1.8	1.6

JEC1021	SOFTWARE DEFINED RADIO	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To understand the basics of Software Defined Radio
- To study synchronization techniques and channel coding schemes
- To Learn multirate signal processing and digital generation of signals
- To know about data converters and smart antennas
- To learn digital hardware and software applications

UNIT I INTRODUCTION TO SOFTWARE DEFINED RADIO 9

Definitions and potential benefits, software radio architecture evolution, technology tradeoffs and architecture implications.

UNIT II SDR ARCHITECTURE 9

Essential functions of the software radio, basic SDR, hardware architecture, Computational processing resources, software architecture, top level component interfaces, interface topologies among plug and play modules.

UNIT III INTRODUCTION TO COGNITIVE RADIOS 9

Marking radio self-aware, cognitive techniques – position awareness, environment awareness in cognitive radios, optimization of radio resources, Massive MIMO, Artificial Intelligence Techniques.

UNIT IV NEXT GENERATION WIRELESS NETWORKS 9

The XG Network architecture, spectrum sensing, spectrum management, spectrum mobility, spectrum sharing, upper layer issues, cross – layer design

UNIT V CASE STUDIES 9

RF MEMS, GNU Radio, Universal Software Radio Peripheral(USRP), Joint Technical Radio System,SDR-3000R, TL-SDR.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

- Discuss the fundamentals of Software Defined Radio
- Determine channel coding schemes and synchronization
- Analyse the multirate signals and generation of digital signals
- Design data converters and smart antennas
- Develop digital hardware and software modules

TEXTBOOKS:

1. Jeffrey H.Reed, "Software Radio: A Modern Approach to Radio Engineering, Prentice Hall,2002.
2. Travis F. Collins, Robin Getz, Alexander M. Wyglinski, Di Pu, “Software-Defined Radio for Engineers”, Artech House, 2018.

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1. S.Shanmugavel, M.A.Bhagyaveni, R.Kalidoss, “Cognitive Radio-An Enabler for Internet of things”, River Publishers, 2017.
2. John Bard, Kovarik.Jr, Vincent.J “Software Defined Radio: The Software Communications Architecture”, Germany, Wiley, 2007.
3. Joseph Mitola, "Software Radio Architecture: Object Oriented Approaches to Wireless System Engineering", Wiley-Inter science; First Edition.
4. Huseyin Arslan, “Cognitive Radio, Software Defined Radio and Adaptive Wireless Systems”, Springer, 2007.

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3. https://www.mathworks.com/discovery/sdr.html
4. http://www.arrl.org/software-defined-radio
5. https://www.ni.com/en-in/innovations/white-papers/17/software-defined-radio--past--present--and-future.html

CO-PO MAPPING

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO-1	2	1	2	1	1	1	-	-	-	-	1	1
CO-2	2	2	2	2	2	2	-	-	-	-	-	1
CO-3	2	2	2	2	2	1	-	-	-	-	1	1
CO-4	2	1	2	2	2	2	-	-	-	-	1	1
CO-5	3	2	2	2	2	2	-	-	-	-	1	1
AVG	2.2	1.6	2	1.8	1.8	1.6	-	-	-	-	0.8	1

CO-PSO MAPPING

CO\PSO	PSO1	PSO2	PSO3
CO1	2	1	2
CO2	2	2	2
CO3	3	2	2
CO4	3	3	3
CO5	3	3	3
AVG	2.6	2.2	2.4

JEC1022	RF INTEGRATED CIRCUITS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To study the basic RF IC Components
- To learn about the various receiver architectures and Low Noise Amplifiers
- To know about feedback systems and power amplifiers
- To understand the PLL and frequency synthesizers
- To learn about mixers and oscillators

UNIT I BASIC RF IC COMPONENTS 9

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

UNIT II RECEIVERS ARCHITECTURE AND LOW NOISE AMPLIFIERS 9

Homodyne and Heterodyne Receiver, Image reject, Low IF Receiver Architectures Direct up conversion Transmitter, Two step up conversion Transmitter, CMOS amplifiers, Single ended and Differential LNAs terminated with Resistors and Source Degeneration LNAs, Power match and Noise match.

UNIT III FEEDBACK SYSTEMS AND POWER AMPLIFIERS 9

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

UNIT IV PLL AND FREQUENCY SYNTHESIZERS 9

Linearized PLL Model, Noise properties, Phase detectors, Loop filters and Charge pumps, PLL Design examples. Integer-N frequency synthesizers, Direct Digital Frequency synthesizers, Case Study: mm-wave Frequency synthesizers.

UNIT V MIXERS AND OSCILLATORS 9

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

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of the course, the students will able to:

- Design the RFIC components
- Design RF low noise amplifiers and receivers
- Design feedback systems and power amplifiers
- Design PLL and frequency synthesizers
- Design and analyze the Mixers and Oscillators

TEXTBOOKS:

1. Reinhold Ludwig and Gene Bogdanov, “RF Circuit Design: Theory and Applications,” Pearson Education Inc., 2011.
2. Razavi, “RF Microelectronics,” Prentice Hall, Second Edition, 2011.

REFERENCES:

1. Frank Ellinger, Radio Frequency Integrated Circuits and Technologies, Springer, 2007.
2. Thomas H. Lee, "The Design of CMOS Radio Frequency Integrated Circuits," Cambridge University Press, 2004.
3. Mathew M Radmanesh, "RF and Microwave Electronics", Prentice Hall India, 2000.

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2. https://www.coursera.org/learn/rf-mmwave-circuit-design
3. https://extension.ucsd.edu/courses-and-programs/rf-circuit-design
4. https://www.microwaves101.com/
5. https://www.udemy.com/course/introduction-to-radio-frequency-integrated-circuit-design/

CO - PO MAPPING

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO-1	2	3	2	2	1	1	-	-	-	-	1	1
CO-2	3	3	2	2	1	1	-	-	-	-	1	1
CO-3	3	3	3	2	2	1	-	-	-	-	1	1
CO-4	3	3	3	2	2	1	-	-	-	-	1	1
CO-5	3	3	2	2	2	3	-	-	-	-	1	2
AVG	2.8	3	2.4	2	1.6	1.4	-	-	-	-	1	1.2

CO-PSO MAPPING

CO\PSO	PSO1	PSO2	PSO3
CO1	2	1	2
CO2	2	2	2
CO3	3	2	2
CO4	3	3	3
CO5	3	3	3
AVG	2.6	2.2	2.4

JEC1015	RADAR AND NAVIGATIONAL AIDS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To understand the basic concepts of Radar system
- To apply Doppler principle to radars and hence detect moving targets, cluster, also to understand tracking radars.
- To refresh principles of antennas and propagation as related to radars, also study of transmitters and Receivers.
- To understand principles of navigation.
- To approach landing aids as related to navigation using the satellite.

UNIT I INTRODUCTION TO RADAR SYSTEM 9

Introduction, Basic Radar, The simple form of the Radar Equation, Radar Block Diagram, Radar Frequencies, Applications of Radar, Prediction of Range Performance, Signal to Noise ratio, Integration of Radar Pulses, Radar Cross Section of Targets, Transmitter Power, Pulse Repetition Frequency, Antenna Parameters.

UNIT II MTI AND PULSE DOPPLER RADAR 9

Introduction to Doppler and MTI Radar, Delay, Line Cancellers, Staggered Pulse Repetition Frequencies, Doppler Filter Banks, Digital MTI Processing, Moving Target Detector, Limitations to MTI Performance, Pulse Doppler Radar, Tracking with Radar, Synthetic Aperture Radar, Case Study: Mono pulse Tracking.

UNIT III DETECTION OF SIGNALS IN NOISE 9

Matched Filter Receiver, Detection Criteria, Detectors, Automatic Detector, Integrators, False Alarm Rate Receivers, Radar Transmitters and Receivers, Linear Beam Power Tubes, Solid State RF Power Sources, Magnetron, Radar Transmitter, The Radar Receiver, Duplexers and Receiver Protectors, Remote Sensing, Case Study: Radar Displays.

UNIT IV RADIO DIRECTION AND RANGES 9

Introduction, Four methods of Navigation, The Loop Antenna and input circuits, An Aural Null Direction Finder, The Gonio meter, Errors in Direction Finding, Adcock Direction Finders, Direction Finding at VHF, Automatic Direction Finders, Range and accuracy of Direction Finders, VOR, UAV, Case Study: The LF/MF Four course Radio Range.

UNIT V SATELLITE NAVIGATION SYSTEM 9

Distance Measuring Equipment, Operation of DME, TACAN**,** ILS, MLS, The Doppler Effect - Beam Configurations, Doppler Frequency Equations, Track Stabilization, Doppler Spectrum and range Equation, components and accuracy of DNS, GLONASS, IRNSS, Case Study: Inertial Navigation, GPS.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

- Explain principles of Radar system
- Identify Target range and detection
- Analyze detection of signals in noise.
- Derive and discuss the Range equation and the nature of detection.
- Describe about the navigation systems using the satellite

TEXTBOOKS:

1. Merrill I. Skolnik," Introduction to Radar Systems", Tata McGraw-Hill, 3rd Edition, 2003.
2. N.S.Nagaraja, “Elements of Electronic Navigation Systems”, Tata McGraw-Hill, 2000.

REFERENCES:

1. Peyton Z. Peebles, "Radar Principles", John Wiley, 2004
2. J.C Toomay, “Principles of Radar", Prentice Hall of India, Second Edition, 2000.
3. Mark A. Richards , James A. Scheer, William A. Holm, “Principles of Modern Radar: Basic Principles”, Sci-Tech publishing, first edition, 2010.

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3. https://www.nasa.gov/mission_pages/station/main/index.html
4. https://www.coursera.org/learn/remote-sensing
5. https://www.coursera.org/learn/dsp1

CO -PO MAPPING

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	2	2	2	1	1	-	-	-	-	1	1
CO2	2	3	2	2	2	2	-	-	-	-	1	1
CO3	3	3	2	2	2	2	-	-	-	-	1	1
CO4	3	3	2	2	2	2	-	-	-	-	1	1
CO5	2	3	2	3	2	2	-	-	-	-	2	2
AVG	2.4	2.8	2	2.4	1.8	1.8	-	-	-	-	1.2	1.2

CO - PSO MAPPING

CO\PSO	PSO1	PSO2	PSO3
CO1	3	2	2
CO2	1	2	1
CO3	2	2	2
CO4	2	2	2
CO5	3	2	1
AVG	2.2	2	1.6

JEC1049	RFID SYSTEM DESIGN AND TESTING	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To provide an overview of RFID System principles
- To make students understand the design and the challenges regarding security issues
- To explain the RFID system design considerations
- To explain the system testing conformance and interoperability
- To describe the RFID system applications

UNIT I INTRODUCTION 9

Introduction to RFID – Comparison with other identification systems – Operating and physical principles. Types of tags – Passive, active, semi-passive, memory capacity – Radio regulatory issues and frequency ranges. Challenges in deployment-cost comparison of tags and readers in India.

UNIT II RFID DESIGN AND CHALLENGES 9

Communication principles, coding, modulation and demodulation – Data integrity multiple access procedures -Anti-collision procedures – Security issues and solutions. Hardware architecture of Tags and readers – Transponder design. Reader RF interface-control unit – Middleware – Near field communications. Comparison of successful RFID standards.

UNIT III RFID SYSTEM DESIGN CONSIDERATIONS 9

Configuration Design-System Design Checklist-Carrier Frequency and Bandwidth-Frequency Band Selection-Power and Range-Link Budget-Forward Link Budget-Reverse Link Budget-Collision Avoidance-Tag–Tag Collision-Reader–Tag Collision- Tag Reading Reliability-RFID Reader–Tag Communication Channel

UNIT IV SYSTEM TESTING 9

Testing and Conformance-Test Equipment-Frequency- and Bandwidth-Related Measurement-Polling and Timing Measurements- Multivendor Interoperability-Test Labs-RFID Security and Privacy Aspects-Health Risks from RFID-Other Developments in Auto-ID Systems

UNIT V CASE STUDIES 9

Smart cards – Public transport – Payment systems – NFC Applications – Electronic passport – Ski Tickets – Access control – Online and offline Systems – Supply chain and transport systems – Container transport animal identification – Stock keeping – Industrial and medical applications.

