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 – 2023

CURRICULUM & SYLLABI

JERUSALEM COLLEGE OF ENGINEERING

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

DEPARTMENT OF ELECTRONICS & COMMUNICATION ENGINEERING

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.

REGULATION 2023

Program Educational Objectives (PEOs)

1. Ability to pursue further studies, research and product development in the fields of Electronics and Communication Engineering with the strong fundamentals acquired.
2. Exhibit professional skills to build systems of varying complexity and provide innovative solutions to real life challenges through the use of modern tools and techniques in the field.
3. Develop effective leadership, team spirit and ethics to act as good human beings and responsible citizens.
4. Demonstrate the ability to sustain and excel in the evolving field of Electronics & Communication Engineering with life-long learning skills.

Program Specific Outcomes (PSOs)

1. To design, simulate and analyze electronic and communication systems with the knowledge of fundamental and latest engineering concepts in the domain.
2. To apply design principles and best practices for developing quality products for scientific and business applications in the fields of Electronics and Communication.
3. To adapt to emerging Information and Communication Technologies (ICT) in order to innovate ideas and provide solutions to existing/novel problems in the field of Electronics and Communication Engineering.

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B.E. ELECTRONICS AND COMMUNICATION ENGINEERING
REGULATION 2023
CHOICE BASED CREDIT SYSTEM
I TO VIII SEMESTERS CURRICULUM AND SYLLABI

SEMESTER 1

S. No	Course Code	Course Title	T/P/I	Category	Contact Periods	L	T	P	C
1	JHS2121	English for Communicative Competence	I	HS	4	2	0	2	3
2	JMA2101	Matrices and Calculus	T	BS	4	2	2	0	3
3	JPH2101	Engineering Physics I	T	BS	3	3	0	0	3
4	JCY2101	Engineering Chemistry	T	BS	3	3	0	0	3
5	JGE2101	Basic Engineering	T	ES	3	3	0	0	3
6	JCS2121	Programming in C	I	ES	5	3	0	2	4
7	JGE2102	Heritage of Tamils	T	HS	1	1	0	0	1
8	JPC2111	Engineering Physics and Chemistry Laboratory	P	BS	2	0	0	2	1
9	JGE2111	Basic Engineering Laboratory	P	ES	2	0	0	2	1
TOTAL					**27**	**17**	**2**	**8**	**22**

SEMESTER 2

S. No	Course Code	Course Title	T/P/I	Category	Contact Periods	L	T	P	C
1	JHS2221	English for Science and Technology	I	HS	4	2	0	2	3
2	JMA2201	Statistics for Engineers	T	BS	4	2	2	0	3
3	JPH2201	Engineering Physics II	T	BS	3	3	0	0	3
4	JGE2221	Engineering Graphics	I	ES	4	2	0	2	3
5	JEC2201	Electronic Devices and Circuit Analysis	T	PC	3	3	0	0	3
6	JCY2201	Environmental Science and Sustainability	T	BS	2	2	0	0	2
7	JGE2202	Tamils and Technology	T	HS	1	1	0	0	1
8	JPC2211	Engineering Physics and Environmental Science Laboratory	P	BS	2	0	0	2	1
9	JEC2211	Electronic Devices and Circuit Analysis Laboratory	P	PC	4	0	0	4	2
10	JGE2241	Gaming and Crafts Studio	P	EEC	4	0	0	4	2
TOTAL					**31**	**15**	**2**	**14**	**23**

SEMESTER 3

S. No	Course Code	Course Title	T/P/I	Category	Contact Periods	L	T	P	C
1	JMA2303	Transforms and Random Processes	T	BS	4	2	2	0	3
2	JEC2301	Electronic Circuits	T	PC	3	3	0	0	3
3	JEC2302	Digital Electronics	T	PC	3	3	0	0	3
4	JEC2321	Signals and Systems	I	PC	5	3	0	2	4
5	JEC2303	Electromagnetic Field Theory	T	PC	3	3	0	0	3
6	-	Non-Credit Mandatory Course 1	T	NCM	3	3	0	0	-
7	JEC2311	Electronic Circuits Laboratory	P	PC	4	0	0	4	2
8	JEC2312	Digital Electronics Laboratory	P	PC	4	0	0	4	2
9	JPT2041	Soft Skills and Aptitude	P	EEC	2	0	0	2	*
TOTAL					**31**	**17**	**2**	**12**	**20**

* 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	T/P/I	Category	Contact Periods	L	T	P	C
1	JMA2402	Applied Linear Algebra	T	BS	4	2	2	0	3
2	JEC2421	Analog and Digital Communication	I	PC	5	3	0	2	4
3	JEC2401	Linear Integrated Circuits	T	PC	3	3	0	0	3
4	JEC2402	Transmission Lines and Waveguides	T	PC	3	3	0	0	3
5	-	Professional Elective 1	T	PE	3	3	0	0	3
6	-	Open Elective 1	T	OE	3	3	0	0	3
7	JEC2411	Linear Integrated Circuits Laboratory	P	PC	4	0	0	4	2
8	JGE2441	e-Protoshop	P	EEC	4	0	0	4	2
9	JPT2041	Soft Skills and Aptitude	P	EEC	2	0	0	2	1
TOTAL					**31**	**17**	**2**	**12**	**24**

SEMESTER 5

S. No	Course Code	Course Title	T/P/I	Category	Contact Periods	L	T	P	C
1	JEC2521	Microprocessors and Microcontrollers	I	PC	5	3	0	2	4
2	JEC2501	Discrete Time Signal Processing	T	PC	3	3	0	0	3
3	JEC2502	Wireless Communication	T	PC	3	3	0	0	3
4	JEC2522	VLSI Design	I	PC	5	3	0	2	4
5	-	Professional Elective 2	T	PE	3	3	0	0	3
6	-	Open Elective 2	T	OE	3	3	0	0	3
7	JHS2541	Professional Communication	P	HS	2	0	0	2	1
8	JEC2511	Discrete Time Signal Processing Laboratory	P	PC	4	0	0	4	2
9	JGE2541	Industry 4.0 Laboratory	P	EEC	4	0	0	4	2
10	JPT2042	Technical Skills and Aptitude	P	EEC	2	0	0	2	*
TOTAL					**34**	**18**	**0**	**16**	**25**

* 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	T/P/I	Category	Contact Periods	L	T	P	C
1	JEC2601	Antennas and Microwave Engineering	T	PC	3	3	0	0	3
2	JEC2621	Embedded System Design	I	PC	5	3	0	2	4
3	JEC2622	Communication Networks	I	PC	5	3	0	2	4
4	-	Professional Elective 3	T	PE	3	3	0	0	3
5	-	Professional Elective 4	T	PE	3	3	0	0	3
6	-	Open Elective 3	T	OE	3	3	0	0	3
7	JEC2611	Antennas and Microwave Laboratory	P	PC	4	0	0	4	2
8	JGE2641	Product Development Laboratory	P	EEC	4	0	0	4	2
9	JPT2042	Technical Skills and Aptitude	P	EEC	2	0	0	2	1
TOTAL					**32**	**18**	**0**	**14**	**25**

SEMESTER 7

S. No	Course Code	Course Title	T/P/I	Category	Contact Periods	L	T	P	C
1	-	Professional Elective 5	T	PE	3	3	0	0	3
2	-	Professional Elective 6	T	PE	3	3	0	0	3
3	-	Open Elective 4	T	OE	3	3	0	0	3
4	-	Non-Credit Mandatory Course 2	T	NCM	3	3	0	0	-
5	JHS2741	Universal Human Values	I	HS	3	1	0	2	2
6	JGE2751	Entrepreneurship Development	I	EEC	4	2	0	2	3
7	JEC2741	Comprehension and Technical Seminar	P	EEC	2	0	0	2	1
8	JEC2742	Internship	P	EEC	-	-	-	4**	2
TOTAL					**21**	**15**	**0**	**6**	**17**

** Internship of one month must be undertaken in industry through semester 4,5 and 6 leading to 2 credits in semester 7

SEMESTER 8

S. No	Course Code	Course Title	T/P/I	Category	Contact Periods	L	T	P	C
1	JEC2831	Project Work	P	PC	20	0	0	20	10
TOTAL					**20**	**0**	**0**	**20**	**10**

CREDIT SUMMARY

S. No.	SUBJECT AREA	CREDITS AS PER SEMESTER								CREDITS TOTAL	PERCENTAGE
		1	2	3	4	5	6	7	8		
1	HS	4	4	-	-	1	-	2		11	6.626
2	BS	10	9	3	3	-	-	-	-	25	15.061
3	ES	8	3	-	-	-	-	-	-	11	6.626
4	PC	-	5	17	12	16	13	-	10	73	43.976
5	PE	-	-	-	3	3	6	6	-	18	10.843
6	OE	-	-	-	3	3	3	3	-	12	7.229
7	EEC	-	2	-	3	2	3	6		16	9.639
Total		22	23	20	24	25	25	17	10	166	100
Non Credit/ Mandatory				1				1			-

DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

R2023
PROFESSIONAL ELECTIVE COURSES: VERTICALS

Vertical I Semiconductor Design and Testing	Vertical II Signal Processing	Vertical III RF Technologies	Vertical IV Space Technologies	Vertical V Sensors and IoT	Vertical VI Underwater Technologies	Vertical VII High Speed Communication
JEC2001-MEMS Design	JEC2008-Advanced Digital Signal Processing	JEC2015-RF Transceivers	JEC2022-Radar Technologies	JEC2029-Sensors and Actuators	JEC2036-Underwater Instrumentation System	JEC2043-Mobile Communication
JEC2002-Wide Bandgap Devices	JEC2009-Digital Image Processing	JEC2016-Antenna Design	JEC2023-Avionics Systems	JEC2030-Sensors for Engineering Applications	JEC2037-Underwater Imaging Systems	JEC2044-4G/5G Communication Networks
JEC2003-CMOS Analog IC Design	JEC2010-Speech Processing	JEC2017-RF Integrated Circuits	JEC2024-Positioning and Navigational Systems	JEC2031-Flexible and Wearable Sensors	JEC2038-Underwater Communication	JEC2045-Multimedia Compression and Communication
JEC2004-Low Power IC Design	JEC2011-Neural Networks and Machine Learning	JEC2018-MICs and RF System Design	JEC2025-Satellite Communication	JEC2032-IoT Fundamentals and Architecture	JEC2039-Ocean Observation Systems	JEC2046-Wireless Sensor Networks
JEC2005-ASIC and FPGA	JEC2012-Pattern Recognition	JEC2019-Electromagnetic Interference and Compatibility	JEC2026-Remote Sensing	JEC2033-IoT Based System Design	JEC2040-Underwater Navigation Systems	JEC2047-High Performance Communication Networks
JEC2006-Validation and Testing Technology	JEC2013-DSP Architecture and Programming	JEC2020-RFID System Design and Testing	JEC2027-Rocketry and Space Mechanics	JEC2034-Industrial IoT and Industry 4.0	JEC2041-Ocean Acoustics	JEC2048-Optical Communication
JEC2007-Mixed Signal IC Design Testing	JEC2014-Computer Vision	JEC2021-mmWave Communication	JEC2028-Introduction to astronomy and astrophysics	JEC2035-Fundamentals of Nanoelectronics	JEC2042-Satellite Oceanography and GIS	JEC2049-Cognitive Radio Networks

DEPARTMENT OF ECE

OPEN ELECTIVES

S. No	Course Code	Course Title	Category	Contact Periods	L	T	P	C
Semester – IV								
1	JEC9201	Communication Systems	OE	3	3	0	0	3
2	JEC9202	Digital Systems and Computing	OE	3	3	0	0	3
3	JEC9203	Simulation Tools in Electronics	OE	3	3	0	0	3
Semester – V								
1	JEC9204	Basics of Signals and its Processing	OE	3	3	0	0	3
2	JEC9205	Microcontroller and its Applications	OE	3	3	0	0	3
3	JEC9206	Introduction to Embedded Systems	OE	3	3	0	0	3
Semester – VI								
1	JEC9207	Introduction to Mobile Communication	OE	3	3	0	0	3
2	JEC9208	Drone Technology	OE	3	3	0	0	3
3	JEC9209	Verilog HDL for Digital Circuit Design	OE	3	3	0	0	3
Semester – VII								
1	JEC9210	Introduction to Satellite Communication	OE	3	3	0	0	3
2	JEC9211	Sensors, Actuators and Interface Electronics	OE	3	3	0	0	3
3	JEC9212	Tools for Computing and Design Platform	OE	3	3	0	0	3

NON-CREDIT MANDATORY COURSES

S. No	Course Code	Course Title	Category	Contact Periods	L	T	P	C
Semester –III								
1		Introduction to Women and Gender Studies	NCM	3	3	0	0	3
2		Elements of Literature	NCM	3	3	0	0	3
3		Film Appreciation	NCM	3	3	0	0	3
4	JNC2361	Disaster Risk Reduction and Management	NCM	3	3	0	0	3
Semester –VII								
1		Well Being with Traditional Practices - Yoga, Ayurveda and Siddha	NCM	3	3	0	0	3
2		History of Science and Technology in India	NCM					
3		Political and Economic Thought for a Humane Society	NCM	3	3	0	0	3
4		State, Nation Building and Politics in India	NCM	3	3	0	0	3
5	JNC2761	Industrial Safety	NCM	3	3	0	0	3

SEMESTER 1

JHS2121	ENGLISH FOR COMMUNICATIVE COMPETENCE	L T P C 2 0 2 3

COURSE OBJECTIVES:

- To enable the students of Engineering to develop their reading and other language skills
- To facilitate the learners to reflect and share their ideas effortlessly
- To develop their skills to communicate thoughts effectively in social contexts
- To expose them to different genres to develop their understanding and expression
- To train the students to improve their writing skills for efficient communication

UNIT I ANALYTICAL GRAMMAR AND INFORMATION SHARING 12

Parts of speech – Functional units – Tenses – Affixes; Reading comprehension: short general passages for skimming and scanning

Language Practice
Reading: Biographical essays, short stories; **Speaking:** Self-introduction, peer introduction; **Listening:** Inspiring speeches, newscasts; **Writing:** Journal writing

UNIT II FOUNDATIONAL GRAMMAR AND EXPRESSING THOUGHTS 12
Framing questions – Prepositions – Compound nouns – Contextual meaning; Letter writing (informal letters)

Language Practice
Reading: Travelogues; Speaking: Small talks, Just A Minute (JAM); Listening: Anecdotes, stories, podcasts; Writing: Fill in the blanks in short dialogues

UNIT III FUNCTIONAL GRAMMAR AND SOCIAL COMMUNICATION 12

Articles – Subject-verb agreement – Synonyms and antonyms – Email etiquette; Dialogue writing

Language Practice
Reading: Adverts; **Speaking:** Role play, storytelling / completion; **Listening:** Messages from social network; **Writing:** Writing messages for social network / emails

UNIT IV STRUCTURAL GRAMMAR AND VISUAL COMMUNICATION 12

Modal verbs – Simple, complex and compound sentences – Discourse markers – Correction of errors; Interpretation of posters on social issues

Language Practice
Reading: Excerpts from literature; **Speaking:** Asking for / giving directions - Picture description; **Listening:** Talks on English and language skills; **Writing:** Reporting on events / incidents

UNIT V TRANSFORMATIONAL GRAMMAR AND WRITTEN COMMUNICATION 12

Degrees of comparison – Reported speech – Connotations – One-word substitutes (general); Essay writing: narrative / descriptive / expository / argumentative

Language Practice
Reading: Newspaper articles, social media messages (educational contexts); **Speaking:** Group discussions (general topics); **Listening:** Formal and informal talks, Ted talks; **Writing:** Writing short stories / poems (guided)

TOTAL: 60 PERIODS

COURSE OUTCOMES:

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

- To comprehend reading passages and express themselves
- To communicate their thoughts confidently and skillfully
- To participate in activities of daily life using appropriate communicative strategies
- To be creative and critical in expressing themselves
- To write effectively and persuasively and produce different types of writing

TEXT BOOKS:

1. Department of English, Anna University, English for Engineers & Technologists, Volume 2, Orient BlackSwan Private Limited, Chennai, 2022.
2. Dhanavel, SP. English and Communication Skills for Students of Science and Engineering. Orient BlackSwan Private Limited, Chennai, 2011.
3. Interact English: Lab Manual for Undergraduate Students. Orient BlackSwan Private Limited, Chennai, 2017.

REFERENCE BOOKS:

1. Chellammal, V. Learning to Communicate. Allied Publishing House, New Delhi, 2004.
2. Raman, Meenakshi & Sangeetha Sharma. Technical Communication: Principles and Practices. Oxford University Press, New Delhi. 2015.
3. Regional Institute of English. English for Engineers. Cambridge University Press, New Delhi. 2008.
4. Rizvi M, Ashraf. Effective Technical Communication, Tata McGraw-Hill Publishing Company Limited, New Delhi, 2017.

WEB LINKS:

- www.esl-lab.com
- www.englishgrammar.org
- www.englishclub.com
- www.usingenglish.com
- www.esl.about.com
- www.bbc.co.uk/learningenglish/
- https://esl-bits.net/
- https://elt.oup.com/
- https://learnenglish.britishcouncil.org
- https://quizizz.com/

Mapping of CO with PO

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

JGE2102	HERITAGE OF TAMILS	L T P C 1 0 0 1

UNIT I LANGUAGE AND LITERATURE 3

Language Families in India - Dravidian Languages — Tamil as aClassical Language - Classical Literature in Tamil — Secular Nature of Sangam Literature — Distributive Justice in Sangam Literature - Management Principles in Thirukural - Tamil Epics and Impact of Buddhism & Jainism in Tamil Land - Bakthi Literature Azhwars and Nayanmars - Forms of minor Poetry - Development of Modern literature in Tamil - Contribution of Bharathiyar and Bharathidhasan.

UNIT II HERITAGE-ROCK ART PAINTINGS TO MODERN ART-SCULPTURE 3

Hero stone to modern sculpture - Bronze icons - Tribes and their handicrafts - Art of temple car making - - Massive Terracotta sculptures, Village deities, Thiruvalluvar Statue at Kanyakumari, Making of musical instruments - Mridhangam, Parai, Veenai, Yazh and Nadhaswaram - Role of Temples in Social and Economic Life of Tamils.

UNIT III FOLK AND MARTIAL ARTS 3

Therukoothu, Karagattam, Villu Pattu, Kaniyan Koothu, Oyillattam, Leather puppetry, Silambattam, Valari, Tiger dance - Sports and Games of Tamils.

UNIT IV THINAI CONCEPT OF TAMILS 3

Flora and Fauna of Tamils & Aham and Puram Concept from Tholkappiyam and Sangam Literature - Aram Concept of Tamils - Education and Literacy during Sangam Age - Ancient Cities and Ports of Sangam Age - Export and Import during Sangam Age - Overseas Conquest of Cholas.

UNIT V CONTRIBUTION OF TAMILS TO INDIAN NATIONAL MOVEMENT AND INDIAN CULTURE 3

Contribution of Tamils to Indian Freedom Struggle - The Cultural Influence of Tamils over the other parts of India — Self-Respect Movement - Role of Siddha Medicine in Indigenous Systems of Medicine — Inscriptions & Manuscripts — Print History of Tamil Books.

TOTAL: 15 PERIODS

TEXT BOOKS:

1. Social Life of Tamils (Dr.K.K.Pillay) A joint publication of TNTB & ESC and RMRL — (in print)

2. Social Life of the Tamils - The Classical Period (Dr.S.SingaraveIu) (Published by: International Institute of Tamil Studies.

3. Historical Heritage of the Tamils (Dr.S.V.Subatamanian, Dr.K.D. Thirunavukkarasu) (Publish by: International Institute of Tamil Studies).

4. The Contributions of the Tamils to Indian Culture (Dr.M.VaIarmathi) (Published by:International Institute of Tamil Studies.)
5. Keeladi - 'Sangam City C ivilization on the banks of river Vaigai' (Jointly Published by: Department ofArchaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu)
6. Studies in the History of India with Special Reference to Tamil Nadu (Dr.K.K.Pillay) (Published by: The Author)
7. Porunai Civilization (Jointly Published by: Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu)
8. Journey of Civilization Indus to Vaigai (R.BaIakrishnan) (Published by: RMRL) — Reference Book.

JMA2101	MATRICES AND CALCULUS	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 understand the concepts of multivariable calculus.
- To introduce concepts of integral calculus as tools required for applications in engineering.
- To familiarize students in the concepts of vector calculus and its applications.
- To help students understand theory of analytic functions and provide knowledge of Cauchy Residue theorem and its applications.

UNIT I MATRICES 9+3

Eigenvalues and Eigenvectors of a real matrix – Characteristic equation – Properties of Eigenvalues and Eigenvectors – Reduction of a quadratic form to canonical form – Nature of quadratic forms

UNIT II FUNCTIONS OF SEVERAL VARIABLES 9+3

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 INTEGRAL CALCULUS 9+3

Double integrals in Cartesian coordinates – Change of order of integration – Area enclosed by plane curves – Triple integrals – Volume of solids

UNIT IV VECTOR CALCULUS 9+3

Gradient and directional derivative – Divergence and curl – Irrotational and Solenoidal vector fields.

Green's theorem, Gauss' divergence theorem, Stoke's theorem – Verification and evaluation in simple problems

UNIT V COMPLEX ANALYSIS 9+3

Analytic functions – Cauchy-Riemann equations – Milne-Thomson rule (given real or imaginary part) – Bilinear transformation.

Residues – Application of Cauchy's Residue theorem for evaluation of real integrals (Circular contour and semi-circular contour only)

TOTAL: 60 PERIODS

COURSE OUTCOMES:

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

- To apply matrix method in reducing quadratic form to canonical form.
- To solve simple optimization problems through differential calculus.
- To evaluate multiple integrals required for solving area and volume problems.
- To apply vector calculus for verifying Green's, Gauss' and Stoke's theorems.
- To solve problems arising in analytic functions and solve real integrals through Cauchy Residue theorem.

TEXT BOOKS:

1. Grewal B S, "Higher Engineering Mathematics", Khanna Publishers, New Delhi, 44th Edition, 2018.
2. Kreyszig Erwin, "Advanced Engineering Mathematics", John Wiley and Sons, New Delhi, 10th Edition, 2016.
3. Anuradha P and Sudhakar V, "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, 8th Edition, 2022.
3. Srimantha Pal and Bhunia S C, "Engineering Mathematics" Oxford University Press, 1st Edition, 2015.
4. Weir, M D and Joel Hass, "Thomas Calculus", 15th Edition, Pearson India, 2022.

WEB REFERENCES:

- https://nptel.ac.in/courses/111107112
- https://nptel.ac.in/courses/111108157
- https://nptel.ac.in/courses/111107108
- https://nptel.ac.in/courses/111106141
- https://nptel.ac.in/courses/111103070

Mapping of CO with PO

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

JPH2101	ENGINEERING PHYSICS I	L T P C 3 0 0 3

OBJECTIVES:

- To enable the students to understand the basics of Properties of Matter
- To expand their knowledge about thermal properties of materials
- To enhance their understanding of Photonics
- To familiarize the students with the principles of quantum mechanics
- To enrich their knowledge on Solid State of Materials

UNIT I PROPERTIES OF MATTER 9

Elasticity – Stress-strain diagram and its uses - factors affecting elastic moduli and tensile strength - 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 II THERMAL PHYSICS 9

Fundamentals of thermal energy - expansion joints – Bimetallic strips - Thermal conductivity, conductions in solids, Differential equation of one dimensional heat flow – Forbes's and Lee's disc method - Conduction through compound media- Solar heater

UNIT III LASERS AND FIBER OPTICS 9

Spontaneous and stimulated emission-Population inversion -Einstein's A and B coefficients derivation – Laser Principle – Nd:YAG and Semiconductor lasers (homojunction & heterojunction) Principle and propagation of light in optical fiber, Derivation of Numerical aperture and Acceptance angle – Fiber optical communication (Block diagram) – Active and passive sensors – Medical endoscope.

UNIT IV BASIC 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 - Schrödinger's wave equation –Time independent and time dependent equations –Physical significance of wave function –Particle in a one dimensional box –Scanning Transmission electron microscope

UNIT V SOLID STATE PHYSICS 9

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

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

- To apply their knowledge in analyzing the elastic property of any materials
- To assess the thermal properties of materials
- To use modern optical fiber communication systems and tools in reallife situations
- To compute problems in Quantum Physics
- To comprehend the structure of solid materials

TEXT BOOKS:

1. Dr. Beula Shanthi John, Dr.P.Mani, "Engineering Physics-I", DhanamPublications, First Edition,2019.
2. Bhattacharya, D.K. & Poonam, T. "Engineering Physics- I". Oxford University Press, 2015.
3. Gaur, R.K. & Gupta, S.L. "Engineering Physics". Dhanpat Rai Publishers, 2012.
4. S. O. Pillai, "Solid State Physics", New Age International Publications, Revised Edition.
5. Pandey, B.K. & Chaturvedi, S. "Engineering Physics". Cengage Learning India, 2012.
6. Kittel, C. ―Introduction to Solid State Physics‖. Wiley, 2005

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'.
4. Rajendran V, "Engineering Physics", Tata McGraw Hill, 2009.
5. Arumugam M, "Materials Science", Anuradha Publications, 2015.
6. Willam F Smith, "Material Science and Engineering", Tata McGraw - Hill Publications, 2008.
7. John D.Cutnell, "Cutnell and Johnson Physics", Willey Publications, 201

WEBSITE REFERENCES:

- **https:// archive.nptel.ac.in/courses/105/105/105105177/**
- **https:// archive.nptel.ac.in/courses/102/105/102105090/**
- **https:// archive.nptel.ac.in/courses/108/104/108104113/**
- **https:// archive.nptel.ac.in/courses/115/104/115104096/**
- **https:// archive.nptel.ac.in/courses/115/104/115104109/**

CO-PO Mapping

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

JCY2101	ENGINEERING CHEMISTRY	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To inculcate the significance of water quality parameters and water treatment techniques.
- To acquaint the properties and applications of industrial polymers.
- To acquire knowledge in corrosion of material and its prevention.
- To import knowledge over energy conversion methods and of energy storage devices.
- To acquire knowledge on the basics of nanomaterials and its preparatory methods.

UNIT 1 WATER AND ITS TREATMENT 9

Water quality parameters (pH, TDS, DO, BOD, COD) - Hardness - Types and estimation (EDTA method). Alkalinity – Types and estimation. Water softening methods- Lime-soda Process (Cold and Hot methods) - Zeolite Process - Ion exchange process. Desalination of brackish water –reverse osmosis. Municipal water treatment- Primary treatment and Disinfection (UV, Ozonation, Chlorination) - Break point chlorination.

UNIT 2 POLYMER AND COMPOSITES 9

Classification of polymers – Functionality – Types of polymerisation (addition & condensation) – Mechanism of addition polymerisation (free radical, cationic, anionic) - Degree of polymerization - Thermoplastic and Thermosetting. Bio degradable polymer- Polylacetic acid, Polyvinyl acetate- Preparation – Properties – applications. Conducting polymer – types – Mechanism – application - Polymer composites – types – properties and application.

UNIT 3 CORROSION AND ITSPREVENTION 9

Corrosion - chemical, electrochemical corrosion, galvanic corrosion and differential aeration corrosion. Factors influencing the rate of corrosion. Corrosion control - material selection, design aspects, cathodic protection, Corrosion inhibitors - Electroplating (copper) and electroless plating (nickel) – Organic coating (Paints – Constituents and function).

UNIT 4 ENERGY SOURCES AND STORAGE DEVICES 9

Nuclear energy- critical mass, light water nuclear power plant and Breeder reactor. Principle, working and applications of solar energy and wind energy. Primary battery (dry cell and alkaline battery). Secondary battery (lead acid, nickel-cadmium and lithium-ion-battery). H2-O2 fuel cell.

UNIT 5 NANOCHEMISTRY 9

Distinction between molecules, nanomaterials and bulk materials - Size-dependent properties - Types of nanomaterials - Nanoparticle, nanocluster, nanorod, nanowire and nanotube. Synthesis of nanomaterials – solvothermal, laser ablation, chemical vapour deposition and electrochemical deposition - General applications of nanomaterial.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

- Identify water quality and propose suitable methods to treat water.
- Analyze the compatibility of polymeric materials for biomedical and electronic applications.
- Recognize the nature of corrosive environment and implement preventive methods of corrosion.
- Design different forms of energy sources for suitable applications.
- Identify suitable synthetic method of nanomaterials for specific applications.

TEXT BOOKS:

1. P. C. Jain and Monica Jain, "Engineering Chemistry", 17th Edition, Dhanpat Rai Publishing Company (P) Ltd, New Delhi, 2018.
2. Sivasankar B., "Engineering Chemistry", Tata McGraw-Hill Publishing Company Ltd, New Delhi, 2008. S.S. Dara, "A Text book of Engineering Chemistry", S. Chand Publishing, 12th Edition, 2018.
3. A.Ravikrishnan, "Engineering Chemistry" Sri Krishna Hitech Publishing CompanyPvt.Ltd., 22ndedition, 2023.

REFERENCES:

1. ShikhaAgarwal, "Engineering Chemistry-Fundamentals and Applications", Cambridge University Press, Delhi, Second Edition, 2019.
2. B. S. Murty, P. Shankar, Baldev Raj, B. B. Rath and James Murday, "Text book of nanoscience and nanotechnology", Universities Press-IIM Series in Metallurgy and Materials Science, 2018.
3. S. Ananda Kumar (Editor)"Eco-friendly Nano-hybrid materials for Advanced Engineering Applications" CRC Press, USA. (2016)
4. O.G. Palanna, "Engineering Chemistry" McGraw Hill Education (India) Private Limited, 2nd Edition, 2017.
5. B.R.Puri, L.R.Sharma, Madan S.Pathana, Principle of physical chemistry, 47th edition, Vishal publishing Co, 2017.
6. Dara S.S, Umare S.S, "Engineering Chemistry", S. Chand & Company Ltd., New Delhi 2013.

WEB REFERENCES:

1. https://nptel.ac.in/courses/113/101/113101098/
2. https://nptel.ac.in/courses/113/106/113106093/

Mapping of CO with PO

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

JGE2101	BASIC ENGINEERING	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To provide students with illustrations about mechanical engineering to satisfy societal needs
- To provide them knowledge on refrigeration, air-conditioning and power plants
- To help students acquire knowledge in the basics of surveying and building materials
- To impart knowledge on the electric circuits and working principles of Electrical Machines.
- To provide the knowledge on the Principles and characteristics of various electronic devices and measuring instruments.

UNIT I BASICS OF MECHANICAL ENGINEERING 9

Introduction to the concepts of Mechanization and Automation, Robotics - Manufacturing methods - casting, machining, forming operations. Introduction to IC Engine - Working principles of four stroke petrol and diesel engines. Electric vehicle Technology- Layout, components and control.

UNIT II REFRIGERATION,AIR CONDITIONING SYSTEM & POWER PLANT 9

Terminology of Refrigeration and Air Conditioning. Principle of vapour compression and absorption system–Layout of typical domestic refrigerator–Window and Split type room Air conditioner. Classification of power plant and working principle of Thermal and Hydel power plant.

UNIT III BASICS OF CIVIL ENGINEERING 9

Introduction to Civil Engineering, Types of buildings, Components of a residential building, Building Materials. Surveying: Objects – Classification – Principles – Measurements of Distances and angles. Rain Water Harvesting, Solid Waste Management

UNIT IV ELECTRIC CIRCUITS AND ELECTRICAL MACHINES 9

Basic circuit components - Ohms Law - Kirchhoff's Law – Introduction to AC circuits - Power and power factor –Construction, Principle of operation and characteristics of DC machines ,Transformers and Induction machines.

UNIT V ELECTRONIC DEVICES & INSTRUMENTATION 9

Types of Materials - N type and P type materials - Principle of operation and Characteristics: PN Junction diode , Zener Diode, BJT, MOSFET. Elements of generalized measurement system -– Operating forces– Principle of operation of moving coil and moving iron instruments -Errors in measurement - Standards of Measurement.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

- To be acquainted with the concepts in mechanical engineering and vehicle concept.
- To understand the fundamentals of refrigeration, air-conditioning and power plant.
- To summarise the surveying, planning of building, infrastructure and building materials.
- Apply the basic concepts of electric circuits and working principles of electrical machines.
- Gain knowledge on the basics of electronics and choose appropriate instruments for electrical measurement for a specific application.

TEXT BOOKS:

1. G Shanmugam, M S Palanichamy, Basic Civil and Mechanical Engineering, McGraw Hill Education; First edition, 2018.
2. Palanikumar, K. Basic Mechanical Engineering, ARS Publications, 2018.
3. Sudhakar A and Shyam Mohan SP, “Circuits and Network Analysis and Synthesis”, Mc Graw Hill, 2015.
4. 4. D P Kothari and I.J Nagarath, , “ Electrical Machines - Basic Electrical and Electronics Engineering” , Third Reprint , Mc Graw Hill Education (India) Private Limited, , 2016.
5. A.K.Sawhney, “ A Course in Electrical & Electronic Measurements & Instrumentation” , Dhanpat Rai and Co, 2010.
6. S Salivahanan , N Suresh Kumar, "Electronic Devices And Circuits ", fifth Edition, Mc Graw Hill, 2022.

REFERENCE BOOKS:

1. Ramamrutham S., “Basic Civil Engineering”, Dhanpat Rai Publishing Co.(P) Ltd, 2013.
2. Ali Emadi, "Advanced Electric Drive Vehicles", CRC Press, First edition 2017.
3. Thereja. B.L., “ Fundament also f Electrical Engineering and Electronics” , S. Chand &Co.Ltd., 2008.
4. H.S.Kalsi, “Electronic Instrumentation “ , Tata Mc Graw-Hill, 2

WEB SITE REFERENCE:

1. **https://archive.nptel.ac.in/courses/112/103/112103262/**
2. **https://archive.nptel.ac.in/courses/112/105/112105129/**
3. **https://archive.nptel.ac.in/courses/105/106/105106201/**
4. **https://archive.nptel.ac.in/courses/105/106/105106201/**
5. **https://youtu.be/LPcQYXjPdIQ?list=PLp6ek2hDcoNCANsWM2mw3qi0387BhfLyV**
6. **https://www.youtube.com/playlist?list=PLMYtBmvT7X7QaLu0b0Jn1QQD4EOuT CA**
7. **https://youtu.be/5ZNeDxfgYAEhttps://youtu.be/36j6hCtL0E**

Mapping of CO with PO

	Program Outcomes											
	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**	**-**	**-**	**-**	**-**	**-**	**-**	**-**

JCS2121	PROGRAMMING IN C	L	T	P	C
		3	0	2	4

COURSE OBJECTIVES

- To understand the concepts of C Language.
- To implement programs using basic constructs of C
- To develop C programs using Arrays and Strings
- To develop modular applications in C using functions and Pointers.
- To be able to use File operations and Structures in C.

UNIT I INTRODUCTION TO C PROGRAMMING 9

Introduction to programming paradigms - Simple model of Computer - Algorithms and Flowcharts - Structure of C program - Applications of C Language - Data Types – Constants - Enumeration - Keywords – Number System.

UNIT II OPERATOR AND EXPRESSIONS 9

Data Input and Output statements – Operators: Arithmetic Operators, Relational Operators, Logical Operators, Increment and Decrement Operators, Bitwise Operators, Assignment Operators and Expressions, Precedence and Order of Evaluation – Decision Making and Branching – Looping statements.

UNIT III ARRAYS AND STRINGS 9

Arrays – Initialization – Declaration – One dimensional array – Two dimensional arrays - String - String operations: length, compare, concatenate, copy – Arrays of strings - Simple programs: Sorting, Searching and Matrix operations.

UNIT IV FUNCTIONS AND POINTERS 9

Function – Definition of function – Function Prototypes - Pass by value - Pass by reference - Recursion. Pointers: Definition- Initialization -Pointer Arithmetic- Pointers and Arrays.

UNIT V STRUCTURES, UNION AND FILES 9

Structure - Structure Definition - Structure Declaration - Nested structures - Array of structures - Union - Storage Classes - Files - Types of file processing: Sequential access, Random access - Sequential access file - Random access file - Command line arguments.

TOTAL: 45 PERIODS

LIST OF EXPERIMENTS

1. Usage of Basic Linux commands.
2. C Programming using Simple I/O Statements, operators and expressions.
3. C Programming using decision making and looping.
4. Simple programming for one dimensional and two dimensional arrays.
5. Solving problems using Strings.
6. C Programming using user defined functions (Pass by value and Pass by reference).
7. C Programming using Recursion.
8. C Programming using Pointers and Array of Pointers.
9. C Programming using structures and union.

10. C Programming using storage classes.
11. C Programming using Files.

TOTAL: 30 PERIODS

COURSE OUTCOMES:

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

- Develop efficient algorithms for solving a problem.
- Develop simple applications using various operators in C.
- Design and Implement applications using Array and Strings.
- Develop applications using Functions and Pointers.
- Design and Develop applications using Structures and Files.

TEXT BOOKS

1. Paul J. Deitel, Harvey M. Deitel, "C: How to Program", 9th Edition, Prentice Hall.
2. Reema Thareja, "Programming in C", Oxford University Press, Second Edition, 2016.
3. E. Balaguruswamy, "Programming in ANSI C", 8th Edition, 2019, McGraw Hill Education.
4. Yashavant P. Kanetkar. "Let Us C", BPB Publications, 16th edition 2017.

REFERENCE BOOKS

1. Pradip Dey, Manas Ghosh, "Programming in C", 2nd Edition, 2018, Oxford University Press, ISBN: 978-01-9949-147-6.
2. Kernighan B.W and Dennis M. Ritchie, "The C Programming Language", 2nd Edition, 2015, Pearson Education India, ISBN: 978-93-3254-944-9.
3. Jacqueline A Jones and Keith Harrow, "Problem Solving with C", Pearson Education. ISBN: 978-93-325-3800-9.
4. PradipDey, ManasGhosh, "Programming in C - As per the latest AICTE syllabus", First Edition, Oxford University Press, 2018.
5. Byron S Gottfried, "Programming with C", Schaum's Outlines, Third Edition, McGraw- Hill, 2010.

WEBSITE REFERENCES

1. http://elearning.vtu.ac.in/econtent/courses/video/BS/14CPL16.html
2. https://nptel.ac.in/courses/106/105/106105171/
3. https://www.w3resource.com/c-programming-exercises/
4. https://www.programiz.com/c-programming/c-structures-pointers
5. https://www.sitesbay.com/cprogramming/c-applications

CO-PO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	2	2	2	-	-	-	3	2	2	-	2
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

JPC2111	ENGINEERING PHYSICS AND CHEMISTRY LABORATORY	L	T	P	C
		0	0	2	1

OBJECTIVES:

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

LIST OF EXPERIMENTS

1. Determination of Young's Modulus for the given Uniform bar by Uniform Bendingmethod
2. Determination of Moment of Inertia of the given Circular disc andRigidity Modulus of thin metal wire using Torsional Pendulum
3. Determination of Planck' constant using different color filters
4. Determine the Wavelength of Mercury Spectrum using Spectrometer.
5. Determine the Thermal conductivity of a Bad conductor using Lee's Disc
6. Determination of Wavelength of the Diode Laser and hencedetermine the Size of the coated powder particle
7. Estimation of Alkalinity of Water Sample.
8. Estimation of Total, Temporary and Permanent Hardness of Water by EDTAmethod.
9. Determination of Molecular Weight of a Polymer by Viscosity Average method
10. Estimation of Amount of an Acid by Conductometric Titration
11. Estimation of Ferrous ions by Potentiometric Titration
12. Estimation of Amount of Hydrochloric Acid using pH Meter.

TOTAL: 30 PERIODS

OUTCOMES:

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

1. Evaluate elasticity of a linear body.
2. Discriminate different wavelengths of optical spectrum and the behavior of particles and waves at the atomic scale.
3. Identify the materials which are utilized for thermal insulation.
4. Estimate and analyze the amount of hardness and alkalinity in water for domestic consumption.
5. Apply the principles of conductivity and viscosity of substances in aqueous solutions for quantitative analysis using analytical instruments.

REFERENCES:

1. D. Bailey and E. Wright, Practical Fiber Optics, 2003.
2. Jerrad H.G. and Mc Neil D.B. -Theoretical and Experimental Physics.
3. Fretter W.B. -Introduction to Experimental Physics.
4. J. Mendham, RC Denney, JD Barnes, MJK Thomas, Text book ofquantitative chemical analysis, Vogel's, 2008.

WEBSITE REFERENCES

1. https://www.jhotpotinfo.com/2020/02/determination-of-youngs-modulus-of- bar.html
2. https://vlab.amrita.edu/index.php?sub=1&brch=280&sim=1518&cnt=1
3. https://vlab.amrita.edu/?sub=1&brch=281&sim=851&cnt=2
4. http://sites.iiserpune.ac.in/~bhasbapat/phy221_files/Lee%27s%20Method.pdf
5. https://edisciplinas.usp.br/pluginfile.php/4212400/mod_resource/content/0/Dunniv ant%2021.pdf
6. https://chem.libretexts.org/Bookshelves/General_Chemistry/Map%3A_A_Molecular_Approach_(Tro)/17%3A_Aqueous_Ionic_Equilibrium/17.04%3A_Titrations_and_pH

Mapping of CO with PO

	Program Outcomes											
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	**1**	**1**	**1**	**2**	**1**	**1**	**-**	**-**	**2**	**1**	**-**	**1**
CO2	**1**	**1**	**1**	**2**	**1**	**1**	**-**	**-**	**2**	**1**	**-**	**1**
CO3	**1**	**1**	**1**	**2**	**1**	**1**	**-**	**-**	**2**	**1**	**-**	**1**
CO4	**1**	**1**	**1**	**2**	**1**	**1**	**-**	**-**	**2**	**1**	**-**	**1**
CO5	**1**	**1**	**1**	**2**	**1**	**1**	**-**	**-**	**2**	**1**	**-**	**1**

JGE2111	BASIC ENGINEERING LABORATORY	L	T	P	C
		0	0	2	1

COURSE OBJECTIVES

- To provide an exposure to students with hands-on experience on various basic engineering practices in Civil, Mechanical Engineering
- To impart knowledge on 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 like vehicles.
- To provide exposure to the students with hands-on experience on various basic engineering practices in Electrical and Electronics Engineering
- To kindle your own creativity, ideation and realize the importance of team working.
- To gain knowledge through experience in handling of engineering aggregates.

GROUP A

I CIVIL ENGINEERING PRACTICE

BUILDINGS:

(a) Study of plumbing and carpentry components of residential and industrial buildings. Safety aspects.

PLUMBINGWORKS:

a) Study of pipe line joints, its location and functions: valves, taps, couplings, unions, reducers, elbows in household fittings.

b) Hands-on-exercise: Basic pipe connections - Mixed pipe material connection Pipe connections with different joining components.

II MECHANICAL ENGINEERING PRACTICE

WELDING AND DRILLING

(a) Preparation of but joints, lap joints and T-joints by Shielded metal arc welding.

(b) Drilling Practice

TWO WHEELER DISMANTLING AND DIAGNOSIS

a. Brake Adjustment and Replacing
b. Chain Adjustment and lubrication
c. Air Filter and Spark plug Cleaning
d. Engine oil Replacement and Carburetor Tuning

STUDY AND DEMONSTRATION ON:

(a) Study of Lathe Machine, tools and components, Safety aspects

(b) Study of Sheet Metal work, tools and components, Safety aspects

GROUP B (ELECTRICAL & ELECTRONICS)

I ELECTRICAL ENGINEERING PRACTICE

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

II ELECTRONICS ENGINEERING PRACTICE

1. Study of Electronic components and equipment's - Resistor, colour coding measurement of AC signal parameter (peak-peak, rms period, frequency) using CRO.
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.

COURSE OUTCOMES:

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

- To fabricate carpentry components and pipe connections including plumbing works.
- To weld various joints in steel plates using arc welding work.
- To understood various mechanism involved in automobiles.
- To illustrate on lathe machine and sheet metal work.
- Carry out basic home electrical works and appliances.
- Measure the electrical quantities.
- Elaborate on the components, gates, soldering practices.

WEBSITE REFERERENCE:

- https://nptel.ac.in/courses/107106088
- www.vikaspublishing.com/engineering-practices-lab
- https://archieve.org/mechanicalengineeeringworkshoplaboratory
- https://nptel.ac.in/courses/107106088
- www.vikaspublishing.com/engineering-practices-lab
- https://archieve.org/mechanicalengineeeringworkshoplaboratory

CO-PO & PSO MAPPING

CO\PO & PSO	Program Outcomes														
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	**1**	**1**	**1**	**1**	**1**	**-**	**-**	**-**	**-**	**-**	**-**	**1**	**1**	**-**	**-**
CO2	**1**	**1**	**1**	**1**	**1**	**-**	**-**	**-**	**-**	**-**	**-**	**2**	**1**	**-**	**2**
CO3	**1**	**1**	**1**	**1**	**1**	**-**	**-**	**-**	**-**	**-**	**-**	**1**	**1**	**-**	**-**
CO4	**1**	**1**	**1**	**1**	**1**	**-**	**-**	**-**	**-**	**-**	**-**	**1**	**-**	**-**	**-**
CO5	**1**	**1**	**1**	**1**	**1**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
AVG	**1**	**1**	**1**	**1**	**1**	**-**	**-**	**-**	**-**	**-**	**-**	**1**	**1**	**-**	**2**

SEMESTER 2

JHS2221	ENGLISH FOR SCIENCE AND TECHNOLOGY (COMMON TO ALL BRANCHES)	L T P C 2 0 2 3

COURSE OBJECTIVES:

- To enable the students of Engineering to comprehend technical texts
- To improve their technical writing skill for better transmission of messages
- To help them acquire language skills required in academic and workplace contexts
- To facilitate them to hone their skills to prepare effective reports
- To equip them with effective communicative skills to meet their future needs

UNIT I COMMUNICATING TECHNICAL INFORMATION 12

Definitions – Conditional clauses – Technical vocabulary; Comprehension of short technical passage and note-making

Language Practice
Reading: Short technical texts / excerpts; **Speaking:** Interviewing on social or global issues; **Listening:** Talks on science, engineering, medicine / interviews of achievers; **Writing:** Sentence Completion, gap filling, verbal aptitude: sentence correction

UNIT II GRAPHICAL ANALYSIS AND INTERPRETATION 12

Purpose statements – Numerical adjectives – Collocation; Process Description - Interpretation of Graphs and Charts

Language Practice
Reading: Emails, invitations; **Speaking:** Describing charts and tables; **Listening:** Process descriptions; **Writing:** Paraphrasing – Developing outlines

UNIT II PERSUASIVE WRITING & INFORMATION DISSEMINATION 12

Cause and effect – Voice (active, personal and impersonal passive) – Words used as nouns and verbs; Instructions – Recommendations

Language Practice
Reading: User manuals, gadget reviews; **Speaking**: Presentation on social / technical topics; **Listening:** Announcements, instructions; **Writing:** Instructions – Recommendations

UNIT IV REPORT WRITING AND GROUP INTERACTION 12

Determiners – Editing - Initialisms and acronyms; Report writing: survey, accident – Minutes of meeting

Language Practice
Reading: Notices, reviews; **Speaking:** Group discussions (technical topics) and debates; **Listening:** IELTS and TOEFL; **Writing:** Writing profiles of personalities and industries

UNIT V CAREER AND BUSINESS COMMUNICATION 12

Adverbials – Misspelt words – Formal and informal English; Letter writing – Job application and resume by mail and email – Inviting and sending quotations and placing orders

Language Practice
Reading: Email invitations to job interviews; **Speaking:** About future / career; **Listening:** Talks by entrepreneurs; **Writing:** Career objective, short-term and long-term goals, tagline

TOTAL: 60 PERIODS

COURSE OUTCOMES:

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

- To read and understand different types of technical texts
- To write procedural texts logically and sequentially in English
- To communicate effectively in academic and professional contexts
- To prepare effective reports and participate in group activities
- To use language precisely and accurately in business relations

TEXT BOOKS:

4. Department of English, Anna University, English for Engineers & Technologists, Volume 2, Orient BlackSwan Private Limited, Chennai, 2022.
5. Dhanavel, SP. English and Communication Skills for Students of Science and Engineering. Orient BlackSwan Private Limited, Chennai, 2011.
6. Interact English: Lab Manual for Undergraduate Students. Orient BlackSwan Private Limited, Chennai, 2017.

REFERENCE BOOKS:

5. Chellammal, V. Learning to Communicate. Allied Publishing House, New Delhi, 2004.
6. Raman, Meenakshi & Sangeetha Sharma. Technical Communication: Principles and Practices. Oxford University Press, New Delhi. 2015.

7. Regional Institute of English. English for Engineers. Cambridge University Press, New Delhi. 2008.
8. Rizvi M, Ashraf. Effective Technical Communication, Tata McGraw-Hill Publishing Company Limited, New Delhi, 2017.

WEB LINKS:

- www.esl-lab.com
- www.englishgrammar.org
- www.englishclub.com
- www.usingenglish.com
- www.esl.about.com
- www.bbc.co.uk/learningenglish/
- https://esl-bits.net/
- https://elt.oup.com/
- https://learnenglish.britishcouncil.org
- https://quizizz.com/

Mapping of CO with PO

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

JGE2202	TAMILS AND TECHNOLOGY	L T P C 1 0 0 1

UNIT I WEAVING AND CERAMIC TECHNOLOGY **3**

Weaving Industry during Sangam Age - Ceramic technology - Black and Red Ware Potteries (BRW) - Graffiti on Potteries.

UNIT II DESIGN AND CONSTRUCTION TECHNOLOGY **3**

Designing and Structural construction House & Designs in household materials during Sangam Age - Building materials and Hero stones of Sangam age - Details of Stage Constructions in Silappathikaram - Sculptures and Temples of Mamallapuram - Great Temples of Cholas and other worship places - Temples of Nayaka Period - Type study (Madurai Meenakshi Temple)- Thirumalai Nayakar Mahal - Chetti Nadu Houses, lndo - Saracenic architecture at Madras during British Period.

UNIT III MANUFACTURING TECHNOLOGY **3**

Art of Ship Building - Metallurgical studies - Iron industry - Iron smelting.steel -Copper and gold- Coins as source of history - Minting of Coins - Beads making-industries Stone beads - Glass beads - Terracotta beads -Shell beads/ bone beats - Archeological evidences - Gem stone types described in Silappathikaram.

UNIT IV AGRICULTURE AND IRRIGATION TECHNOLOGY **3**

Dam, Tank, ponds, Sluice, Significance of Kumizhi Thoompu of Chola Period, Animal Husbandry - Wells designed for cattle use - Agriculture and Agro Processing - Knowledge of Sea - Fisheries – Pearl-Conche diving - Ancient Knowledge of Ocean - Knowledge Specific Society.

UNIT V SCIENTIFIC TAMIL & TAMIL COMPUTING **3**

Development of Scientific Tamil - Tamil computing - Digitalization of Tamil Books - Development of Tamil Software - Tamil Virtual Academy- Tamil Digital Library- Online Tamil Dictionaries - Sorkuvai Project.

TOTAL: 15 PERIODS

TEXT BOOKS:

1. Social Life of Tamils (Dr.K.K.Pillay) A joint publication of TNTB & ESC and RMRL — (in print)

2. Social Life of the Tamils - The Classical Period (Dr.S.SingaraveIu) (Published by: International Institute of Tamil Studies.

3. Historical Heritage of the Tamils (Dr.S.V.Subatamanian, Dr.K.D. Thirunavukkarasu) (Publish by: International Institute of Tamil Studies).

4. The Contributions of the Tamils to Indian Culture (Dr.M.VaIarmathi) (Published by:International Institute of Tamil Studies.)
5. Keeladi - ‘Sangam City C ivilization on the banks of river Vaigai’ (Jointly Published by: Department ofArchaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu)
6. Studies in the History of India with Special Reference to Tamil Nadu (Dr.K.K.Pillay) (Published by: The Author)
7. Porunai Civilization (Jointly Published by: Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu)
8. Journey of Civilization Indus to Vaigai (R.BaIakrishnan) (Published by: RMRL) — Reference Book.

JMA2201	STATISTICS FOR ENGINEERS	L	T	P	C
		2	2	0	3

COURSE OBJECTIVES:

- To provide basic concepts of discrete, continuous random variables and moments.
- To acquaint students in the concepts and problems of standard distributions.
- To familiarize students in problems of correlation and regression.
- To provide students knowledge of testing of hypothesis and its applications.
- To introduce Design of Experiments for practical problem solving.

UNIT I RANDOM VARIABLES 9+3

Discrete and continuous random variables – Moments – Moment generating functions

UNIT II STANDARD DISTRIBUTIONS 9+3

Discrete distributions: Binomial distribution – Poisson distribution – Geometric distribution Continuous distributions: Uniform distribution – Exponential distribution – Normal distribution

UNIT III STATISTICAL CORRELATION AND REGRESSION 9+3

Correlation coefficient – Rank correlation – Correlation for bivariate data – Regression coefficients – Lines of regression

UNIT IV TESTING OF HYPOTHESIS 9+3

Normal tests for mean and difference of means – t tests for mean and difference of means – Chi-square test for goodness of fit – Chi-square test for independence of attributes

UNIT V DESIGN OF EXPERIMENTS 9+3

ANOVA classification – Completely Randomized Design – Randomized Block Design – Latin Square Design

TOTAL: 60 PERIODS

COURSE OUTCOMES:

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

- To solve problems of discrete and continuous type random variables for finding mean and variance.
- To apply standard probability distributions in solving real time problems.

- To solve correlation problems and to use regression analysis for predicting values of variables.
- To apply hypothesis testing for making statistical inferences in large and small sample real life problems.
- To compare and contrast various design of experiments methods and use them in problems.

TEXT BOOKS:

1. Gupta S C and Kapoor V K, “Fundamentals of Mathematical Statistics”, Sultan Chand and Sons, 12th Edition, 2020.
2. Ibe O C, "Fundamentals of Applied Probability and Random Processes", Elsevier, 2nd Edition, 2014.
3. Johnson R A, “Miller & Freund’s Probability and Statistics for Engineers”, Pearson Education, Asia, 9th Edition, 2018.

REFERENCES:

1. Hwei Hsu, "Schaum‘s Outline of Theory and Problems of Probability, Random Variables and Random Processes", Tata McGraw Hill Edition, New Delhi, 3rd Edition 2014.
2. Trivedi K S, "Probability and Statistics with Reliability, Queueing and Computer Science Applications", John Wiley and Sons, 2nd Edition, 2016.

WEB REFERENCES:

- https://nptel.ac.in/courses/117105085
- https://nptel.ac.in/courses/111105041
- https://nptel.ac.in/courses/102101056
- https://nptel.ac.in/courses/102106051

Mapping of CO with PO

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

JPH2201	ENGINEERING PHYSICS II	L T P C 3 0 0 3

COURSE OBJECTIVES:

- To enlighten the students on the principles of semiconductor materials and Electron transport properties
- To acquaint them with the applications of magnetic materials
- To impart knowledge on superconducting materials
- To help them acquire a basic understanding of dielectric materials
- To introduce the basic principles in nano electronic devices

UNIT I SEMICONDUCTING MATERIALS 9

Intrinsic Semiconductors – Energy band diagram – direct and indirect band gap semiconductors -Carrier concentration in intrinsic semiconductors – extrinsic semiconductors - Carrier concentration in N-type & P-type semiconductors – Hall Effect- Hall Coefficient in N-type and P-type semiconductors.

UNIT II MAGNETIC MATERIALS 9

Origin of magnetic moment – Bohr magneton – comparison of Dia, Para and Ferro magnetism Domain theory – Hysteresis – Soft and Hard magnetic materials– Ferrites and its applications – Memory devices-ROMs and RAMs(R/W)

UNIT III SUPERCONDUCTING MATERIALS 9

Properties of Superconductors – Josephson junction - Type I and Type II superconductors – BCS theory of superconductivity(Qualitative) – High Tc superconductors - Applications – SQUIDS. Cryotron and Maglev train.

UNIT IV DIELECTRIC MATERIALS 9

Polarization mechanisms in dielectrics– dielectric loss – internal field – Clausius-Mosotti relation- dielectric loss and dielectric breakdown – high-k dielectrics – Types of dielectrics – Applications in transformers and capacitors.

UNIT V NANOELECTRONIC MATERIALS 9

Size dependence of Fermi energy– quantum confinement – quantum structures - Density of states in quantum well, quantum wire and quantum dot structures - Single electron phenomena and Single Electron Transistor.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

- To be familiar with the functioning of semiconductors
- To assess the magnetic properties of materials
- To make use of superconductors in real life situations
- To understand the nuances of advanced solid state physics
- To recognize the uses of Nano electronic materials

TEXT BOOKS:

1. Dr.P.Mani, "Engineering Physics – II", DhanamPublications, First Edition,2019.
2. Dr.G.Senthil Kumar "Engineering Physics – II", VRB Publications, Revised Edition 2018.
3. Gaur, R.K. & Gupta, S.L. "Engineering Physics". Dhanpat Rai Publishers, 2012.
4. S.O.Pillai, "Solid State Physics", New Age International Publications, Revised Edition.
5. Bhattacharya, D.K. & Poonam, T. "Engineering Physics". Oxford University Press,2015.
6. Pandey, B.K. & Chaturvedi, S. "Engineering Physics". Cengage Learning India,2012.

REFERENCES:

1. R. Murugeshan, "Modern Physics", Sultan chand & sons, 2021. 2.Halliday,
2. D., Resnick, R. & Walker, J. "Principles of Physics". Wiley, 2020.
3. Serway, R.A. & Jewett, J.W. "Physics for Scientists and Engineers". Cengage Learning,2017.
4. Tipler, P.A. & Mosca, G. "Physics for Scientists and Engineers with ModernPhysics'.
5. Willam F Smith, "Material Science and Engineering", Tata McGraw - HillPublications, 4th Edition.

WEBSITE REFERENCES:

- https://archive.nptel.ac.in/courses/108/108/108108122/
- https://archive.nptel.ac.in/courses/115/103/115103038/
- https://archive.nptel.ac.in/courses/115/103/115103108/
- https://www.brainkart.com/article/Dielectric-Materials_6827/
- https://archive.nptel.ac.in/courses/117/108/117108047/

CO-PO Mapping

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

JCY2201	ENVIRONMENTAL SCIENCES AND SUSTAINABILITY	L	T	P	C
		2	0	0	2

COURSE OBJECTIVES:

- To study the inter-relationship between living organisms and environment.
- To learn causes, effects and preventive methods of environmental pollution.
- To import knowledge on the needs of renewable and new energy sources.
- To acquire broad knowledge on sustainable development and its values on society.
- To expertise sustainability practices of sustainable habitat, sustainable energy and Green engineering.

UNIT 1 ENVIRONMENT AND BIODIVERSITY 6

Definition, scope and importance of environment – need for public awareness. Eco-system and Energy flow– ecological succession. Biodiversity – Types and values. India as a mega-diversity nation – hot-spots of biodiversity - endangered and endemic species of India - threats to biodiversity – conservation of biodiversity - In-situ and ex-situ - Field visit

UNIT 2 ENVIRONMENTAL POLLUTION 6

Causes, Effects and preventive measures of water, air, soil and thermal pollution. Solid, Hazardous and E-Waste management. Case studies on Occupational Health and Safety Management system (OHASMS). Environmental protection acts - Field visit

UNIT 3 RENEWABLE SOURCES OFENERGY 6

Energy management and conservation – Need of new energy sources - Applications of-Hydrogen energy - Ocean energy resources - Tidal energy conversion. Concept, origin and power plants of geothermal energy.

UNIT 4 SUSTAINABLE DEVELOPMENT 6

Sustainability- concept, needs and challenges- economic and social aspects of sustainability - millennium development goals and protocols- Sustainable Development Goals - targets, indicators and intervention areas. Climate change - Global, Regional and local environmental issues and possible solutions - case studies. Concept of carbon credit and carbon footprint.

UNIT 5 SUSTAINABILITY PRACTICES 6

Zero waste and 3R concept, Circular economy, ISO 14000 Series, Material Life cycle assessment, Environmental Impact Assessment. Sustainable habitat: Green buildings, Green materials, Energy efficiency and sustainable transports. Sustainable energy: Energy Cycles - carbon cycle, emission and sequestration. Green Engineering: Sustainable urbanization - Socio- economic and technological change.

TOTAL: 30 PERIODS

COURSE OUTCOMES:

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

- Recognize the function of ecosystem and contribute to conservation of biodiversity.
- Identify the causes and effects of environmental pollution and practice the preventive measures.
- Recognize various types of new renewable sources of energy and their potential applications.
- Apply the sustainable development goals for technological advancement and societal development.
- Adopt sustainability practices for energy efficiency and sustainable urbanization.

TEXT BOOKS:

1. Anubha Kaushik and C. P. Kaushik's "Perspectives in Environmental Studies", 6th Edition,New Age International Publishers ,2018.
2. Benny Joseph, 'Environmental Science and Engineering', Tata McGraw-Hill, New Delhi,2016.
3. Sanjay K Sharma, Green Corrosion Chemistry and Engineering: Opportunities and challenges, Wiley-VCH Verlag GmbH & Co. KGaA, Germany (2011)
4. Gilbert M.Masters, 'Introduction to Environmental Engineering and Science', 2nd edition,Pearson Education, 2004.

REFERENCES:

1. R.K. Trivedi, 'Handbook of Environmental Laws, Rules, Guidelines, Compliances and Standards', Vol. I and II, Enviro Media. 38 . Edition 2010.
2. Cunningham, W.P. Cooper, T.H. Gorhani, 'Environmental Encyclopedia', Jaico Publ., House, Mumbai, 2001.
3. Dharmendra S. Sengar, 'Environmental law', Prentice hall of India PVT. LTD, New Delhi, 2007.
4. Rajagopalan, R, 'Environmental Studies-From Crisis to Cure', Oxford University Press, Third Edition, 2015.
5. Erach Bharucha "Textbook of Environmental Studies for Undergraduate Courses" Orient Blackswan Pvt. Ltd. 2013.

Related Links

1. https://www.hzu.edu.in/bed/E%20V%20S.pdf
2. https://catalogimages.wiley.com/images/db/pdf/9781119582052.excerpt.pdf
3. https://ncert.nic.in/textbook/pdf/keec109.pdf

CO-PO Mapping

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

JGE2221	ENGINEERING GRAPHICS	L	T	P	C
		2	0	2	3

COURSE OBJECTIVES:

- To acquaint students with the importance of graphics in engineering
- To develop their skills in the 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 CONIC SECTIONS AND SPECIAL CURVES 12

Conics - Construction of ellipse, Parabola and hyperbola by eccentricity method, Rectangle method- Drawing of tangents and normal to the above curves.
Special curves: Cycloid-Involute-Drawing of tangents and normal to the curves.

UNIT II PROJECTION PLANE SURFACES & ORTHOGRAPHIC PROJECTIONS 12

Introduction to Points, Lines (Only theory not for Exam Practice) – Projection of Plane Surfaces- Projection of polygonal surface and circular lamina inclined to both reference planes.
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 III- PROJECTION OF SOLIDS 12

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

UNIT IV DEVELOPMENT OF SURFACES 12

Introduction to Section of Solids (Only theory not for Exam Practice)
Development of lateral surfaces of simple and truncated solids - Prisms, pyramids, cylinders and cones

UNIT V ISOMETRIC AND PERSPECTIVE PROJECTIONS 12

Principles of isometric projection – isometric projections of simple solids, truncated prisms, pyramids, cylinders and cones. Conversion of orthographic views into Isometric Drawing (Simple Objects) - Perspective projection of prisms and pyramids by visual ray method.

TOTAL: 60 PERIODS

COURSE OUTCOMES:

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

- To be familiar with the fundamental and standards of engineering graphics.
- To perform free hand sketching of basic geometrical constructions and multiple views of object.
- To project orthographic projections of lines and plane surfaces.
- To draw projection of solids and development of surfaces.
- To interpret isometric and perspective view of objects.

TEXT BOOKS:

1. Natrajan K.V., "A text book of Engineering Graphics", Dhanalakshmi Publishers, Chennai, 2018.
2. Venugopal K and Prabhu Raja V., "Engineering Graphics", New Age International (P) Limited,2016.

REFERENCES:

1. Bhatt N.D. and Panchal V.M., "Engineering Drawing", Charotar Publishing House, 53rd Edition, 2019.
2. Gopalakrishna K.R., "Engineering Drawing" (Vol. I & II combined), Subhas Stores, Bangalore,2017..
3. Shah M.B and Rana B.C., "Engineering Drawing", Pearson, 2nd Edition, 2009.
4. Publication of Bureau of Indian Standards(BIS):
    i. IS 10711 - 2001: Technical products Documentation - Size and lay out of drawing sheets.
    ii. IS 9609 (Parts 0 & 1) - 2001: Technical products Documentation - Lettering.
    iii. IS 10714 (Part 20) - 2001 & SP 46 - 2003: Lines for technical drawings.
    iv. IS 11669 - 1986 & SP 46 - 2003: Dimensioning of Technical Drawings.
    v. IS 15021 (Parts 1 to 4) - 2001: Technical drawings - Projection Method

Website References:

1. www.pdfdrive.com/engineering drawing-books.html
2. https://freevideolectures.com
3. https://nptel.ac.in/courses

CO-PO MAPPINGS:

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	1	1	1	1	-	-	-	-	-	-	-	-

JEC2201	ELECTRONIC DEVICES AND CIRCUIT ANALYSIS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

- To help students understand the basic methods to analyse circuits and concepts of network theorems
- To acquaint the students with in-depth knowledge of the characteristics of electronic diodes.
- To familiarize the working, characteristics and applications of BJT
- To make students understand the characteristics and different operating modes of FET, MOSFET.
- To familiarize students with working of special electronic devices such as UJT, Tunnel diode and power devices such as SCR, TRIAC etc.

UNIT 1 CIRCUIT ANALYSIS FUNDAMENTALS 9

Passive and Active elements, Source transformation rules, Star-Delta conversion, Kirchhoff's laws, Mesh Analysis and Nodal Analysis, Quantitative Analysis of Network Theorems - Thevenin's and Norton Theorems, Super position Theorem, Maximum power transfer theorem, Fundamental of Resonance circuits, Basics of coupled circuits.