TOTAL PERIODS: 45

COURSE OUTCOMES:

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

- Describe RFID System principles
- Elucidate the design and the challenges regarding security issues
- Analyze and gain knowledge on the RFID system design considerations
- Infer about the system testing conformance and interoperability
- Describe the RFID system applications

TEXTBOOKS:

1. Harvey Lehpamer “RFID Design Principles” Artech House Microwave Library 2008

REFERENCES:

1. Curty, Declercq, Dehollain and Joehl, “Design and Optimization of passive UHF RFID Systems”, Springer, 2007.
2. V.D. Daniel, A. Puglia and M. Puglia, “RFID: A Guide to Radio Frequency Identification”, Wiley, 2007.
3. Nemai Chandra Karmakar Mohammad Zomorrodi Chamath Divarathne,” Chipless RFID tag design MIMO-Based Imaging at 60 GHz–ML Detection” Wiley Series In Microwave And Optical Engineering,2016.

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3. https://www.testandmeasurementtips.com/understanding-bandwidth-concepts/
4. https://voyantic.com/rfid-tag-design/

CO-PO/PSO MAPPING:

CO\PO, PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	2	2	2	3	-	-	-	-	2	2	2	2	2
CO2	3	2	2	2	2	3	-	-	-	-	3	3	3	3	3
CO3	3	2	2	3	3	3	-	-	-	-	3	3	3	3	3
CO4	2	2	3	3	3	3	-	-	-	-	3	3	3	3	3
CO5	2	3	3	3	3	3	-	-	-	-	3	3	3	3	3
AVG	**2.6**	**2.2**	**2.4**	**2.6**	**2.4**	**3**	**-**	**-**	**-**	**-**	**2.8**	**2.8**	**2.8**	**2.8**	**2.8**

JEC1013	SATELLITE COMMUNICATION	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To understand the basics of satellite orbits and launching methods
- To understand the satellite segment and subsystem
- To understand the design of satellite link and losses
- To know the various methods of satellite access and coding schemes
- To understand the applications of satellites

UNIT I SATELLITE ORBITS AND LAUNCHING METHODS 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 - PSLV, GSLV.

UNIT II SPACE SEGMENT AND SUBSYSTEM 9

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

UNIT III SATELLITE LINK DESIGN 9

EIRP, Interference and Losses, System Noise, Antenna Noise, The Link-Power Budget Equation, Carrier-to-Noise Ratio, The Uplink, Saturation flux density, Input back-off, Downlink, Output back-off, Case Study; Combined Uplink and Downlink C/N Ratio.

UNIT IV SATELLITE ACCESS AND CODING METHODS 9

Modulation and Multiplexing: Voice, Data, Video, Analog and digital transmission system, Digital video Broadcast, Multiple access: FDMA, TDMA, CDMA, DAMA Assignment Methods, Satellite-Switched TDMA, Coding Schemes, Case Study; compression, encryption.

UNIT V SATELLITE APPLICATIONS 9

INTELSAT Series, INSAT, VSAT, Mobile satellite services: GSM, INMARSAT, Satellite Navigational System: GPS, Differential GPS, DBS/DTH services, MATV, CATV, Hybrid satellite-terrestrial networks, IRS, Case Study; Satellite Radio Broadcasting.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

- Analyze the satellite orbits and launching techniques
- Analyze the space segment and subsystem
- Analyze the satellite Link design
- Analyze the various satellite access and coding methods
- Design various satellite applications

TEXT BOOKS:

1. Dennis Roddy, "Satellite Communication", McGraw Hill International, Fourth Edition, 2006.
2. Timothy Pratt, Charles W.Bostain, Jeremy E.Allnutt, "Satellite Communication", Wiley Publications, Second edition, 2002.

REFERENCES:

1. Tri T. Ha, "Digital Satellite Communication", McGraw-Hill, Second edition, 1990.
2. Wilbur L.Pritchard, Hendri G.Suyderhoud, Robert A. Nelson, "Satellite Communication Systems Engineering", Prentice Hall/Pearson, 2007.
3. Bruce R. Elbert, "The Satellite Communication Applications", Hand Book, Artech House Bostan London, 1997.

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CO - PO MAPPING

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	2	1	2	1	1	-	-	-	-	1	1
CO2	2	3	2	2	2	2	-	-	-	-	1	1
CO3	3	3	2	2	2	2	-	-	-	-	1	1
CO4	3	3	2	2	2	2	-	-	-	-	1	1
CO5	2	3	2	2	2	2	-	-	-	-	1	2
AVG	2.4	2.8	1.8	2.4	1.8	1.8	-	-	-	-	1	1.2

CO - PSO MAPPING

CO\PSO	PSO1	PSO2	PSO3
CO1	3	2	1
CO2	3	2	1
CO3	3	2	1
CO4	3	2	1
CO5	3	2	1
AVG	3	2	1

JEC1050	MICROWAVE INTEGRATED CIRCUITS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To explain about Hybrid and Monolithic MIC technology.
- To explain and design microstrip integrated circuit design using lumped elements.
- To define and design coupled microstrip and directional couplers
- To familiarize microstrip circulator, isolators and phase shifters.
- To make understand the measurement, testing and applications of MIC

UNIT I INTRODUCTION 9

Introduction to Monolithic Microwave Integrated Circuits (MMICs) - their advantages over discrete circuits - MMIC fabrication techniques - thick and thin film technologies and materials - Encapsulation and mounting of active devices - Microstrips on semiconductor substrates - Hybrid MIC's

UNIT II ANALYSIS AND DESIGN OF MICROSTRIPLINE 9

Analysis of Stripline and Microstripline, Planar transmission lines for MICs, Method of conformal Transformation, Characteristic parameters of strip, Microstrip lines, Microstrip Circuit Design, Impedance transformers, Filters, Lumped constant Microstrip circuits

UNIT III COUPLED MICROSTRIPLINES AND ITS APPLICATIONS 9

Coupled Microstrips and Directional couplers, Even and odd mode analysis, Theory of coupled microstrip Directional couplers, Calculations for a coupled pair of Microstrips, Branch line couplers. Lumped Elements for MIC's Design and fabrication of lumped elements, circuits using lumped elements.

UNIT IV COMPONENTS OF MIC 9

Non reciprocal components for MIC's Microstrip on Ferromagnetic substrates, Microstrip circulators. Isolators and phase shifters, Design of microstrip circuits – high power and low power circuits

UNIT V MIC DESIGN, MEASUREMENT AND TESTING TECHNIQUES 9

Microwave Integrated Circuits – MIC Materials- Hybrid versus Monolithic MICs – Multichip Module Technology - Fabrication Techniques, Miniaturization techniques, Introduction to SOC, SOP, Test fixture measurements, probe station measurements, thermal and cryogenic measurements, experimental field probing techniques, MIC applications.

TOTAL PERIODS: 45

COURSE OUTCOMES:

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

- Describe the concept of hybrid and monolithic MIC technology.
- Explain conformal transformation method and its application in characterization and design of microstrip integrated circuits.
- Illustrate the concept of coupled microstrip and directional couplers.
- Explain microstrip circulator, isolators and phase shifters.
- Explain the application of MIC

TEXT BOOKS:

1. Samuel. Y. Liao, "Microwave Circuit Analysis and Amplifier Design", Prentice Hall. Inc., 1987.
2. Lefteris Tyler, "Advanced Microwave Circuits And Systems", Scitus, 2017
3. Thomas H.Lee, "Planar Microwave Engineering", Cambridge University Press, 2004

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1. Hoffman R.K. "Handbook of Microwave Integrated Circuits", Artech House, Boston, 1987.
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CO-PO/PSO MAPPING:

CO\PO,PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	2	2	2	3	-	-	-	-	2	2	2	2	2
CO2	3	2	2	2	2	3	-	-	-	-	3	3	3	3	3
CO3	3	2	2	3	3	3	-	-	-	-	3	3	3	3	3
CO4		2	3	3	3	3	-	-	-	-	3	3	3	3	3
CO5	2	3	3	3	3	3	-	-	-	-	3	3	3	3	3
AVG	**2.6**	**2.2**	**2.4**	**2.6**	**2.4**	**3**	**-**	**-**	**-**	**-**	**2.8**	**2.8**	**2.8**	**2.8**	**2.8**

JEC1051	mm WAVE COMMUNICATION	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To describe the fundamentals of Millimeter wave devices and circuits.
- To explain the various components of Millimeter wave Communications system.
- To familiarize mm wave communication Systems
- To make understand the mm wave MIMO communication systems.
- To familiarize antennas for millimeter wave communication system

UNIT I OVERVIEW OF mm WAVE 9

Millimeter wave characteristics- millimeter wave wireless, challenges, Radio wave propagation for mm wave: Large scale and small scale propagation channel effects, Outdoor and Indoor channel models, Applications of millimeter wave communications.

UNIT II mm WAVE DEVICES AND CIRCUITS 9

Millimeter wave generation and amplification: Peniotrons, Ubitrons, Gyrotrons and Free electron lasers. HEMT, models for mm wave Transistors, transistor configurations, Analog mm wave components: Amplifiers, Mixers, VCO, PLL.

UNIT III mm WAVE COMMUNICATION SYSTEMS 9

Modulations for millimeter wave communications: OOK, PSK, FSK, QAM, OFDM, Millimeter wave link budget, Transceiver architecture, Transceiver without mixer, Receiver without Oscillator, Millimeter wave design considerations.

UNIT IV mm WAVE MIMO SYSTEMS 9

Massive MIMO Communications, Spatial diversity of Antenna Arrays, Multiple Antennas, Multiple Transceivers, Noise coupling in MIMO system, Potential benefits for mm wave systems, Spatial, Temporal and Frequency diversity.

UNIT V ANTENNAS FOR mm WAVE SYSTEMS 9

Antenna beamwidth- polarization- advanced beam steering and beam forming- mm wave design consideration- On-chip and In package mm wave antennas- Techniques to improve gain of on-chip antennas- Implementation for mm wave in adaptive antenna arrays- Device to Device communications over 5G systems.

TOTAL PERIODS: 45

COURSE OUTCOMES:

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

- Discuss the fundamentals of Millimeter wave devices and circuits.
- Interpret the various components of Millimeter wave Communications system.
- Explain mm wave communication Systems
- Describe the mm wave MIMO communication systems.
- Discuss the antennas for millimeter wave communication system

TEXT BOOKS:

1. Robert W. Heath, Robert C. Daniel, James N. Theodore S. Rappaport, Murdock, "Millimeter Wave Wireless Communication", Prentice Hall, 2014.
2. K.C. Huang, Z. Wang, "Millimeter Wave Communication Systems", Wiley-IEEE Press, March 2011.

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2. Chia-Chin Chong, Kiyoshi Hamaguchi, Peter F. M. Smulders and Su-Khiong, "Millimeter - Wave Wireless Communication Systems: Theory and Applications," Hindawi Publishing Corporation, 2007.
3. John S. Seybold "Introduction to RF propagation" John Wiley and Sons, 2005.