UNIT 2 DIODE AND APPLICATIONS 9

PN junction diode – Biasing, energy band diagram, V-I Characteristics, Drift and Diffusion currents, Space charge width, Capacitances associated with PN junction diode, Varactor diode, Breakdown diodes – Zener and Avalanche mechanism, Zener diode as regulator, Design of power supply, Clipper and Clamper.

UNIT 3 BIPOLAR JUNCTION TRANSISTOR 9

Types, current components. CB, CE, CC configurations – current gain and relations, input and output characteristics, h-parameter model of BJT, Quantitative analysis of current gain, voltage gain, input impedance and output admittance of transistor configurations, Applications- BJT as transistors.

UNIT 4 FIELD EFFECT TRANSISTORS 9

Classifications of FET, JFETs – Types, construction and operation, Channel length modulation, characteristics. JFET parameters, Quantitative measure of drain current and Pinch off voltage, MOSFET- Characteristics of MOSFET, JFET Vs MOSFET, MOSFET as switch.

UNIT 5 SPECIAL SEMICONDUCTOR DEVICES & POWER DEVICES 9

Unijunction Transistor and applications, Thyristor - Schottky barrier diode, SCR, TRIAC, DIAC, Applications- Tunnel diode, Photo diode, Phototransistor, Opto Coupler, Photo Voltaic Cells, CCD, Case study on Solar energy.

TOTAL: 45 PERIODS

COURSE OUTCOMES

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

- Apply and analyse circuits using network theorems
- Explain the characteristics of semiconductor diodes.
- Explain the working, characteristics and applications of BJT
- Explain the characteristics of FET, MOSFET
- Comprehend the characteristics of various electronic components and power devices

TEXTBOOKS

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. Albert Paul Malvino, "Electronic Principles", 7th Edition, Mcgraw Hill Publication, 2017
2. Salivahanan. S and Suresh Kumar S. N, ―Electronic Devices and circuit, Fourth Edition, Tata McGraw- Hill, 2016.
3. R. S. Sedha, A Textbook of Electronic Devices and Circuits, Second Edition, S. Chand Publishing, 2008.
4. Sudhakar A and Shyam Mohan SP, "Circuits and Network Analysis and Synthesis",McGraw Hill, 2015.

WEB SITE REFERENCES

- https://archive.nptel.ac.in/courses/108/105/108105112/
- https://nptel.ac.in/courses/108/102/108102042/
- https://nptel.ac.in/courses/117/103/117103063/
- https://archive.nptel.ac.in/courses/117/107/117107095/
- https://www.elprocus.com/semiconductor-devices-types-and-applications/

CO-PO Mapping

CO\PO & PSO	Program Outcomes														
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	**3**	**3**	**3**	**3**	**1**	**2**	**-**	**-**	**-**	**-**	**3**	**3**	**2**	**3**	**2**
CO2	**3**	**3**	**3**	**3**	**2**	**2**	**-**	**-**	**-**	**-**	**3**	**3**	**2**	**3**	**2**
CO3	**3**	**3**	**3**	**3**	**2**	**1**	**-**	**-**	**-**	**-**	**3**	**3**	**2**	**3**	**3**
CO4	**3**	**3**	**3**	**3**	**2**	**2**	**-**	**-**	**-**	**-**	**2**	**3**	**2**	**3**	**3**
CO5	**3**	**3**	**3**	**3**	**2**	**2**	**-**	**-**	**-**	**-**	**3**	**3**	**2**	**3**	**3**
AVG	**3**	**3**	**3**	**3**	**2**	**2**	**-**	**-**	**-**	**-**	**3**	**3**	**2**	**3**	**2.6**

JPC2211	ENGINEERING PHYSICS AND ENVIRONMENTAL SCIENCE LABORATORY	L	T	P	C
		0	0	2	1

OBJECTIVES:

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

LIST OF EXPERIMENTS

1. Determination of Numerical Aperture of the giver Fiber and Estimate the Linearityof the Laser Source.
2. Determine the Dispersive power of a given Prism using Spectrometer
3. Determination of Thickness of the given thin Wire by forming Interference fringes using air-wedge setup
4. Analysis of I-V Characterization of Solar cell
5. Determination of Energy gap of the given Semiconductor Diode by plotting the graph between current and temperature.
6. Determination of Young's Modulus for the given bar by Nonuniform Bending method.
7. Determination of Dissolved oxygen by Winkler's method
8. Estimation of amount of chloride in water.
9. Estimation of the amount of mixture of acids in water
10. Estimation of Iron content in water by Spectrophotometeric method
11. Estimation of acetic acid adsorbed on charcoal.
12. Determination of per capita energy consumption and carbon footprint.

TOTAL: 30 PERIODS

COURSE OUTCOMES

At the end of the course, the students will able

1. To lucid the effective communication system and to scrutiny the required wavelength.
2. To quantify micro sized linear objects and to ascertain band gap ofsemiconducting materials.
3. To configure solar power system as close as possible to its maximum peak powerpoint.
4. To quantify the degree of pollution of water samples by measuring water quality parameters.
5. To carry out energy audit and practice energy conservation methods.

REFERENCES

1. D. Bailey and E. Wright, Practical Fiber Optics, Newnes publications, 2003.
2. Fretter W.B. -Introduction to Experimental Physics UCL Press, 2005
3. Gurdeep R.Chatwal, Sham K. Anand, Instrumental methods of chemical analysis, Himalaya Publishing House, 2007.

WEBSITE REFERENCES:

1. https://vlab.amrita.edu/?sub=1&brch=281&sim=851&cnt=2
2. https://anilpangantiwar.tripod.com/expt10.htm
3. https://praxilabs.com/en/3d-simulations/i-v-characteristics-of-solar-cell-I-physics-simulation
4. https://vlab.amrita.edu/?sub=2&brch=193&sim=575&cnt=1
5. https://jigyasa-csir.in/neeri/n32-t1-a2/

CO-PO Mapping

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

JEC2211	ELECTRONIC DEVICES AND CIRCUIT ANALYSIS LABORATORY	L	T	P	C
		0	0	4	2

COURSE OBJECTIVES

- To verify the characteristics of diodes
- To verify the characteristics of BJT, FET, UJT, SCR
- To demonstrate the use of KVL & KCL
- To verify various Network Theorems in Circuit analysis.
- To demonstrate the frequency response and transient behaviour of RL, RC and RLC circuits

LIST OF EXPERIMENTS:

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

TOTAL: 60 PERIODS

COURSE OUTCOMES:

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

- Verify the characteristics of diodes
- Verify the characteristics of BJT, FET, UJT, SCR
- Demonstrate the use of KVL & KCL
- Verify various Network Theorems in Circuit analysis.
- Demonstrate the frequency response and transient behaviour of RL, RC and RLC circuits

LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS SOFTWARE

REQUIREMENTS

1. BC 107, BC 148,2N2646, BFW10 - 25 each
2. 1N4007, Zener diodes - 25 each
3. Resistors, Capacitors, Inductors - sufficient quantitie
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

WEB SITE REFERENCE:

- https://www.youtube.com/watch?v=csxkMy0PYWg
- https://www.youtube.com/watch?v=RPI4AcILfeY
- https://circuitdigest.com/tutorial/rc-rl-and-rlc-circuits

CO-PO Mapping

CO\PO & PSO	Program Outcomes														
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	**3**	**3**	**3**	**3**	**2**	**2**	**-**	**-**	**-**	**-**	**2**	**3**	**2**	**3**	**2**
CO2	**3**	**3**	**3**	**3**	**2**	**2**	**-**	**-**	**-**	**-**	**2**	**3**	**2**	**3**	**2**
CO3	**3**	**3**	**3**	**3**	**2**	**2**	**-**	**-**	**-**	**-**	**2**	**3**	**2**	**3**	**3**
CO4	**3**	**3**	**3**	**3**	**2**	**2**	**-**	**-**	**-**	**-**	**2**	**3**	**2**	**3**	**3**
CO5	**3**	**3**	**3**	**3**	**2**	**2**	**-**	**-**	**-**	**-**	**2**	**3**	**2**	**3**	**3**
AVG	**3**	**3**	**3**	**3**	**2**	**2**	**-**	**-**	**-**	**-**	**2**	**3**	**2**	**3**	**2.6**

JGE2241 Gaming and Crafts Studio

Objectives:

- Understand the fundamental principles of game development and the Unity interface.
- Analyse various game design principles to enhance gameplay experience.
- Evaluate and integrate audio and visual assets to create immersive game environments.
- Create a complete game project that incorporates learned techniques and personalized creative elements.
- Reflect on the game development process and critique peer projects to foster a collaborative learning environment.

Module 1: The World of Game Development and Gaming Fundamentals

- Introduction to Game Development & Unity
- Understanding the core elements of gameplay, such as mechanics, dynamics, and aesthetics.
- Interactive tutorial on Unity, exploring the interface and project setup.
- Navigate Unity and set up a basic project.

Module 2: Game Design Principles, Visual and Audio Design

- Game Design Principles & Basic Scripting - implementing basic game mechanics.
- implement simple player controls and game mechanics using C#.
- create responsive player controls using various input methods.
- Player Control and Game Technologies - Hands-on scripting for player controls.

Module 3: Game Mechanics, Technology, and Development

- Creating Game Assets- modelling and texturing basic game assets.
- Physics and Interactions - Practical exercises adding physics and collisions to objects.
- UI & Menus - UI development sessions for creating intuitive game menus.
- Audio and Visual Effects - Implementing background music and particle effects.

Module 4: Critical Analysis, Feedback, and Ethical Considerations

- Coding challenges to implement state machines and level progression.
- Testing and Debugging
- Debugging tools and techniques,
- Refine gameplay and fix issues, Optimisation

Module 5: Game Project & Presentation

- Students will work in groups of 4-5 to design and develop a functional video game prototype.
- The game should incorporate concepts and mechanics from at least two different genres.
- A GDD (Game Design Document) will be required as part of this project.
- Students will present their game prototype and GDD to the class and receive feedback from peers and instructors.

Course Outcome:

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

- navigate Unity and set up a basic project, implement simple player controls and game mechanics using C#.
- create responsive player controls using various input methods and import custom assets into Unity.
- Integrate Unity's Physics engine into their game projects and develop functional game menus and UI elements.
- enhance their games with audio cues and visual effects.
- use advanced scripting to manage game states and progression and perform debugging to refine gameplay and fix issues.

Resources:

https://www.youtube.com/watch?v=XtQMytORBmM

https://www.youtube.com/watch?v=AmGSEH7QcDg

https://www.youtube.com/watch?v=AmGSEH7QcDg

https://www.youtube.com/watch?v=HAvfA1F3qTo

https://www.youtube.com/playlist?list=PLfhbBaEcybmg-WnFoWDxgSIatmrzBRWSQ

https://www.youtube.com/watch?v=ldP0c2o1FJI

https://www.youtube.com/watch?v=ldP0c2o1FJI

JMA2303	TRANSFORMS AND RANDOM PROCESSES (For ECE)	L	T	P	C
		2	2	0	3

COURSE OBJECTIVES:

- To build concepts of Laplace transforms and its properties.
- To conceptualize Fourier transforms and its properties.
- To outline the applications of Z-transform in solving difference equations.
- To explain concepts of random processes and its applications.
- To familiarize students in correlation and spectral densities.

UNIT I LAPLACE TRANSFORMS 9+3

Definition – Transforms of elementary functions – Properties (without proofs) – Initial and Final value theorems (without proofs) – Transforms of periodic functions – Convolution theorem (without proof) – Inverse using partial fractions and convolution theorem

UNIT II FOURIER TRANSFORMS 9+3

Fourier transform pair – Fourier sine and cosine transforms – Properties – Transforms of simple functions – Convolution theorem – Parseval's identity

UNIT III Z-TRANSFORMS AND DIFFERENCE EQUATIONS 9+3

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

UNIT IV RANDOM PROCESSES 9+3

Classification – Stationary process – Markov process – Discrete Parameter Markov chain – Chapman-Kolmogorov equations (without proof) – Limiting distributions – Poisson process

UNIT V CORRELATION AND SPECTRAL DENSITIES 9+3

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, the student should be able to:

- Find Laplace transforms and inverse Laplace transforms using properties.
- Find Fourier transforms by efficient use of properties.
- Apply Z-transforms in solving difference equations.
- Demonstrate efficient use of random processes in modeling engineering problems.
- Apply concepts of correlation and spectral densities.

TEXT BOOKS:

1. Grewal B.S., “Higher Engineering Mathematics”, Khanna Publishers, New Delhi, 44th Edition, 2021.
2. Kreyszig Erwin., "Advanced Engineering Mathematics", John Wiley and Sons, 10th Edition, New Delhi, 2016.
3. Ibe O.C., "Fundamentals of Applied Probability and Random Processes", 2nd Edition, Elsevier, 2014.
4. Johnson R.A., Miller I., and Freund J., "Miller and Freund‘s Probability and Statistics for Engineers", Pearson Education, Asia, 8th Edition, 2015.

REFERENCES:

1. Bali. N.P and Manish Goyal., "A Textbook of Engineering Mathematics", 9th Edition, Laxmi Publications Pvt. Ltd, 2016.
2. Ramana. B.V., "Higher Engineering Mathematics", McGraw Hill Education Pvt. Ltd, New Delhi, 2016.
3. Devore. J.L., "Probability and Statistics for Engineering and the Sciences”, Cengage Learning, New Delhi, 8th Edition, 2014.

WEB REFERENCES:

- https://nptel.ac.in/courses/111106139/
- https://nptel.ac.in/courses/111102129/
- https://nptel.ac.in/courses/117103067/

Mapping of CO with PO

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

JEC2301	ELECTRONIC CIRCUITS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To understand the methods of biasing BJT transistors
- To understand the methods of biasing FET and MOSFET.
- To study about the Feedback amplifiers principles.
- To study about Oscillators and Tuned amplifiers.
- To understand the analysis of Power amplifiers.

UNIT I BJT BIASING AND BJT AMPLIFIERS 9

BJT- Need for biasing -DC Load Line and Bias Point- DC analysis of Transistor circuits - Various biasing methods of BJT -Fixed, voltage divider, collector to base bias - Stability factors- CE, CB and CC Configurations - Small Signal Hybrid pi equivalent circuit of BJT- Analysis of CE amplifiers using Hybrid pi equivalent circuits.

UNIT II FET BIASING AND FET AMPLIFIERS 9

Biasing circuits for JFET and MOSFET - CS, CD and CG configurations - Small Signal Hybrid pi equivalent circuit of FET and MOSFET - Analysis of CS amplifiers using Hybrid p equivalent circuits - BiCMOS circuits.

UNIT III FEEDBACK AMPLIFIERS 9

General Feedback Structure – Properties of negative feedback – Basic Feedback Topologies current series, current shunt, voltage series, voltage shunt- Effect of feedback on gain stability, distortion, bandwidth, input and output impedances - Analysis of Feedback Amplifiers - Voltage series.

UNIT IV OSCILLATORS AND TUNED AMPLIFIERS 9

Barkhausen criterion for oscillation – RC phase shift, Wien bridge - Hartley & Colpitt's oscillators – crystal oscillators- Concepts of Single, Double and Stagger tuned amplifiers – Analysis of capacitor coupled single tuned amplifier.

UNIT V POWER AMPLIFIERS 9

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

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

- Explain the methods of biasing BJT transistors & design of BJT Amplifiers.
- Explain the methods of biasing FET transistors & design of FET Amplifiers
- Analyze the operation and performance of Feedback amplifiers.
- Analyze the operation of Oscillator circuits and tuned amplifiers.
- Explain the design concepts of Power amplifiers.

TEXT BOOKS:

1. Sedra and Smith, "Micro Electronic Circuits", Sixth Edition, Oxford University Press, 2011.
2. Robert L. Boylestad and Louis Nasheresky, "Electronic Devices and Circuit Theory", 11th Edition, Pearson Education, 2013.

REFERENCES:

1. R.S. Sedha, "A Textbook of Electronic Devices and Circuits", 2nd edition, S. Chand Publishing, 2008.
2. Salivahanan and N. Suresh Kumar, "Electronic Devices and Circuits", 4th Edition, McGraw Hill Education (India) Private Ltd., 2017.
3. Donald. A. Neamen, "Electronic Circuits Analysis and Design", 3rd Edition, McGraw Hill Education (India) Private Ltd., 2010.

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/PSO MAPPINGS

CO\PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	2	1	2	2	-	-	-	1	3	3	2	2
CO2	3	3	2	2	1	2	1	-	-	-	2	3	3	2	2
CO3	3	2	2	2	1	2	2	-	-	-	2	3	3	2	2
CO4	3	2	2	2	1	2	1	-	-	-	2	2	3	2	2
CO5	3	2	2	2	2	3	2	-	-	-	2	2	3	2	2
AVG	3	2	2	2	1	2	2	-	-	-	2	3	3	2	2

JEC2302	DIGITAL ELECTRONICS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To help students to acquire knowledge on number systems and Boolean algebra.
- To make students design and implement Combinational logic circuits
- To make students design Synchronous Sequential digital circuits
- To make students design Asynchronous Sequential digital circuits
- To familiarize the realization of 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, ALU Design.

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.

UNIT IV ASYNCHRONOUS SEQUENTIAL CIRCUITS 9

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

UNIT V MEMORY DEVICES AND DIGITAL INTEGRATED CIRCUITS 9

Basic memory structure – ROM -PROM – EPROM – EEPROM –EAPROM, RAM – Static and dynamic RAM, SDRAM, DDR 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 PERIODS: 45

COURSE OUTCOMES:

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

- To apply knowledge of number systems and Boolean algebra
- To implement Combinational logic circuits
- To design and implement Synchronous Sequential logic circuits
- To design Asynchronous Sequential circuits
- To realize combinational circuits using PLDs

TEXTBOOKS:

1. S.Salivahanan and S.Arivazhagan “Digital Electronics”, 5th Edition, Oxford University Press, 2018.
2. M. Morris Mano and Michael D. Ciletti, “Digital Design”, 5th Edition, Pearson, 2014.

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.

WEBSITE REFERENCES:

1. https://archive.nptel.ac.in/courses/106/105/106105185/
2. https://www.electronics-tutorials.ws/combination/comb_1.html
3. https://www.javatpoint.com/sequential-circuits-in-digital-electronics
4. https://www.youtube.com/watch?v=7OV4TAYOR0o
5. https://www.encyclopedia.com/computing/news-wires-white-papers-and-books/memory-devices5.

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	1	-	-	-	-	2	2	3	2	2
CO2	3	3	3	2	3	1	-	-	-	-	2	2	3	2	2
CO3	3	3	3	2	3	1	-	-	-	-	2	2	3	2	2
CO4	3	3	3	2	3	1	-	-	-	-	2	2	3	2	2
CO5	3	3	3	2	3	1	-	-	-	-	2	2	3	2	2
AVG	**3**	**3**	**2.8**	**2**	**2.8**	**1**	**-**	**-**	**-**	**-**	**2**	**2**	**3**	**2**	**2**

JEC2321	SIGNALS AND SYSTEMS (Integrated)	L	T	P	C
		3	0	2	4

COURSE OBJECTIVES:

- To understand the basic representation, properties and classification of signals.
- To understand the use of Fourier and Laplace Transforms in the analysis of continuous time signals.
- To study about the classification of continuous time systems and their analysis using Laplace Transform.
- To understand frequency domain representation of discrete time signals using Discrete time Fourier Transform and Z transform.
- To study about the classification of Discrete time systems and their analysis using Z transform.

UNIT I CLASSIFICATION OF SIGNALS 9

Introduction to signals and systems -Analog signals, Generation of DT signals, Standard CT and DT signals - Classification of CT and DT signals- Periodic & Aperiodic, Deterministic & Random, Energy & Power, Basic Operation on signals.

UNIT II FREQUENCY DOMAIN ANALYSIS OF CONTINUOUS TIME SIGNALS 9

Fourier series of Periodic signals -Trigonometric representation , Fourier Transform of CT signals, Laplace Transform of CT signals.

UNIT III CLASSIFICATION AND ANALYSIS OF CONTINUOUS TIME SYSTEMS 9

Properties of CT systems- Linearity, Time in-variance, Causality, Stability, LTI System– Impulse response, Convolution Integral & Differential Equation representation, Laplace transform Analysis of LTI systems.

UNIT IV FREQUENCY DOMAIN ANALYSIS OF DISCRETE TIME SIGNALS 9

Introduction to Sampling theorem - Nyquist sampling rate, Fourier Transform of discrete time signals (DTFT), Z Transform of DT signals - ROC & Properties.

UNIT V CLASSIFICATION AND ANALYSIS OF DISCRETE TIME SYSTEMS 9

Properties of DT systems- Linearity, Time in-variance, Causality, Stability, Recursiveness, LTI System-Impulse response, Convolution sum & Difference equation representation, Z Transform Analysis of LTI systems.

TOTAL PERIODS: 45

LIST OF EXPERIMENTS

1. Introduction to MATLAB
2. Generation of signals
3. Basic operations on signals
4. Linear convolution
5. Circular convolution
6. Auto and Cross Correlation
7. Plotting spectrum of discrete signals using DTFT
8. Sampling and effect of aliasing

TOTAL PERIODS: 30

TOTAL PERIODS: 75

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

• MATLAB/ EQUIVALENT software package for simulation experiments
• PCs - 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

COURSE OUTCOMES:

At the end of the course, the student will be able:
• To classify continuous and discrete time signals based on properties.
• To analyze CT signals in frequency domain using Fourier transform and Laplace transform.
• To classify CT systems and analyze frequency response using Laplace transform.
• To analyze DT signals in frequency domain using Discrete Time Fourier transform and Z Transform
• To classify DT systems and analyze frequency response using 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.

WEBSITE REFERENCES:

1. https://nptel.ac.in/courses
2.https://www.youtube.com/watch?v=7Z3LE5uM-6Y&list=PLbMVogVj5nJQQZbah2uRZIRZ_9kfoqZyxProf. K.S. Venkatesh, 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/PSO MAPPING:

CO\ PO, PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	3	3	3	2	2	1	-	-	-	-	2	2	2	1	1
CO2	3	3	3	2	2	1	-	-	-	-	2	2	2	1	1
CO3	3	3	3	2	2	1	-	-	-	-	2	2	3	1	1
CO4	3	3	3	2	2	1	-	-	-	-	2	2	3	2	1
CO5	3	3	3	2	2	1	-	-	-	-	2	2	3	3	3
AVG	3	3	3	2	2	1	-	-	-	-	2	2	2.6	1.6	1.4

JEC2303	ELECTROMAGNETIC FIELD THEORY	L	T	P	C
		3	0	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

UNIT I INTRODUCTION 9

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, Stoke's theorem, Vector identities.

UNIT II ELECTROSTATICS 9

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

UNIT III MAGNETOSTATICS 9

Biot-Savart law and applications, Ampere's law and its applications, Vector magnetic potential, Boundary conditions, Inductance and mutual inductance - coaxial cable, solenoid, toroid.

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

Lorentz force equation, Faraday's law, Displacement current, 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 9

Plane waves in lossless media, Plane waves in lossy media (low-loss dielectrics and good conductors), Power and Poynting vector, Visualization of signal propagation using Matlab.

TOTAL PERIODS: 45

COURSE OUTCOMES:

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

- 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 BOOKS:

1. Matthew N.O Sadiku, "Principles of electromagnetic", 6th Edition, Oxford University Press, 2015.
2. W.H. Hayt and J.A. Buck, "Engineering Electromagnetics", 7th ed., McGraw-Hill (India), 2006 (UNIT I-V)

REFERENCES:

1. D.K. Cheng, "Field and wave electromagnetic", 6th ed., Pearson (India), 2000 (UNIT I, II,III,IV,V)
2. 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/PSO MAPPING:

CO\PO, PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	1	1	-	2	1	-	-	-	2	2	2	1	1
CO2	3	2	3	3	2	2	2	-	-	-	2	2	3	1	1
CO3	3	2	3	2	2	2	1	-	-	-	2	2	3	2	2
CO4	3	2	2	2	2	2	1	-	-	-	2	2	3	3	2
CO5	3	2	2	2	2	2	1	-	-	-	2	2	3	3	2
AVG	**3**	**2**	**2.2**	**2**	**2**	**2**	**1.2**	**-**	**-**	**-**	**2**	**2**	**2.8**	**2**	**1.6**

JNC2361	DISASTER RISK REDUCTION AND MANAGEMENT	L	T	P	C
		3	0	0	0

COURSE OBJECTIVES

- To impart knowledge on concepts related to disaster, disaster risk reduction, disaster management
- To acquaint with the skills for planning and organizing disaster response

UNIT I HAZRADS, VULNERABILITY AND DISASTER RISKS 9

Definition: Disaster, Hazard, Vulnerability, Resilience, Risks – Types of Disasters: Natural, Human induced, Climate change induced –Earthquake, Landslide, Flood, Drought, Fire etc – Technological disasters- Structural collapse, Industrial accidents, oil spills -Causes, Impacts including social, Economic, political, environmental, health, psychosocial, etc.- Disaster vulnerability profile of India and Tamil Nadu - Global trends in disasters: urban disasters, pandemics, Complex emergencies, - Inter relations between Disasters and Sustainable development Goals.

UNIT II DISASTER RISK REDUCTION (DRR) 9

Sendai Framework for Disaster Risk Reduction**,** Disaster cycle - Phases, Culture of safety, prevention, mitigation and preparedness community Based DRR, Structural- nonstructural measures, Roles and responsibilities of- community, Panchayati Raj Institutions / Urban Local Bodies (PRIs/ULBs), States, Centre, and other stakeholders- Early Warning System – Advisories from Appropriate Agencies.- Relevance of indigenous Knowledge, appropriate technology and Local resources.

UNIT III DISASTER MANAGEMENT 9

Components of Disaster Management – Preparedness of rescue and relief, mitigation, rehabilitation and reconstruction- Disaster Risk Management and post disaster management – Compensation and Insurance- Disaster Management Act (2005) and Policy - Other related policies, plans, programmers and legislation - Institutional Processes and Framework at State and Central Level- (NDMA –SDMA-DDMA-NRDF- Civic Volunteers)

UNIT IV TOOLS AND TECHNOLOGY FOR DISASTER MANAGEMENT 9

Early warning systems -Components of Disaster Relief: Water, Food, Sanitation, Shelter, Health, Waste Management, Institutional arrangements (Mitigation, Response and Preparedness, – Role of GIS and Information Technology Components in Preparedness, Risk Assessment, Response and Recovery Phases of Disaster – Disaster Damage Assessment. - Elements of Climate Resilient Development –Standard operation Procedure for disaster response – Financial planning for disaster Management

UNIT V DISASTER MANAGEMENT: CASE STUDIES 9

Discussion on selected case studies to analyse the potential impacts and actions in the contest of disasters-Landslide Hazard Zonation: Earthquake Vulnerability Assessment of Buildings and Infrastructure: Case Studies, Drought Assessment: Case Studies, Coastal Flooding: Storm Surge Assessment, Floods: Fluvial and Pluvial Flooding: Case Studies; Forest Fire: Case Studies, Man Made disasters: Case Studies, Space Based Inputs for Disaster Mitigation and Management and field works related to disaster management.- Field work-Mock drill -

TOTAL : 45 PERIODS

TEXT BOOKS:

1. Taimpo (2016), Disaster Management and Preparedness, CRC Publications.
2. Singh R (2017), Disaster Management Guidelines for earthquakes, Landslides, Avalanches and tsunami, Horizon Press Publications.
3. Singhal J.P. "Disaster Management", Laxmi Publications, 2010. ISBN-10: 9380386427 ISBN-13: 978-9380386423.
4. Tushar Bhattacharya, "Disaster Science and Management", McGraw Hill India Education Pvt. Ltd., 2012. **ISBN-10:** 1259007367, **ISBN-13:** 978-1259007361]

REFERENCES

1. Govt. of India: Disaster Management Act, Government of India, New Delhi, 2005.
2. Government of India, National Disaster Management Policy, 2009.
3. Shaw R (2016), Community based Disaster risk reduction, Oxford University Press

COURSE OUTCOME:

CO1: To impart knowledge on the concepts of Disaster, Vulnerability and Disaster Risk reduction
(DRR)
CO2: To enhance understanding on Hazards, Vulnerability and Disaster Risk Assessment prevention and risk reduction
CO3: To develop disaster response skills by adopting relevant tools and technology
CO4: Enhance awareness of institutional processes for Disaster response in the country and
CO5: Develop rudimentary ability to respond to their surroundings with potential disaster response in areas where they live, with due sensitivity

CO's-PO's & PSO's MAPPING

CO\ PO, PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	3	-	-	2	2	-	-	2	-	2	-	1
CO2	3	3	3	3	-	-	2	1	-	-	2	-	2	-	1
CO3	3	3	3	3	-	-	2	2	-	-	-	-	2	-	1
CO4	3	3	2	3	-	-	2	1	-	-	2	-	2	-	1
CO5	3	3	2	3	-	-	2	2	-	-	2	-	3	-	1
AVG	3	3	3	3	-	-	2	2	-	-	2	-	2	-	1

JEC2311	ELECTRONIC CIRCUITS 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. Schmitt Trigger circuit .

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 Amplifiers 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 - 50 Nos

Components and Accessories:

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

WEBSITE REFERENCE:

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/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	1	1	2	-	-	-	1	3	3	3	3
CO2	3	3	2	2	1	1	1	-	-	-	2	2	3	3	3
CO3	3	2	2	2	1	1	2	-	-	-	2	2	3	3	3
CO4	3	2	2	2	1	1	1	-	-	-	2	2	3	3	3
CO5	3	2	2	2	2	2	2	-	-	-	2	2	3	3	3
AVG	3	2	2	2	1	1	2	-	-	-	2	2	3	3	3

JEC2312	DIGITAL ELECTRONICS LABORATORY	L	T	P	C
		0	0	4	2

COURSE OBJECTIVES:

- To make students design and implement code converters.
- To make students implement adder/subtractor circuits.
- To make students implement mux, demux, encoder and decoder.
- To make students implement counters.
- To make students implement shift registers

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

TOTAL PERIODS: 60

COURSE OUTCOMES:

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

- Design and implement the code converters.
- Design and implement the adder/subtractor circuits.
- Design and implement the mux, demux, encoder and decoder.
- Design and implement counters
- Design and implement shift registers

LIST OF EQUIPMENTS AND COMPONENTS

1. Digital IC Tester -2 Nos
2. Power Supply- 10 5V DC
3. Multimeter- 10 Digital
4. Bread Board - 10

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,

WEBSITE REFERENCES:

1. https://de-iitr.vlabs.ac.in/exp/truth-table-gates/theory.html
2. https://da-iitb.vlabs.ac.in/exp/generalized-simulator/theory.html
3. https://www.iitg.ac.in/cseweb/vlab/Digital-System-Lab/experiments.php
4. https://he-coep.vlabs.ac.in/exp/shift-registers/

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	1	2	1	-	-	-	2	3	3	3	3
CO2	3	3	2	2	1	2	1	-	-	-	2	3	3	3	3
CO3	3	2	2	2	1	2	1	-	-	-	2	3	3	3	3
CO4	3	3	2	2	1	2	1	-	-	-	2	3	3	3	3
CO5	3	2	2	2	1	2	1	-	-	-	2	3	3	3	3
AVG	**3**	**2.6**	**2**	**2**	**1**	**2**	**1**	**-**	**-**	**-**	**2**	**3**	**3**	**3**	**3**

JPT2041	SOFT SKILLS AND APTITUDE	L	T	P	C
		0	0	2	0

COURSE OBJECTIVES:

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

UNIT-I SOFT SKILLS AND APTITUDE - I **6**

Synonyms - Antonyms - Odd Words - Idioms and Phrases - Error Spotting - Interpersonal Communication- Sentence Correction - Resume Writing Skills - Interview Skills.

UNIT-II SOFT SKILLS AND APTITUDE-II **6**

Reading Comprehension - Sentence Improvement - Jumbled Sentences - Parts of speech - Fact, Inference, Judgements - . Paragraph formation -Fill in the Blanks - Group Discussion - Mock Interview Sessions.

UNIT III QUANTITATIVE APTITUDE **6**

Number Theory - Divisibility rule - LCM and HCF - Simplification - Surds and Indices - Average – Percentage.

UNIT IV LOGICAL REASONING **6**

Number and letter Series - Coding and Decoding - Ranking and Ordering - Odd man out - Image Based Relationships.

UNIT V TECHNICAL APTITUDE IN C-I **6**

Pointers - Pointer dereferencing - Functions - Call by value, Call by reference - Structures - Structure Pointers - Arrays - One Dimensional, Two Dimensional, Multi Dimensional - Sorting - Time Complexity- Strings - String Methods.

TOTAL: 30 PERIODS

COURSE OUTCOMES:

At the end of the course, the student should 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

TEXT BOOKS:

1. Dr.RS Aggarwal, "Quantitative Aptitude", S Chand Publishing, 2020
2. Dr.R.S Aggarwal. "A Modern Approach To Verbal Reasoning",S. Chand Publishing, 2017
3. Dr. R. S. Aggarwal, "A Modern Approach to Non-Verbal Reasoning". S. Chand Publishing, 2017
4. Pradip Dey, ManasGhosh, "Fundamentals of Computing and Programming in C. First

REFERENCES:

1. Data Communications and Networks- 2nd edition -Achyut S Godbole- and AtulKahate Tata McGraw-Hill, 2017.

2. Computer Networking - James F. Kurose & Keith W. Ross- PEARSON, 6th EDITION, 2017. 3. Computer Communications and Networking Technologies - Michael A. Gallo & William M. Hancock- BROOKS&COLE, 2001.

WEB REFERENCES:

- https//www.indiabix.com/aptitude questions-and-answers
- https://m4maths com placement-puzzles php
- www.freshersworld.com

JMA2402	APPLIED LINEAR ALGEBRA (For CSE, CSE (AI&ML), CSE (CS), CS&BS, AI&DS, IT & ECE)	L	T	P	C
		2	2	0	3

COURSE OBJECTIVES:

- To impart knowledge of consistency of system of equations through Rouche-Capelli theorem.
- To familiarize students in the concepts of vector spaces, bases and dimension.
- To enable students understand concepts of linear transformation, Eigenvalues, Eigenvectors and Diagonalizability.
- To introduce inner product spaces, orthogonalization and least square approximations.

UNIT I MATRICES AND SYSTEM OF LINEAR EQUATIONS 9+3

Matrices – Row Echelon form – Rank – Non-homogeneous system of linear equations – Homogeneous system of linear equations – Rouche-Capelli theorem (without proof) – Consistency – Gauss Jordan method – Gauss Seidel method

UNIT II VECTOR SPACES 9+3

Definition of field – Vector spaces – Subspaces – Properties – Linear combinations – Linear independence and linear dependence – Span – Bases and dimensions

UNIT III LINEAR TRANSFORMATION 9+3

Linear transformation – Properties – Kernel and Range – One-to-One correspondence – Rank and Nullity – Dimension theorem

UNIT IV DIAGONALIZATION 9+3

Matrix representations of linear transformations – Eigenvalues and eigenvectors – Diagonalizability

UNIT V INNER PRODUCT SPACES 9+3

Inner products and norms – Gram Schmidt orthogonalization process – Least square approximation

TOTAL: 60 PERIODS

COURSE OUTCOMES:

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

- Apply Rouche-Capelli theorem for solving system of equations.
- Solve problems occurring in vector spaces and subspaces.
- Conceptualize linear transformation and use it in real-time problems.
- Demonstrate efficient use of matrix representations and diagonalization.
- Solve problems using orthogonalization process and use least square approximations.

TEXT BOOKS:

1. Grewal B.S., "Higher Engineering Mathematics", Khanna Publishers, New Delhi, 44th Edition, 2021.
2. Kreyszig Erwin., "Advanced Engineering Mathematics", John Wiley and Sons, 10th Edition, New Delhi, 2016.
3. Friedberg. A.H., Insel. A.J. and Spence. L., "Linear Algebra", Prentice Hall of India, New Delhi, 2004.

REFERENCES:

1. Kumaresan. S., "Linear Algebra – A Geometric Approach", Prentice – Hall of India, New Delhi, Reprint, 2010.
2. 4. Lay D.C., "Linear Algebra and its Applications", 5th Edition, Pearson Education, 2015.

WEB REFERENCES:

- https://nptel.ac.in/courses/111107105/
- https://nptel.ac.in/courses/108104174/
- https://nptel.ac.in/courses/111104137/
- https://nptel.ac.in/courses/111106135/
- https://nptel.ac.in/courses/111108157/

Mapping of CO with PO

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

JEC2421	ANALOG AND DIGITAL COMMUNICATION (Integrated)	L	T	P	C
		3	0	2	4

COURSE OBJECTIVES:

- To understand Amplitude modulation systems
- To provide basic concepts of Frequency modulation system
- To learn about Baseband Transmission and information theory
- To make students understand the concepts of Digital modulation systems
- To explain some basic error control coding theorem

UNIT I AMPLITUDE MODULATION 9

Introduction, Amplitude Modulation - Balance modulator, Envelope detector – DSBSC AM - Balanced Modulators, Coherent detection – SSB modulation - Phase discrimination method, Coherent detection, Super heterodyne Receiver.

UNIT II FREQUENCY MODULATION 9

Basic concepts of Phase Modulation, Frequency Modulation Narrow band FM, Wide band FM, -Generation of FM Signal- Armstrong Method, Detection of FM -Foster Seeley discriminator.

UNIT III BASEBAND TRANSMISSION 9

Quantization - Uniform &Non-uniform quantization, PCM, TDM, DM, Line codes, Discrete Memoryless source – Information, Entropy, Shannon – Fano & Huffman codes.

UNIT IV DIGITAL MODULATION SCHEME 9

ASK- Modulator, Coherent ASK Detector, FSK- Modulator, Non Coherent FSK Detector, BPSK- Modulator, Coherent BPSK Detection. Principles of QPSK, Differential PSK.

UNIT V ERROR CONTROL CODING 9

Linear Block Codes - Hamming Codes - Minimum distance - Error Detecting Capability- Error Correcting Capability – Convolutional Codes.

TOTAL: 45 PERIODS

LIST OF EXPERIMENTS

1. AM Modulator and Demodulator
2. FM Modulator and Demodulator
3. Analog Pulse Modulation
4. Delta Modulation and Demodulation
5. Line Coding Techniques
6. Simulation of generation of ASK, FSK, and BPSK
7. Simulation of Linear Block and Cyclic error control coding schemes
8. Simulation of Convolutional coding scheme

TOTAL: 30 PERIODS

TOTAL: 75 PERIODS

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

COURSE OUTCOMES:

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

- Explain the concepts of Amplitude modulation systems
- Elucidate the principles of Frequency modulation systems
- Comprehend baseband communication systems and source coding techniques
- Describe digital communication systems
- Analyze different error control and coding schemes

TEXTBOOK:

1. J.G.Proakis, M.Salehi, "Fundamentals of Communication Systems", Pearson Education 2014
2. S. Haykin, "Digital Communications", John Wiley, 2017

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/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	1	-	-	-	-	-	2	2	3	2	1
CO2	3	3	3	2	1	-	-	-	-	-	2	2	3	2	1
CO3	3	3	3	3	1	-	-	-	-	-	2	2	3	2	1
CO4	3	3	3	3	1	-	-	-	-	-	3	2	3	2	1
CO5	3	3	3	3	1	-	-	-	-	-	3	3	3	2	1
AVG	**3**	**3**	**3**	**2.6**	**1**	**-**	**-**	**-**	**-**	**-**	**2.4**	**2.2**	**3**	**2**	**1**

JEC2401	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, adder, subtractor, Amplifiers-Instrumentation amplifier, Integrator, Differentiator. Voltage level detectors - Comparators, Schmitt trigger, peak detector, clipper and clamper, Active 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

D/A converters- 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** –Flash type, Successive Approximation type, Single and Dual Slope type.

UNIT V WAVEFORM GENERATORS AND SPECIAL FUNCTION ICs 9

Waveform Generators: Sine, Square and Triangle- Timer IC 555, IC 723 general purpose regulator - Monolithic switching regulator.

TOTAL PERIODS: 45

COURSE OUTCOMES:

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

- Explain the basic building blocks and performance characteristics of Op - Amps
- Explain the design of linear and non-linear applications of OP – AMPS
- Explain the concepts and applications of analog multiplier and PLL
- Analyze the design of ADC and DAC using OP – AMPS
- Describe waveform generation using OP – AMP and 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.

REFERENCE:

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/PSO MAPPINGS

CO\PO, PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	3	2	1	2	-	-	-	-	1	3	2	2	3
CO2	3	2	3	2	1	2	-	-	-	-	1	3	3	3	2
CO3	3	2	3	2	1	2	-	-	-	-	1	3	3	3	2
CO4	3	2	1	1	1	2	-	-	-	-	-	2	3	3	2
CO5	3	3	2	3	2	2	-	-	-	-	2	3	3	3	2
AVG	3	2	2	2	1	2	0	0	0	0	1	3	2.8	2.8	2.2

JEC2402	TRANSMISSION LINES AND WAVEGUIDES	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To introduce the various types of transmission lines and their characteristics
- To provide a thorough understanding of high frequency line, power and impedance measurements
- To impart technical knowledge in impedance matching using smith chart
- To explain the design of passive filters
- To introduce the characteristics of TE and TM waves

UNIT I TRANSMISSION LINE THEORY 9

General theory of Transmission lines - general solution - 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.

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 - Measurement of VSWR and wavelength.

UNIT III IMPEDANCE MATCHING IN HIGH FREQUENCY LINES 9

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

UNIT IV PASSIVE FILTERS 9

Characteristic impedance of symmetrical networks – filter fundamentals, Design of filters: Constant K – Low Pass, High Pass, Band Pass, Band Elimination, m- derived sections – low pass, high pass.

UNIT V 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.

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
- Describe about the standing wave ratio and input impedance in high frequency transmission lines
- Analyze impedance matching by stubs using smith charts
- Explain the design of passive filters
- Analyze the characteristics of TE and TM waves

TEXTBOOKS:

1. John D Ryder, ―Networks, lines and fields, 2nd Edition, Prentice Hall India, 2015.

REFERENCES:

1 E.C. Jordan and K.G. Balmain, ―Electromagnetic Waves and Radiating Systems Prentice Hall of India, 2015.

2 G.S.N Raju, "Electromagnetic Field Theory and Transmission Lines Pearson Education, 2006.

WEBSITE REFERENCES:

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

CO-PO/PSO MAPPING:

CO\PO, PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	3	3	2	2	1	-	-	-	-	3	2	3	2	1
CO2	3	2	3	3	3	1	-	-	-	-	2	3	3	2	1
CO3	2	3	2	2	3	2	-	-	-	-	3	2	3	2	1
CO4	3	3	3	3	2	1	-	-	-	-	2	2	3	2	1
CO5	3	2	3	2	3	1	-	-	-	-	3	2	3	2	1
AVG	**2.6**	**2.6**	**2.8**	**2.4**	**2.6**	**1.2**	**-**	**-**	**-**	**-**	**2.6**	**2.2**	**3**	**2**	**1**

JEC2411	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 PSPICE 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. Study of R-2R Ladder Type D- A Converter using Op-amp.
11. DC power supply using LM317 / LM723.
12. Study of SMPS

SIMULATION USING PSPICE:

1. Active low-pass, High-pass and band-pass filters using Op-amp
2. Astable and Monostable multivibrators using NE555 Timer.

TOTAL PERIODS: 60

COURSE OUTCOMES:

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

- Design linear and non linear applications of OP – AMPS
- Design applications using analog multiplier and PLL
- Design ADC and DAC using OP – AMPS
- Demonstrate waveforms using OP – AMP Circuits
- Analyze special function ICs.

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/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	2	-	-	-	-	3	3	2	2	3
CO2	3	2	2	3	1	2	-	-	-	-	3	3	3	3	2
CO3	3	3	2	3	3	3	-	-	-	-	3	3	3	3	2
CO4	3	2	3	3	3	2	-	-	-	-	3	3	3	3	2
CO5	3	3	2	3	3	3	-	-	-	-	3	3	3	3	2
AVG	3	2	2	3	2	2	0	0	0	0	3	3	2.8	2.8	2.2

JGE2441	e-PROTOSHOP	L	T	P	C
		0	0	4	2

COURSE OBJECTIVES:

- To help students to Identify societal needs and problems and able to find solutions.
- To help students learn the fundamentals/essentials of the Design Thinking and Innovation process.
- To creates awareness in the students through design tools, observation, discovery, analysis, experience, collaboration, visualization and reflection.
- To nurture the student's curiosity and enhance their explorative abilities to foster creativity and innovation in students in any field.
- To enable the students to realize their ideas as prototypes and set a roadmap to commercialize the product developed.

1. **Design thinking** - Determine Innovative Idea – Need, understand the requirement, Define and redefine the problem, Brainstorm to generate ideas.

2. **Product design** – Conceptualization, Analysis, sketching a design that represents a product idea, Optimize a design through market experts.

3. **Virtual model Generation** – create realistic model of the proposed design using a 3D imaging software.

4. **Training on Skills and Tools** - Specific training on tools and machinery relevant to the prototype generation – Knowledge on specific tools, machinery, etc. (Hands-on workshops)

5. **Minimum Viable product** – POC contains hardware and software components, Hardware-software codesign, operatable like a finished product.

6. **Prototype creation** – Deployment, testing, redesign, user satisfaction and feedback, prototype upgradation.

7. **Roadmap to startup –** Analysis of target market, Marketing and sales plan, Business plan, Financial projections, Team building, Register your startup, licensing, permissions and certifications.

COURSE OUTCOMES:

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

- Understand the problem identification and finding solutions using one or more domains of technology.
- Create virtual mode of design.
- Use the tools and techniques relevant to the prototype generation.
- Develop a prototype of product ad a minimum viable product.
- Initiate start up and commercialize the product developed.

REFERENCES:

1. Arun Jain, From Teenager to Achiever, School of Design thinking www.d-thinking.com
2. Chakku 7C's https://www.idc.iitb.ac.in/~chakku/chakku7Cs.pdf
3. Collaborative Model For Innovation https://www.idc.iitb.ac.in/~chakku/COLLABORATIVE_ MODEL_FOR_INNOVATION.pdf
4. Pitfalls in the Innovation process https://www.idc.iitb.ac.in/~chakku/Pitfalls_in_the_innovation_process.pdf
5. Innovation By Design – Collaboration is the key to cross the Pitfalls in the Innovation Process https://www.idc.iitb.ac.in/~chakku/Innovation_by_Design.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	1	3	3	3	3	3	3	2	1	1	3	1	3
CO2	3	3	3	3	3	3	2	3	3	3	1	1	3	2	3
CO3	2	2	3	3	3	2	2	3	2	2	1	1	3	3	3
CO4	2	2	3	2	2	2	2	3	2	2	1	1	2	2	**3**
CO5	2	2	2	2	2	3	3	3	3	3	3	2	1	1	**3**
AVG	**2.2**	**2.2**	**2.4**	**2.6**	**2.6**	**2.6**	**2.4**	**3**	**2.6**	**2.4**	**1.4**	**1.2**	**2.4**	**1.8**	**3**

JPT2041	SOFT SKILLS AND APTITUDE	L	T	P	C
		0	0	2	1

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 – SWOT Analysis

UNIT III QUANTITATIVE APTITUDE 6

Profit and Loss and Discount – Simple and compound Interest - Ratio and Proportions – Allegations and Mixtures – Problem on Ages

UNIT IV LOGICAL REASONING 6

Directions – Blood Relation – Linear and Circular Arrangement – Cross variables - Set theory

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

COURSE OUTCOMES

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

- To enhance their knowledge in JAVA concepts.
- To Enhance knowledge in JAVA programming.
- To gain knowledge in Coding the concepts of JAVA programming.
- To solve the complex Arithmetic problems practically with real time application problems.
- To think logically in solving problems enhance their decision making for difficult situations.
- To enhance their employability skills and well prepared to face the MNCs Campus Interviews.

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.

WEBSITES:

https://www.indiabix.com/aptitude/questions-and-answers/
https://m4maths.com/placement-puzzles.php
www.freshers world.com
www.careerride.com
www.youtube.com/watch/python
www.youtube.com/watch/concepts of python
https://stackoverflow.com/
https://www.w3schools.com/
https://www.geeksforgeeks.org/

JEC2521	MICROPROCESSORS AND MICROCONTROLLERS	L	T	P	C
		3	0	2	4

COURSE OBJECTIVES:

- To explain the 8 bit and 16-bit microprocessors.
- To explain the architecture and programming of 8-bit microcontroller
- To explore the need and use of peripherals and interfacing.
- To make students understand microoperation concepts.
- To introduce the concepts of advanced processors and discuss system design.

UNIT I 8-BIT AND 16-BIT PROCESSORS 9

Introduction to 8 bit and 16 bit processors – Architecture of 8086 processor - Instruction set, Addressing modes, Programming, Minimum and Maximum mode configurations.

UNIT II 8-BIT MICROCONTROLLER 9

8051 – Architecture, Special Function Registers (SFRs), Instruction set, Addressing modes, Assembly language programming, I/O Ports, Timers/counters, Interrupts and serial communication.

UNIT III INTERFACING WITH PERIPHERAL UNITS 9

Processor interfacing: PPI (8255), Keyboard display (8279), ADC0808 and DAC0808 Interface, Programmable Timer (8254), PIC (8259), Serial Communication (8251) Controller interfacing: Stepper Motor, DC Motor using PWM, 16x2 LCD.

UNIT IV MICROPROGRAMMING 9

Overview of computer organization, CISC vs RISC, Data Transfer and Manipulation, Register Transfer, Timing Diagram, Bus and Memory Transfers, Arithmetic Micro-Operations, Logic Micro-Operations, I/O interface, Programmed IO, Memory Mapped IO, Interrupt Driven IO, DMA.

UNIT V SYSTEM DESIGN AND ADVANCED PROCESSORS 9

Case studies – Traffic light control, washing machine control, RTC Interfacing using I2C Standard Motor Control- Relay, PWM, DC & Stepper Motor. Introduction to ARM, PIC and Embedded processors.

TOTAL: 45 PERIODS

LIST OF EXPERIMENTS

Microprocessor based experiments using MASM software and kits

- Basic arithmetic and Logical operations using processor
- Move a data block
- Programming with control instructions

Microcontroller based experiments with kits

- Basic arithmetic and logical operations
- 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

TOTAL: 30 PERIODS

LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS

S. No.	Equipment	Required
1	8086 Microprocessor kits	15 Nos.
2	8051 Microcontroller kits	15 Nos.
3	Interfacing kits	5 each
4	Personal Computer with MASM Software	15 Nos.

TOTAL: 75 PERIODS

COURSE OUTCOMES:

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

- Explain the architecture and programming the microprocessors.
- Explain the architecture and programming the 8-bit microcontroller.
- Describe and experiment the interfacing of peripherals units.
- Explain the concepts of Microprogrammed control
- Develop skills on system design and understand the advanced processors.

TEXTBOOKS:

1. R.S. Gaonkar, "Microprocessor Architecture Programming and Application", with 8085, Wiley Eastern Ltd., New Delhi, 2013.
2. Krishna Kant, "Microprocessor and Microcontrollers, Architecture, Programming and System Design 8085, 8086, 8051", Second Edition, PHI Learning Private Limited, 2014.
3. A.P.Godse, "ARM Controller", Technical Publications, 2020.

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.

WEBSITE REFERENCES:

1. https://www.javatpoint.com/8086-microprocessor
2. https://www.javatpoint.com/peripheral-devices
3. http://www.digimat.in/nptel/courses/video/108105102/L31.html
4. https://microcontrollerslab.com/lpc-2148-microcontroller-architecture/
5. GitHub - vivekkj123/ktu-s5-csl-331-ssmp-lab: KTU S5 System Software and MicroProcessors Lab (CSL 331) Programs (2019 - Scheme)

CO - PO MAPPINGS:

CO\PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	3	3	1	-	-	-	-	-	1	2	3	3	1
CO2	3	2	3	3	1	-	-	-	-	-	1	2	3	3	1
CO3	3	2	3	3	1	-	-	-	-	-	1	2	3	3	1
CO4	3	2	3	3	1	-	-	-	-	-	1	2	3	3	1
CO5	3	2	3	3	1	-	-	-	-	-	1	2	3	3	1
AVG	3	2	3	3	1	-	-	-	-	-	1	2	3	3	1

JEC2501	DISCRETE-TIME SIGNAL PROCESSING	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To study the concepts of Discrete Fourier Transform and its applications.
- To learn design of digital IIR filters to filter undesirable signals in various frequency bands.
- To learn design of FIR filters to filter undesirable signals in various frequency bands.
- To understand the effects of finite precision representation on digital filters.
- To understand the basic concepts of multi rate signal processing and its applications.

UNIT I INTRODUCTION TO DISCRETE FOURIER TRANSFORM 9

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 9

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 9

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 realization.

UNIT IV FINITE WORD LENGTH EFFECTS 9

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

UNIT V MULTIRATE SIGNAL PROCESSING 9

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 – subband coding - speech signal compression.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

- Apply DFT for the analysis of discrete signals and systems.
- Design IIR filters.
- Design FIR filters.
- Characterize the effects of finite precision representation on digital filters.
- Elucidate multirate filters.

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/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	1	-	-	-	-	1	1	3	3	1
CO2	3	3	3	3	3	1	-	-	-	-	1	1	3	3	1
CO3	2	3	3	3	3	1	-	-	-	-	1	1	2	3	1
CO4	3	3	3	2	3	1	-	-	-	-	1	1	3	3	1
CO5	3	3	3	2	3	1	-	-	-	-	1	1	3	3	1
AVG	3	3	3	3	3	1	-	-	-	-	1	1	3	3	1

JEC2502	WIRELESS COMMUNICATION	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To ensure a comprehensive understanding of Cellular concepts
- To understand the multipath propagation and mobile radio fading
- To learn the various modulation techniques for multiuser systems
- To familiarize various multipath mitigation techniques and MIMO systems
- To elaborate standard wireless systems such as 4G, LTE, 5G and 6G networks

UNIT I CELLULAR CONCEPTS 9

Introduction to Multiple Access techniques: TDMA, FDMA, CDMA- System design- Frequency reuse - Channel Assignment- Hand off- Interference & System Capacity- Trunking & GoS – Capacity improvement in cellular systems - Technical Challenges.

UNIT II MOBILE RADIO PROPAGATION 9

Large scale path loss – Path loss models: Free Space and Two-Ray models -Link Budget design – Small scale fading and its types - Parameters of mobile multipath channels.

UNIT III MODULATION TECHNIQUES 9

Pulse shaping techniques-Linear Modulation Techniques: QPSK, pi/4 QPSK, MSK, GMSK-Spread Spectrum Modulation Techniques- OFDM principle – Cyclic prefix, Windowing, PAPR.

UNIT IV MITIGATION TECHNIQUES 9

Equalisation – Linear & Non-Linear Equalizer - Adaptive equalization: Zero forcing and LMS Algorithms. Diversity – Micro and Macro diversity, Diversity combining techniques, Rake receiver – MIMO systems.

UNIT V STANDARDIZED WIRELESS SYSTEMS 9

GSM- IS-95- GPRS, UMTS- WLAN- WPAN- WMAN- Ultra Wideband communications, 4G - LTE-beyond 5G and 6G networks.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

- Explain the fundamentals of Cellular concepts
- Brief the multipath propagation and mobile radio fading
- Apply different modulation techniques
- Summarize the mitigation techniques
- Identify various standard wireless systems such as 4G, LTE, 5G and 6G networks

TEXT BOOKS:

1. Rappaport,T.S., ―Wireless communications‖, Pearson Education, Second Edition, 2010.
2. A.F.Molisch, Wireless Communications, Wiley, Second Edition, 2011
3. A.Goldsmith, Wireless Communications, Cambridge University Press, Second Edition 2020.

REFERENCES:

1. P.Muthu Chidambara Nathan, "Wireless Communication"s, PHI, Reprint 2013.
2. Ke-Lin Du, M.N.S.Swamy, "Wireless Communication Systems", Cambridge University Press, 2010.
3. K.Fazel & S. Kaiser," Multi-carrier and Spread Spectrum Systems", Wiley, 2003
4. S.G. Glisic, "Advanced Wireless Communications", 4G Technologies, Wiley, 2006.

WEBSITE REFERENCES:

1. https://archive.nptel.ac.in/courses/108/106/106106167/
2. https://www.youtube.com/watch?v=cJQZvxfDFug
3. https://www.youtube.com/watch?v=ZV_MuwhyL7U
4. https://www.youtube.com/watch?v=T7NyrG4_RSI
5. https://www.youtube.com/watch?v=wqC0JJ-qC30&t=32s
6. https://www.youtube.com/watch?v=vjH7wMxP_J4

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	2	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	2.6	2.6	1	-	-	-	-	1	2	2.8	2.6	2.8

JEC2522	VLSI DESIGN	L	T	P	C
		3	0	2	4

COURSE OBJECTIVES:

- To introduce the fundamentals of VLSI Design concepts.
- To familiarize the VLSI combinational logic circuits design.
- To familiarize the VLSI sequential logic circuits design.
- To explain the various arithmetic circuits and testing methodologies
- To make students understand different FPGA architectures.

UNIT I MOS TRANSISTOR PRINCIPLES 9

MOS Transistor, CMOS Fabrication process, Electrical properties of CMOS circuits, device modeling. CMOS Inverter, DC Transfer characteristics, Layout Design Rules, Stick Diagrams. Study of the technological development in MOS.

UNIT II COMBINATIONAL CIRCUIT DESIGN 9

Combinational Circuits: Static CMOS, Ratioed Circuits, Pass Transistor, Transmission Gates, DCVSL, Dynamic Circuits, Domino Logic, NP CMOS logic, NORA logic.
Dynamic Power, Static Power, Low Power Architecture

UNIT III SEQUENTIAL CIRCUIT DESIGN 9

Static latches and Registers, Dynamic latches and Registers, Pipelining, Timing Issues. Memory Architectures and Building Blocks, Memory Core and Memory Peripheral Circuitry.

UNIT IV ARITHMETIC BUILDING BLOCK AND TESTING TECHNIQUES 9

Arithmetic Building Blocks: Data Paths, Adders, Multipliers, Shifters.
Testing: Need for testing, Manufacturing test principles, Design for Testability, Boundary Scan Testing, BIST.

UNIT V IMPLEMENTATION STRATEGIES 9

Full Custom and Semicustom Design, Standard Cell design and cell libraries, FPGA building block architectures, FPGA interconnect routing procedures. ASIC Design flow - Development of IC in commercial aspects.

TOTAL: 45 PERIODS

LIST OF EXPERIMENTS

1. Design, simulation and synthesis of code converter.
2. Design, simulation and synthesis of a counter.
3. Design, simulation and synthesis of 4 ALU.
4. Design and implementation of multiplexer.
5. Design and implementation of 8-bit adder.
6. Design and simulation of CMOS inverter using cadence.
7. Design and simulation of amplifier.

TOTAL: 30 PERIODS
TOTAL: 75 PERIODS

LIST OF EQUIPMENT 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	15 Nos.

COURSE OUTCOMES:

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

- Describe the fundamentals of VLSI Design.
- Design the VLSI combinational logic circuits
- Design the VLSI sequential circuits
- Explain the various arithmetic circuits and testing methodologies
- Explain and differentiate different FPGA architectures.

TEXTBOOKS:

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‖, 4thEdition, 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.

WEBSITE REFERENCES:

1. https://www.tutorialspoint.com/vlsi_design/vlsi_design_digital_system.html
2. https://nptel.ac.in/courses/117/106/117106093/
3. https://archive.nptel.ac.in/courses/117/106/117106092/
4. https://mevlsi-iitkgp.vlabs.ac.in/List%20of%20experiments.html
5. https://www.javatpoint.com/verilog

CO - PO MAPPINGS:

CO\PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	2	1	2	2	1	-	-	-	-	2	2	2	1	2
CO2	2	2	2	2	2	1	-	-	-	-	2	3	2	2	2
CO3	2	2	2	2	2	1	-	-	-	-	2	3	3	2	2
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	1.4	-	-	-	-	2.4	2.8	2.6	2.2	2.4

JHS2541	PROFESSIONAL COMMUNICATION	L	T	P	C
		0	0	2	1

COURSE OBJECTIVES:

- To enhance reading comprehension and oral communication through self-reflection and peer feedback
- To improve listening and speaking skills through exposure to diverse accents and group discussions
- To develop professional writing and critical thinking through email composition and career-related tasks
- To refine presentation skills and job application writing for effective workplace communication
- To build interview confidence and problem-solving abilities through simulations and case analysis

LIST OF EXPERIMENTS AND ACTIVITIES:

1. Reading: 21st Century Skills

Activity: Read an article or infographic on 21st-century skills, summarize key skills and conduct a quiz.

2. Speaking: Self-introduction

Activity: Deliver a 2 to 3-minute self-introduction or elevator pitch and receive peer feedback on content and delivery.

3. Listening: Accents in English

Activity: Listen to English audio clips in British, American, and Indian accents and answer comprehension questions based on the content.

4. Speaking: Group Discussion Dynamics

Activity: Participate in a formal group discussion on a current or technical topic and observe turn-taking, assertiveness, and relevance.

5. Writing: Working in Virtual Teams

Activity: Conduct a virtual team-based design challenge, simulate and record a remote meeting, and complete a reflective report on communication effectiveness.

6. Reading: Career Planning and Research Proposals

Activity: Read and analyse a sample career plan or research proposal, extract key points and compare effectiveness.

7. Speaking: Presentation Skills

Activity: Prepare and deliver a 4 to 5-minute oral or PPT presentation on a technical or career-related topic and receive peer and instructor feedback.

8. Writing: Job Application and Resume Writing

Activity: Prepare a tailored cover letter and resume—both by mail and email—for a specific job description, emphasizing clarity, proper formatting, and relevance.

9. Speaking: Interview Skills

Activity: Participate in mock interviews in pairs or with instructors, practice behavioural questions and receive structured feedback.

10. Listening: Professional Challenges

Activity: Listen to workplace case studies based on real-life experiences shared by friends or relatives, identify challenges and discuss possible solutions and ethical considerations.

TOTAL: 30 PERIODS

COURSE OUTCOMES:

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

- To demonstrate improved reading and speaking through summarization and structured self-introductions
- To apply listening and discussion strategies by interpreting diverse accents and engaging in collaborative dialogues
- To produce professional emails and analyse career-related documents with clarity
- To deliver concise presentations and craft effective job applications tailoring to contexts
- To show interview readiness and ethical awareness by engaging in mock interviews and analysing workplace challenges.

TEXT BOOKS:

1. Meenakshi Raman & Sangeeta Sharma, Technical Communication: Principles and Practice Oxford University Press, 2022.
2. Pushp Lata & Sanjay Kumar, Communication Skills, Oxford University Press, 2011

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. Dhawan, Erica. (2021). Digital Body Language: How to Build Trust and Connection, No Matter the Distance. New York: St. Martin’s Press.
4. Gallo, Carmine. (2014). Talk Like TED: The 9 Public-Speaking Secrets of the World’s Top Minds. New York: St. Martin’s Press.
5. Interact English Lab Manual for Undergraduate Students, 2016, Hyderabad: Orient BlackSwan.
6. Mitra, Barun K, 2016, Personality Development and Soft Skills, New Delhi: Oxford University Press.
7. Raman, Meenakshi and Sangeeta Sharma, 2022, Professional Communication, Oxford: Oxford University Press.
8. Rizvi, Ashraf, M, 2018, Effective Technical Communication, Chennai: McGraw-Hill Education.

WEBSITE REFERENCES:

1. https://www.coursera.org/learn/english-for-career-development
2. https://owl.purdue.edu/
3. https://www.mindtools.com/
4. https://www.toastmasters.org/resources/public-speaking-tips
5. https://www.ted.com/topics/communication
6. https://learnenglish.britishcouncil.org/skills
7. https://www.indeed.com/career-advice/resumes-cover-letters
8. https://www.skillsyouneed.com/

CO - PO MAPPINGS:

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

JEC2511	DISCRETE TIME SIGNAL PROCESSING LABORATORY	L	T	P	C
		0	0	4	2

COURSE OBJECTIVES:

- To explore computation of DFT using MATLAB.
- To design FIR and IIR filters using MATLAB
- To perform Up-sampling and Down-sampling operations
- To study the architecture of DSP processor and perform MAC operations
- To learn about signal generation and FIR and IIR Implementation using DSP Processor.

LIST OF EXPERIMENTS:

MATLAB Simulation

1. Computation of DFT
2. Circular convolution of two sequences
3. Design of FIR filters (LPF/HPF/BPF/BSF) and demonstration of frequency response
4. Design of Butterworth IIR filters (LPF/HPF/BPF/BSF) and demonstration of frequency response
5. Illustration of Sampling rate conversion

DSP PROCESSOR

6. Study of architecture of Digital Signal Processor.
7. Perform MAC operation using various addressing modes.
8. Generation of various signals.
9. Demonstration of Low pass and High pass FIR Filters.
10. Demonstration of Low pass and High pass IIR Filters.
11. Implementation of upsampling and downsampling.

TOTAL: 60 PERIODS

COURSE OUTCOMES:

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

- Demonstrate the frequency response using DFT.
- Demonstrate filtering operation using MATLAB
- Demonstrate sampling rate conversion.
- Demonstrate arithmetic operations using DSP Processor
- Demonstrate filtering operation using DSP Processor

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

- MATLAB software package for simulation experiments
- PCs - 15 Nos
- Kits - DSP Processor 10 Nos.
- CROs - 10 Nos,
- Function Generators – 5 Nos.

WEBSITE REFERENCE

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 MAPPINGS:

CO\PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	3	2	2	-	-	-	-	1	1	3	3	2
CO2	3	3	3	3	2	2	-	-	-	-	1	1	2	2	2
CO3	3	3	3	2	2	2	-	-	-	-	1	1	1	2	2
CO4	3	3	3	2	3	2	-	-	-	-	1	1	2	2	3
CO5	3	3	3	2	3	1	-	-	-	-	1	1	2	2	1
AVG	3	3	3	2	2	2	-	-	-	-	1	1	2	2	2

JGE2541	INDUSTRY 4.0 LABORATORY	L	T	P	C
		0	0	4	2

COURSE OBJECTIVES

- To provide a thorough understanding of Arduino and ESP32 platforms
- To equip learners with foundational and practical knowledge of the Raspberry Pi platform
- To develop a deep understanding of industrial sensor and actuator networks
- To provide a comprehensive introduction to build basic IoT sensing systems
- To introduce the foundational concepts of mobile robotics

MODULE I ARDUINO AND ITS APPLICATIONS

Arduino Fundamentals, Advanced Interfacing & ESP32 Concepts, Hands-on Lab -ESP32 GPIO & Advanced Applications, Project presentations.