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CO-PO/PSO MAPPING:

CO\ PO, PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	2	2	3	-	-	-	-	2	2	2	2	2
CO2	3	3	2	2	2	3	-	-	-	-	3	3	3	3	3
CO3	3	3	2	3	3	3	-	-	-	-	3	3	3	3	3
CO4	2	2	3	3	3	3	-	-	-	-	3	3	3	3	3
CO5	2	2	3	3	3	3	-	-	-	-	3	3	3	3	3
AVG	**2.6**	**2.6**	**2.4**	**2.6**	**2.6**	**3**	**-**	**-**	**-**	**-**	**2.8**	**2.8**	**2.8**	**2.8**	**2.8**

JEC1052	RADAR TECHNOLOGIES	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To make students understand the basics of Radar and Radar equation
- To explain the types of Radar
- To familiarize tracking Radar
- To explain various signal processing in Radar
- To make students understand the Subsystems in Radar.

UNIT I INTRODUCTION TO RADAR 9

Introduction- Radar classifications, Radar Fundamentals: Detection, Range, velocity, Pulsed Radar equation, Detection of Signals in Noise- Receiver Noise, Probabilities of Detection and False Alarm, Integration of Radar Pulses, Radar Cross Section of Targets, Transmitter Power, Pulse Repetition Frequency, Antenna Parameters, System losses.

UNIT II CW, MTI AND PULSE DOPPLER RADAR 9

CW and Frequency Modulated Radar, Doppler and MTI Radar- Delay Line Cancellers, Staggered Pulse Repetition Frequencies, Doppler Filter Banks, Digital MTI Processing, Moving Target Detector, Limitations to MTI Performance, MTI from a Moving Platform (AMIT), Pulse Doppler Radar.

UNIT III TRACKING RADAR 9

Tracking with Radar, Monopulse Tracking, Conical Scan, Sequential Lobing, Limitations to Tracking Accuracy, Low-Angle Tracking - Comparison of Trackers, Track while Scan (TWS) Radar- Target prediction , state estimation, Measurement models, alpha – beta tracker, Kalman Filtering, Extended Kalman filtering.

UNIT IV RADAR SIGNAL PROCESSING 9

Radar Signal Processing Fundamentals, Detection strategies, Optimal detection, Threshold detection, Constant False alarm rate detectors, Adaptive CFAR, pulse compression waveforms, LFM waveforms matched filtering, radar ambiguity functions, Detection of radar signals in Noise and clutter, detection of nonfluctuating target in noise.

UNIT V RADAR TRANSMITTERS AND RECEIVERS 9

Radar Transmitter, Linear Beam Power Tubes, Solid State RF Power Sources, Crossed Field Amplifiers, Other RF Power Sources. The Radar Receiver, Receiver noise power, Duplexers and Receiver Protectors- Radar Displays. Radar Antenna - Reflector Antennas - Electronically Steered Phased Array Antennas – Phase Shifters

TOTAL PERIODS: 45

COURSE OUTCOMES:

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

- Explain the basics of Radar and Radar equation
- Differentiate the types of Radar
- Describe tracking and filtering schemes
- Explain various signal processing in Radar
- Explain the Subsystems in Radar.

TEXTBOOKS:

1. Habibur Rahman, Fundamental Principles of Radar, CRC press, Taylor and Francis, 2019
2. M. R. Richards, J. A. Scheer, W. A. Holm, Editors "Principles of Modern Radar, Basic Principles", SciTech Publishing, 2012

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1. Nathansan, "Radar design principles-Signal processing and environment", PHI, 2nd Edition,2007.
2. M.I.Skolnik , "Introduction to Radar Systems", Tata McGraw Hill 2006.
3. Mark A. Richards, "Fundamentals of Radar Signal Processing", McGraw-Hill, 2005.

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3. https://www.tutorialspoint.com/radar_systems/radar_systems_tracking_radar.htm
4. https://www.youtube.com/watch?v=KKTfcmHceLw
5. https://www.youtube.com/watch?v=uBaGBnzAzis

CO-PO/PSO MAPPING:

CO\PO, PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	2	2	2	-	-	-	-	-	3	2	3	2
CO2	3	3	3	2	2	1	-	-	-	-	-	2	2	3	2
CO3	3	3	2	2	2	2	-	-	-	-	-	2	2	2	1
CO4	3	3	3	2	2	1	-	-	-	-	-	2	2	2	1
CO5	3	3	3	3	2	2	-	-	-	-	-	1	2	2	1
AVG	**3**	**3**	**3**	**2**	**2**	**2**	-	-	-	-	-	**2**	**2**	**2**	**2**

JEC1053 POSITIONING AND NAVIGATIONAL SYSTEMS L T P C
3 0 0 3

COURSE OBJECTIVES:

- To explain the fundamentals of navigation systems.
- To make students understand the inertial navigation systems
- To impart knowledge on radio navigation.
- To give an overview of global positioning systems
- To explain the hybrid navigation systems.

UNIT I NAVIGATION CONCEPTS 9

Fundamentals of navigation systems and Position Fixing – Categories of navigation - Geometric concepts of Navigation – The Earth in inertial space - Different Coordinate Systems – Coordinate Transformation - Euler angle formulations - Direction cosine matrices formulation - Quaternion formulation.

UNIT II INERTIAL NAVIGATION SYSTEMS 9

Inertial sensors - Gyroscopes -Types - Mechanical - Electromechanical-Optical Gyro -Ring Laser gyro- Fiber optic gyro- Accelerometers – Pendulous type – Force Balance type – MEMs - Basic Principles of Inertial Navigation – Types - Platform and Strap down - Mechanization INS system - Rate Corrections - Acceleration errors – Schuler Tuning.

UNIT III RADIO NAVIGATION & AIR TRAFFIC MANAGEMENT 9

Different types of radio navigation- ADF, VOR, DME, TACAN, VORTAC - Doppler – Hyperbolic Navigations – Air Traffic Management – RADAR Surveillance - Airborne Collision Avoidance Systems.

UNIT IV GLOBAL POSITIONING SYSTEM 9

Overview of GPS: system architecture, GPS Signals Signal structure, anti-spoofing (AS), selective availability, GPS for position and velocity determination, GPS aided Geo-augmented navigation (GAGAN) architecture-GPS errors – IRNS

UNIT V HYBRID NAVIGATION & RELATIVE NAVIGATION SYSTEMS 9

Hybrid Navigation - Introduction to Kalman filtering – Case Studies -Integration of GPS and INS using Kalman Filter - Relative Navigation – fundamentals – Equations of Relative Motion for circular orbits - Sensors for Rendezvous Navigation - Relative positioning - Point positioning and differential positioning

TOTAL PERIODS: 45

COURSE OUTCOMES:
At the end of the course, the students will be able to:

- Explain the concepts of Positioning and Navigation systems and exposure on various Navigation systems
- Explain Gyroscopes and accelerometers and Inertial Navigation systems and its types
- Describe the different Radio Navigation aids and its usage
- Explain the Satellite Navigation
- Describe hybrid navigation systems and Relative navigation in a spacecraft.

TEXTBOOKS:

1. Myron Kyton, Walfred Fried, 'Avionics Navigation Systems', John Wiley & Sons,2 edition,1997
2. Nagaraja, N.S. "Elements of Electronic Navigation", Tata McGraw-Hill Pub. Co., New Delhi, 2nd edition, 1975.

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1. George M Siouris, 'Aerospace Avionics System; A Modern Synthesis', Academic Press Inc., 1993.
2. Albert Helfrick, 'Practical Aircraft Electronic Systems', Prentice Hall Education, Career & Technology, 1995. 3. Albert D. Helfrick, 'Modern Aviation Electronics', Second Edition, Prentice Hall Career & Technology, 1994.
3. Paul. D. Groves. 'Principles of GNSS, Inertial, and Multisensor Integrated Navigation Systems', Artech House, 2013.
4. Maxwell Noton, "Spacecraft navigation and guidance", Springer (London, New York), 1998

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2. https://dewesoft.com/blog/what-is-inertial-navigation-system
3. https://www.encyclopedia.com/computing/news-wires-white-papers-and-books/aircraft-traffic-management
4. https://www.aai.aero/en/content/what-gagan
5. https://cjme.springeropen.com/articles/10.1186/s10033-022-00775-4

CO-PO/PSO MAPPING:

CO\PO, PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	2	2	2	-	-	-	-	-	3	3	2	2
CO2	3	3	3	2	2	2	-	-	-	-	-	2	3	2	2
CO3	3	3	3	2	2	2	-	-	-	-	-	2	3	2	3
CO4	3	3	3	2	2	2	-	-	-	-	-	2	2	2	2
CO5	3	3	3	3	2	2	-	-	-	-	-	2	2	2	2
AVG	**3**	**3**	**2.8**	**2.2**	**2**	**2**	**-**	**-**	**-**	**-**	**-**	**2.2**	**2.6**	**2**	**2.8**

JEC1054	AVIONICS SYSTEMS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To impart knowledge on the needs for avionics for both Civil and military aircraft.
- To explain avionics architecture and Avionics data bus.
- To describe understand the various cockpit displays and human interfaces.
- To provide knowledge on the concepts of flight control systems, FMS and their importance
- To explain different navigation aids and need for certification

UNIT I INTRODUCTION TO AVIONICS 9

Basics of Avionics-Basics of Cockpits – Need for Avionics in civil and military aircraft and space systems – Integrated Avionics Architecture –Military and Civil system – Typical avionics System and Sub systems – Design and Technologies – Requirements and Importance of illities of Avionic Systems.

UNIT II DIGITAL AVIONICS BUS ARCHITECTURE 9

Evolution of Avionics architecture– Avionics Data buses MIL-STD-1553, MIL-STD-1773, ARINC429, ARINC-629, AFDX/ARINC-664, ARINC-818 – Aircraft system Interface.

UNIT III COCKPIT DISPLAYS AND MAN-MACHINE INTERACTION 9

Design parameters at the base station-Practical link budget design using path loss models-Smart antenna systems- Beamforming-MIMO Systems- RAKE receiver.

UNITIV FLIGHT CONTROL SYSTEMS 9

Introduction to Flight control systems and FMS– Longitudinal control – Lateral Control – Autopilot – Flight planning – Radar Electronic Warfare - Certification-Military and civil aircrafts.

UNIT V NAVIGATION SYSTEMS 9

Overview of navigation systems - Communication Systems – Radio navigation – Types & Principles – Fundamentals of Inertial Sensors – INS – GNSS -- GPS – Approach and Landing Aids – ILS & MLS – Hybrid Navigation

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

- Explain the different of Avionics Systems and its need for civil and military aircrafts considering the reliability and safety aspects
- Select a suitable architecture and data bus based on the requirements
- Compare the different display technologies used in cockpit
- Explain the principles of flight control systems and the importance of FMS
- Explain the communication and navigation techniques used in aircrafts

TEXTBOOKS:

1. R.P.G. Collinson, "Introduction to Avionics", Springer Publications, Third Edition, 2011.

REFERENCES:

1. Cary R .Spitzer, "The Avionics Handbook", CRC Press, 2000.
2. Middleton, D.H. "Avionics Systems", Longman Scientific and Technical, Longman Group UK Ltd., England, 1989. 159
3. Spitzer, C.R. "Digital Avionics Systems", Prentice Hall, Englewood Cliffs, N.J., U.S.A., 1987.
4. Myron Kayton , Walter R. Fried "Avionics Navigation Systems" 2nd Edition, Wiley Publication, 2008.
5. Jim Curren, "Trend in Advanced Avionics", IOWA State University, 1992.

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3. https://nptel.ac.in/courses/101101079

CO-PO/PSO MAPPING:

CO\PO,PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	3	3	2	-	-	-	-	-	3	3	3	2
CO2	3	3	3	2	2	2	-	-	-	-	-	3	3	2	2
CO3	3	3	3	3	1	2	-	-	-	-	-	3	3	3	2
CO4	2	3	3	2	2	1	-	-	-	-	-	2	2		2
CO5	3	3	2	2	2	1	-	-	-	-	-	2	2	2	2
AVG	**3**	**3**	**3**	**2**	**2**	**2**	**-**	**-**	**-**	**-**	**-**	2	**2**	**2**	**2**

JEC1055	REMOTE SENSING	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To make students understand the principles of electromagnetic radiation.
- To explain atmospheric radiation interactions.
- To describe the laws of planetary motion.
- To explain the different types of resolution.
- To make students understand the concepts of digital interpretation.