MODULE II RASPBERRY PI FOR EMBEDDED SYSTEMS AND IOT

Raspberry Pi fundamentals, setting up Raspberry Pi (OS installation, configurations), Hands-on Lab – GPIO, Serial port & Data collection, Hands – on Lab – Actuators & Complete Projects.

MODULE III INDUSTRIAL SENSOR NETWORKS AND AUTOMATION

Industrial sensor networks – Hands – on lab: Advanced actuators. Industry applications and case studies – Complete sensor – actuator system, Project presentations.

MODULE IV FUNDAMENTALS OF IoT SYSTEMS AND CLOUD INTEGRATION

IoT Fundamentals, Sensors in IoT applications, Hands – on lab: Basic IoT sensing, IoT Connectivity and Cloud Integration, Hands – on lab: Cloud integration, IoT project planning and deployment, Project presentations.

MODULE V INTRODUCTION TO ROBOTICS, SENSORS AND ACTUATORS

Introduction to robotics basics and key components, Introduction to sensors and actuators, Mobile robot fundamentals, Basic motion control principles, Introduction to sensor – based navigation, Project Integration, building a robot that can follow lines and avoid obstacles.

TOTAL: 60 PERIODS

COURSE OUTCOMES

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

- program using Arduino and interfacing techniques
- design and implement end-to-end embedded and IoT solutions.
- apply knowledge in industrial automation and smart systems
- build basic IoT sensing systems
- develop a mobile robot capable of line follow and obstacle avoidance

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	1	3	3	3	3	3	3	2	1	1	3	1	3
CO2	3	3	3	3	3	3	2	3	3	3	1	1	3	2	3
CO3	2	2	3	3	3	2	2	3	2	2	1	1	3	3	3
CO4	2	2	3	2	2	2	2	3	2	2	1	1	2	2	3
CO5	2	2	2	2	2	3	3	3	3	3	3	2	1	1	3
AVG	2.2	2.2	2.4	2.6	2.6	2.6	2.4	3	2.6	2.4	1.4	1.2	2.4	1.8	3

JPT2042	TECHNICAL SKILLS AND APTITUDE	L	T	P	C
		0	0	2	*

COURSE OBJECTIVES:

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

UNIT I FUNDAMENTALS OF C++ 6

Introduction to C++ - Data Types and Operators - Control Structures - Functions in C++ - Arrays and Strings - Structures and Unions - File Handling

UNIT II OBJECT-ORIENTED PROGRAMMING (OOP) & ADVANCED C++ 6

Object-Oriented Programming (OOP) - Inheritance & Polymorphism - Operator Overloading - Templates and Exception Handling - Standard Template Library (STL) - Multi-threading & Advanced Topics

UNIT III PYTHON BASICS & FUNDAMENTALS 6

Introduction to Python - Data Types & Variables - Operators & Expressions - Control Flow Statements - Functions & Modules - File Handling - Exception Handling

UNIT IV QUANTITATIVE APTITUDE 6

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

UNIT V LOGICAL REASONING 6

Syllogism: Statement and Conclusion – Clocks - Inequalities – Non Verbal Reasoning – Logical Sequence, Inferred Meaning

TOTAL: 30 PERIODS

COURSE OUTCOMES

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

- enhance their knowledge in OOPS concepts
- enhance knowledge in PYTHON programming
- gain knowledge in Coding the concepts of python programming.
- solve the complex Arithmetic problems practically with real time application problems
- think logically in solving problems enhance their 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/

JEC2601	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 provide basics of antenna arrays and smart antennas.
- To explain the basics of microwave passive and active devices.
- To explain the design of RF components.

UNIT I INTRODUCTION TO MICROWAVE SYSTEMS AND ANTENNAS 9

Microwave frequency bands, Physical concept of radiation, Near- and far-field regions, Antenna Pattern Characteristics, Antenna Directivity, Antenna Gain and Efficiency, Aperture Efficiency and Effective Area, 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 linear 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, PIN diodes, Microwave tubes: Two cavity Klystron, Reflex Klystron, Cylindrical Magnetron.

UNIT V MICROWAVE DESIGN PRINCIPLES 9

Impedance transformation, Impedance Matching, Microwave Filter 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
- Describe the design concepts of array antennas and smart antennas
- Explain the working principles of microwave passive and active devices
- Explain the design of RF components.

TEXTBOOKS:

1. John D Krauss, Ronald J Marhefka and Ahmad S. Khan, "Antennas and Wave Propagation: Fifth Edition, Tata McGraw-Hill, 2018. (UNIT I, II, III)
2. David M. Pozar, "Microwave Engineering", Fourth Edition, Wiley India, 2013 (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, 2007.

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/PSO MAPPING:

CO\PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	2	3	1	-	-	-	-	3	2	2	2	1
CO2	2	3	2	2	3	1	-	-	-	-	2	3	2	2	2
CO3	3	2	3	2	3	1	-	-	-	-	3	3	2	2	2
CO4	2	2	3	3	2	1	-	-	-	-	3	3	1	2	3
CO5	3	3	3	2	2	2	-	-	-	-	2	2	3	1	1
AVG	2.6	2.6	2.8	2.4	2.6	1.2	-	-	-	-	2.6	2.6	2	1.8	1.8

JEC2621	EMBEDDED SYSTEMS DESIGN (Integrated)	L	T	P	C
		3	0	2	4

COURSE OBJECTIVES:

- To understand and learn the architecture, basic instruction set of ARM processor.
- To discuss on the embedded computing platform design and analysis
- To interpret the basic concepts of process and scheduling
- To illustrate the principles of embedded system design and communication
- To analyze case studies in embedded system and use cases in IoT

UNITI INTRODUCTION TO EMBEDDED COMPUTING AND ARM PROCESSORS 9

Introduction- Characteristics of Embedded Computing System-Challenges–Embedded system design process – Basic operation of computing system- Instruction set Architecture-Classification of CPU Architecture - ARM Processor architecture – register organization and modes– Caches.

UNIT II EMBEDDED COMPUTING PLATFORM DESIGN 9

Bus organization protocol-DMA-Memory devices and systems–Designing with computing platforms - Components for embedded programs- Assembly, linking and loading –Program validation and testing.

UNIT III PROCESSES AND OPERATING SYSTEMS 9

Introduction – Multiple tasks and multiple processes – Multirate systems - Priority based scheduling: Round Robin- Earliest Deadline First (EDF) Scheduling - Interprocess Communication mechanisms

UNIT IV SYSTEM DESIGN AND NETWORKS 9

Design methodologies- Design flows - System analysis and Architecture Design - Distributed embedded systems: CAN Bus-I^2C-MPSoCs and shared memory multiprocessors: Accelerators.

UNIT V CASE STUDY 9

Alarm Clock-ATM system- Engine Control unit- Inkjet Printer-Data Compressor-Overview of Embedded IoT- Use Case examples: Smart Transportation -Smart Cities-Smart Industry-Smart Agriculture.

TOTAL: 45 PERIODS

LIST OF EXPERIMENTS

Experiments using Tiva TM C Series TM4C123G & MSP-EXP430F5529LP

- Study of ARM Evaluation System
- Flashing of LEDs
- Interfacing ADC
- Temperature Sensing
- Interfacing of PWM
- Interfacing keypad & LCD
- Augmented Experiments using IoT trainer kits

LAB Requirements for a Batch of 30 students

- Energia 1.8.10E23
- MSP-EXP430F5529LP Launch Pad
- Code Composer Studio V6.0
- Tiva TM C Series TM4C123G Launch Pad evaluation Kit
- IOT trainer kit – Raspberry Pi4
- PCs-15

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

- Describe the architecture and basic instruction set of ARM processor.
- Outline the concepts of Embedded Computing
- Explain the basic concepts of Real Time Operating system and scheduling
- Use the system design methodologies and communication protocols in embedded systems
- Illustrate the design and working of Embedded and IoT case studies

TEXTBOOKS:

1. Marilyn Wolf, "Computers as Components - Principles of Embedded Computing System Design", Third Edition "Morgan Kaufmann Publisher (An imprint from Elsevier), 2012
2. Robert Barton, Patrick Grossetete, David Hanes, Jerome Henry, Gonzalo Salgueiro, "IoT Fundamentals: Networking Technologies, Protocols, and Use Cases for the Internet of Things", CISCO Press, 2017

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. K.V.K.K.Prasad, "Embedded Real-Time Systems: Concepts, Design & Programming", Dream Tech Press,2005.
5. Sriram V Iyer, Pankaj Gupta, "Embedded Real Time Systems Programming", Tata Mc Graw Hill, 2004.
6. Vijay Madisetti, Arshdeep Bahga, ―Internet of Things (A Hands-on Approach), Universities Press, 2015

WEBSITE REFERENCES:

1. E Book Embedded system Designhttp://esd.cs.ucr.edu/
2. https://resources.pcb.cadence.com/blog/embedded-systems-design-functionality-and-processes
3. https://onlinecourses.nptel.ac.in/noc25_cs30
4. https://onlinecourses.nptel.ac.in/noc22_cs93
5. https://www.digi.com/blog/post/iot-in-agriculture
6. https://www.rishabhsoft.com/blog/iot-in-smart-cities-applications-benefits
7. https://www.semtech.com/applications/internet-of-things/smart-agriculture

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	1	2	2	2
CO5	3	3	3	3	3	3	2	1	2.5	1	1	1	3	2	3
AVG	**2.6**	**2.6**	**2.6**	**2.6**	**2.4**	**2.2**	**2**	**1**	**2.5**	**1**	**1**	**1**	**2.4**	**2.2**	**2.2**

JEC2622	COMMUNICATION NETWORKS	L	T	P	C
		3	0	2	4

COURSE OBJECTIVES:

- To understand the OSI layer, various transmission media and Error detection and correction Codes
- To study the MAC protocols and wireless technologies
- To understand the Routing protocols and addressing
- To learn the flow control and congestion control algorithms
- To study various applications and security concepts

UNIT I FUNDAMENTALS AND TRANSMISSION MEDIA 9

Overview of Data Communications- Networks – the OSI Model –layers in OSI Model- TCP/IP protocol suite-Data Rate limits-performance parameters (definitions)-Transmission Media: Guided Media-unguided Media-Packet Switched Networks-Transmission modes- Types of Errors-Modular Arithmetic-Block coding: Hamming Distance-Cyclic codes: CRC-Checksum

UNIT II DATA LINK CONTROL AND MULTIPLE ACCESS 9

Framing-flow and error control –Protocols: Stop and Wait ARQ-Go-back N ARQ-selective repeat ARQ-Point to point protocol. Multiple-Access Protocols: CSMA-CSMA/CD-CSMA/CA-controlled access protocols-Channelization protocols: FDMA, TDMA, and CDMA. Wired and Wireless technologies: Ethernet IEEE 802.3 - Wireless LANs – Bluetooth– WiFi –Zigbee

UNIT III NETWORK LAYER AND ROUTING 9

Network Layer Services - 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 - 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, MMSC.

TOTAL: 45 PERIODS

LIST OF EXPERIMENTS

1. Implementation of bus and ring topology
2. Implementation of Stop and Wait, Go Back-N and selective repeat protocols.
3. To create scenario and study the performance of network with CSMA / CA and CSMA/CD protocols.
4. Implementation of Distance vector routing algorithm and link state routing.
5. Simulation of topology using NS2
6. Simulation of error control protocols
7. Study of Cisco packet Tracker.

TOTAL: 30 PERIODS

TOTAL: 75 PERIODS

LAB REQUIREMENTS FOR A BATCH OF 30 STUDENTS

- Vi-RtSim
- NS2, Cisco Packet Tracker
- PCs-15

COURSE OUTCOMES:

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

- Explain the OSI layer model and evaluate the error detection and correction codes
- Describe the MAC protocols and wireless technologies
- Compare and contrast the various Routing protocols and addressing
- Trace the flow of information from one node to another node in the network
- Describe various applications and security concepts

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,DepartmentofComputer 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/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	2	1	2.5	1	1	1	3	2	3
AVG	2.6	2.6	2.6	2.6	2.4	2.2	2	1	2.5	1	1	1	2.4	2.2	2.2

JEC2611	ANTENNAS AND MICROWAVE LABORATORY	L	T	P	C
		0	0	4	2

COURSE OBJECTIVES

- To design and simulate the antennas using electromagnetic computation
- To determine the radiation pattern and gain of directional antennas
- To learn about the characteristics of microwave oscillators
- To demonstrate the behavior of microwave components
- To measure S-parameters of microwave devices

LIST OF ANTENNA EXPERIMENTS

1. Simulation of the Microstrip Patch Antenna
2. Simulation of Radiation Pattern of the Omni-Directional Antenna
3. Simulation of Radiation pattern of an End-fire and broadside array antennas
4. Measurement of Radiation Pattern of the Horn Antenna
5. Measurement of Radiation Pattern of the Parabolic Antenna

LIST OF MICROWAVE EXPERIMENTS

1. Mode Characteristics of Reflex Klystron
2. VI Characteristics of Gunn Diode
3. Frequency and Wave Length Measurement
4. Directivity, Coupling Coefficient and S – Parameter Measurement of Directional Coupler
5. S-parameter measurement of Isolator and Circulator
6. S- Matrix Characterization of E – plane Tee, H-Plane Tee and Magic Tee
7. Characteristics of variable attenuator

TOTAL: 60 PERIODS

COURSE OUTCOMES:

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

- Design and analyse the S-parameter of various antennas using electromagnetic simulation computation.
- Characterize the radiation pattern and gain of various antennas.
- Analyze the mode characteristics of microwave active devices.
- Measure the various parameters of directional couplers.
- Measure the S-parameters of microwave passive devices.

WEBSITE REFERENCES:

1. https://onlinecourses.nptel.ac.in/noc20_ee20/preview
2. https://www.antenna-theory.com/
3. https://nptel.ac.in/courses/108103141
4. https://onlinecourses.nptel.ac.in/noc25_ee50/preview
5. https://www.microwaves101.com/

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

1. PC with Matlab/CST/Equivalent Software – 10 No's
2. Microwave test Bench at X band and Antenna turn table to measure Radiation pattern of Horn antenna – 1 No.
3. Microwave test Bench at X band and Antenna turn table to measure Radiation pattern of Parabolic antenna – 1 No.
4. Microwave test Bench at X band to determine Directional coupler characteristics. - 1 No.
5. Microwave test Bench at X band to determine VSWR for Isolator and Circulator, VSWR meter, Isolator, Circulator, E Plane Tee, H plane Tee. - 1 No.
6. Microwave Test Bench at X band, to determine the characteristics of Variable Attenuator – 1 No

CO - PO MAPPINGS:

CO\ PO	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	2	2	2	2	1	2	-	-	-	-	1	1	2	2	2
CO3	2	2	2	2	1	1	-	-	-	-	1	1	2	2	2
CO4	3	2	2	2	2	1	-	-	-	-	1	1	2	2	2
CO5	2	2	1	2	2	2	-	-	-	-	1	1	3	2	3
AVG	2.2	2	1.8	2	1.6	1.6	-	-	-	-	1	1	2.4	2.2	2.2

JGE2641	PRODUCT DEVELOPMENT LABORATORY	L	T	P	C
		0	0	4	2

COURSE OBJECTIVES:

- To provide overview of product development boards
- To familiarize students with embedded platforms, sensors, actuators, communication protocols, and cloud-based IoT integration.
- To enhance problem-solving skills in real-world applications across various domains
- To develop prototyping skills using modern tools and techniques
- To provide hands-on experience in designing and product development.

LIST OF EXPERIMENTS / MODULES

Module 1: Introduction to Product Development & Embedded Platforms

- Introduction to IoT and Embedded Systems in various domains.
- Overview of development boards (Arduino, ESP32, STM32, Raspberry Pi).
- Basics of sensors, actuators, and communication modules.
- Industry best practices and future scope in IoT and embedded systems.
- Hands-on: Blinking LED, sensor interfacing, GPIO control.

Module 2: Communication Protocols & IoT Integration

- Overview of wired and wireless communication protocols (UART, I2C, SPI, Bluetooth, Wi-Fi, MQTT, LoRa).
- Hands-on: Interfacing with an IoT cloud platform (Thingspeak, Firebase, AWS IoT, Google Firebase).
- Data acquisition and visualization using IoT dashboards.

Module 3: Embedded System Development & Real-Time Processing

- Introduction to RTOS for embedded applications.
- Hands-on: Task scheduling and real-time data processing using FreeRTOS on ESP32.
- Sensor fusion techniques for real-world applications.

Module 4: Domain-Specific Product Development

Students will choose a domain and develop a prototype based on real-world needs. Sample applications are listed but not limited to: Consumer electronics, wearable electronics, automotive Electronics, Agricultural, EV, BMS, Energy monitoring, smart metering, biomedical products such as IoT based patient monitoring, signal processing etc. home automation, product for automobile industries.

Module 5: Prototyping, Testing, Product deployment and Documentation

- Hardware design: PCB designing using KiCad / Eagle.
- Firmware development and debugging using Keil / MPLAB / Arduino IDE.
- Product reliability testing and performance analysis.
- Project presentations, demonstration of working prototypes.
- Writing technical documentation, reports, and product manuals.

TOTAL: 60 PERIODS

TOOLS & SOFTWARE REQUIRED:

- **Development Boards**: Arduino UNO, ESP32, STM32, Raspberry Pi
- **Sensors & Actuators**: Temperature, humidity, motion, pressure sensors, servo motors, relays
- **Communication Modules**: Bluetooth (HC-05), Wi-Fi (ESP8266/ESP32), LoRa modules
- **Embedded Development Environments**: Arduino IDE, STM32CubeIDE, Keil uVision, MPLAB X, PlatformIO
- **IoT Platforms**: Thingspeak, AWS IoT, Google Firebase, Blynk
- **PCB Design Tools**: KiCad, Eagle, Altium Designer
- **Simulation Tools**: Proteus, Tinkercad, MATLAB Simulink

COURSE OUTCOMES:

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

- Design and implement embedded systems for real-world applications.
- Develop IoT-based solutions using appropriate hardware and software tools.
- Interface sensors, actuators, and communication modules with microcontrollers.
- Analyze product requirements and create working prototypes.
- Document product development processes and present project outcomes.

TEXTBOOKS:

1. Raj Kamal, Internet of Things: Architecture and Design Principles, McGraw Hill.
2. Arshdeep Bahga, Vijay Madisetti, Internet of Things: A Hands-On Approach, Universities Press.
3. Muhammad Ali Mazidi, The 8051 Microcontroller and Embedded Systems, Pearson.

REFERENCE BOOKS:

1. Pethuru Raj, Anupama C. Raman, The Internet of Things: Enabling Technologies, Platforms, and Use Cases, CRC Press.
2. Jan Axelson, Embedded Ethernet and Internet Complete, Lakeview Research.
3. Jonathan W. Valvano, Embedded Systems: Introduction to ARM Cortex-M Microcontrollers, CreateSpace.
4. Adrian McEwen, Designing the Internet of Things, Wiley.

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	1	3	3	3	3	3	3	2	1	1	3	1	3
CO2	3	3	3	3	3	3	2	3	3	3	1	1	3	2	3
CO3	2	2	3	3	3	2	2	3	2	2	1	1	3	3	3
CO4	2	2	3	2	2	2	2	3	2	2	1	1	2	2	3
CO5	2	2	2	2	2	3	3	3	3	3	3	2	1	1	3
AVG	2.2	2.2	2.4	2.6	2.6	2.6	2.4	3	2.6	2.4	1.4	1.2	2.4	1.8	3

JPT2042	TECHNICAL SKILLS AND APTITUDE	L	T	P	C
		0	0	2	1

COURSE OBJECTIVES:

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

UNIT1 OBJECT-ORIENTED & ADVANCED PYTHON 6

Object-Oriented Programming (OOP) - Advanced Data Structures & Algorithms - Decorators & Closures - Regular Expressions & String Manipulation - Multi-threading & Multiprocessing.

UNIT II JAVA FUNDAMENTALS 6

Introduction to Java - Data Types & Variables - Operators & Control Statements - Functions & Methods - Arrays & Strings.

UNIT III OBJECT-ORIENTED PROGRAMMING (OOP) & ADVANCED JAVA 6

Object-Oriented Programming (OOP) Basics - Exception Handling - Inheritance & Polymorphism - Collections Framework - File Handling & Serialization.

UNIT IV QUANTITATIVE APTITUDE 6

Permutation and combination: Letter, Number and circular permutation – Probability – Logarithm – Mensuration – Data sufficiency.

UNIT V LOGICAL REASONING 6

Calendar – Visual Reasoning – Mirror Image and Water Image – Picture analogy – Pattern completion – Data Interpretation – Selection decision table.

TOTAL: 30 PERIODS

COURSE OUTCOMES

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

- enhance the knowledge in JAVA concepts and programming
- gain knowledge in Coding the concepts of JAVA programming
- solve the complex Arithmetic problems practically with real time application problems
- think logically in solving problems enhance their decision making for difficult situations.
- enhance the employability skills and well prepared to face the MNCs Campus interviews.

TEXTBOOKS:

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/

JNC2761	INDUSTRIAL SAFETY	L	T	P	C
		3	0	0	0

COURSE OBJECTIVES

- To Understand the Introduction and basic Terminologies safety.
- To enable the students to learn about the Important Statutory Regulations and standards.
- To enable students to Conduct and participate the various Safety activities in the Industry.
- To have knowledge about Workplace Exposures and Hazards.
- To assess the various Hazards and consequences through various Risk Assessment Techniques.

UNIT I SAFETY TERMINOLOGIES 9

Hazard-Types of Hazard- Risk-Hierarchy of Hazards Control Measures-Lead indicators- lag Indicators-Flammability- Toxicity Time-weighted Average (TWA) - Threshold LimitValue (TLV) - Short Term Exposure Limit (STEL)- Immediately dangerous to life or health (IDLH)- acute and chronic Effects- Routes of Chemical Entry-Personnel Protective Equipment- Health and Safety Policy-Material Safety Data Sheet MSDS.

UNIT II STANDARDS AND REGULATIONS 9

Indian Factories Act-1948- Health- Safety- Hazardous materials and Welfare- ISO 45001:2018 occupational health and safety (OH&S) - Occupational Safety and Health Audit IS14489:1998- Hazard Identification and Risk Analysis- code of practice IS 15656:2006

UNIT III SAFETY ACTIVITIES 9

Toolbox Talk- Role of safety Committee- Responsibilities of Safety Officers and Safety Representatives- Safety Training and Safety Incentives- Mock Drills- On-site Emergency Action Plan- Off-site Emergency Action Plan- Safety poster and Display- Human Error Assessment

UNIT IV WORKPLACE HEALTH AND SAFETY 9

Noise hazard- Particulate matter- musculoskeletal disorder improper sitting poster and lifting Ergonomics RULE & REBA- Unsafe act & Unsafe Condition- Electrical Hazards- Crane Safety- Toxic gas Release

UNIT V HAZARD IDENTIFICATION TECHNIQUES 9

Job Safety Analysis-Preliminary Hazard Analysis-Failure mode and Effects Analysis- Hazard and Operability- Fault Tree Analysis- Event Tree Analysis Qualitative and Quantitative Risk Assessment- Checklist Analysis- Root cause analysis- What-If Analysis- and Hazard Identification and Risk Assessment

TOTAL: 45 PERIODS

COURSE OUTCOMES:

Course outcomes on completion of this course the student will be able to:

- Understand the basic concept of safety.
- Obtain knowledge of Statutory Regulations and standards.
- Know about the safety Activities of the Working Place.
- Analyze on the impact of Occupational Exposures and their Remedies
- Obtain knowledge of Risk Assessment Techniques.

TEXTBOOKS:

1. R.K. Jain and Prof. Sunil S. Rao Industrial Safety, Health and Environment Management Systems KHANNA PUBLISHER
2. L. M. Deshmukh Industrial Safety Management: Hazard Identification and Risk Control McGraw-Hill Education

REFERENCES:

1. Frank Lees (2012) 'Lees' Loss Prevention in Process Industries.Butterworth-Heinemann
3. publications, UK, 4th Edition.
2. John Ridley & John Channing (2008) Safety at Work: Routledge, 7th Edition.
3. Dan Petersen (2003) Techniques of Safety Management: A System Approach.
4. Alan Waring.(1996). Safety management system: Chapman &Hall,England
5. Society of Safety Engineers, USA

WEBSITE REFERENCES:

- ISO 45001:2018 occupational health and safety (OH&S) International Organization for
- Standardization https://www.iso.org/standard/63787.html
- Indian Standard code of practice on occupational safety and health audit
- https://law.resource.org/pub/in/bis/S02/is.14489.1998.pdf
- Indian Standard code of practice on Hazard Identification and Risk Analysis IS 15656:2006
- https://law.resource.org/pub/in/bis/S02/is.15656.2006.pdf

CO-PO/PSO MAPPING:

CO\PO, PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
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CO2	2	3	2	2	1	3	2	3	3	2	1	3	3	3	3
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CO4	3	3	3	2	2	3	2	2	3	2	1	3	3	3	3
CO5	3	2	3	2	2	3	2	2	3	2	2	3	3	3	3
AVG	3	3	3	2	1	3	2	2	3	2	1	3	3	3	3

JHS2741	UNIVERSAL HUMAN VALUES	L	T	P	C
		1	0	2	2

COURSE OBJECTIVES:

- Development of a holistic perspective based on self-exploration about themselves (human being), family, society and nature/existence.
- Understanding (or developing clarity) of the harmony in the human being, family, society and nature/existence
- Strengthening of self-reflection.
- Development of commitment and courage to act.

Module I Introduction (3L, 6P)

Purpose and motivation for the course, recapitulation from Universal Human Values-I, Self-Exploration– Its content and process; 'Natural acceptance' and Experiential Validation- as the process for self-exploration Continuous Happiness and Prosperity- A look at basic Human Aspirations Right understanding, Relationship and Physical Facility- the basic requirements for fulfilment of aspirations of every human being with their correct priority Understanding Happiness and Prosperity correctly- A critical appraisal of the current scenario, Method to fulfil the above human aspirations: understanding and living in harmony at various levels.

Practical Session: *Include sessions to discuss natural acceptance in human being as the innate acceptance for living with responsibility (living in relationship, harmony and co-existence) rather than as arbitrariness in choice based on liking-disliking*

Module II Harmony in the Human Being (3L, 6P)

Understanding human being as a co-existence of the sentient 'I' and the material 'Body', Understanding the needs of Self ('I') and 'Body' - happiness and physical facility, Understanding the Body as an instrument of 'I' (I being the doer, seer and enjoyer), Understanding the characteristics and activities of 'I' and harmony in 'I', Understanding the harmony of I with the Body: Sanyam and Health; correct appraisal of Physical needs, meaning of Prosperity in detail, Programs to ensure Sanyam and Health.

Practical Session: *Include sessions to discuss the role others have played in making material goods available to me. Identifying from one's own life. Differentiate between prosperity and accumulation. Discuss program for ensuring health vs dealing with disease.*

Module III: Harmony in the Family and Society **(3L, 6P)**

Understanding values in human-human relationship; meaning of Justice (nine universal values in relationships) and program for its fulfilment to ensure mutual happiness; Trust and Respect as the foundational values of relationship, Understanding the meaning of Trust; Difference between intention and competence, Understanding the meaning of Respect, Difference between respect and differentiation; the other salient values in relationship, Understanding the harmony in the society (society being an extension of family): Resolution, Prosperity, fearlessness (trust) and co-existence as comprehensive Human Goals, Visualizing a universal harmonious order in society- Undivided Society, Universal Order- from family to world family.

Practical Session*: Include sessions to reflect on relationships in family, hostel and institute as extended family, real life examples, teacher-student relationship, goal of education etc. Gratitude as a universal value in relationships. Discuss with scenarios. Elicit examples from students' lives*

Module IV: Harmony in the Nature and Existence **(3L, 6P)**

Understanding the harmony in the Nature, Interconnectedness and mutual fulfilment among the four orders of nature- recyclability and self regulation in nature, Understanding Existence as Co-existence of mutually interacting units in all- pervasive space, Holistic perception of harmony at all levels of existence.

Practical Session: *Include sessions to discuss human being as cause of imbalance in nature (film "Home" can be used), pollution, depletion of resources and role of technology etc.*

Module V: Implications of Harmony on Professional Ethics **(3L, 6P)**

Natural acceptance of human values, Definitiveness of Ethical Human Conduct, Basis for Humanistic Education, Humanistic Constitution and Humanistic Universal Order, Competence in professional ethics: a. Ability to utilize the professional competence for augmenting universal human order b. Ability to identify the scope and characteristics of people friendly and eco-friendly production systems, c. Ability to identify and develop appropriate technologies and management patterns for above production systems. Case studies of typical holistic technologies, management models and production systems, Strategy for transition from the present state to Universal Human Order: a. At the level of individual: as socially and ecologically responsible engineers, technologists and managers b. At the level of society: as mutually enriching institutions and organizations, Sum up.

Practical Session: *Include Exercises and Case Studies will be taken up in Sessions E.g. To discuss the conduct as an engineer or scientist etc.*

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

- Become more aware of themselves, and their surroundings (family, society, nature);
- Have more responsible in life, and in handling problems with sustainable solutions, while keeping human relationships and human nature in mind.
- Have better critical ability.
- Become sensitive to their commitment towards what they have understood (human values, human relationship and human society).
- Apply what they have learnt to their own self in different day-to-day settings in real life, at least a beginning would be made in this direction.

REFERENCES:

1. Human Values and Professional Ethics by R R Gaur, R Sangal, G P Bagaria, Excel Books, New Delhi, 3rd revised edition, 2023.
2. Jeevan Vidya: Ek Parichaya, A Nagaraj, Jeevan Vidya Prakashan, Amarkantak, 1999.
3. Human Values, A.N. Tripathi, New Age Intl. Publishers, New Delhi, 2004.
4. The Story of Stuff (Book).
5. The Story of My Experiments with Truth - by Mohandas Karamchand Gandhi
6. Small is Beautiful - E. F Schumacher.
7. Slow is Beautiful - Cecile Andrews.
8. Economy of Permanence - J C Kumarappa
9. Bharat Mein Angreji Raj – Pandit Sunderlal
10. Rediscovering India - by Dharampal
11. Hind Swaraj or Indian Home Rule - by Mohandas K. Gandhi
12. India Wins Freedom - Maulana Abdul Kalam Azad
13. Vivekananda - Romain Rolland (English)
14. Gandhi - Romain Rolland (English)

WEBSITE REFERENCES:

1. Class preparations: https://fdp-si.aicte-india.org/UHV-II%20Class%20Note.php
2. Lecture presentations: https://fdp-si.aicte-india.org/UHV-II_Lectures_PPTs.php
3. Practice and Tutorial Sessions: https://fdp-si.aicte-india.org/UHV-II%20Practice%20Sessions.php

CO - PO MAPPINGS:

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

JGE2751	ENTREPRENEURSHIP DEVELOPMENT	L	T	P	C
		2	0	2	3

COURSE OBJECTIVES:

- Learn basic concepts in entrepreneurship, develop mind-set and skills necessary to explore entrepreneurship
- Apply process of problem - opportunity identification and validation through human centred approach to design thinking in building solutions as part of engineering projects
- Analyse market types, conduct market estimation, identify customers, create customer persona, develop the skills to create a compelling value proposition and build a Minimum Viable Product
- Explore business models, create business plan, conduct financial analysis and feasibility analysis to assess the financial viability of a venture ideas & solutions built with domain expertise
- Prepare and present an investible pitch deck of their practice venture to attract stakeholders

MODULE I ENTREPRENEURIAL MINDSET 4L, 8P

Introduction to Entrepreneurship: Definition – Types of Entrepreneurs – Emerging Economics – Developing and Understanding an Entrepreneurial Mindset – Importance of Technology Entrepreneurship – Benefits to the Society.

Case Analysis: Study cases of successful & failed engineering entrepreneurs - Foster Creative Thinking: Engage in a series of Problem-Identification and Problem-Solving tasks

MODULE II OPPORTUNITIES 4L, 8P

Problems and Opportunities – Ideas and Opportunities – Identifying problems in society –Creation of opportunities – Exploring Market Types – Estimating the Market Size, - Knowing the Customer and Consumer - Customer Segmentation - Identifying niche markets – Customer discovery and validation; Market research techniques, tools for validation of ideas and opportunities

Activity Session: Identify emerging sectors / potential opportunities in existing markets - Customer Interviews: Conduct preliminary interviews with potential customers for Opportunity Validation - Analyse feedback to refine the opportunity.

MODULE III PROTOTYPING & ITERATION 4L, 8P

Prototyping – Importance in entrepreneurial process – Types of Prototypes - Different methods – Tools & Techniques.

Hands-on sessions on prototyping tools (3D printing, electronics, software), Develop a prototype based on identified opportunities; Receive feedback and iterate on the prototypes

MODULE – IV: BUSINESS MODELS & PITCHING **4L, 8P**

Business Model and Types - Lean Approach - 9 block Lean Canvas Model - Riskiest assumptions to Business Models – Using Business Model Canvas as a Tool – Pitching Techniques: Importance of pitching - Types of pitches - crafting a compelling pitch – pitch presentation skills - using storytelling to gain investor/customer attention.