UNIT I REMOTE SENSING AND ELECTROMAGNETIC RADIATION 9

Introduction to Remote Sensing – Merits and demerits of Data Collation between conventional and remote sensing methods - Electromagnetic Spectrum – Radiation principles - Wave theory, Planck‘s law, Wien’s Displacement Law, Stefan’s Boltzmann law, Kirchoff‘s law – Radiation sources: active & passive

UNIT II EMR INTERACTION WITH ATMOSPHERE 9

Standard atmospheric profile – main atmospheric regions and its characteristics – interaction of radiation with atmosphere – Scattering, absorption and refraction – Atmospheric windows – Energy balance equation – Specular and diffuse reflectors – Spectral reflectance & emittance– Spectroradiometer – Spectral Signature concepts

UNIT III ORBITS AND PLATFORMS 9

Motions of planets and satellites – Newton ‘s law of gravitation – Gravitational field and potential - Orbital perturbations and maneuvers – Types of remote sensing platforms - Ground based, Air borne platforms and Space borne platforms – Classification of satellites – Sun synchronous and Geosynchronous satellites – Legrange Orbit

UNIT IV SENSING TECHNIQUES 9

Classification of remote sensors – Resolution concept: spatial, spectral, radiometric and temporal resolutions - Scanners - Along and across track scanners – Optical-infrared sensors – Thermal sensors – microwave sensors – Calibration of sensors – High Resolution Sensors - LIDAR, UAV – Orbital and sensor characteristics of live Indian earth observation satellites.

UNIT V DATA PRODUCTS AND INTERPRETATION 9

Photographic and digital products – Types, levels and open-source satellite data products – selection and procurement of data – Visual interpretation: basic elements and interpretation keys - Digital interpretation – Concepts of Image rectification, Image enhancement and Image classification.

TOTAL PERIODS: 45

COURSE OUTCOMES:

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

- Explain the principles of electromagnetic radiation.
- Describe atmospheric radiation interactions.
- Describe the laws of planetary motion.
- Explain the different types of resolution.
- Illustrate the concepts of digital interpretation.

TEXTBOOKS:

1. Thomas M. Lillesand, Ralph W. Kieferand Jonathan W. Chipman, Remote Sensing and Image interpretation, John Wiley and Sons, Inc., New York, 2015.
2. George Joseph and C Jeganathan, Fundamentals of Remote Sensing, Third Edition Universities Press (India) Private limited, Hyderabad, 2018.

REFERENCES:

1. Stanley A Morain; Amelia M Budge; Michael S Renslow. Manual of Remote Sensing. Vol. I, American Society for Photogrammetry and Remote Sensing, Virginia, USA,2019, 4th edition
2. Verbyla, David, Satellite Remote Sensing of Natural Resources. CRC Press,2022 first edition.
3. Paul Curran P. J. Principles of Remote Sensing Longman, RLBS, 1996.
4. Introduction to Physics and Techniques of Remote Sensing, Charles Elachi and Jacob Van Zyl, 2021 Edition3, Wiley Publication.
5. BasudebBhatta, Remote Sensing and GIS, Oxford University Press, 2020 third edition.

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3. https://www.esa.int/Enabling_Support/Space_Transportation/Types_of_orbits
4. https://eos.com/blog/types-of-remote-sensing/
5. https://egyankosh.ac.in/bitstream/123456789/39515/1/Unit-6.pdfSignals

CO-PO/PSO MAPPING:

CO\PO, PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	2	3	2	3	-	-	-	-	-	1	3	3	3
CO2	3	2	2	3	2	3	-	-	-	-	-	1	3	3	3
CO3	1	2	1	3	2	3	-	-	-	-	-	1	3	3	3
CO4	1	2	3	1	2	3	-	-	-	-	-	1	3	3	3
CO5	2	2	2	1	2	3	-	-	-	-	-	1	3	3	3
AVG	**2**	**2**	**2**	**2.2**	**2**	**3**	-	-	-	-	-	**1**	**3**	**3**	**3**

JEC1056	UNDERWATER INSTRUMENTATION SYSTEM	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To make students understand the basics of underwater vehicle control system
- To explain the basic sensors and transducers used in underwater vehicles
- To describe the types of communication systems
- To explain different types of underwater vehicles and their applications
- To elaborate on subsea battery and power management system

UNIT I INTRODUCTION ON DATA ACQUISITION AND CONTROL SYSTEM 9

PLC, SCADA and HMI, Real time Controller, Signal conditioning circuits: Ethernet Modem, SMPS, Media converters, Ethernet switches, Pressure Compensator, Pressure compensated batteries, Volve amplifiers, Actuators, proportional valves and solenoid valves, Solid State Relay and Electromagnetic relay, Pressure casing for underwater DACs

UNIT II UNDERWATER SENSORS AND TRANSDUCERS 9

Inertial Navigation System, FOG/RLG, GPS, DGPS, Gyroscope, Motion Reference Unit, Doppler Velocity Log, Acoustic Transponder, Beacon, Positioning System- LBL, SBL, SSBL, Underwater Encoder, Proximity switches, Conductivity sensor, Temperature sensor, Depth sensor, Accelerometer, Tilt sensor, LVDT, Vacuum sensor, Current meters.

UNIT III UNDERWATE SCIENTIFIC INSTRUMENTS 9

Acoustic Doppler Current Profiler, Echosounder, Hydrophones, SONAR- Forward looking SONAR, Bottom Looking SONAR, Altimeter, Swell and wave sensor, PH sensor, Turbidity sensor, Oxygen sensor, Water samplers, Nitrogen sensor, CTD

UNIT IV TELEMETRY SYSTEM 9

Telemetry system for tethered vehicles, Fiber optic communication, Single mode fiber, Multimode fiber, Fiber optics in oceanographic applications, Basis of optical fiber transmission, Fiber losses and signal attenuation, Slip rings, Umbilical cables, Underwater cables and connectors, Field installable Termination Assembly

UNIT V TYPES OF UNDERWATER VEHICLES 9

Type of vehicles, manned and unmanned vehicles, Tethered and untethered vehicles, Remotely Operable Vehicle (ROV), Autonomous Underwater vehicle (AUV), Gliders, Solar powered Gliders, Manned submersible, Submarines, Deep Sea Rescue vehicle (DSRV), Various Propulsion systems.

TOTAL PERIODS: 45

COURSE OUTCOMES:

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

- Explain the basics of underwater vehicle control system
- Explain basic sensors and transducers used in underwater vehicles
- Describe the types of communication systems
- Elaborate on different types of underwater vehicles and their applications
- Explain subsea battery and power management system

TEXTBOOKS:

1. Yang Xiao, “Underwater Acoustic Sensor Networks”, first edition, Auerbach Publications, 2019
2. Noah Carter, “Autonomous Underwater Vehicles: Technology and Applications”, Clanrye International, 2015

REFERENCES:

1. Ferial El- Hawary, “Ocean engineering Handbook”, 1st Edition, 2000
2. Thor I Fossen, “Guidance and control of Ocean Vehicles”, Wiley, 1994
3. Marc Le mann, “Instrumentation and metrology in Oceanography”, Wiley, 2012
4. Gwyn Griffiths, “Technology and applications of AUV”, 1st edition, 2002
5. Karl Von Ellenrieder, “Fundamentals of Marine Vehicle Control”, Springer, 2021

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4. https://oceanservice.noaa.gov/facts/auv-rov.html

CO-PO/PSO MAPPING:

CO\ PO, PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	2	2	3	-	-	-	-	-	3	3	3	3
CO2	3	3	3	2	2	2	-	-	-	-	-	3	3	3	3
CO3	3	3	3	2	3	2	-	-	-	-	-	3	3	3	3
CO4	3	3	3	2	2	2	-	-	-	-	-	3	3	3	3
CO5	3	3	2	2	2	2	-	-	-	-	-	2	3	3	2
AVG	**3**	**3**	**2.8**	**2**	**2.2**	**2.2**	-	-	-	-	-	**2.8**	**3**	**3**	**2.8**

JEC1057	UNDER WATER IMAGING SYSTEMS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To introduce the fundamental components of optical imaging
- To make students understand the challenges involved in Underwater imaging
- To introduce the fundamental of Ocean Acoustics
- To familiarize the principle of image processing techniques
- To familiarize the SONAR Systems and various applications.

UNIT I FUNDAMENTALS OF OPTICAL IMAGING 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 DIGITAL IMAGE PROCESSING FOR UNDERWATER IMAGES 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, Logarithmic notation, Basics of propagation losses, Target Strength, Back scattering, Acoustic noise, Multiple paths, Time characteristics of echoes, Active and passive sonar equations, Underwater electro acoustic transducers-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 beam forming, Array gain, Angular resolution, Transmitting signals Narrowband Vs Chirp, Matched filtering, Range resolution.

UNIT V 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 PERIODS: 45

COURSE OUTCOMES:

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

- Comprehend the techniques involved in underwater imaging
- Explain the image processing techniques for under water images.
- Explain the fundamentals of underwater acoustics and ambient noise
- Describe the design of Filter and impedance matching circuits for underwater imaging applications
- Comprehend various types of SONAR systems and its applications

TEXTBOOKS:

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

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1. Tinku & Ajoy K. Ray,”Image Processing principles & Applications, First Edition, Wiley Interscience,2005
2. Xavier Lurton,”An Introduction to Underwater Acoustics (Principles and applications), 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

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6. https://youtu.be/tRC8c2GZ3JU

CO-PO/PSO MAPPING:

CO\PO, PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	2	2	2	-	-	-	-	-	3	2	3	2
CO2	3	3	3	2	2	1	-	-	-	-	-	2	2	3	2
CO3	3	3	2	2	2	2	-	-	-	-	-	2	2	2	1
CO4	3	3	3	2	2	1	-	-	-	-	-	2	2	2	1
CO5	3	3	3	3	2	2	-	-	-	-	-	1	2	2	1
AVG	**3**	**3**	**3**	**2**	**2**	**2**	-	-	-	-	-	**2**	**2**	**2**	**2**

JEC1058	UNDERWATER NAVIGATION SYSTEMS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To make students understand the basics of underwater communication.
- To explain various types of navigational equipment & sensors
- To describe the basic communication methods and signal losses, attenuation.
- To explain the types of Acoustic transponders, Beacon and Responder
- To describe the applications

UNIT I BASICS OF UNDERWATER COMMUNICATION 9

Underwater acoustics, Thermoclines in Ocean Waters, subsea communication sensors, Sound propagation in the ocean – Sound Velocity Profiles (SVP) in the deep water and shallow water; Sound attenuation in the sea – absorption, scattering, transmission loss, reverberation, Snell's law, target strength; Laser communication and limitations.

UNIT II UNDERWATER NAVIGATION SENSOR AND DEVICES 9

Different types of navigational sensors, Accelerometers, Fiber Optic Gyroscopes (FOGs), Ring Laser Gyroscope (RLG) types and Working principles, and their applications, Doppler Velocity Log, Error sources in subsea navigation, Calibration overview for subsea navigation. Attitude Heading and Reference Systems (AHRS) & IMU

UNIT III ACOUSTIC POSITIONING SYSTEMS 9

Subsea navigation possible solutions, Vehicle positioning, Acoustic Positioning systems, Short BaseLine (SBL), Super Short Base Line (SSBL), Long Base line (LBL) Configurations and Positioning overview.

UNIT IV SUBSEA VEHICLE NAVIGATION 9

Subsea navigation, Uses of subsea navigation, challenges of subsea navigation. Basics of underwater navigation, Types of underwater Navigations, Aided navigational systems, Inertial Navigational systems. role of dead-reckoning navigation in subsea navigation, Kalman filters (XKF) and Invariant extended Kalman filters for navigation.

UNIT V CASE STUDY 9

Tethered vehicle deployment guidelines and preparedness, AUV /ROV based search operation requirements and planning, Tethered crawling vehicle sensors, data acquisition and maneuvering, Acoustic positioning system transponder deployment and recovery, Aided and unaided navigation system study.

TOTAL PERIODS: 45

COURSE OUTCOMES:

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

1. Explain about the Underwater Navigation System
2. Describe about the INS and its aiding sensor
3. Explain about the challenges involved in underwater navigation
4. Illustrate how navigation system is integrated with manned andunmanned underwater vehicles
5. Explain various applications

TEXTBOOKS:

1. L.M.Brekhovskikh and Yu. P. Lysanov, "Fundamentals of ocean acoustics", 3rd Edition, 2006
2. P. H. Milne, "Underwater Acoustic Positioning Systems", Gulf Publishing Company, 1983

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2. TT Fossen, "Guidance & Control of Ocean Vehicles", 1st Edition, John Wiley & Sons Inc, 1994
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3. https://dynamic-positioning.com/proceedings/dp1998/SVickery.PDF
4. https://sites.google.com/view/ph-d-diego-mercado/research/underwater-navigation

CO-PO/PSO MAPPING:

CO\ PO, PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	3	2	2	-	-	-	-	-	2	3	3	3
CO2	3	3	2	2	**2**	2	-	-	-	-	-	2	3	2	3
CO3	3	3	2	2	2	2	-	-	-	-	-	2	3	2	3
CO4	3	3	3	2	2	1	-	-	-	-	-	2	1	2	2
CO5	3	3	3	2	2	2	-	-	-	-	-	3	2	1	2
AVG	**3**	**3**	**3**	**2**	**2**	**2**	-	-	-	-	-	**2**	**3**	**2**	**2**

JEC1059	UNDERWATER COMMUNICATION	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To explain fiber optic communication for underwater application
- To familiarize underwater communication and sensor networking
- To describe underwater acoustic communication
- To make students understand the challenges in underwater communication
- To explain underwater cables and handing system for various application

UNIT I UNDERWATER FIBRE OPTICS COMMUNICATION 9

Basics of Fibre Optics communication**:** Working Principle, Single Mode, Multi-Mode, Effect on Fibre bending, Standard FO Connectors, Cable Requirement for Underwater Application, Cable Characteristics, Basic design for Electro-Optical(E-O) Underwater Cable, Handling system for E-O cables, Optical slip ring and its application,

UNIT II UNDERWATER OPTICAL COMMUNICATION 9

Classification of Underwater Wireless Optical Communication Links, Underwater Optical Communication (UWOC) System: Modulation, Coding, Light Source Technology, CommonLasers in UWOC, Alignment and Compensation, UWCNetwork, UWOC Channel Modeling, UWOC Link Turbulence,Noise in the UWOC Channel. UWOC Networks

UNIT III UNDERWATER MI COMMUNICATION & SENSOR NETWORKS 9

MI Communication System: MI Coil, Matching Network, Communication Block: MI Wireless Sensor Networks: UW sensor network Application and Its Architecture, Localization, Medium Access protocols, Routing Protocols, Cross-layer Protocols, Recent trend on MI communication.

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UNITIV PRINCIPLES OF UNDERWATER ACOUSTIC COMMUNICATION 9

Ocean Acoustic environment; Sound propagation in the ocean – sound velocity profiles in the deep water and shallow water Speed of underwater sound, Underwater Sound Transmission Loss, Acoustic Field Model: Ray Theory Model, Structure and Performance of UWAC Systems, Characteristics of the UWA Channel

UNIT V UNDERWATER ACOUSTIC NETWORK TECHNOLOGY 9

Basics on Underwater Acoustic Modem and its construction, Bandwidth and its limitations, Characteristics of UWA Network, Topology of UWA Network, Network Protocol Architecture of UWA Network, UWAC Challenges and Research Trends, Underwater telephone, Acoustic Positioning System, Underwater beacon.

TOTAL PERIODS: 45

COURSE OUTCOMES:

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

- Explain different underwater communication system
- Describe the use of MI coil for underwater communication
- Explain the importance of underwater communication and challenges
- Describe the strength of Underwater acoustic communication
- Explain the sensor network concepts and its application

TEXTBOOKS:

1. Yi Lou, Niax Ahmed, Underwater Communications and Networks, First Edition, Springer,2021

REFERENCES:

1. Ferial El-Hawary, The Ocean Engineering Hand book, First Edition, CRC Press, 2001
2. L.M. Brekhovskikh and Yu. P. Lysanov, Fundamentals of ocean acoustics, Third Edition,Springer, 2003
3. Robert J Urick, Principles of underwater sound, Third Edition, Peninsula Publishing, 2013
4. Rahul Sharma, Deep Sea Mining Handbook, First Edition, Springer,2017

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1. https://www.britannica.com/video/179500/seabed-laying-Crete-cable
2. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7219055/
3. https://www.youtube.com/watch?v=DnnTO2yCG5Q
4. https://www.mit.edu/~millitsa/resources/pdfs/mandar.pdf

CO-PO/PSO MAPPING:

CO\ PO, PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	2	3	1	3	2	-	-	-	-	1	3	3	3
CO2	3	2	2	3	1	3	2	-	-	-	-	1	3	3	3
CO3	3	3	3	3	2	3	2	-	-	-	-	1	3	3	3
CO4	3	2	3	1	3	3	2	-	-	-	-	1	3	3	3
CO5	2	2	2	3	3	3	2	-	-	-	-	1	3	3	3
AVG	**2**	**2**	**2**	**2**	**2**	**3**	**2**	**-**	**-**	**-**	**-**	**1**	**3**	**3**	**3**

OPEN ELECTIVES 1
SEMESTER - IV

JEC9001	COMMUNICATION SYSTEMS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To understand Noise and analog communication techniques.
- To gain knowledge on sampling and digital communication techniques.
- To learn the basics of mobile telecommunication systems.
- To understand the basic concept of satellite orbits & satellite link design.
- To understand the fundamentals of cognitive networks.

UNIT I ANALOG COMMUNICATION 9

Introduction to Communication Systems - Modulation - Need for Modulation. Theory of Amplitude Modulation - Evolution and Description of SSB Techniques - Theory of Frequency and Phase Modulation – Comparison of Analog Communication Systems (AM – FM – PM).
Noise: Source of Noise - External Noise- Internal Noise- Noise Calculation.

UNIT II DIGITAL COMMUNICATION 9

Low pass sampling – Aliasing- Signal Reconstruction-Quantization - Amplitude Shift Keying (ASK) – Frequency Shift Keying (FSK)–Phase Shift Keying (PSK) – BPSK– QPSK – Quadrature Amplitude Modulation (QAM) – Bandwidth Efficiency– Comparison of various Digital Communication System (ASK – FSK – PSK – QAM).

UNIT III MOBILE COMMUNICATION 9

Generations of Mobile Communication Technologies-MAC Protocols – SDMA- TDMA- FDMA-CDMA- Global System for Mobile Communications (GSM) Architecture - GPRS- Wireless LANs – IEEE 802.11 Standard Architecture –Introduction of Mobile network, transport, application layer-Mobile IP- Mobile TCP– WAP – Architecture

UNIT IV SATELLITE COMMUNICATION 9

Introduction of Satellite orbits - Kepler's laws, Newton's law, orbital parameters, orbital perturbations-Geostationary orbit- Antenna look angles, Limits of visibility, Earth Eclipse of Satellite, Sun transit outage, launching orbits- Spacecraft Technology- Structure, Primary power, Attitude and Orbit control-Satellite uplink and downlink Analysis and Design.

UNIT V COGNITIVE NETWORKS 9

Fundamental Tradeoffs in spectrum sensing, Spectrum Sharing Models of Dynamic Spectrum Access - Unlicensed and Licensed Spectrum Sharing, Fundamental Limits of Cognitive Radio.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

- To apply analog communication techniques.
- To apply digital communication techniques.
- To explain the basics of mobile telecommunication system and its different layers.
- To analyze the satellite orbit & satellite link.
- To explain the fundamentals of cognitive network.

TEXT BOOKS:

1. Wayne Tomasi, "Advanced Electronic Communication Systems", 6th Edition, Pearson Education, 2009. (Unit I & II)
2. George Kenndy, "Electronics Communication Systems", Tata McGraw Hill

REFERENCES:

1. Jochen Schiller, "Mobile Communications", Second Edition, PHI, 2003. (Unit III)
2. Dennis Roddy, "Satellite Communication", 4th Edition, McGraw Hill International, 2006.
3. M.G. Srinivas (Edited by), "Remote Sensing Application"s, Narosa Publishing House, 2001.
4. Simon Haykin, "Communication Systems", 4th Edition, John Wiley & Sons, 2004
5. Martin S.Roden, "Analog and Digital Communication System", 3 rd Edition, Prentice Hall of India, 2002.
6. Dharma Prakash Agarval, Qing and An Zeng, "Introduction to Wireless and Mobile systems",Thomson Asia Pvt Ltd, 2005.

WEBSITE REFERENCES:

1. https://nptel.ac.in/courses/117/105/117105143/, Amplitude modulation - Prof Goutam Das of IIT Kharagpur.
2. https://nptel.ac.in/courses/108/102/108102096/, Digital communication - Prof. Surendra Prasad of IIT Delhi.
3. https://nptel.ac.in/courses/117/104/117104099/, Advanced 3G and 4G Wireless Mobile Communications - Prof. Aditya K. Jagannatham of IIT Kanpur.
4. https://nptel.ac.in/courses/117/105/117105131/, Satellite Communication Systems - Prof. KalyankumarBandyopadhyay of IIT Kharagpur.
5. https://nptel.ac.in/courses/105/107/105107201/, Remote Sensing Essentials - Dr.ArunK.Saraf of IIT Roorkee.

CO - PO MAPPING

CO / PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	2	1	1	2	1	-	-	-	-	1	1
CO2	3	3	2	2	2	1	-	-	-	-	1	1
CO3	2	2	2	2	2	1	-	-	-	-	1	1
CO4	3	3	2	2	2	1	-	-	-	-	1	1
CO5	2	3	2	2	2	2	-	-	-	-	1	2
AVG	2.4	2.6	1.8	1.8	2.0	1.2	-	-	-	-	1	1.2

JEC9002	INTRODUCTION TO EMBEDDED SYSTEMS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To introduce the concepts of real time systems, challenges and design process
- To know about ARM processor, architecture and its instruction set
- To understand about various, I/O devices and concept of interfacing.
- To introduce the concepts of real time operating systems (RTOS).
- To study model real time applications.

UNIT I INTRODUCTION TO EMBEDDED COMPUTING 9

Introduction--Concept of Real time Systems-Challenges in Embedded System Design-Design Process: Requirements, Specifications, Architecture Design, Components Design, System Integration.

UNIT II EMBEDDED SYSTEM ARCHITECTURE 9

Instruction Set Architecture –Basic Embedded Processor/Microcontroller Architecture- Caches, Virtual Memory, Memory Management Unit and Address Translation.

UNIT III IO DEVICES 9

Timers and Counters - Watchdog Timers- Interrupt Controllers - DMA Controllers - A/D and D/A Converters - Displays - Keyboards -Infrared devices. Interfacing: Memory Interfacing and I/O Device Interfacing.

UNIT IV OPERATING SYSTEM 9

Basic Features of an Operating System-Real-time Kernels- Processes and Threads- Context Switching-Scheduling - Inter-process Communication.