Activity Session: Develop a business model canvas for the prototype; present and receive feedback from peers and mentors - Prepare and practice pitching the business ideas- Participate in a Pitching Competition and present to a panel of judges - receive & reflect feedback

MODULE – V: ENTREPRENEURIAL ECOSYSTEM **4L, 8P**

Understanding the Entrepreneurial Ecosystem – Components: Angels, Venture Capitalists, Maker Spaces, Incubators, Accelerators, Investors. Financing models – equity, debt, crowdfunding, etc, Support from the government and corporates. Navigating Ecosystem Support: Searching & Identifying the Right Ecosystem Partner – Leveraging the Ecosystem - Building the right stakeholder network

Activity Session: Arrangement of Guest Speaker Sessions by successful entrepreneurs and entrepreneurial ecosystem leaders (incubation managers; angels; etc), Visit one or two entrepreneurial ecosystem players (Travel and visit a research park or incubator or makerspace or interact with startup founders)

TOTAL: 60 PERIODS

COURSE OUTCOMES:

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

- Develop an Entrepreneurial Mind-set and Understand the Entrepreneurial Ecosystem Components and Funding types
- Comprehend the process of opportunity identification through design thinking, identify market potential and customers
- Generate and develop creative ideas through ideation techniques
- Create prototypes to materialize design concepts and conduct testing to gather feedback and refine prototypes to build a validated MVP
- Analyse and refine business models to ensure sustainability and profitability Prepare and deliver an investible pitch deck of their practice venture to attract stakeholders

REFERENCES:

1. Robert D. Hisrich, Michael P. Peters, Dean A. Shepherd, Sabyasachi Sinha (2020). Entrepreneurship, McGraw Hill, 11th Edition
2. Ries, E. (2011). The Lean Startup: How Today's Entrepreneurs Use Continuous Innovation to Create Radically Successful Businesses. Crown Business
3. Blank, S. G., & Dorf, B. (2012). The Startup Owner's Manual: The Step-by-Step Guide for Building a Great Company. K&S Ranch
4. Roy, R. (2017). Indian Entrepreneurship: Theory and Practice. New Delhi: Oxford University Press
5. Osterwalder, A., & Pigneur, Y. (2010). Business Model Generation: A Handbook for Visionaries, Game Changers, and Challengers. John Wiley & Sons

JEC2741	COMPREHENSION AND 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

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.

EVALUATION:

Technical Seminar (50)	Comprehension (50)	Total (100)	Internal Marks (50)	Internal Marks (100)

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 MAPPINGS:

CO\ PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	1	2	1	3	2	2	2	2	2	1	1	2	2	1
CO2	2	2	2	3	3	1	1	1	1	1	1	3	2	2	2
CO3	2	2	2	3	3	2	2	2	2	2	1	1	1	2	2
CO4	1	2	2	1	3	1	1	1	1	1	1	3	2	3	1
CO5	1	2	2	3	3	1	1	1	1	1	1	1	2	1	3
AVG	**1.4**	**1.8**	**2**	**2.2**	**3**	**1.4**	**1.4**	**1.4**	**1.4**	**1.4**	**1**	**1.8**	**2.2**	**2**	**1.8**

JEC2742	INTERNSHIP	L	T	P	C
		0	0	4	2

COURSE OBJECTIVES:

- To get connected with reputed industry/ laboratory/academia / research institute
- To get practical knowledge on Product Development / Software Design and Development / Testing / Analytics/ research/ startups/ professionalism / business processes and insights / domain knowledge/ Industry Practices/ and other related aspects and develop skills to solve related problems
- To develop technical, soft, team skills to cater to the needs of the industry / academia / businesses / research / organizations in the core aspects of Automation, Digitalization

The students may undergo Industrial training for a period as specified in the Curriculum during summer/winter vacation. In this case the training has to be undergone continuously for the entire period.

In lieu of Industrial training, students may undergo Internship at Industry / Research organizations / University (after due approval from Head of the Department) during the IV,V or VI semester breaks for a continuous period of 30 days to an Industry / Organization / University and two credits is allotted in the seventh semester based on a viva voce examination. The Industrial / Practical Training, Summer Project, Internship, shall carry 100 marks and shall be evaluated through internal assessment only.

At the end of Industrial/Practical Training/Internship/ Summer Project, the student shall submit an attendance certificate from the organization where he / she has undergone training and a brief report. The evaluation will be made based on this report and a viva-voce Examination, conducted internally by a three member Departmental Committee constituted by the Head of the Institution consisting of the course coordinator and two experts from the Department. The certificates (issued by the organization) submitted by the students shall be attached to the mark list sent by the Head of the Institution to the Controller of Examinations.

EVALUATION:

Internship Report (40)	Presentation (30)	Viva Voce (30)	Total Marks (100)

NUMBER OF DAYS: 30

COURSE OUTCOMES:

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

- Industry Practices, Processes, Techniques, technology, automation and other core aspects of software industry
- Analyze, Design solutions to complex business problems
- Build and deploy solutions for target platform
- Preparation of Technical reports and presentation.
- Ability to acknowledge the value of continuing education for oneself and to stay up with technology advancements.

CO/PO MAPPING:

CO/PO	PO1	PO2	PO3	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO 2	PSO 3
CO1	3	3	3	3	-	-	-	-	-	-	-	-	-	3	3	3
CO2	-	-	-	-	3	3	-	-	-	-	-	-	-	3	3	3
CO3	-	-	-	-	-	-	3	-	3	-	-	-	-	3	3	3
CO4	-	-	-	-	-	-	-	-	3	3	3	3	-	3	3	3
CO5	-	-	-	-	-	-	-	-	-	-	-	-	3	3	3	3
AVG	3	3	3	3	3	3	3	-	3	3	3	3	3	3	3	3

JEC2831	PROJECT WORK	L	T	P	C
		0	0	20	10

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.

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.

PROJECT EVALUATION

ZEROTH REVIEW

Novelty/Problem Identification & Objectives (20)	Literature survey (30)	Methodology (10)	Guide (20)	PowerPoint Presentation (20)			Total (100)
				BL (5)	CS (5)	CP (10)	

FIRST REVIEW

Implementation of Methodology (20)	Design/ Analysis/ Testing/ Algorithm/Model (30)	Inferences (10)	Guide (20)	Power Point Presentation (20)			Total (100)
				BL (5)	CS (5)	CP (10)	

SECOND REVIEW

Progress (20)	Results (30)	Preparation of Conference Paper (10)	Guide (20)	Power Point Presentation (20)			Total (100)
				BL (5)	CS (5)	CP (10)	

THIRD REVIEW

Results & Discussions (30)	Conclusions (20)	Publications (10)	Guide (20)	Power Point Presentation (20)			Total (100)
				BL (5)	CS (5)	CPS (10)	

BL - Body Language, CS-Communication Skills, CP-Content of Presentation

TOTAL: 300 PERIODS

END SEMESTER EXAM

Project report (External Only) (30)	Result/Demonstration (30)		Power Point Presentation (20)		Viva (External Only) (20)	Total (100)
	Internal	External	Internal	External		

COURSE OUTCOMES:

At the end 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 for implementing the project.
- 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 MAPPINGS:

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	3	3	2	2	2	1	1	1	-	-	1	1	3	1	3
CO2	3	3	3	2	2	1	1	1	-	-	1	1	3	1	1
CO3	3	2	3	3	3	1	1	1	2	2	1	1	3	2	3
CO4	3	2	2	3	3	-	-	2	2	1	1	1	3	1	1
CO5	2	2	2	2	2	-	-	2	2	2	1	1	3	2	2
AVG	3	2	2	2	2	1	1	1	2	1	1	1	3	1	2

JEC2001	MEMS DESIGN	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To introduce the concepts of micro electromechanical devices
- To make students know the fabrication process of Microsystems
- To describe the design concepts of micro sensors S
- To explain the design concepts of micro actuators
- To make students understand about applications of MEMS

UNIT I INTRODUCTION TO MEMS 9

Introduction to design of MEMS, Overview of Microelectromechanical Systems, Applications of Micro electromechanical systems, Materials for MEMS: Silicon, silicon compounds, polymers, metals.

UNIT II MEMS FABRICATION TECHNOLOGIES 9

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

UNIT III MICRO SENSORS 9

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

UNIT IV MICRO ACTUATORS 9

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

UNIT V 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, Case Study: BioChip.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

- Interpret the basics of micro electromechanical systems including their applications and advantages
- Recognize the use of materials in microfabrication and describe the fabrication processes
- Analyze the design of different sensors
- Design the actuators
- Apply the knowledge of CAD tools for MEMS design

TEXTBOOKS:

1. Tai Ran Hsu, "MEMS and Microsystems design and manufacture" , Tata McGraw Hill Publishing Company, 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 Micro electromechancial 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.

WEBSITE REFERENCES:

1. https://www.slideshare.net/MuhammadChhattalsola/materials-for-mems
2. https://www.fiberoptics4sale.com/blogs/fiber-optic-passive-components/99098118-micro-electro-mechanical-systems-mems-fabrication-technology
3. https://resources.pcb.cadence.com/blog/2019-rf-switch-circuits-applications-and-functions-in-todays-electronics
4. https://archive.nptel.ac.in/courses/108/108/108108147/
5. https://www.ntt-review.jp/archive/ntttechnical.php?contents=ntr201501fa4.html

CO-PO/PSO MAPPING:

CO\ PO, PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	3	2	2	1	1	-	-	-	-	1	1	2	2	2
CO2	3	3	2	2	1	1	-	-	-	-	1	1	2	2	2
CO3	3	3	3	2	2	1	-	-	-	-	1	1	3	2	3
CO4	3	3	3	2	2	1	-	-	-	-	1	1	3	3	3
CO5	3	3	2	2	2	3	-	-	-	-	1	2	3	3	3
AVG	2.8	3	2.4	2	1.6	1.4	-	-	-	-	1	1.2	2.6	2.4	2.6

JEC2002	WIDE BANDGAP DEVICES	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To introduce the concept of wide band gap (WBG) devices and its application in real world
- To make students understand the advantages and disadvantages of WBG devices
- To provide an introduction to basic operation of WBG power devices
- To make students learn Design principles of modern power devices
- To explain high frequency design complexity

UNIT I WBG DEVICES 9

Review of semiconductor basics, Operation and characteristics of the SiC Schottky Barrier Diode, SiC DMOSFET and GaN HEMT, Review of Wide bandgap semiconductor technology – Band gap Transistors -Advantages and disadvantages.

UNIT II SWITCHING CHARACTERIZATION OF WBG 9

Revirw of switching characteristics -Turn-on and Turn-off characteristics of the device, Hard switching loss analysis, Double pulse test set-up.

UNIT III DRIVERS FOR WIDE BAND GAP DEVICES 9

Gate driver, Impact of gate resistance, Gate drivers for wide bandgap power devices- Transient immunity integrated gate drivers

UNIT IV HIGH FREQUENCY DESIGN AND PCB DESIGNING 9

Effects of parasitic inductance, Effects of parasitic capacitance , EMI filter design for high frequency power converters High frequency PCB design, Conventional power loop design, High frequency power loop optimization, Separation of power from signal PCB.

UNIT V APPLICATIONS 9

Consumer electronics applications, Wireless power transfer applications, Electric vehicle applications , Renewable energy sources applications.

TOTAL PERIODS: 45

COURSE OUTCOMES:

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

- Explain the concept of wide band gap (WBG) devices and its application in real world
- Explain advantages and disadvantages of WBG devices
- Comprehend basic operation of WBG power devices
- Explain the design principles of modern power devices
- Explain high frequency design complexity

TEXTBOOKS:

1. Lidow, J. Strydom, M. D. Rooij, D. Reusch, GaN Transistors for Efficient Power Convertion, Wiley, 2014, ISBN-13: 978-1118844762.
2. G. Meneghesso, M. Meneghini, E. Zanoni, “Gallium Nitride-enabled High Frequency and High Efficiency Power Conversion,” Springer International Publishing, 2018, ISBN: 978-3- 319-77993-5.

REFERENCES:

1. F. Wang, Z. Zhang and E. A. Jones, Characterization of Wide Bandgap Power Semiconductor Devices, IET, ISBN-13: 978-1785614910 (2018).
2. B.J.Baliga, "Gallium Nitride and Silicon Carbide Power Devices," World Scientific Publishing Company (3 Feb. 2017).
3. L. Corradini, D. Maksimovic, P. Mattavelli, R. Zane, "Digital Control of HighFrequency Switched-Mode Power Converters", Wiley, ISBN-13: 978-1118935101 (9th June, 2015)

WEBSITE REFERENCES:

1. https://www.everythingpe.com/community/what-are-silicon-carbide-sic-schottky-barrier-diodes
2. https://www.infineon.com/cms/en/product/technology/wide-bandgap-semiconductors-sic-gan/
3. https://eepower.com/technical-articles/simulating-wide-bandgap-power-circuits-using-advanced-characterization-and-modeling/#
4. https://www.researchgate.net/publication/348387353_review_on_driving_circuits_for_wide-bandgap_semiconductor_switching_devices_for_mid-_to_high-power_applications

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	-	-	-	-	-	-	-	1	1	3
CO2	3	3	3	2	2	-	-	-	-	-	-	-	2	1	2
CO3	3	3	2	2	2	-	-	-	-	-	-	-	2	2	2
CO4	3	3	3	3	2	-	-	-	-	-	-	-	3	2	2
CO5	3	3	3	3	2	-	-	-	-	-	-	-	2	2	2
AVG	**3**	**3**	**2.8**	**2.6**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**2**	**1.6**	**2.2**

JEC2003	CMOS ANALOG IC DESIGN	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To introduce the basics of MOS Circuits.
- To explain the noise characteristics of amplifiers.
- To make students understand the performance parameters of amplifiers.
- To explain the compensation techniques
- To explain the detection and testing of faults.

UNIT I SINGLE STAGE AMPLIFIERS 9

Basic MOS circuits and models, CS, CG and Source Follower, differential amplifier with active load, Cascode and Folded Cascode configurations with active load, design of Differential and Cascode Amplifiers – specified SR, noise, gain, BW, ICMR and power dissipation, voltage swing, high gain amplifier structures.

UNIT II HIGH FREQUENCY AND NOISE CHARACTERISTICS OF AMPLIFIERS 9

Miller effect, association of poles with nodes, frequency response of CS, CG and Source Follower, Cascode and Differential Amplifier stages, statistical characteristics of noise, noise in Single Stage amplifiers, noise in Differential Amplifiers.

UNIT III FEEDBACK AND SINGLE STAGE OPERATIONAL AMPLIFIERS 9

Properties and types of negative feedback circuits, effect of loading in feedback networks, operational amplifier performance parameters, single stage Op Amps, two-stage Op Amps, input range limitations, gain boosting, slew rate, power supply rejection, noise in Op Amps.

UNIT IV STABILITY, FREQUENCY COMPENSATION 9

Multipole Systems, Phase Margin, Frequency Compensation, Compensation Of Two Stage Op Amps, Slewing In Two Stage Op Amps, Other Compensation Techniques.

UNIT V LOGIC CIRCUIT TESTING 9

Faults in Logic Circuits- Basic Concepts of Fault Detection- Design for Testability- Ad Hoc Techniques, Level-Sensitive Scan Design, Partial Scan, Built-in Self-Test.

TOTAL PERIODS: 45

COURSE OUTCOMES:

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

- Explain the basics of MOS Circuits.
- Describe the noise characteristics of amplifiers.
- Describe the performance parameters of amplifiers.
- Explain the compensation techniques
- Explain the detection and testing of faults.

TEXTBOOKS:

1. Behzad Razavi, “Design Of Analog Cmos Integrated Circuits”, Tata Mcgraw Hill, 2001.
2. Parag K.Lala, “An Introduction to Logic Circuit Testing”,Morgan & Claypool Publishers,2009.

REFERENCES:

1. Willey M.C. Sansen, “Analog Design Essentials”, Springer, 2006.
2. Grebene, “Bipolar And Mos Analog Integrated Circuit Design”, John Wiley & Sons,Inc.,2003. Phillip E.Allen, Douglas R .Holberg, “Cmos Analog Circuit Design”, Oxford University Press, 2nd Edition, 2002.
3. Recorded Lecture Available at http://www.ee.iitm.ac.in/vlsi/courses/ee5320_2021/start
4. Jacob Baker “CMOS: Circuit Design, Layout, And Simulation, Wiley IEEE Press, 3rd Edition, 2010.

WEBSITE REFERENCES:

1. http://www.ee.iitm.ac.in/vlsi/courses/ee5320_2021/start
2. https://www.electronics-tutorials.ws/amplifier/frequency-response.html
3. https://www.youtube.com/watch?v=_VSa5Bm1IPk
4. https://www.youtube.com/watch?v=3MFTR91Yruw
5. https://www.studocu.com/in/document/delhi-technological-university/digital-vlsi-design/digital-vlsi-design-faults/27002399

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	1	2	-	-	-	-	-	2	3	2	3
CO3	3	3	2	2	2	1	-	-	-	-	-	2	3	2	3
CO4	3	3	3	2	2	2	-	-	-	-	-	2	1	2	2
CO5	3	3	3	2	2	2	-	-	-	-	-	3	2	1	2
AVG	**3**	**3**	**2.6**	**2.2**	**1.8**	**1.8**	**-**	**-**	**-**	**-**	**-**	**2.2**	**2.4**	**2**	**2.6**

JEC2004	LOW POWER IC DESIGN	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

- To introduce sources of power in an IC.
- To explain the power reduction techniques based on technology dependence
- To make students understand the design of low power circuits.
- To explain design of low power multipliers.
- To explain circuits with low power dissipation

UNIT I FUNDAMENTALS AND SOURCES OF LOW POWER CIRCUITS 9

Need for Low Power Circuit Design, Sources of Power Dissipation – Switching Power Dissipation, Short Circuit Power Dissipation, Leakage Power Dissipation, Glitching Power Dissipation, Short Channel Effects –Drain Induced Barrier Lowering and Punch Through.

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 CIRCUITS 9

Computer arithmetic techniques for low power system – reducing power consumption in memories – low power clock, interconnect and layout design – Advanced techniques – Special techniques – Adiabatic switching system

UNIT IV LOW -POWER MULTIPLIERS 9

Introduction, Overview of Multiplication, Types of Multiplier Architectures, Braun Multiplier, BaughWooley Multiplier, Booth Multiplier, Introduction to Wallace Tree Multiplier

UNIT V SYNTHESIS 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 - CAD Tools for Low Power VLSI Circuits.

TOTAL PERIODS:45

COURSE OUTCOMES:

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

- Explain the basics of power dissipation in CMOS
- Describe the different power optimization techniques
- Design low power CMOS circuits
- Describe the low power multiplier design
- Design and synthesize the low power CMOS circuits using software

TEXTBOOKS:

1. Ajit Pal, “Low-power CMOS Circuit and Systems”, Springer,2015.
2. Neil H. E. Weste and K. Eshraghian, Principles of CMOS VLSI Design, 2nd Edition, Addison Wesley (Indian reprint).
3. Kaushik Roy and S.C.Prasad, “Low power CMOS VLSI circuit design”, Wiley,2000

REFERENCES:

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.

WEBSITE REFERENCES:

1. https://nptel.ac.in/courses/106105034
2. http://www.nitttrc.edu.in/nptel/courses/video/108103108/lec1.pdf
3. http://www.nitttrc.edu.in/nptel/courses/video/106105034/lec1.pdf
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
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CO2	3	2	1	2	3	-	-	-	-	-	-	1	2	2	1
CO3	3	3	3	2	2	-	-	-	-	-	-	1	2	2	2
CO4	2	3	3	3	3	-	-	-	-	-	-	2	2	2	3
CO5	3	3	3	2	2	-	-	-	-	-	-	2	2	2	3
AVG	**2.8**	**2.8**	**2.4**	**2.4**	**2.4**	**-**	**-**	**-**	**-**	**-**	**-**	**1.6**	**2**	**2**	**2.2**

JEC2005	ASIC AND FPGA	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 FPGA design
- To make understand the SoC concepts.

UNIT I FPGA 9

Field Programmable gate arrays- Logic blocks, routing architecture, Design flow technology - mapping for FPGAs, Xilinx XC4000 - ALTERA's FLEX 8000/10000, ACTEL's ACT-1,2,3 Case studies: Altera MAX 5000 and 7000 - Altera MAX 9000 – Spartan II and Virtex II

UNIT II 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 III 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 IV 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 V SYSTEM ON CHIP 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 about the FPGA.
- Discuss about the design issues of SOC.

TEXTBOOKS:

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. Wayne Wolf, FPGA-Based System Design, Prentice Hall PTR, 2004.

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.
6. P.K.Chan& S. Mourad, Digital Design using Field Programmable Gate Array, Prentice Hall..

WEBSITE REFERENCES:

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%202011%20Chapter%206%20%20Physical%20Design.pdf
3. https://www.xilinx.com/htmldocs/xilinx14_7/sim.pdf
4. https://www.einfochips.com/blog/asic-design-flow-in-vlsi-engineering-services-a-quick-guide/
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**

JEC2006	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
- Develop 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

TEXT BOOKS:

1. Michael L. Bushnell and Vishwani D. Agrawal, “Essentials of Electronic Testing for Digital, Memory & Mixed-Signal VLSI Circuits” , Kluwer Academic Publishers, 2017.
2. Niraj K. Jha and Sandeep Gupta, “Testing of Digital Systems”, Cambridge University Press, 2017.

REFERENCES:

1. Laung-Terng Wang, Cheng-Wen Wu and Xiaoqing Wen, "VLSI Test Principles and Architectures", Elsevier, 2017
2. Z.Navabi, Digital System Test and Testable Design, Springer, 2011.

WEBSITE REFERENCES:

1. http://people.ee.duke.edu/~krish/teaching/ECE538/FaultModeling.pdf
2. https://archive.nptel.ac.in/content/storage2/courses/106103116/handout/mod8.pdf
3. https://digitalsystemdesign.in/atpg-for-sequential-circuits/
4. https://eecs.ceas.uc.edu/~jonewb/DFTnew.pdf
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**

JEC2007	MIXED SIGNAL IC DESIGN TESTING	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
- Model 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.

WEBSITE REFERENCES:

1. https://www.academia.edu/28850089/DEEP_SUBMICRON_CMOS_DESIGN
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.allaboutcircuits.com/technical-articles/modeling-adcs-and-dacs/
5. https://www.techtarget.com/searchnetworking/definition/phase-locked-loop

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**

JEC2008 ` ADVANCED DIGITAL SIGNAL PROCESSING L T P C
3 0 0 3

OBJECTIVES:

The student should be made to:

- Know about multi-rate signal processing and its applications.
- Learn the concepts of Discrete time random signal processing.
- Gain knowledge about prediction theory and filtering.
- Study the Concepts of adaptive filters.
- Understand the spectrum estimation techniques.

UNIT I MULTIRATE SIGNAL PROCESSING 9

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 .

UNIT III LINEAR PREDICTION AND FILTERING 9

Linear Prediction – Forward and Backward - Wiener filters for filtering and prediction – FIR Wiener Filter – IIR Wiener 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 .

COURSE OUTCOMES:

After successful completion of the course the student will be able to

- Comprehend multirate signal processing and demonstrate its applications
- Demonstrate an understanding of the power spectral density and apply 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.

TEXT BOOKS :

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
2. Sons Inc. New York, Indian reprint 2008.
3. Haykin, Adaptive Filter Theory, 4th Edition, Pearson Education, New Delhi, 2006.
4. Sophoncles J. Orfanidis, " Applied Optimum Signal Processing ", McGraw Hill, 2018..

WEBSITE REFERENCES:

1. https://archive.nptel.ac.in/courses/108/106/108106136/
2. https://www.youtube.com/watch?v=EIED8sa_ljw
3. https://www.youtube.com/watch?v=aOaTWGbFMYQ
4. https://nptel.ac.in/courses/117105075
5. http://www.digimat.in/nptel/courses/video/117105085/L37.html

CO-PO/PSO MAPPING:

CO\ PO, PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
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CO2	3	3	3	2	2	-	-	-	-	-	3	3	3	3	3
CO3	3	3	3	3	3	-	-	-	-	-	3	3	3	3	3
CO4	3	3	3	3	3	-	-	-	-	-	3	3	3	3	3
CO5	3	3	3	3	3	-	-	-	-	-	3	3	3	3	3
AVG	**3**	**3**	**2.8**	**2.6**	**2.6**	**-**	**-**	**-**	**-**	**-**	**2.8**	**2.8**	**3**	**2.8**	**2.8**

JEC2009	DIGITAL IMAGE PROCESSING	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To become familiar with digital image fundamentals and computer vision concept
- To get exposed to simple image enhancement techniques and role of computer vision.
- To learn concepts of degradation function and restoration techniques.
- To study the image segmentation, representation techniques and applications in medical image analysis.
- To become familiar with image compression, recognition methods and a computer vision case study.

UNIT I DIGITAL IMAGE FUNDAMENTALS 9

Steps in Digital Image Processing –Elements of Visual Perception – Image Sensing and Acquisition – Image Sampling and Quantization – Relationships between pixels - Color image fundamentals - RGB, HSI models, 2D transforms - DFT, DCT. Brief overview of Computer Vision.

UNIT II IMAGE ENHANCEMENT 9

Spatial Domain: Gray level transformations – Histogram processing – Basics of Spatial Filtering– Spatial operations – directional smoothening and Sharpening. Frequency Domain: Introduction to Fourier Transform– Smoothing and Sharpening frequency domain filters – Ideal, Butterworth and Gaussian filters, Homomorphic filtering, - Role of Image enhancement in Computer Vision Applications.

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 - Role of Image restoration in Image preprocessing**.**

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– Dam construction – Watershed segmentation algorithm. Applications of image segmentation in medical image analysis and object detection.

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. Brief overview of image processing in Computer Vision: A Case study.

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. Richard Szeliski, Computer Vision: Algorithms and Applications, Springer-Verlag London Limited, 2011.
4. D. A. Forsyth, J. Ponce: Computer Vision: A Modern Approach, Pearson Education, 2003.
5. J. Michael Fitzpatrick and Milan Sonka, "Handbook of Medical Imaging, Vol. 2, SPIE Press, 2000
6. Milan Sonka et al _Image processing, analysis and machine vision', Brookes/Cole, Vikas Publishing House, 2nd edition, 1999

WEBSITE REFERENCES:

1. https://nptel.ac.in/courses/117105135
2. https://nptel.ac.in/courses/117105079
3. https://nptel.ac.in/courses/117104069
4. https://nptel.ac.in/courses/108103174
5. https://www.youtube.com/watch?v=7Pzq9IwscbE

CO-PO/PSO MAPPING:

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CO2	3	3	3	2	2	-	-	-	-	-	3	3	3	3	3
CO3	3	3	3	3	3	-	-	-	-	-	3	3	3	3	3
CO4	3	3	3	3	3	-	-	-	-	-	3	3	3	3	3
CO5	3	3	3	3	3	-	-	-	-	-	3	3	3	3	3
AVG	**3**	**3**	**2.8**	**2.6**	**2.6**	**-**	**-**	**-**	**-**	**-**	**2.8**	**2.8**	**3**	**2.8**	**2.8**

JEC2010 SPEECH PROCESSING L T P C
3 0 0 3

COURSE 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”, Pearson Education, 2006
2. Frederick Jelinek, “Statistical Methods of Speech Recognition”, MIT Press, 1998
3. Daniel Jurafsky and James H Martin, “Speech and Language Processing - An Introduction to 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.

WEBSITE REFERENCES:

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**

JEC2011 NEURAL NETWORK AND MACHINE LEARNING L T P C
3 0 0 3

COURSE OBJECTIVES:

The student should be made to:

- Understand the fundamentals of Neural Networks
- Get familiarised with Feed forward Neural Networks
- Learn basics of Machine Learning
- Gain knowledge on Regression and Classification algorithms
- Explore Clustering and Dimensionality reduction

UNIT I INTRODUCTION TO NEURAL NETWORKS 9

Fundamentals of Neural Networks – Model of Artificial Neuron – McCulloch Pitts model, linear separability, Hebb model – Learning Methods – Taxonomy of Neural Network Architectures – Applications.

UNIT II FEED FORWARD NEURAL NETWORKS 9

Features Perceptron Models: Discrete, Continuous and Multi-Category –Training Algorithms: Discrete and Continuous Perceptron Networks – Limitations of the Perceptron Model – Generalized Delta Rule, MLP, Derivation of Back propagation (BP) Training algorithm.

UNIT III MACHINE LEARNING BASICS 9

Definition of learning systems - Types of learning; Supervised, Unsupervised and Reinforcement learning – Performance Metrics -cross-validation. - Concepts of overfitting and under fitting.

UNIT IV REGRESSION AND CLASSIFICATION ALGORITHMS 9

Introduction to Simple linear regression – Multiple linear regression – Logistic Regression – Introduction to Classification - k-Nearest Neighbour Algorithm - Decision Trees -Random Forests, Support Vector Machines.

UNIT V CLUSTERING AND DIMENSIONALITY REDUCTION 9

Introduction to clustering - k-Means Clustering - choosing number of clusters, Dimensionality Reduction - Need for Dimensionality Reduction – Subset Selection – Principal Component Analysis

COURSE OUTCOMES:

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

- Explain the basic concepts in Neural Networks and applications
- Summarize Feed forward networks and their training issues.
- Illustrate Concepts of Machine Learning
- Elaborate Regression and Classification Algorithms.
- Implement clustering and dimensionality reduction

TEXT BOOKS:

1. Charu C. Aggarwal "Neural Networks and Deep learning" Springer International Publishing,2018
2. Introduction to Machine Learning by Ethem Alpaydin, Prentice-Hall of India, 2006.

REFERENCES:

1. Bishop, Christopher M. Pattern Recognition and Machine Learning. Springer, 2006
2. Duda, Richard, Peter Hart, and David Stork. Pattern Classification. 2nd ed. New York, NY: Wiley-Interscience, 2000.
3. Machine Learning, Tom Mitchell , McGraw Hill, 1997
4. Satish Kumar, "Neural Networks, A Classroom Approach", Tata McGraw - Hill, 2007.
5. Simon Haykin, "Neural Networks, A Comprehensive Foundation", 2nd Edition, Addison Wesley Longman, 2001.

WEBSITE REFERENCES:

1. https://onlinecourses.nptel.ac.in/noc23_cs18/preview
2. https://machinelearningknowledge.ai/category/deeplearning/
3. https://nptel.ac.in/courses/117105084
4. https://nptel.ac.in/courses/106/106/106106224
5. https://www.youtube.com/watch?v=QlhHqMnd9Wo

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**

JEC2012	PATTERN RECOGNITION	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To study the fundamental of pattern classifier.
- To know about various clustering concepts.
- To originate the various structural pattern recognition and feature extraction.
- To familiarize the role of Hidden Markov model and SVM in pattern recognition.
- To explore recent advances in pattern recognition.

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: K Means algorithm - C Means algorithm – Hierarchical clustering – Graph theoretic approach to pattern Clustering

UNIT III FEATURE EXTRACTION AND STRUCTURAL PATTERN RECOGNITION 9

Principle component analysis – Independent component analysis – Linear discriminant analysis – Feature selection: through functional approximation - heuristic approach – 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- Real Life applications of SVM -Introduction to deep learning.

UNITV RECENT ADVANCES 9

Fuzzy logic – Fuzzy Pattern Classifiers – Pattern Classification using Genetic Algorithms – Random Forest Classifier - Case Study using Fuzzy Pattern Classifier – Case Study of multiclass classification using deep learning.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

• Classify the data and identify the patterns.
• Analyze clustered patterns.
• Utilize the given data set to extract and select features for Pattern recognition. • Explain Markov models and support vector machine.
• Discuss on recent advances in pattern recognition

REFERENCES:

1. R.O.Duda, P.E.Hartand D.G.Stork, "Pattern Classification",JohnWiley,2001

2. C.M.Bishop, "Pattern Recognition and Machine Learning",Springer,2006.

3. AndrewWebb," Stastical Pattern Recognition", Arnold publishers,London,1999

4. M.Narasimha Murthy and V.Susheela Devi, "Pattern Recognition", Springer 2011.

5. Menahem Friedman , Abraham Kandel, "Introduction to Pattern Recognition Statistical, Structural, Neural and Fuzzy Logic Approaches", World Scientific publishing Co.Ltd,2000.

6. Robert J.Schalk off, "Pattern Recognition Statistical, Structural and Neural Approaches", John Wiley &SonsInc., New York, 1992.

7. R.O.Duda, P.E.Hartand D.G.Stork, "Pattern Classification",JohnWiley,2001 8. S.Theodoridis and K.Koutroumbas, "Pattern Recognition", 4th Ed., Academic Press. 2009.