UNIT V DESIGN EXAMPLES 9

Data Compressor - Alarm Clock -Washing Machine - Automotive Systems-Telephone PBX - Inkjet Printer- ATM System.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of the course the students will be able:

- To review the concepts of embedded systems
- To describe the architecture and programming of ARM processor.
- To explain concepts of interfacing and various I/O devices.
- To explain the basic concepts of real time Operating system design.
- To explain real-time design technology concepts and apply it in real time systems.

TEXT BOOK:

1. Marilyn Wolf, “Computers as Components - Principles of Embedded Computing System Design”, Third Edition “Morgan Kaufmann Publisher (An imprint from Elsevier), 2012.

REFERENCES:

1. Jonathan W.Valvano, “Embedded Microcomputer Systems Real Time Interfacing”, Third Edition Cengage Learning,2012.
2. David. E. Simon, “An Embedded Software Primer”, 1st Edition, Fifth Impression, Addison-Wesley Professional,2007.
3. Raymond J.A. Buhr, Donald L.Bailey, “An Introduction to Real-Time Systems- From Design to Networking with C/C++”, Prentice Hall, 1999.
4. C.M. Krishna, Kang G. Shin, “Real-Time Systems”, International Editions, McGraw Hill, 1997
5. K.V.K.K.Prasad, “Embedded Real-Time Systems: Concepts, Design & Programming”, Dream Tech Press,2005.
6. Sriram V Iyer, Pankaj Gupta, “Embedded Real Time Systems Programming”, Tata McGraw Hill, 2004.

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1. https://nptel.ac.in/courses/106/105/106105193/
2. https://nptel.ac.in/courses/108102045/
3. E Book Embedded system Designhttp://esd.cs.ucr.edu/
4. https://www.youtube.com/watch?v=PfsGn344JwM - Praveen Meduri , University of Buffalo
5. https://www.youtube.com/channel/UCvIm1q1NZuBNfLgGqPsu1wQ,Marilyn Wolf, Embedded systems Channel

CO - PO MAPPING

CO / PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	2	1	1	2	1	-	-	-	-	1	1
CO2	3	3	2	2	2	1	-	-	-	-	1	1
CO3	2	2	2	2	2	1	-	-	-	-	1	1
CO4	3	3	2	2	2	1	-	-	-	-	1	1
CO5	2	3	2	2	2	1	-	-	-	-	1	1
AVG	2.4	2.6	1.8	1.8	2.0	1	-	-	-	-	1	1

JEC9003	SIMULATION TOOLS IN ELECTRONICS	L	T	P	C
		2	0	2	3

COURSE OBJECTIVES:

- To perform simulation using electronic workbench
- To perform simulation using PSpice
- To perform simulation using ModelSim.
- To perform simulation using Matlab
- To perform simulation using Scilab

UNIT I ELECTRONIC WORK BENCH 9

Introduction to electronic workbench- design using NI Multisim-simulation procedure, measuring electric parameters, design examples of different electronic circuits using NI Multisim, series- parallel DC circuits

UNIT II PSPICE 9

Introduction to PSpice-Design of simple electronic circuits- Simulation of electronic circuits using PSpice, Response of transient circuits in the time domain, PCB design layout generation using PSpice, Design of BJT and FET oscillators.

UNIT III MODELSIM 9

Introduction to Model Sim- simple codes using HDL- simulation procedure- design and simulation of HDL using Model Sim for simple digital circuits

UNIT IV MATLAB 9

Introduction-Matlab Basics-functions and statements, loops in Matlab-Solving problems with Matlab-design of simple model using Simulink

UNIT V SCILAB 9

Introduction-Scilab Basic functions in Scilab - design and simulation of simple model using Scilab

COURSE OUTCOMES:

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

- To simulate using electronic workbench
- To simulate using PSpice
- To simulate using ModelSim.
- To simulate using Matlab
- To simulate using Scilab

REFERENCES:

1. JohnAdams,\"MasteringElectronicsWorkbench",McGraw-Hill in NewYork,2001 .
2. https://www.nandland.com/vhdl/tutorials/tutorial-modelsim-simulation-walkthrough.html
3. M. H. Rashid, "Introduction to PSpice Using OrCAD for Circuits and Electronics", Pearson/Prentice Hall,2004
4. Randy Moore in Computer Science, "Programming with MATLAB for Scientists: A Beginner's Introduction"
5. Sandeep Nagar, "Introduction to Scilab: For Engineers and Scientists"

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2. https://www.youtube.com/watch?v=zctXkLXWfQ4
3. https://www.youtube.com/watch?v=Z8whdGa7RtY
4. https://swayam.gov.in/nd1_noc20_ma40/preview
5. https://swayam.gov.in/nd2_aic20_sp38/preview

CO - PO MAPPING

CO / PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	3	2	2	2	1	-	-	-	-	1	1
CO2	2	3	2	2	2	1	-	-	-	-	1	1
CO3	2	3	2	2	2	1	-	-	-	-	1	1
CO4	2	3	2	2	2	1	-	-	-	-	1	1
CO5	2	3	2	2	2	1	-	-	-	-	1	1
AVG	2	3	2	2	2	1	-	-	-	-	1	1

OPEN ELECTIVE 2
SEMESTER V

JEC9004	BASICS OF SIGNALS AND ITS PROCESSING	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To understand the concept of signals and its types
- To analyze different classification of signals.
- To understand the basic properties of signal
- To analyze continuous time signals by using Fourier transform and Laplace transform
- To analyze discrete time signals in the Discrete time Fourier and Z transform domain

UNIT I INTRODUCTION TO SIGNALS 7

Introduction to Signals, Types of time signals, Continuous and discrete signal representation, Characteristics of Signals, Standard signals- Step, Ramp, Pulse, Impulse, Real and complex, Exponentials and Sinusoids, Energy of a Signal, Power of a signal, Problems, Different types of Signal Processing

UNIT II CLASSIFICATION OF SIGNALS 8

Classification of signals – Continuous time (CT) and Discrete Time (DT) signals, Periodic & A periodic signals, Deterministic & Random signals, Causal and Non causal Signals, Problems.

UNIT III PROPERTIES OF SIGNALS 10

Properties of Continuous and discrete time signals: Reflection, Shifting, Scaling, Reversal, Periodic composite signals, Signal and noise, Frequency spectrum and Bandwidth, Problems.

UNIT IV FREQUENCY DOMAIN REPRESENTATION OF CT SIGNALS 10

Fourier Series for periodic signals, Fourier Transform, Properties of CTFT, Gibbs Phenomena, Dirichlet Conditions, Laplace Transforms, Properties of Laplace Transforms

UNIT V FREQUENCY DOMAIN REPRESENTATION OF DT SIGNALS 10

Baseband signal Sampling, Discrete Time Fourier Series, Discrete Time Fourier Transform, Properties of DTFT, Z Transform, and Properties of Z Transform.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

- To be able to understand the fundamental concept of signals and different classification of signals
- To be able to understand different classification of signals
- Able to know the various properties of signals
- Able to know the various properties of continuous time signals and its frequency domain representation
- Able to know the various properties of Discrete time signals and its frequency domain representation

TEXT BOOKS:

1. Allan V.Oppenheim, S.Wilsky and S.H.Nawab, “Signals and Systems”, Pearson, 2015.
2. Hwei P. Hsu, “Schaum's Outlines ofSignals and Systems”, Third Edition, Mc Graw Hill.

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 Signals and Systems”, Thomson, 2007.

WEB SITE REFERENCES:

1.UNIT-1: https://nptel.ac.in/courses/108/104/108104100/, Prof.K.Aditya Jaganath, IIT-Kanpur.
2. UNIT-2: https://nptel.ac.in/courses/108/106/108106163/, Dr.Khusal Shah , IISER Bhopal
3. UNIT-3: https://nptel.ac.in/courses/108/106/108106163/, Dr.Khusal Shah , IISER Bhopal
4. UNIT-4: https://nptel.ac.in/courses/108/106/108106163/, Dr.Khusal Shah , IISER Bhopal
5. UNIT-5: https://nptel.ac.in/courses/108/104/108104100/, Prof.K.Aditya Jaganath, IIT-Kanpur.

CO - PO MAPPING

CO\PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	2	2	1	2	-	-	1	-	1	1	2
CO2	3	2	2	3	2	1	-	-	-	1	1	2
CO3	2	3	1	1	2	-	-	-	-	1	1	2
CO4	3	1	3	2	2	1	-	1	-	1	1	1
CO5	1	3	1	3	3	1	-	1	-	1	3	-
AVG	2.2	2.2	1.8	2	2.2	1	0	1	0	1	1.4	1.75

JEC9005	BASICS OF RF CIRCUITS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To understand the basics of wireless transmission systems
- To analyze the various wireless mobile networks
- To learn about mobile network and transport layers techniques and protocols.
- To study about fundamentals of GSM and 3G Services, its protocols and applications
- To learn about evolution of 4G Networks, its architecture and applications

UNIT I INTRODUCTION TO WIRELESS TRANSMISSION 9

Introduction to mobile computing, Frequencies for radio transmission, Generations of Mobile Communication, Signals, Antennas ranges, Signal propagation, Multiplexing, Modulation, MAC Protocols, accessing techniques, Case Study: Cellular systems.

UNIT II WIRELESS MOBILE NETWORKS 9

WLAN System and Protocol architecture, IEEE 802.11a, IEEE 802.11b, HIPERLAN1/2, Bluetooth, WPAN-802.15.4, Wireless USB, Zigbee, 6LoWPAN, LoRaWAN, Case Study: WiMAX.

UNIT III MOBILE NETWORK AND TRANSPORT LAYER 9

Mobile IP, Registration, Tunneling and encapsulation, IPv6, DHCP, Adhoc Routing Protocols, Multicast Routing, Traditional TCP, Classical TCP improvements, TCP over 2.5/3G wireless networks, IoT, IoB, Case Study; VANET.

UNIT IV GSM AND 3G COMMUNICATIONS SYSTEMS 9

Introduction to GSM, Architecture, Protocols, Connection Establishment, Frequency Allocation, Routing, Mobility Management, Security, GPRS, UMTS Architecture, Case Study: CDMA2000, LMDS, MMDS.

UNIT V 4G AND BEYOND 9

4G Network- Introduction, vision, features, challenges and applications, 4G Technologies- Multicarrier Modulation, Smart antenna techniques, OFDM-MIMO Systems, Software Defined Radio, Cognitive Radio, LTE, advanced LTE.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

- Explain wireless transmission techniques
- Describe various wireless mobile networking technologies
- Explain mobile network and transport layers techniques and protocols
- Describe fundamentals of GSM and 3G Services, its protocols and applications
- Explain the evolution of 4G Networks, its architecture and applications

TEXT BOOKS:

1. Jochen Schiller, “Mobile Communications”, Second Edition, Pearson Education, 2012.
2. Vijay Garg, “Wireless Communications and networking”, First Edition, Elsevier, 2007.

REFERENCES:

1. Rappaport,T.S,“Wirelesscommunications”,PearsonEducation,SecondEdition,2010.
2. Simon Haykin , Michael Moher, David Koilpillai, “Modern Wireless Communications”, Pearson Education, First Edition, 2013.
3. Erik Dahlman, Stefan Parkvall, Johan Skold and Per Beming, “3G Evolution HSPA and LTE for Mobile Broadband”, Academic Press, Second Edition, 2008.