WEBSITE REFERENCES:

1. https://nptel.ac.in/courses/106/106/106106046/ Principles of Patten Recognition by Prof C.A.Murthy ISI Kolkata, Prof Sugundu das IITM

2. https://nptel.ac.in/courses/117/108/117108048/ Pattern Recognition by Prof. P.S. Sastry, Department of Electronics & Communication Engineering, IISc Bangalore

3. https://www.youtube.com/watch?v=9iaQg1vp4wE- Pattern Recognition by Prof. P.S. Sastry, Department of Electronics & Communication Engineering, IISc Bangalore

4. https://www.youtube.com/watch?v=Z66_2_VG_k8, Introduction to Statistical Pattern Recognition

5. https://www.youtube.com/watch?v=mfePdDh9t6Q, Principles of Pattern Recognition I (Introduction and Uses)

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	2	2	2	2
CO2	3	3	2	2	2	-	-	-	-	-	3	3	2	2	2
CO3	3	3	2	3	3	-	-	-	-	-	3	3	3	2	2
CO4	3	2	3	3	3	-	-	-	-	-	3	3	3	3	3
CO5	3	2	3	3	3	-	-	-	-	-	3	3	3	3	3
AVG	**3**	**2.6**	**2.4**	**2.6**	**2.6**	**-**	**-**	**-**	**-**	**-**	**2.8**	**2.8**	**2.6**	**2.4**	**2.4**

JEC2013 DSP ARCHITECTURE AND PROGRAMMING L T P C
3 0 0 3

COURSE OBJECTIVES:

The student should be made to:

- Understand the basics on Digital Signal Processors
- Acquire knowledge about Programmable DSP Architecture of fixed point Processor.
- Gain knowledge about Programmable DSP Architecture of floating point Processor.
- Learn Programming for signal processing applications
- Accomplish knowledge on interfacing and applications.

UNIT I FUNDAMENTALS OF PROGRAMMABLE DSPs 9

Basic Architectural feature- DSP Computational building blocks- Bus architecture and memory- Data addressing capabilities- Address generation Unit- Programmability and program execution-Speed issues- Features for external interfacing.

UNIT II TMS320C5X PROGRAMMABLE DSP PROCESSOR 9

Architecture of TMS320C54xx DSP processors, Addressing modes – Assembly language Instructions -Memory space, interrupts, and pipeline operation of TMS320C54xx DSP Processor, On-Chip peripherals, Block Diagram of TMS320C54xx DSP starter kit

UNIT III TMS320C6X PROGRAMMABLE DSP PROCESSOR 9

Commercial TI DSP processors, Architecture of TMS320C6x DSP Processor, Linear and Circular addressing modes, TMS320C6x Instruction Set, Assembler directives, Linear Assembly, Interrupts, Multichannel buffered serial ports, Block diagram of TMS320C67xx DSP Starter Kit and Support Tools.

UNIT IV IMPLEMENTATION OF DSP ALGORITHMS 9

DSP Development system, On-chip, and On-board peripherals of C54xx and C67xx DSP development boards, Code Composer Studio (CCS) and support files, Implementation of Conventional FIR, IIR, and Adaptive filters in TMS320C54xx/TMS320C67xx DSP processors for real-time DSP applications.

UNIT V APPLICATIONS OF DSP PROCESSORS 9

Voice scrambling using filtering and modulation, Voice detection and reverse playback, Audio effects, Graphic Equalizer, Adaptive noise cancellation, DTMF signal detection, Speech thesis using LPC, Automatic speaker recognition.

COURSE OUTCOMES:

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

- Analyze the fundamental concepts of Digital Signal Processors.
- Discuss about details of fixed point DSP processor
- Elaborate the basics of Floating point DSP processor
- Implement algorithms using floating and fixed point DSP processors
- Demonstrate real-time signal processing applications

TEXT BOOKS:

1. Avtar Singh and S. Srinivasan, Digital Signal Processing – Implementations using DSP Microprocessors with Examples from TMS320C54xx, Cengage Learning India Private Limited, Delhi 2012.

2. Rulph Chassaing and Donald Reay, Digital Signal Processing and Applications with the C6713 and C6416 DSK, John Wiley & Sons, Inc., Publication, 2012 (Reprint).

REFERENCES :

1. B. Venkataramani and M. Bhaskar, ―Digital Signal Processors – Architecture, Programming and Applications‖ – Tata McGraw – Hill Publishing Company Limited. New Delhi, 2003.
2. TMS320C5416/6713 DSK user manual at https://www.ti.com
3. Digital Signal Processors: Architectures, Implementations,and applications, Kuo 2005
4. Architectures for Digital Signal Processing , Peter Pirsch John Weily, 2007
5. User guides Texas Instruments, Analog Devices and NXP.

WEBSITE REFERENCES:

- http://www.dspguide.com/CH28.PDF
- https://nptel.ac.in/courses/108102045/9
- https://www.ti.com

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	2	3	2	2
CO2	3	3	3	2	2	-	-	-	-	-	3	3	3	3	3
CO3	3	3	3	3	3	-	-	-	-	-	3	3	3	3	3
CO4	3	3	3	3	3	-	-	-	-	-	3	3	3	3	3
CO5	3	3	3	3	3	-	-	-	-	-	3	3	3	3	3
AVG	**3**	**3**	**2.8**	**2.6**	**2.6**	**-**	**-**	**-**	**-**	**-**	**2.8**	**2.8**	**3**	**2.8**	**2.8**

JEC2014	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.

WEBSITE REFERENCES:

1. https://uomustansiriyah.edu.iq/media/lectures/5/5_2017_03_26!05_24_35_PM.pdf
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**

JEC2015	RF TRANSCEIVERS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To acquire knowledge on the transceiver specifications and architectures.
- To understand the impedance matching networks and amplifiers.
- To know the various classifications and principles of feedback systems and power amplifier systems.
- To understand the basic principles and design aspects of RF filters, oscillators and mixers.
- To gain knowledge on PLL and frequency synthesizers.

UNIT I CMOS PHYSICS, TRANSCEIVER SPECIFICATIONS AND ARCHITECTURES 9

CMOS: Introduction to MOSFET Physics - Noise: Thermal, shot, flicker, popcorn noise - Transceiver Specifications: Two port Noise theory, Noise Figure, IP2, IP3, Sensitivity Transceiver Architectures: Receiver: Homodyne, Heterodyne, Image reject, Low-IF Architectures - Transmitter: Direct-up conversion, Two-step up conversion schemes.

UNIT II IMPEDANCE MATCHING NETWORKS AND AMPLIFIERS 9

Review of S-parameters and Smith chart - Passive IC components - Two element Impedance matching networks - Amplifiers: Common Gate, Common Source Amplifiers - High frequency amplifier design - Low Noise Amplifiers: single-ended and differential LNAs.

UNIT III FEEDBACK SYSTEMS AND POWER AMPLIFIERS 9

Feedback Systems: Stability of feedback systems, Gain and phase margin, Root-locus techniques, Time and Frequency domain considerations, Compensation - Power Amplifiers: General model - Class A, AB, B, C, D, E and F amplifiers - Linearization Techniques.

UNIT IV FILTERS, OSCILLATORS AND MIXERS 9

Overview - basic filter configuration, special filter realizations, filter implementation - Basic oscillator model, high-frequency oscillator configuration, Colpitt's oscillator – basic characteristics of mixers, single and double-balanced mixers.

UNIT V PLL AND FREQUENCY SYNTHESIZERS 9

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

COURSE OUTCOMES:

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

- Interpret the nonlinear effects in RF circuits
- Design RF impedance matching networks
- Analyze the performance of feedback and power amplifiers
- Apply knowledge to identify a suitable architecture and systematically design an RF System
- Explain the principles of PLL and frequency synthesizers.

TEXT BOOKS:

1. Lee T, Design of CMOS RF Integrated Circuits, Cambridge, Second Edition, 2004.
2. Razavi B, RF Microelectronics, Pearson Education, Second Edition, 2012.

REFERENCES:

1. Ludwig R, and Bretchko P, RF Circuit Design Theory and Applications, Prentice Hall, 2000.
2. Razavi B, Design of Analog CMOS Integrated Circuits, McGraw Hill, Second Edition, 2017.
3. Kyung-WhanYeom, Microwave Circuit Design - A Practical Approach using ADS, Pearson Education, 2015.

WEBSITE REFERENCES:

1. https://onlinecourses.nptel.ac.in/noc24_ee75/preview
2. https://www.coursera.org/learn/rf-mmwave-circuit-design
3. https://www.cadence.com/en_US/home/training/all-courses/86272.html
4. https://www.mathworks.com/learn/training/rf-system-design-using-mathworks-tools.html
5. https://www.youtube.com/watch?v=hkJ4enk5-rc

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	2	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**	**2.6**	**2.6**	**1**	**-**	**-**	**-**	**-**	**1**	2	**2.8**	**2.6**	**2.8**

JEC2016	ANTENNA DESIGN	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To understand the basic parameters of antennas
- To learn the radiation mechanism of linear wire and loop antennas
- To design the various antenna arrays
- To study the microstrip and mobile communication antennas
- To understand the special antennas

UNIT I FUNDAMENTALS OF ANTENNAS 9

Microwave frequency bands, Physical concept of radiation, Near and far-field regions, Antenna Pattern Characteristics, Antenna Gain and Efficiency, Aperture Efficiency and Effective Area, Impedance matching, Friis transmission equation.

UNIT II LINEAR WIRE AND LOOP ANTENNAS 9

Radiation Mechanisms of Linear Wire Antennas, Infinitesimal Dipole, Small dipole, Half-Wavelength Dipole, Horizontal and Vertical electric dipole, Loop antennas, Case Study - Numerical Methods in Antenna Modeling.

UNIT III ANTENNA ARRAYS AND APPLICATIONS 9

Two-element array, N-Element Linear Array - Broadside Array, End-Fire Array, Array factor, Pattern multiplication, Phased array antennas, Yagi-Uda array, Binomial array, Case Study - Turnstile array.

UNIT IV MICROSTRIP AND MOBILE ANTENNAS 9

Rectangular Patch, Circular Patch, Quality factor, Bandwidth, efficiency, microstrip antenna coupling, Planar Inverted-F Antenna, Inverted-F Antenna, Multiband Antennas for Mobile Units, Slot antennas, broadband antennas, Case Study – UWB antennas.

UNIT V SPECIAL ANTENNAS 9

Horn antennas, Reflector Antennas, Frequency independent antennas, Smart antennas, Reconfigurable antennas, Biconical antennas, Lens Antennas, MEMS antennas, EBG antennas, PBG antennas, Case Study – Millimeterwave antennas.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

- Analyse the fundamentals of antennas
- Analyse the linear wire and loop antennas
- Analyse the array antennas
- Design the microstrip and mobile communication antennas
- Design various special antennas

TEXT BOOKS:

1. Constantine A. Balanis, "Antenna Theory analysis and Design," John Wiley & Sons, Fourth Edition, 2016.
2. Das, Annapurna, and Das, Sisir K. “Antenna and Wave Propagation” India, Tata McGraw Hill Education, 2013.

REFERENCES:

1. Raju, G. S. N.. Antennas and Wave Propagation. India, Dorling Kindersley, 2012.
2. Harish, A. R., and Sachidananda, M. “Antennas and Wave Propagation” India, Oxford University Press, 2007.
3. Handa, Deepak, and Prasad, K. D. “Antenna and Wave Propagation” India, Satya Prakashan, 2003.
4. Collin, Robert E. “Antennas and radio wave propagation,” Taiwan, McGraw-Hill, 1985.

WEBSITE REFERENCES:

1. www.microwaves101.com
2. https://onlinecourses.nptel.ac.in/noc22_ee22/preview
3. https://www.ansys.com/training-center/course-catalog/electromagnetics/ansys-hfss-for-antenna-design
4. www.ocw.mit.edu\Electromagnetics and applications
5. https://www.coursera.org/learn/microwave-antenna

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	3	1	-	-	-	-	3	2	2	2	1
CO2	2	3	2	2	3	1	-	-	-	-	2	3	2	2	2
CO3	3	2	3	2	3	1	-	-	-	-	3	3	2	2	2
CO4	2	2	3	3	2	1	-	-	-	-	3	3	1	2	3
CO5	3	3	3	2	2	2	-	-	-	-	2	2	3	1	1
AVG	2.6	2.6	2.8	2.4	2.6	1.2	-	-	-	-	2.6	2.6	2	1.8	1.8

JEC2017	RF INTEGRATED CIRCUITS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To introduce the basic RF IC Components
- To explain the various receiver architectures and Low Noise Amplifiers
- To describe feedback systems and power amplifiers
- To elaborate the PLL and frequency synthesizers
- To explain about mixers and oscillators

UNIT I BASIC RF IC COMPONENTS 9

Skin effect, Resistors, Capacitor, Inductor 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.

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, 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.

TOTAL PERIODS: 45

COURSE OUTCOMES:

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

- Explain the RF IC components
- Comprehend RF low noise amplifiers and receivers
- Describe feedback systems and power amplifiers
- Elaborate PLL and frequency synthesizers
- 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.

WEBSITE REFERENCES:

1. https://nptel.ac.in/courses/117/102/117102012/
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/PSO MAPPING:

CO\PO, PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	3	2	2	1	1	-	-	-	-	1	1	2	1	2
CO2	3	3	2	2	1	1	-	-	-	-	1	1	2	2	2
CO3	3	3	3	2	2	1	-	-	-	-	1	1	3	2	2
CO4	3	3	3	2	2	1	-	-	-	-	1	1	3	3	3
CO5	3	3	2	2	2	3	-	-	-	-	1	2	3	3	3
AVG	**2.8**	**3**	**2.4**	**2**	**1.6**	**1.4**	**-**	**-**	**-**	**-**	**1**	**1.2**	**2.6**	**2.2**	**2.4**

JEC2018	MICs AND RF SYSTEM DESIGN	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) - advantages over discrete circuits - MMIC fabrication techniques - thick and thin film technologies and materials - Encapsulation and mounting of active devices - 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, 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 - Introduction to SOC, SOP, 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

REFERENCES:

1. Hoffman R.K. "Handbook of Microwave Integrated Circuits", Artech House, Boston, 1987.
2. Ivan Kneppo, J. Fabian, P. Bezousek, "Microwave Integrated Circuits", Springer India Private Ltd., 2006

WEBSITE REFERENCES:

1. https://www.idconline.com/technical_references/pdfs/electronic_engineering/Thick_film_technology.pdf
2. https://eng.libretexts.org/Bookshelves/Electrical_Engineering/Electronics/Microwave_and_RF_Design_II_Transmission_Lines_(Steer)/03%3A_Planar_Transmission_Lines/3.03%3A_Planar_Transmission_Line_Structures
3. http://www.ittc.ku.edu/~jstiles/723/handouts/section_7_6_Coupled_Line_Directional_Couplers_package.pdf
4. https://www.craneae.com/sites/default/files/documents/designing-microstrip-circuits-with-low-loss-cuflon-substrates_0.pdf
5. https://www.intechopen.com/chapters/37593

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**

JEC2019	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

UNIT II COUPLING MECHANISM 9

Electromagnetic field sources and Coupling paths, Coupling via the supply network, CM and DM coupling, Impedance coupling, Inductive and Capacitive coupling, Ground loop coupling, Cable related emissions and coupling

UNIT III EMI MITIGATION TECHNIQUES 9

Murphy's Law, LF Magnetic shielding, Apertures and shielding effectiveness, Choice of Materials for H, E, and free space fields, PCB Level shielding, Principle of Grounding, Isolated grounds, Grounding strategies for Large systems, mixed signal systems, Filters

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 Standards Organizations; IEC, ANSI, FCC, CISPR, BSI, CENELEC, ACEC. EM Emission and susceptibility standards and specifications

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, MIL -STD test methods, Civilian STD test method

TOTAL PERIODS: 45

COURSE OUTCOMES:

At the end of the course, the students will 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

TEXT BOOKS:

1. V.P.Kodali, “Engineering EMC Principles, Measurements and Technologies”, IEEE Press, Newyork, 1996.
2. Clayton.R.Paul,”Introduction to Electromagnetic Compatibility”, Second edition, Wiley indiapvt Ltd.

REFERENCES:

1. Henry W.Ott., Noise Reduction Techniques in Electronic Systems”, A Wiley Inter Science Publications, John Wiley and Sons, Newyork, 1988.
2. Bemhard Keiser, “Principles of Electromagnetic Compatibility”, 3rd Ed, Artech house, Norwood, 1986.
3. Don R. J.White Consultant Incorporate, “Handbook of EMI/EMC”, Vol I-V, 1988.

WEBSITE REFERENCES:

1. https://nptel.ac.in/courses/108/106/108106138/
2. https://nptel.ac.in/noc/courses/noc19/SEM1/noc19-ee17/
3. https://www.youtube.com/watch?v=55rgbgwFpck&list=PLyqSpQzTE6M8KHvPajlKmZDAP Y_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/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	3	2	1
CO2	3	2	2	3	2	1	-	-	-	-	2	1	1	2	1
CO3	3	3	3	3	2	1	-	-	-	-	2	1	1	1	2
CO4	3	3	2	2	2	1	-	-	-	-	2	1	2	2	1
CO5	2	3	2	3	3	1	-	-	-	-	2	1	3	2	3
AVG	**2.8**	**2.8**	**2.2**	**2.6**	**2.4**	**1.2**	**-**	**-**	**-**	**-**	**2.2**	**1.2**	**2**	**1.8**	**1.6**

JEC2020	RFID SYSTEM DESIGN AND TESTING	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To provide an overview of RFID System principles
- To understand the design and the challenges regarding security issues
- To study and analyze the RFID system design considerations
- To infer about the system testing conformance and interoperability
- To explore 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 – memory- Sensors. Reader RF interface-control unit.

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 -Tag Reading Reliability-RFID Reader–Tag Communication.

UNIT IV SYSTEM TESTING 9

Testing and Conformance-Test Equipment-Frequency- and Bandwidth-Related Measurement-Polling and Timing Measurements-Collision - 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 – 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
- Explore on the RFID system applications

TEXT BOOKS:

1. Klaus Finkenzeller, "RFID Handbook – Fundamentals and applications in contact less smart cards, radio frequency identification and near-field communication", 3rd edition,Wiley 2010.
2. 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.

WEBSITE REFERENCES:

1. https://www.intechopen.com/chapters/18101
2. https://www.omni-id.com/pdfs/Omni-ID_Best-Practices_RFID_Tag_Reliability_ White_ Paper.pdf
3. https://rc.library.uta.edu/uta- ir/bitstream/handle/10106/29447/ Jones_RFID system_ Report_ CTEDD_2020.pdf? sequence=1&isAllowed=y
4. https://voyantic.com/rain-rfid-tagged-items

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**

JEC2021	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

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.

REFERENCES:

1. Xiang, W; Zheng, K; Shen, X.S; "5G Mobile Communications: Springer, 2016.
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.

WEBSITE REFERENCES:

1. https://archive.nptel.ac.in/courses/117/105/117105139/
2. https://link.springer.com/chapter/10.1007/978-3-030-92188-0_14
3. https://onlinecourses.nptel.ac.in/noc21_ee76/preview
4. https://www.digimat.in/nptel/courses/video/117105139/L01.html
5. https://freevideolectures.com/course/4749/nptel-millimeter-wave-technology

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**

JEC2022	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

REFERENCES:

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.

WEBSITE REFERENCES:

1. https://www.arrow.com/en/research-and-events/articles/introduction-to-radar
2. https://www.youtube.com/watch?v=L5FlRd0exNc
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**

JEC2023	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.

WEBSITE REFERENCES:

1. https://www.digimat.in/nptel/courses/video/101108047/L01.html
2. https://www.digimat.in/nptel/courses/video/105107194/L01.html
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**

JEC2024	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 error sources-clock error, ionospheric error, tropospheric error, multipath.

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.

REFERENCES:

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

WEBSITE REFERENCES:

1. https://www.beyonddiscovery.org/navigation-systems/54-the-position-fix.html
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**

JEC2025	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 ISATELLITE 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. Case Study - PSLV, GSLV and SSLV.

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, The Antenna Subsystem, Case Study - International Space Station.

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, Combined Uplink and Downlink C/N Ratio, Case Study - RF Satellite Link.

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 and 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, Indian Remote Sensing Satellite, Case Study - Smaller satellites, Satellite IoT.

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.

WEBSITE REFERENCES:

1. https://nptel.ac.in/courses/117/105/117105131/
2. https://www.coursera.org/learn/satellite-communications
3. https://www.nasa.gov/mission_pages/station/main/index.html
4. https://ocw.mit.edu/courses/aeronautics-and-astronautics/16-851-satellite-engineering-fall- 2003/
5. https://www.cssteap.org/course-content-satcom

CO - PSO MAPPING

CO\PO, PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2	1	2	1	1	-	-	-	-	1	1	3	2	1
CO2	2	3	2	2	2	2	-	-	-	-	1	1	3	2	1
CO3	3	3	2	2	2	2	-	-	-	-	1	1	3	2	1
CO4	3	3	2	2	2	2	-	-	-	-	1	1	3	2	1
CO5	2	3	2	2	2	2	-	-	-	-	1	2	3	2	1
AVG	**2.4**	**2.8**	**1.8**	**2**	**1.8**	**1.8**	**-**	**-**	**-**	**-**	**1**	**1.2**	**3**	**2**	**1**

JEC2026	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.

WEBSITE REFERENCES:

1. https://gisrsstudy.com/electromagnetic-radiation/
2. https://ecampusontario.pressbooks.pub/remotesensing/chapter/chapter-4-emr-interactions-with-the-atmosphere-and-with-the-surface/
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**

JEC2027	ROCKETRY AND SPACE MECHANICS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To gain knowledge on the fundamental laws in orbital mechanics.
- To understand the methods of perturbations and parameters calculations in orbits
- To learn the principle of operation of rocket motions
- To investigate the drags experienced by the rocket and the launching problems
- To analyze the need of multistaging of rocket vehicles and to study the stage separation techniques

UNIT I ORBITAL MECHANICS 9

Description of solar system – Kepler's Laws of planetary motion – Newton's Law of Universal gravitation – Two body and Three-body problems – Jacobi's Integral, Librations points - Estimation of orbital and escape velocities.

UNIT II SATELLITE DYNAMICS 9

Geosynchronous and geostationary satellites- factors determining life time of satellites – satellite perturbations – methods to calculate perturbations- Hohmann orbits – calculation of orbit parameters – Determination of satellite rectangular coordinates from orbital elements

UNIT III ROCKET MOTION 9

Principle of operation of rocket motor - thrust equation – one dimensional and two dimensional rocket motions in free space and homogeneous gravitational fields – Description of vertical, inclined and gravity turn trajectories determinations of range and altitude – simple approximations to burnout velocity.

UNIT IV ROCKET AERODYNAMICS 9

Description of various loads experienced by a rocket passing through atmosphere – drag estimation – wave drag, skin friction drag, form drag and base pressure drag – Boat-tailing in missiles – performance at various altitudes – conical and bell shaped nozzles – adapted nozzles – rocket dispersion – launching problems.

UNIT V STAGING AND CONTROL OF ROCKET VEHICLES 9

Need for multistaging of rocket vehicles – multistage vehicle optimization – stage separation dynamics and separation techniques- aerodynamic and jet control methods of rocket vehicles – SITVC

COURSE OUTCOMES:

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

- Explain the fundamental laws in orbital mechanics
- Examine the methods of perturbations and parameter calculations in orbits
- Interpret the principle of operation of rocket motions
- Investigate the drags experienced by the rocket and the launching problems
- Analyze the need of multistaging of rocket vehicles and to study the stage separation techniques

TEXTBOOKS:

1. G.P. Sutton, "Rocket Propulsion Elements", John Wiley & Sons Inc., New York, 5th Edition, 1986.
2. J.W. Cornelisse, "Rocket Propulsion and Space Dynamics", J.W. Freeman & Co., Ltd., London, 1982
3. Travis S.Taylor , **"**Introduction to Rocket Science and Engineering" Second Edition CRC Press, 2017.

REFERENCES

1. Van de Kamp, "Elements of Astromechanics", Pitman Publishing Co., Ltd., London, 1980.
2. E.R. Parker, "Materials for Missiles and Spacecraft", McGraw-Hill Book Co., Inc., 1982.

WEBSITE REFERENCES:

1. https://www.grc.nasa.gov/www/k-12/rocket/TRCRocket/rocket_principles.html
2. https://brilliant.org/wiki/rocket-physics/
3. https://www.grc.nasa.gov/www/k-12/TRC/Rockets/history_of_rockets.html
4. https://www.coursera.org/learn/basics-of-rocket-science

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	1	-	-	-	-	2	2	2	2
AVG	**3**	**3**	**3**	**2**	**2**	**2**	**1**	-	-	-	-	2	**2**	**2**	**2**

JEC2028	INTRODUCTION TO ASTRONOMY AND ASTROPHYSICS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

- To understand the concepts of Astronomy
- To make measurement of astronomical parameters such as distance, stellar brightness, stellar mass, radii, temperature and spectra
- To explain the different layers of solar system and results of magneto hydrodynamics
- To explain Basic structure of different galaxies and rotation of the Milky Way galaxy
- To explain Basic concepts of cosmology and its principles

UNIT I INTRODUCTION TO ASTRONOMY 9

Overview of the night sky; diurnal and yearly motions of the Sun; basic concepts of positional astronomy: celestial sphere, astronomical coordinate systems (Horizon and Equatorial systems of coordinates), circumpolar stars; sidereal and solar day

UNIT II BASIC PARAMETERS OF STARS 9

Measurement of astronomical distances (stellar parallax, aberration, proper motion), measurement of brightness, radiant flux and luminosity (apparent and absolute magnitude scales; distance modulus); determination of stellar mass (visual binaries, eclipsing binaries, spectroscopic binaries); measurement of stellar temperature and radius; stellar spectra, dependence of spectral types on temperature; Stellar classification (Harvard and modern Morgan - Keenan classification schemes), H-R diagram

UNIT III SUN AND THE SOLAR SYSTEM 9

Solar parameters; Sun's internal structure; solar photosphere; solar atmosphere; chromosphere; corona; solar activity; solar system (characteristics of terrestrial and Jovian planets); origin of the solar system

UNIT IV PHYSICS OF GALAXIES 9

Physics of galaxies: Basic structure and properties of different types of Galaxies; Nature of rotation of the Milky Way: Differential rotation of the Galaxy and Oort constants, rotation curve of the Galaxy and the dark matter, virial theorem

UNIT V COSMOLOGY 9

Cosmology: Standard Candles (Cepheids and SNe Type1a); cosmic distance ladder; expansion of the Universe, Cosmological Principle, Newtonian Cosmology and Fried mann Models

TOTALPERIODS:45

COURSE OUTCOMES:

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

- Basic concepts of positional astronomy and astronomical coordinate systems
- Measurement of astronomical parameters such as distance, stellar brightness, stellar mass, radii, temperature and spectra
- The different layers of solar atmosphere and basic results of solar magneto hydrodynamics
- Basic structure of different galaxies and rotation of the Milky Way galaxy
- Basic concepts of cosmology and its principles

TEXTBOOKS:

1. Fundamental Astronomy, H. Karttunen et al., Springer Berlin, Heidelberg
2. Introductory Astronomy and Astrophysics, M. Zeilik and S. A. Gregory, Saunders College Publishing.

REFERENCES:

1. An Introduction to Astronomy and Astrophysics, Pankaj Jain, CRC Press,2015
2. Harwit, M. Astrophysical Concepts, 3rd ed, Springer-verlag, 2006.
3. Fundamentals of solar astronomy, A. Bhatnagar and W. C. Livingston, World Scientific.
4. Astrophysics Stars and Galaxies, K. D. Abhyankar, University Press.
5. Modern Astrophysics, B. W. Carroll and D. A. Ostlie, Addison-Wesley Publishing Co.

WEBSITE REFERENCES:

1. https://archive.nptel.ac.in/courses/115/105/115105046/#
2. https://nptel.ac.in/courses/115107130
3. https://universe.bits-pilani.ac.in/uploads/Chapters1-2.pdf
4. https://web.iucaa.in/~dipankar/gradschool2013/Home_files/AAIntro1-Lectures-2013.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	2	-	-	-	-	-	2	2	2	2
CO2	3	3	1	2	2	2	-	-	-	-	-	1	2	2	3
CO3	3	3	2	2	2	2	-	-	-	-	-	2	2	2	2
CO4	3	3	2	2	2	2	-	-	-	-	-	2	2	2	3
CO5	3	3	2	2	2	2	-	-	-	-	-	2	2	2	3
AVG	**3**	**3**	**1.8**	**2**	**2**	**2**	**-**	**-**	**-**	**-**	**-**	**1.8**	**2**	**2**	**2.6**

JEC2029	SENSORS AND ACTUATORS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To introduce static and dynamic characteristics of measurement systems.
- To explain various types of sensors.
- To describe State-of-the-art digital sensors and measurement of parameters using various types of sensors.
- To make students understand different types of actuators and its types
- To explain 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 MAGNETIC 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
- Comprehend 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.

REFERENCES:

1. Andrzej M. Pawlak, "Sensors and Actuators in Mechatronics Design and Applications", First Edition, CRC Press,2006.
2. E.O. Doeblin, "Measurement System: Applications and Design", McGraw Hill publications
3. Clarence W.de Silva "Sensors and Actuators: Control System Instrumentation", CRC Press, 2007.

WEBSITE REFERENCES:

1. https://ocw.mit.edu/courses/media-arts-and-sciences/mas-836-sensor-technologies-for-interactive-environments-spring-2011/lecture-notes/MITMAS_836S11_Class1Elect.pdf
2. https://nptel.ac.in/content/storage2/courses/112104158/lecture36.pdf- Dr. Bi h khBishakhBhtt h Bhattacharya Professor, Department of Mechanical Engineering IIT Kanpur
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/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	1	-	-	-	-	3	2	3	2	1
CO2	3	3	3	3	3	1	-	-	-	-	2	3	3	2	1
CO3	2	3	3	3	3	1	-	-	-	-	3	3	2	2	1
CO4	3	3	3	3	3	1	-	-	-	-	2	3	3	2	1
CO5	3	3	3	3	3	1	-	-	-	-	3	2	3	2	1
AVG	3	3	3	3	2.8	1	-	-	-	-	2.6	2.6	3	2	1

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JEC2030	SENSORS FOR ENGINEERING APPLICATIONS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

- To understand the fundamental concepts of sensors
- To explain different position and weight sensors.
- To understand the concept of Biosensor and chemical sensors.
- To understand the concept of sound, Ultrasound and Infrasound sensors.
- To understand the concept of temperature and humidity sensors.

UNIT I SENSORS FUNDAMENTALS AND APPLICATIONS 9

Sensor characteristics, System Characteristics, Instrument selection, Data Acquisition and Readout, Installation, Acceleration, Shock and Vibration sensors: Technology Fundamentals, Selecting and Specifying Accelerometers, Applicable Standards, Interfacing and designing.

UNIT II POSITION AND WEIGHT SENSORS 9

Force, Load and weight sensors, Quartz Sensors, Piezoelectric Sensors - Construction, Strain gage sensors and its types, Pressure sensor - piezoelectric pressure sensors.

UNIT III BIOSENSORS AND CHEMICAL SENSORS 9

Introduction to Bio-Sensors, Applications, Origin of biosensors, Bio-receptor molecules, Transduction mechanisms in Biosensors, Application range of Biosensors, technology fundamentals of chemical sensors, Chemical sensing techniques and applications.

UNIT IV ULTRASOUND AND INFRASOUND SENSORS 9

Principles, Audio to Electrical sensors and Transducers: Moving iron and Moving Coil Microphone, Capacitors Microphone, Frequency and wavelengths, Electrical to Audio transducers: Moving iron and Moving coil Transducers, Capacitor Transducers, Ultrasonic transducers, Infrared sensors.

UNIT V TEMPERATURE AND HUMIDITY SENSORS 9

Humidity Sensor: Types and Technology, Selecting and specifying humidity sensors, Applicable standards, Interfacing and design Information, Temperature Sensors - Types and Technology, Selecting and specifying temperature sensors, Applicable standards.

TOTAL PERIODS:45

COURSE OUTCOMES:

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

- Explore sensors and its fundamentals.
- Explain different position and weight sensors.
- Explain different biosensors and chemical sensors.
- Describe various sound, ultrasound and Infrasound sensors.
- Explain the concept of temperature and humidity sensors.

TEXTBOOKS:

1. Jon S. Wilson, Sensor technology handbook, Newnes publications, 2004.

2. Ian R.Sinclair, Sensors and Transducer, 3rd edition, Newnes Publications.

REFERENCES:

1. Doebelin,"Measurement Systems: Application and Design", McGraw Hill Kogakusha Ltd
2. Jocob Fraden, "Handbook of Modern Sensors, Physics, Designs, and Applications", Springer.
3. Henry Bolte, "Sensors – A Comprehensive Sensors", John Wiley.
4. https://doc.lagout.org/science/0_Computer%20Science/8_Electronics%20%26%20Robotics/Sensor%20Technology%20Handbook%20-%20By%20J.%20Wilson.pdf

WEBSITE REFERENCES:

1. https://www.slideshare.net/venkatasuman1983/sensors-for-engineering-applications
2. https://college.gift.edu.in/website/blog/single.php?id=105
3. https://onlinecourses.nptel.ac.in/noc23_ee95/preview
4. https://onlinecourses.nptel.ac.in/noc24_ee68/preview

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	3	3	3	3	-	-	-	-	2	3	3	2
CO2	3	3	2	3	3	3	2	-	-	-	-	2	3	3	3
CO3	3	3	2	3	3	3	2	-	-	-	-	2	2	3	3
CO4	3	3	2	3	3	3	2	-	-	-	-	2	2	3	3
CO5	3	3	2	3	3	3	2	-	-	-	-	2	2	3	3
AVG	**3**	**3**	**2**	**3**	**3**	**3**	**2.2**	**-**	**-**	**-**	**-**	**2**	**2.4**	**3**	**2.8**

JEC2031	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 with materials processing for thin film electronics.
- To expose the students for the materials selection and patterning methods for thin film electronics development.
- To describe the process involved in transferring the flexible electronics from foils to textiles and also the challenges, opportunities and future of wearable devices.
- To expose the students to the design and 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

History of flexible electronics - Materials for flexible electronics: degrees of flexibility, substrates, backplane electronics, front plane technologies, encapsulation - Fabrication technology for flexible electronics - Fabrication on sheets by batch processing, fabrication on web by Roll-to Roll processing - Additive printing-Review of semiconductors employed in flexible electronics - Plastic electronics for smart textiles - Improvements and limitations.