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2. http://vlabs.iitkgp.ernet.in/fcmc/
3. https://www.electronicsforu.com/technology-trends/mobile-communication-1g-4g
4. http://ee.sharif.edu/~pr.wireless.comm/references/Schwartz.pdf
5. https://www.tutorialspoint.com/umts/umts_history_of_mobile_communication.htm

CO - PO MAPPING

CO / PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	2	1	1	2	1	-	-	-	-	1	1
CO2	3	3	2	2	2	1	-	-	-	-	1	1
CO3	2	2	2	2	2	1	-	-	-	-	1	1
CO4	3	3	2	2	2	1	-	-	-	-	1	1
CO5	2	3	2	2	2	2	-	-	-	-	1	2
AVG	2.4	2.6	1.8	1.8	2.0	1.2	-	-	-	-	1	1.2

JEC9006	EMBEDDED SYSTEMS APPLICATIONS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- Understand the basic concepts of Embedded System.
- Understand the requirements for design in Embedded System.
- Understand the Code sign concepts.
- Learn design of embedded units with examples
- Understand the applications of Embedded Systems.

UNIT I INTRODUCTION TO BASICS 9

Introduction to Embedded Systems- Embedded Control Applications-2 Open-loop and Closed Loop Control Systems-Examples: Speed Control.

UNIT II DESIGN METHODOLOGIES 9

UML as Design tool- UML notation-Requirement Analysis and Use case Modeling-Static Modeling-Dynamic Modeling.

UNIT III ARCHITECTURAL DESIGN 9

Introduction to partitioning- Hardware/Software Codesign- Hardware/Software Partitioning - Hardware/Software Integration.

UNIT IV DESIGN EXAMPLES 9

Program Modeling of Embedded systems: Telephone PXB–Inkjet Printer–PDA- Set Top Box–Elevator Control System–ATM System.

UNIT V APPLICATION EXAMPLES 9

Case Studies: Automatic vending Machine- Automotive Systems - Auto-focusing digital camera-Adaptive Cruise Control.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

- Explain the basic concepts of Embedded System.
- Analyse the requirements for design in Embedded System.
- Describe the Codesign concepts.
- Design of embedded units with examples
- Describe the applications of Embedded Systems.

TEXT BOOKS:

1. Marilyn Wolf, "Computers as Components - Principles of Embedded Computing System Design"Third Edition-Morgan Kaufmann Publisher (An imprint from Elsevier), 2012.
2. RajKamal, "Embedded Systems- Architecture, Programming and Design", Second Edition, The McGraw Hills Companies.

REFERENCES:

1. Herma K, "Real Time Systems – Design for distributed Embedded Applications", Kluwer Academic, 2003
2. Steven F.Barrett,DanielJ.Pack,"Embedded Systems-Design & Application with the 68HC12 & HCS12", Pearson Education,2008

WEBSITE REFERENCES:

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2. https://microcontrollerslab.com/embedded-systems-architecture/
3. https://instrumentation.com/automatic-vending-machine/
4. https://www.tutorialspoint.com/embedded_systems/

CO - PO MAPPING

CO\PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	2	1	2	2	2	-	-	-	-	2	2
CO2	3	2	2	2	2	2	-	-	-	-	2	3
CO3	3	3	2	2	2	2	-	-	-	-	2	3
CO4	3	3	3	3	3	3	-	-	-	-	3	3
CO5	3	3	3	3	3	3	-	-	-	-	3	3
AVG	2.8	2.6	2.2	2.4	2.4	2.4	-	-	-	-	2.4	2.8

OPEN ELECTIVE 3
SEMESTER - VI

JEC9007	INTRODUCTION TO MOBILE COMMUNICATION	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To understand the basics of wireless transmission systems
- To analyze the various wireless mobile networks
- To learn about mobile network and transport layers techniques and protocols.
- To study about fundamentals of GSM and 3G Services, its protocols and applications
- To learn about evolution of 4G Networks, its architecture and applications

UNIT I INTRODUCTION TO WIRELESS TRANSMISSION 9

Introduction to mobile computing, Frequencies for radio transmission, Generations of Mobile Communication, Signals, Antennas ranges, Signal propagation, Multiplexing, Modulation, MAC Protocols, accessing techniques, cellular systems.

UNIT II WIRELESS MOBILE NETWORKS 9

WLAN System and Protocol architecture, IEEE 802.11a, IEEE 802.11b, HIPERLAN1/2, Bluetooth, WPAN-802.15.4, Wireless USB, Zigbee, 6LoWPAN, LoRaWAN, WiMAX.

UNIT III MOBILE NETWORK AND TRANSPORT LAYER 9

Mobile IP, Registration, Tunneling and encapsulation, IPv6, DHCP, Adhoc Routing Protocols, Multicast Routing, Traditional TCP, Classical TCP improvements, TCP over 2.5/3G wireless networks, VANET, IoT.

UNIT IV GSM AND 3G COMMUNICATIONS SYSTEMS 9

Introduction to GSM, Architecture, Protocols, Connection Establishment, Frequency Allocation, Routing, Mobility Management, Security, GPRS, UMTS Architecture, LMDS, MMDS.

UNIT V 4G AND BEYOND 9

4G Network- Introduction, vision, features, challenges and applications, 4G Technologies- Multicarrier Modulation, Smart antenna techniques, OFDM-MIMO Systems, Software Defined Radio, Cognitive Radio, LTE, advanced LTE, Introduction to 5G Networks.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

- Explain wireless transmission techniques
- Describe various wireless mobile networking technologies
- Explain mobile network and transport layers techniques and protocols
- Describe fundamentals of GSM and 3G Services, its protocols and applications
- Explain the evolution of 4G Networks, its architecture and applications

TEXT BOOKS:

1. Jochen Schiller, “Mobile Communications”, Second Edition, Pearson Education, 2012.
2. Vijay Garg, “Wireless Communications and networking”, First Edition, Elsevier, 2007.

REFERENCES:

1. Rappaport. T. S, "Wireless Communications", Pearson Education, Second Edition, 2010.
2. Simon Haykin, Michael Moher, David Koilpillai, "Modern Wireless Communications", Pearson Education, First Edition, 2013.
3. Erik Dahlman, Stefan Parkvall, Johan Skold and Per Beming, "3G Evolution HSPA and LTE for Mobile Broadband", Academic Press, Second Edition, 2008.

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1. https://nptel.ac.in/courses/117/102/117102062/
2. http://vlabs.iitkgp.ernet.in/fcmc/
3. https://www.electronicsforu.com/technology-trends/mobile-communication-1g-4g
4. http://ee.sharif.edu/~pr.wireless.comm/references/Schwartz.pdf
5. https://www.tutorialspoint.com/umts/umts_history_of_mobile_communication.htm

CO - PO MAPPING

CO/ PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	2	1	1	2	1	-	-	-	-	1	1
CO2	3	3	2	2	2	1	-	-	-	-	1	1
CO3	2	2	2	2	2	1	-	-	-	-	1	1
CO4	3	3	2	2	2	1	-	-	-	-	1	1
CO5	2	3	2	2	2	2	-	-	-	-	1	2
AVG	2.4	2.6	1.8	1.8	2.0	1.2	-	-	-	-	1	1.2

JEC9008	TELECOMMUNICATION SWITCHING NETWORKS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- Understand the basics and evolution of telecommunication systems
- Study about the evolution of switching systems.
- Study about the telecommunication traffic and its measurements.
- Learn the technologies associated telephone and data networks.
- Understand the digital switching system

UNIT I INTRODUCTION TO TELECOMMUNICATIONS 9

Introduction to telecommunications transmission, Power levels, Four wire circuits, Evolution of Telecommunications, Simple Telephone Communication, Digital transmission, FDM, TDM, PDH and SDH

UNIT II SWITCHING SYSTEMS 9

Introduction -Message switching, Circuit switching, Functions of switching systems, Distribution systems, Manual switching system -Strowger Switching System, Crossbar Switching. Electronic switching.

UNIT III TELECOMMUNICATION TRAFFIC ENGINEERING 9

Introduction, Unit of traffic, Congestion, Network Traffic load and parameters, Mathematical model - Grade of service and blocking probability, lost call systems, Queuing systems, Single stage networks, Gradings, Link Systems, GOS of Linked systems.

UNIT IV TELEPHONE NETWORKS AND DATA NETWORKS 9

Switching Hierarchy and Routing, Transmission Plan, Transmission Systems, Numbering Plan, Charging Plan, Signalling Techniques, Cellular mobile telephony. Data communication Architecture, ISO-OSI Reference Model, Fiber optic networks, and Data network standards, Integrated Services Digital Networks, Public Protection and Disaster Relief (PPDR).

UNIT V DIGITAL SWITCHING SYSTEM 9

Evolution of digital switching systems - characteristics, building blocks, Stored Program Control, Centralized SPC, Distributed SPC, Digital switching system model - Hardware architecture, Software architecture, Time multiplexed Space Switching, Time Multiplexed time switching, combination Switching, OTA chambers for 5G NR mmW testing.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

- Explain the telecommunication transmission fundamentals
- Have broad understanding of all manual telecommunication switching systems
- Analyze the telecommunication traffic and provide solution for the delay free calling
- Analyze the networking of data transmission and call networking
- Describe the latest evolution of digital switching system.

TEXT BOOKS:

1. Thiagarajan Vishwanathan, “Telecommunication Switching Systems and Networks”; PHI Publications.
2. J. E. Flood, “Telecommunications Switching, Traffic and Networks”, Pearson Education.

REFERENCES:

1. Digital Switching Systems, Syed R. Ali, TMH Ed 2002.
2. John C. Bellamy, “Digital Telephony”, Third Edition; Wiley Publications

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2. https://www.youtube.com/watch?v=udU5ykeHg3c
3. https://www.youtube.com/watch?v=p7hH4Wk5FQI
4. https://www.youtube.com/watch?v=GDCfz76m5ZQ
5. https://www.youtube.com/watch?v=sG6WGvzmVaw
6. https://nptel.ac.in/courses/117/105/117105081/
7. https://www.youtube.com/watch?v=mLoLouF026g

CO - PO MAPPING

CO\PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	2	2	2	2	2	2	2	-	-	2
CO2	3	2	3	2	2	3	2	2	1	1	1	3
CO3	3	3	3	3	3	2	2	1	3	-	2	2
CO4	3	3	3	3	3	2	2	1	3	-	2	2
CO5	3	2	3	2	3	3	2	1	3	-	1	2
AVG	3	2.4	2.8	2.4	2.6	2.4	2	2.4	2.4	0.2	1.2	2.2

JEC9009	VERILOG HDL FOR DIGITAL CIRCUIT DESIGN	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To study the different programming methodologies adopted in verilog
- To Learn basic building blocks of writing verilog program
- To study the concepts of delay in verilog HDL
- To learn how the data is transversed /handled in verilog HDL
- To Learn How to handle the system function in verilog Module

UNIT I HIERARCHICAL MODELING CONCEPTS 9

Introduction to Verilog HDL- Design Methodologies- Gate Level Modeling - Dataflow Modeling - Behavioral Modeling – Switch Level Modeling.

UNIT II BASIC CONSTRUCTS, MODULES AND PORTS 9

Lexical Conventions- Logic value set and Data types -System Task and Compiler Derivatives- Modules and Ports declaration and Connections- Hierarchical Names- Design Examples.

UNIT III TIMING AND DELAYS 9

Types of Delay Models- Path Delay Modeling – Timing Checks – Delay Back-Annotation.

UNIT IV USER DEFINED PRIMITIVES AND PROGRAMMING 9

User Defined Programming Basics – Combinational UDPs – Sequential UDPs- Guidelines for UDP Design.

UNIT V PROGRAMMING LANGUAGE INTERFACE 9

Uses of Programming Language Interface. – Linking and Invocation of PLI – PLI Library Routines: Types and Examples.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

- Understand the different programming methodologies adopted in verilog
- Explain the basic building blocks of writing verilog program
- Understand the concepts of delay in verilog HDL
- Understand how the data is transverse /handled in verilog HDL
- Explain How to handle the system function in verilog Module

TEXT BOOKS:

1. Samir Planitkar, "Verilog HDL- A Guide to Digital Design and Synthesis", Sun Soft Press 1992.
2. J. Bhasker, "A Verilo HDL Primer", Third Edition, Star Galaxy Publishing, 2018

REFERENCE BOOKS:

1. M. Morris Mano and Michael D. Ciletti, Digital Design: With an Introduction to the Verilog HDL, 5th Edition, Pearson Education, 2013.
2. Joseph Cavanagh, Digital Design and Verilog HDL Fundamentals, CRC Press, 2008.
3. M.D.Ciletti, "Modeling, Synthesis and Rapid Prototyping with the Verilog HDL", PHI, 1999.
4. C. H. Roth, Jr., L.K.John, "Digital Systems Design Using VHDL - Thomson Learning EMEA", Limited, 2008

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1. http://cse.iitkgp.ac.in/~abhij/course/lab/SCLD/Spring16/
2. https://www.youtube.com/watch?v=zok4iU9YJiE
3. https://onlinecourses.nptel.ac.in/noc19_cs72/preview
4. https://nptel.ac.in/courses/106/105/106105165/
5. https://cse.iitkgp.ac.in/~pallab/testing_and_verification/Lec-3-Verilog.pdf

CO - PO MAPPING

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	2	2	2	2	-	-	-	-	3	2
CO2	2	2	2	3	2	1	-	-	-	-	2	1
CO3	3	3	2	3	2	1	-	-	-	-	2	1
CO4	3	3	2	2	3	1	-	-	-	-	2	1
CO5	2	3	2	3	3	1	-	-	-	-	2	1
AVG	2.6	2.8	2	2.6	2.4	1.2	-	-	-	-	2.2	1.2

SEMESTER VII

JEC9010	INTRODUCTION TO SATELLITE COMMUNICATION	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To understand the basics of satellite orbits
- To learn the satellite space segment and subsystem
- To Study satellite link design
- To analyze the various methods of satellite access
- To study the applications of satellite Communication

UNIT I SATELLITE ORBITS AND LAUNCHING METHODS 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: PSLV - GSLV.

UNIT II SPACE SEGMENT AND SUBSYSTEM 9

The Power Supply – Attitude Control: Spinning and Momentum wheel stabilization – Thermal Control – TT&C Subsystem – Transponders: wideband receiver - input demultiplexer- power amplifier – Antenna Subsystem.

UNIT III SATELLITE LINK DESIGN 9

EIRP – Losses – The Link-Power Budget Equation – System Noise – Antenna Noise– Carrier-to-Noise Ratio – The Uplink - Saturation flux density - Input back-off – Downlink - Output back-off – Combined Uplink and Downlink C/N Ratio.

UNIT IV SATELLITE ACCESS 9

Single Access – FDMA: Pre-assigned FDMA -Demand Assigned FDMA – Spade System – TDMA: Pre-assigned TDMA - Demand-assigned TDMA – Satellite-Switched TDMA and CDMA.

UNIT V APPLICATIONS OF SATELLITE COMMUNICATION 9

INTELSAT – INSAT – Transmit-Receive Earth Stations – DBS Services – DTH TV System, – MATV System – CATV System– VSATs – GPS – Satellite Mobile Services – Satellite Radio Broadcasting.

TOTAL PERIODS:45

COURSE OUTCOMES:

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

- Analyze the satellite orbits
- Analyze the space segment and subsystem
- Analyze the satellite Link design
- Analyze the satellite Access
- Design various satellite applications

TEXT BOOKS:

1. Dennis Roddy, "Satellite Communication", Fourth Edition, Mc Graw Hill International, 2006.
2. Timothy,Pratt,Charles,W.Bostain,JeremyE.Allnutt,"SatelliteCommunication",Second Edition,Wiley Publications,2002

REFERENCES:

1. Wilbur L.Pritchard, Hendri G.Suyderhoud, Robert A. Nelson, "Satellite CommunicationSystems Engineering", Prentice Hall/Pearson, 2007.
2. Bruce R. Elbert, "The Satellite Communication Applications Hand Book", Artech House Bostan London, 2003
3. Tri T. Ha, "Digital Satellite Communication", Second edition, 2008.
4. Emanuel Fthenakis, "Manual of Satellite Communications",Second edition, Mc Graw Hill Book Co., 1984.

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2. https://ocw.mit.edu/courses/aeronautics-and-astronautics/16-851-satellite-engineering-fall-2003/lecturenotes/l21satelitecomm2_done.pdf
3. https://onlinecourses.nptel.ac.in/noc20_ce62/previewGlobal Navigation Satellite Systems And Applications prof Arun K.SarafIIt Roorkee

CO- PO MAPPING

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	2	1	2	1	1	-	-	-	-	1	1
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CO3	3	3	2	2	2	2	-	-	-	-	1	1
CO4	3	3	2	2	2	2	-	-	-	-	1	1
CO5	2	3	2	2	2	2	-	-	-	-	1	2
AVG	2.4	2.8	1.8	2.4	1.8	1.8	-	-	-	-	1	1.2

JEC9011	SENSORS, ACTUATORS AND INTERFACE ELECTRONICS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To provide basic understanding of measurement and instrumentation systems.
- To gain knowledge about the variety of measuring instruments, their methods of measurement and the use of different sensors.
- To learn about special purpose sensors
- To analyse the concepts associated with actuators.
- To study about data acquisition and its interface

UNIT I MEASUREMENT CONCEPTS AND CHARACTERISTICS OF SENSORS 9

General concepts and terminology of measurement systems - Sensors - transducers - Classification of sensors –Static characteristics - Dynamic characteristics of measurement systems .

UNIT II VARIABLE RESISTIVE AND REACTIVESENSORS 9

Resistive potentiometric- Strain gauge - Thermistor- Light dependent resistor - Linear variable differential transformers (LVDT) - Characteristics and applications of LVDT - Capacitive sensor.

UNIT III SPECIAL PURPOSE SENSORS 9

Piezoelectric sensor, Ultrasonic sensor, Hall effect sensor- - Fiber optic sensors- Resistance Temperature Detector- Infrared Thermography- Photosensor- Microsensors.

UNIT IV ACTUATORS 9

Actuators - Piezoelectric and Piezoresistive actuators, micropumps and micro actuators with practical applications- Stepper Motors -Actuators in motor vehicles Electro-pneumatic and electro-hydraulic actuators.

UNIT V DATA ACQUISITION AND INTERFACE 9

Data loggers –computer controlled instrumentation – IEEE 488 bus- sensors- Sensor Interfacing with Microprocessor to build electronic system -Smart sensors - Wearable sensors

TOTAL PERIODS: 45

COURSE OUTCOMES:

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

- Differentiate between the types of sensors available and its characteristics
- Analyze different resistive, inductive and capacitive sensors and utilize them for suitable applications.
- Select a sensor for specific application
- Analyze Actuators and its types
- Analyze data acquisition and interface with embedded systems

TEXT BOOKS:

1. Jacob Fraden, “Hand Book of Modern Sensors: physics, Designs and Applications”, Third Edition, Springer, New York 2015,
2. Clarence W. de Silva "Sensors and Actuators: Engineering System Instrumentation", Second Edition, CRC Press, 2015.

REFERENCES:

1. E.O. Doeblin, “Measurement System : Applications and Design”, Fifth Edition McGraw Hill publications 2004.
2. Clarence W.de Silva “Sensors and Actuators: Control System Instrumentation”,Second Edition, CRC Press, 2007.
3. Jon. S. Wilson, “Sensor Technology Hand Book”,First edition, Elsevier, Netherland2011

WEBSITE REFERENCES:

1. https://nptel.ac.in/courses/108/108/108108147/, *Sensors* and *Actuators, IISc Bangalore.*
2. https://www.youtube.com/watch?v=oRydUfgMdgA , Smart sensor by Prof. A. Barua, Department of Electrical Engineering, IIT Kharagpur.
3. https://nptel.ac.in/courses/108/108/108108147/ , Biosensor.
4. https://nptel.ac.in/courses/108/108/108108147/ , Arduino interface for sensors,
5. https://www.coursera.org › lecture › wearable-technologies,Wearable sensors.

CO - PO MAPPING

CO\PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	2	1	2	-	-	-	-	1	1	-
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CO4	3	3	2	1	2	-	-	-	-	1	1	-
CO5	3	3	2	1	2	-	-	-	-	1	2	-
AVG	3	3	2	1	2	-	-	-	-	1	1.2	-

JEC9012	TOOLS FOR COMPUTING AND DESIGN PLATFORM	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- Understand the basics of electronic circuit assembly
- Study about the Xilinx ISE design suite for programming and simulation of HDL designs.
- Study about the implementation of VHDL and simulation using Altera Quartus.
- Learn the technologies associated ARM, DSP and embedded processors.
- Understand the role of cloud in the design development of IC and IOT based embedded system.

UNIT I TINKERCAD 9

Create a breadboard circuit, Circuit build, Virtual circuit design, programming, simulation, Arduino electronic circuits, Programme your Arduino, Test your Arduino circuit and code,
3D Design

UNIT II XILINX ISE DESIGN SUITE 9

Synthesis and analysis of HDL designs, enabling the developer to synthesize ("compile") their designs, perform timing analysis, examine RTL diagrams, simulation, Spartan family of FPGAs, CPLDs

UNIT III ALTERA QUARTUS 9

Implementation of VHDL and Verilog for hardware description, visual edition of logic circuits and vector waveform simulation. Cyclone family of FPGAs, MAX family of CPLDs.

UNIT IV CODE COMPOSER STUDIO IDE 9

IDE for developing applications for Texas Instruments embedded processors. Texas Instruments embedded processors include DSPs, ARM based devices, MSP430.

UNIT V ROLE OF THE CLOUDS IN ELECTRONIC DESIGN 9

History of high-performance computing, Cloud service model basics -user's interest, service type, service providers, Cloud concerns, Pros and Cons with electronics design - on-premises, all cloud, Hybrid cloud, Cadence Cloud in IC design

TOTAL PERIODS: 45

COURSE OUTCOMES:

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

- Analyze the fundamentals electronic circuit build, Arduino board programming and simulation
- Have broad understanding of HDL design, spartan family of FPGA and CPLD.
- Analyze the VHDL and Verilog
- Analyze the IDE for the Texas Instruments processors, ARM and embedded processors.
- Describe the latest evolution cloud in the development of IOT based embedded system.

TEXT BOOKS:

1. Tinkercad For Dummies, "by Shaun C. Bryant", John Wiley & sons, 2018..
2. JMichaelKavis, "Architecting the Cloud: Design Decisions for Cloud Computing Service Models (SaaS, PaaS, and IaaS)", Wiley, 2014.

REFERENCES:

1. ISE In-Depth Tutorial, https:// www.xilinx.com/support/documentation/sw_manuals /xilinx13_3 /ise_tutorial_ug695.pdf
2. Introduction to Quartus II Software, http:// www. ee.ic.ac.uk /pcheung /teaching / ee2_ digital /R2_3%20quartus2_introduction.pdf
3. Code-Composer-Studio-v6.0-for-MSP430-Users-Guide, http://www. compel. ru/ wordpress/wp-content/uploads/2015/02/Code-Composer-Studio-v6.0-for-MSP430-Users-Guide.pdf.

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- https://www.xilinx.com/products/design-tools/ise-design-suite.html - ISE Design suite
- https://www.intel.in/content/www/in/en/software/programmable/quartus-prime/download.html -- Altera Quartus
- https://www.ti.com/tool/CCSTUDIO - Texas
- https://www.youtube.com/watch?v=kF9rwyPHe7k -Role of the Cloud in Electronic Design

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CO3	3	3	3	3	3	3	2	1	-	1	2	3
CO4	3	3	3	3	3	3	2	1	-	1	2	3
CO5	3	3	3	3	3	3	2	1	-	3	2	3
AVG	3	3	3	3	3	2.6	1.8	0.8	-	1.4	1.8	2.6