UNIT II NANO-CRYSTALLINE SILICON MATERIALS AND THIN FILM TRANSISTORS 9

Fundamental issues for low temperature processing - low temperature 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 MATERIALS AND NOVEL 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 WEARABLES FUNDAMENTALS AND HAPTICS 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

Introduction-Systems design - Challenges in chemical and biochemical sensing - Application areas -Wearable inertial sensors - obtained parameters from inertial sensors - Applications for wearable motion sensors - Practical considerations for wearable inertial sensor - Application in clinical practice and future scope - Textile sensors for physiological state monitoring - Biomechanical sensing - Noninvasive sweat monitoring by textile sensors and other applications.

TOTAL PERIODS: 45

COURSE OUTCOMES:

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

- Realize the technology developments in flexible electronics technology.
- Identify the suitable materials and its processing for the development of thin film electronics
- Design 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, 2011, 1st Edition, Springer, New York.
2. Edward Sazonov, Michael R. Newman, "Wearable Sensors: Fundamentals, Implementation and Applications", 2014, 1st Edition, Academic Press, Cambridge

REFERENCES:

1. Michael J. McGrath, Cliodhna Ni Scanaill, Dawn Nafus, "Sensor Technologies: Healthcare, Wellness and Environmental Applications", 2001, 1st Edition , Apress Media LLC, New York.
2. Kate Hartman, "Make: Wearable Electronics: Design, prototype, and wear your own interactive garments", 2014, 1st Edition, Marker Media, Netherlands.
3. Guozhen Shen, Zhiyong Fan, "Flexible Electronics: From Materials to Devices", 2015, 1st Edition, World Scientific Publishing Co, Singapore.
4. Yugang Sun, John A. Rogers, "Semiconductor Nanomaterials for Flexible Technologies: From Photovoltaics and Electronics to Sensors and Energy Storage (Micro and Nano Technologies)", 2011, 1st Edition, William Andrew, New York.

WEBSITE REFERENCES:

1. https://www.frontiersin.org/articles/10.3389/felec.2020.594003/full
2. https://gesrepair.com/future-of-flexible-electronic/
3. https://www.frontiersin.org/articles/10.3389/felec.2021.668619/full
4. https://sites.tufts.edu/eeseniordesignhandbook/2015/wearable-electronics/
5. https://pubs.rsc.org/en/content/articlelanding/2018/lc/c7lc00914c
6. 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**

JEC2032	IOT FUNDAMENTALS AND ARCHITECTURE	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To make understand the fundamentals of Internet of Things
- To provide knowledge on the components of IoT
- To define and explain various Architecture of IoT
- To explain about the basics of various IoT protocols
- To provide an overview of applications of IoT

UNIT I INTRODUCTION 9

Definition,Characteristics, Physical Design of IoT- Logical Design of IoT- IoT Enabling Technologies - IoT Levels & Deployment Templates - IoT System Management with NETCONF-YANG

UNIT II COMPONENTS OF IOT 9

IoT Components-Sensors-features,resolutions,classes and types, Actuators and its types - Open-Source Hardware - Arduino and Raspberry Pi ,Basic programming in Arduino and Raspberry Pi

UNIT III ARCHITECTURE OF IoT 9

IoT and M2M - M2M high-level ETSI architecture - IETF architecture for IoT - OGC architecture - IoT reference architecture, 5G in IoT Middleware

UNIT IV IoT PROTOCOLS 9

MQTT - CoAP - XMPP - AMQP - IEEE 802.15.4 - Zigbee - WSN Protocols – SCADA Protocols – 6LowPAN

UNIT V APPLICATIONS OF IoT 9

Smart city, Smart mobility and transport, Industrial IoT, Smart health, Environment monitoring and surveillance – Home Automation – Smart Agriculture

TOTAL PERIODS: 45

COURSE OUTCOMES:

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

- Articulate the fundamental concepts, key technologies, strength and limitations of IoT
- Study the components of Internet of Things
- Identify the architecture, infrastructure models of IoT
- Analyze various protocols of IoT
- Understand the applications of IoT in various domains

TEXT BOOKS:

1. Robert Barton, Patrick Grossetete, David Hanes, Jerome Henry, Gonzalo Salgueiro, "IoT Fundamentals: Networking Technologies, Protocols, and Use Cases for the Internet of Things", CISCO Press, 2017.
2. ArshdeepBahga, Vijay Madisetti, "Internet of Things – A hands-on approach", Universities Press, 2015.

REFERENCES:

1. Samuel Greengard, The Internet of Things, The MIT Press, 2015.
2. Olivier Hersent, David Boswarthick, Omar Elloumi, "The Internet of Things – Key applications and Protocols", Wiley, 2012
3. Perry Lea, "Internet of things for architects", Packt, 2018.
4. IOT (Internet of Things) Programming: A Simple and Fast Way of Learning, IOT Kindle Edition.
5. Dieter Uckelmann, Mark Harrison, Michahelles, Florian (Eds), "Architecting the Internet of Things", Springer, 2011.

WEBSITE REFERENCES:

1. https://onlinecourses.nptel.ac.in/noc23_cs83/unit?unit=18&lesson=24
2. http://www.cse.wustl.edu/~jain/cse570-15/ftp/iot_prot/index.html.
3. https://docplayer.net/9841295-Architecting-the-internet-of-things.html
4. https://www.codemag.com/Article/1607071/Introduction-to-IoT-Using-the-Raspberry-Pi
5. https://www.elprocus.com/building-the-internet-of-things-using-raspberry-pi/

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**

JEC2033	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 area where IoT can be applied.

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:

- Implement fundamental required for IoT.
- Perform the designing and interfacing of the IoT nodes.
- Design a portable IoT using Raspberry Pi
- Deploy an IoT application and connect to the cloud and analyze applications of IoT in real time scenario
- Develop applications of a system using IoT

TEXT BOOKS:

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

WEBSITE REFERENCES:

1. https://www.intechopen.com/online-first/82415
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**

JEC2034	INDUSTRIAL IoT AND INDUSTRY 4.0	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To understand the fundamentals of internet of things
- To know the usefulness of IoT technology in manufacturing process of Industry.
- To provide over view of the evolution of industrial revolution and its impact in 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

REFERENCE(S)

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.

WEBSITE REFERENCE:

1. https://nptel.ac.in/courses/106105195
2. https://sustainability-success.com/industry-1-0-to-4-0-2-3-revolution/
3. https://library.oapen.org/bitstream/handle/20.500.12657/43836/external_content.pdf?sequence=1&isAllowed=y
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	1	2	3	2	3	3	3	3
CO2	3	2	3	3	3	2	2	2	2	3	2	2	3	2	2
CO3	3	2	2	2	3	2	2	1	2	3	1	3	3	2	2
CO4	3	2	2	3	3	2	2	1	2	3	2	3	3	2	3
CO5	3	2	1	2	3	3	3	3	1	3	2	3	3	3	3
AVG	**3**	**2**	**2**	**2.6**	**3**	**2.2**	**2.2**	**1.6**	**1.8**	**3**	**2**	**2.8**	**3**	**2.4**	**2.4**

JEC2035	FUNDAMENTALS OF NANOELECTRONICS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To explain the basics of nanomaterial science.
- To make students understand the general preparation methods.
- To make students know about the various nanomaterials.
- To explain the different characterization techniques.
- To make students understand the applications of nanoscience.

UNIT I INTRODUCTION 9

Nanoscale Science and Technology - Classifications of nanostructured materials- nanoparticles- quantum dots, nanowires ultra-thin films-multilayered materials. Length Scales involved and effect on properties: Electronic and Optical properties.

UNIT II GENERAL METHODS OF PREPARATION 9

Bottom-up Synthesis-Top-down Approach: Co-Precipitation, Ultrasonication, Mechanical Milling, Colloidal routes, Self-assembly, Vapour phase deposition, MOCVD, 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, 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, Bioimaging - MEMS, Nano ElectroMechanical Systems (NEMS)- Nano sensors, Nanoparticles for sun barrier products - In Photostat, printing, solar cell, battery.

TOTAL PERIODS: 45

COURSE OUTCOMES:

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

- Review the science of nanomaterials
- Demonstrate the preparation methods of nanomaterials
- Analyze the characteristics of nanomaterials
- Analyze the characterization techniques
- Design various nanoscience applications

TEXTBOOKS:

1. Hanson, Fundamentals of Nanoelectronics, Pearson Education, 2009.
2. N John Dinardo, "Nanoscale Characterization of surfaces & Interfaces", 2nd edition, Weinheim Cambridge, Wiley-VCH, 2000.

REFERENCES:

1. Jan Dienstuhl, Karl Goser, and Peter Glösekötter, Nanoelectronics and Nanosystems: From Transistors to Molecular and Quantum Devices, Springer-Verlag, 2004.
2. Mircea Dragoman and Daniela Dragoman, Nanoelectronics: Principles and Devices, Artech House, 2009.
3. Robert Puers, Livio Baldi, Marcel Van de Voorde and Sebastiaan E. Van Nooten, Nanoelectronics: Materials, Devices, Applications, Wiley, 2017.
4. Brajesh Kumar Kaushik, Nanoelectronics: Devices, Circuits and Systems, Elsevier science, 2018

WEBSITE REFERENCES:

1. https://www.youtube.com/watch?v=qUEbxTkPIWI Dr. Kantesh Balani & Dr. Anandh Subramaniam, IIT Kanpur
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/PSO MAPPING:

CO\PO, PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	1	3	1	-	3	3	-	-	-	-	2	3	1	2
CO2	2	1	3	2	-	-	2	-	-	-	-	-	3	2	2
CO3	2	2	3	2	1	1	2	-	-	-	-	2	3	3	2
CO4	1	2	3	2	1	-	2	-	-	-	-	2	3	3	3
CO5	2	1	3	1	2	2	3	-	-	-	-	3	3	3	3
AVG	**2**	**1**	**3**	**1**	**-**	**3**	**3**	**-**	**-**	**-**	**-**	**2**	**3**	**2.4**	**2.4**

JEC2036	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

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 UNDERWATER 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, 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

WEBSITE REFERENCES:

1. https://techexplorations.com/guides/labjack/what-is-daq/
2. https://www.researchgate.net/publication/337048952_Underwater_Acoustic_Transducers
3. https://www.whoi.edu/know-your-ocean/ocean-topics/ocean-tech/acoustics/acoustic-doppler-current-profiler-adcp/
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
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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**

JEC2037	UNDERWATER 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 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, Color Temperature, lumens, Beam angle.

UNIT II DIGITAL IMAGE PROCESSING FOR UNDERWATER IMAGES 9

Sampling and Quantization, Geometric Transformation, Interpolation, Image Reconstruction, Spatial Filtering, Histogram, Binary Image, Color Fundamentals, Color transformations, Color Interpolation, Morphology, Image segmentation, Pattern 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, Coordinate systems, Propagating waves, Wave number- frequency space, Finite continuous apertures, Spatial sampling, Directivity, Beamforming, Time and frequency domain beamforming, 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 underwater 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. Rafael C. Gonzalez, Richard E. Woods, Steven Eddins, “Digital Image Processing using MATLAB, Third Edition, Gatesmark Publishing,2020.
2. Xavier Lurton,”An Introduction to Underwater Acoustics (Principles and applications), Second Edition, Springer,2010.

REFERENCES:

1. Tinku&Ajoy K. Ray,”Image Processing principles & Applications, First Edition, Wiley Interscience,2005
2. Don H. Johnson and Dan E. Dudgeon,”Array Signal Processing: Concepts and Techniques, First Edition, Prentice Hall,1993
3. Harry L. Van Trees,”Optimum Array Processing, First Edition, Wiley-Interscience,2002
4. Richard O. Nielsen,”Sonar Signal Processing, First Edition, Artech House,1991.
5. P.K. Thiruvikraman,”A Course on Digital Image processing with MATLAB, First Edition, IOP Publishing,2020

WEBSITE REFERENCES:

1. https://www.youtube.com/watch?v=1FhypxIo42c
2. https://www.youtube.com/watch?v=dRwcHGpQ4XI
3. https://www.sciencedirect.com/topics/earth-and-planetary-sciences/underwater-acoustics
4. https://www.youtube.com/watch?v=iWYIaq9s6SQ
5. https://www.studocu.com/row/document/university-of-engineering-and-technology-lahore/signals-and-systems/sonar-signal-processing/8755203
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**

JEC2038	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 Fiber Optics communication -Working Principle, Single Mode, Multi-Mode, Effect on fiber bending. Standard FOC connectors, Cable Requirement for Underwater Application, Cable Characteristics, Basic design for Electro-Optical(E-O) Underwater Cable, Handling system for E/O converter cables, Optic Slip Ring And its application,

UNIT II UNDERWATER OPTICAL COMMUNICATION 9

Underwater Wireless Optical Communication Classification Links, Underwater Optical Communication (UWOC) System -Modulation, Coding, Light Source Technology ,Common Lasers in UWOC, Alignment and Compensation, UWC Network, 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 communication.

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UNIT IV PRINCIPLES OF UNDERWATER ACOUSTIC COMMUNICATION9

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 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. YiLou,Nian Ahmed,Underwater Communications Networks,FirstEdition,Springer,2021

REFERENCES:

1. FerialEl-Hawary,TheOceanEngineeringHandbook, FirstEdition,CRCPress,2001
2. L.M. Brekhovskikh and Yu. P. Lysanov, Fundamentals of ocean acoustics,Third Edition,Springer,2003
3. RobertJUrick,Principles of underwater sound,ThirdEdition, PeninsulaPublishing,2013
4. RahulSharma, DeepSeaMiningHandbook,FirstEdition,Springer,2017

WEBSITE REFERENCES:

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**

JEC2039	OCEAN OBSERVATION SYSTEMS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

- To understand the concepts of ocean dynamics and parameters
- To explain different sensor interface for marine applications
- To analyze the suitable platform for various measurement & applications
- To understand the various telemetries for ocean data transfer
- To apply the methods of data processing for ocean parameters

UNIT I INTRODUCTION TO ESSENTIAL OCEAN VARIABLES 9

Ocean – Dynamics of upper ocean, Air Sea interaction, Waves, Currents, Tides, Salinity, Conductivity, Pressure, Temperature, Wind amplitude & Direction, Humidity, Ocean circulation, Sea states, Importance of Ocean observation: Coastal Zones-Cyclones-Tsunami.

UNIT II INSTRUMENTATION AND OBSERVATION SYSTEMS 9

Measurement of Meteorological and Oceanographic Surface & Sub Surface Parameters, Remote measurements. Sensors and instruments - Oceanic Parameters and their conversion to Electrical signals. Sensors for wave, Salinity, Temperature, Rainfall, Water current & Direction. Pressure sensors for Tide and Waves. Acoustic sensors for measurement of Current speed & Direction.

UNIT III OCEAN OBSERVATION PLATFORMS 9

Eulerian-Langragian – Ship Based Observations, Surface Drifters, Moored Data Buoys, Tsunami Buoys, Argo float, Gliders, Satellite Based Observations, Challenges Associated with Underwater Measurements, Fouling-Corrosion.

UNIT IV OCEAN DATA TELEMETRY 9

Data telemetry, Wire telemetry, Modems, Wireless telemetry- Acoustic communications-Underwater Optic communication – Satellite Telemetry-LEO-GEO-MEO, GSM-GPRS, Inmarsat, INSAT, Iridium. ARGOS

UNITV OCEAN DATA PROCESSING 9

Data processing and storage: Raw and processed data. Storage systems and methods- Data presentation, charts, electronic and graphic presentation, Data exchange, data formats

TOTAL PERIODS:45

COURSE OUTCOMES:

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

- Explore on Ocean Dynamics and parameters
- Describe sensor interface for marine applications
- Identify suitable platform for various measurement & applications
- Explain about various telemetries for ocean data transfer
- Apply data processing and plotting methods for ocean parameters

TEXTBOOKS:

1. James Irish, and Albert Williams III. 2.693, Principles of Oceanographic Instrument Systems – Sensors and Measurements (13.998), Springer, 2004.
2. Observing the Oceans in Real Time, R. Venkatesan and Amit Tandon, Springer, 2017.

REFERENCES:

1. Ocean Instrumentation, Electronics, and Energy, — S. R. Vijayalakshmi and S. Muruganand, Mercury Learning & Information, 2016.
2. Data analysis methods in Physical Oceanography, —Richard E. Thomson and William J.Emery, Elsevier Science,2014.

WEBSITE REFERENCES:

1. https://cjme.springeropen.com/articles/10.1186/s10033-020-00449-zhttps://nptel.ac.in/courses/115107130
2. https://archive.nptel.ac.in/courses/114/106/114106035
3. https://archive.nptel.ac.in/courses/114/105/114105002/
4. https://atoc.colorado.edu/~whan/ATOC5051/Class_Notes/chapter2.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	3	2	2	3	3	-	-	-	-	2	3	2	2
CO2	3	3	3	2	2	3	2	-	-	-	-	2	3	2	3
CO3	3	3	3	2	2	3	2	-	-	-	-	2	2	2	2
CO4	3	3	3	2	2	3	2	-	-	-	-	2	2	2	3
CO5	3	3	2	2	2	3	2	-	-	-	-	2	2	2	3
AVG	**3**	**3**	**2.8**	**2**	**2**	**3**	**2.2**	**-**	**-**	**-**	**-**	**2**	**2.4**	**2**	**2.6**

JEC2040	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 and shallow water; Sound attenuation in the sea–absorption, scattering, transmission loss, reverberation, Snell's Law, Laser Communication And Limitations.

UNIT II UNDERWATER NAVIGATION SENSORS 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 Base Line (SBL), Super Short Base Line (SSBL), Long Baseline (LBL) Configurations and Positioning Overview.

UNIT IV SUBSEA VEHICLE NAVIGATION 9

Uses and challenges subsea navigation, Basics and types of underwater navigation, Aided navigation systems, Inertial Navigation systems. role of dead-reckoning navigation in subsea navigation, Kalman filters (XKF)an 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 it's aiding sensor

3. Explain about The Challenges involved in underwater navigation
4. Illustrate how navigation system is integrated with manned and unmanned underwater vehicles
5. Explain various applications

TEXTBOOKS:

1. L.M.Brekhovskikh andYu. P.Lysanov, "Fundamentals Of Ocean Acoustics", 3rd Edition, 2006
2. P.H.Milne, "Underwater Acoustic Positioning Systems", Gulf Publishing Company, 1983

REFERENCES:

1. Norvald Kjerstad, "Electronic and Acoustic Navigation systems for Maritime Studies", NTNU Norwegian University of Science and Technology, 2016
2. TT Fossen, "Guidance & Control of Ocean Vehicles",1st Edition, John Wiley & Sons Inc, 1994
3. Morgan,M, "Dynamic Positioning of Offshore Vessels" Pennwell Books, U.S, 1978

WEBSITE REFERENCES:

1. https://www.marinetechnologynews.com/articles/marinetechnology/introduction-to-underwater-communications-100052
2. https://www.unmannedsystemstechnology.com/company/sonardyne-international/
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**

JEC2041	OCEAN ACOUSTICS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To understand the basics of underwater sound and its propagation in the ocean.
- To simulate / design any underwater SONAR systems for ocean application
- To identify different kinds of noises and its impact present in marine biodiversity
- To analyze and apply suitable techniques for underwater acoustic signals and images
- To recognize different types of acoustic instruments used practically

UNIT I FUNDAMENTALS OF UNDERWATER ACOUSTICS 9

Ocean Acoustic environment - Measuring sound levels and relevant units, Sound propagation in the ocean, sound velocity profiles in the deep water and shallow water, Sound attenuation in the sea -absorption, scattering, transmission loss, reverberation, Snell's law, SONAR systems- active, passive SONAR equations and system parameters.

UNIT II SONAR SIGNAL PROCESSING 9

Spatial signals-Signals in space and time, Coordinate systems, Propagating waves, Wave number-frequency space, Finite continuous apertures, Spatial sampling, Directivity, Time and frequency domain beam forming, Array gain, Angular resolution, Transmitting signals Narrowband vs Chirp, Matched filtering, Range resolution, Time Varying Gain (TVG),

UNIT III AMBIENT NOISE IN THE OCEAN 9

Sources of noise, Natural and Physical sounds – Seismic, Wind, Wave, Rain and Turbulence. Biological sounds – Dolphin, Whales, Fishes; Man made Noises- Shipping Machinery noises, Pile driving, Wind Mills; Variability of Ambient noises; Frequency Bands, Noise levels, Impacts of Sound on Marine Animals.

UNIT IV UNDERWATER ACOUSTIC NETWORK TECHNOLOGY 9

Basics on Underwater Acoustic Modem and its construction, Bandwidth, Characteristics of UWA Network, Topology of UWA Network, Network Protocol Architecture of UWA Network, UWAC Challenges and Research Trends, Comparison study on RF, Optical and Acoustic Communication in Underwater. Underwater telephone, Acoustic Positioning System, Underwater beacon.

UNIT V UNDERWATER ACOUSTIC INSTRUMENTS AND ITS APPLICATION 9

Principles of Sonar systems, Echo sounder – single beam, multi beam; Side scan sonars – Imaging, Underwater acoustic camera; Sub bottom profilers -Sediment classification; Acoustic modem -Tsunami systems; Acoustic Positioning system- Transponders, USBL, SSBL systems, HiPAP; Underwater telephone; Underwater noise recorders; Underwater Beacons.

TOTAL PERIODS: 45

COURSE OUTCOMES:

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

- Understand the basics of underwater sound and its propagation in ocean
- To simulate / design any underwater SONAR systems for ocean application
- To identify different kinds of noises ocean and its impacts on the marine biodiversity
- Ability to get exposure in finding suitable techniques for underwater acoustic signals and images
- To recognize different types of acoustic instruments used practically

TEXTBOOKS:

1. Robert J Urick, Principles of underwater sound, Third Edition, Peninsula Publishing,2013
2. Herman Medwin and Clarence S. Clay, Fundamental of acoustical oceanography, First Edition, Academic Press,1998.

REFERENCES:

1. Norvald Kjerstad, "Electronic and Acoustic Navigation systems for Maritime Studies", NTNU Norwegian University of Science and Technology, 2016
2. TTFossen, "Guidance & Control of Ocean Vehicles",1st Edition, John Wiley & Sons Inc, 1994
3. Morgan,M, "Dynamic Positioning of Offshore Vessels" Pennwell Books,U.S, 1978

WEBSITE REFERENCES:

1. https://www.marinetechnologynews.com/articles/marinetechnology/introduction-to-underwater-communications-100052
2. https://www.unmannedsystemstechnology.com/company/sonardyne-international/
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**

JEC2042	SATELLITE OCEANOGRAPHY AND GIS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To give a broad knowledge of different remote sensing techniques in oceanography, with special focus on satellite measurement
- To learn about the Remote Sensing Platforms and Sensors
- To get idea about Geographic Information System
- To learn about the ocean properties and their observations through satellites.
- To learn about different remote sensing techniques in retrieving oceanographic parameters.

UNIT I ELEMENTS OF REMOTE SENSING 9

Satellite orbits: Newton's laws, Kepler's laws, Kepler's equation, orientation in space, orbital elements, Geostationary orbits, Sun synchronous orbits, visible and infrared radiometers, multiscanner radiometers;

UNIT II REMOTE SENSING PLATFORMS & SENSORS 9

Remote sensing platforms; satellite orbits; near polar, geostationary, and sun-synchronous satellites; swath; spatial, temporal, spectral and radiometric resolution; LANDSAT; SPOT; IRS; INSAT; SEASAT; ERS; JERS; MOS; RADARSAT;

UNIT III GEOGRAPHIC INFORMATION SYSTEM(GIS) 9

Spatial and attribute data, Raster and Vector spatial data structures, thematic characteristics of spatial data, Sources of Oceanographic spatial data-ship and Buoy data, satellite images, field data. Geographic Information System application and development for coastal zone and ocean.

UNIT IV OCEAN PROPERTIES MEASURABLE FROM SATELLITES 9

Ocean Color Remote Sensing - optical theory for Ocean color remote sensing, useful information from ocean color, estimating water parameters from spectral band ratios, identifying Potential Fishing Zones.IR measurement of Sea Surface Temperature – estimation of SST, AVHRR, Oceanographic application of IR SST data.

UNIT V FUNDAMENTALS OF REMOTE SENSING IN OCEANOGRAPHY 9

Visible Remote Sensing - Theory of optical remote sensing, scattering, absorption, radiative transfer. Ocean colour sensors and satellites, Interpretation of ocean colour and applications of Ocean colour scanners. Role of water constituents such as chlorophyll, yellow substances, and Suspended sediments.

TOTAL PERIODS: 45

COURSE OUTCOMES:

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

- Will get a broad knowledge of different remote sensing techniques in oceanography,
- Learn about the Remote Sensing Platforms and Sensors
- Get idea about Geographic Information System
- Learn about the ocean properties and their observations through satellites.
- Get idea on various remote sensing techniques in retrieving oceanographic parameters.

TEXTBOOKS:

1. Discovering the Ocean from Space: The Unique Applications of Satellite oceanography, I.S. Robinson, Springer. 2010.
2. An Introduction to Ocean Remote Sensing ,2 nd Edition, Seelve Martin, , Cambridge Univ. Press. 2014.

REFERENCES:

1.Methods of Satellite Oceanography: Robert H. Stewart, Publisher: Berkeley, California. 1985.

2. Fundamentals of satellite remote sensing, Chuvieco, Emilio, CRC Press, 2016.

3. Remote sensing of coastal environments, Wang,Yeqiao, Taylor & Francis series in remote sensing applications, CRC Press, 2010..

WEBSITE REFERENCES:

1. https://www.marinetechnologynews.com/articles/marinetechnology/introduction-to-underwater-communications-100052
2. https://www.unmannedsystemstechnology.com/company/sonardyne-international/
3. https://dynamic-positioning.com/proceedings/dp1998/SVickery.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	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**

JEC2043	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 BASICS OF WIRELESS TRANSMISSION 9

Introduction, Frequencies for radio transmission, Signals, Antennas ranges, Signal propagation, Multiplexing, Modulation, Spread spectrum, Cellular systems.

UNIT II WIRELESS MOBILE NETWORKS 9

WLAN System and Protocol architecture, IEEE 802.11a, IEEE 802.11b, HIPERLAN, Bluetooth architecture and protocols, WPAN-802.15.4, Wireless USB, Zigbee.

UNIT III MOBILE NETWORK AND TRANSPORT LAYER 9

Mobile IP- DHCP, Mobile ad-hoc networks - Traditional TCP, Classical TCP improvements, TCP over 2.5/3G wireless networks, IoT.

UNIT IV GSM AND 3G COMMUNICATIONS SYSTEMS 9

GSM, DECT, TETRA, UMTS-UMTS system architecture, UMTS radio interface, UTRAN, Core network.

UNIT V 4G & BEYOND 9

4G Technologies: Multicarrier Modulation, Smart antenna techniques, OFDM-MIMO Systems, Software-Defined Radio, Cognitive Radio, IMS Architecture, LTE, advanced LTE.

TOTAL PERIODS: 45

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”,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.

WEBSITE REFERENCES:

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/PSO MAPPING:

CO\PO, PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2	1	1	2	1	-	-	-	-	1	1	1	1	2
CO2	3	3	2	2	2	1	-	-	-	-	1	1	3	2	1
CO3	2	2	2	2	2	1	-	-	-	-	1	1	2	1	2
CO4	3	3	2	2	2	1	-	-	-	-	1	1	1	2	2
CO5	2	3	2	2	2	2	-	-	-	-	1	2	2	3	2
AVG	**2.4**	**2.6**	**1.8**	**1.8**	**2.0**	**1.2**	**-**	**-**	**-**	**-**	**1**	**1.2**	**1.8**	**1.8**	**1.8**

JEC2044 4G/5G COMMUNICATION NETWORKS L T P C
3 0 0 3

COURSE OBJECTIVES:

- To understand the concept and technologies of 4G networks.
- To learn the fundamentals of 5G and its channel access methods.
- To know the Radio Access Network for 5G communications.
- To analyze the various channel models for 5G networks.
- To learn 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, BLAST System, Case Study - LTE Advanced.

UNIT II INTRODUCTION TO 5G AND CHANNEL ACCESS METHODS 9

Introduction to 5G, Evolving LTE to 5G Capability, 5G Standardization, 3GPP and IMT2020, Spectrum for 5G, 5G deployment, Challenges and Applications. OFDMA, GFDM, Non NOMA, Universal Filtered OFDM, Case Study – FBMC.

UNIT III RADIO ACCESS NETWORK FOR 5G 9

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, mm Wave Communications, Massive MIMO, Beam forming Techniques.

TOTAL PERIODS: 45

COURSE OUTCOMES:

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

- Explain the technologies of 4G networks.
- Identify the concepts of 5G and its channel access methods.
- Explain the Radio Access Network for 5G communications.
- Design the various channel models for 5G networks.
- Describe 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.

WEBSITE REFERENCES:

1. https://www.iitk.ac.in/mwn/latest5G/speaker.html
2. https://www.coursera.org/learn/5g-training-qualcomm
3. https://onlinecourses.nptel.ac.in/noc22_ee56/preview
4. https://qwa.qualcomm.com/course-catalog/Fundamentals-Cellular-Communication-5G
5. https://dot.egr.uh.edu/programs/professional/5g-lte

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**

JEC2045	MULTIMEDIA COMPRESSION AND COMMUNICATION	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To explain the compression schemes for voice
- To make students understand the compression schemes for image and video
- To explain the text compression techniques
- To make students understand the QoS issues in multimedia network
- To explain 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 – 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 – 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:

- Comprehend the compression schemes for voice
- Configure the compression schemes for image and video
- Explain the text compression techniques
- Explain the suitable service model for specific application
- Describe 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.

WEBSITE REFERENCES:

1. https://nptel.ac.in/courses/117/105/117105083/
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/PSO MAPPING:

CO\PO, PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	P10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	3	3	2	2	1	-	-	-	-	3	2	2	2	2
CO2	3	2	3	3	3	1	-	-	-	-	2	3	3	2	2
CO3	2	3	2	2	3	2	-	-	-	-	3	2	3	3	3
CO4	3	3	3	3	2	1	-	-	-	-	2	2	2	2	2
CO5	3	2	3	2	3	1	-	-	-	-	3	2	3	3	3
AVG	**2.6**	**2.6**	**2.8**	**2.4**	**2.6**	**1.2**	**-**	**-**	**-**	**-**	**2.6**	**2.2**	**2.6**	**2.4**	**2.4**

JEC2046	WIRELESS SENSOR NETWORKS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To understand the fundamentals of wireless sensor network
- To learn the various architectures
- To study about the networking sensors in MAC and Routing protocols
- To study about the infrastructure establishment related to topology control, clustering
- To learn sensor network platforms and tools

UNIT I INTRODUCTION 9

Introduction to Wireless Sensor Networks- Challenges for WSN, Comparison of WSN, Enabling Technologies for Wireless Sensor Networks, WSN application examples

UNIT II ARCHITECTURES 9

Single-Node Architecture - Hardware Components, Energy Consumption of Sensor Nodes , Operating Systems and Execution Environments, Network Architecture - Sensor Network Scenarios, Optimization Goals and Figures of Merit, Gateway Concepts.

UNIT III NETWORKING PROTOCOLS AND ROUTING 9

Physical Layer and Transceiver Design Considerations, MAC Protocols for Wireless Sensor Networks, Low Duty Cycle Protocols And Wakeup Concepts - Mediation Device Protocol, Wakeup Radio Concept, Assignment of MAC Addresses, Routing Protocols- Energy-Efficient Routing, Geographic Routing.

UNIT IV INFRASTRUCTURE ESTABLISHMENT 9

Topology Control, Clustering, Time Synchronization, Localization and Positioning, Sensor Tasking and Control.

UNIT V SENSOR NETWORK PLATFORMS AND TOOLS 9

Sensor Node Hardware – Berkeley Motes, Programming Challenges, Node-level software platforms, Node-level Simulators, State-centric programming.

TOTAL PERIODS: 45

COURSE OUTCOMES:

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

- Explain fundamental concepts of Wireless Sensor Networks
- Describe various architectures of WSN
- Explain the MAC and Routing protocols
- Describe fundamentals of infrastructure establishment
- Experiment the tools and platforms of sensor networks

TEXT BOOKS:

1. Holger Karl & Andreas Willig, "Protocols And Architectures for Wireless Sensor Networks" , John Wiley Publication, 2006.
2. Anna Forster, “Introduction to Wireless Sensor Networks”, Wiley, 2017.
3. Feng Zhao & Leonidas J. Guibas, “Wireless Sensor Networks- An Information Processing Approach", Elsevier, 2007.

REFERENCES:

1. Kazem Sohraby, Daniel Minoli, & Taieb Znati, “Wireless Sensor Networks- Technology, Protocols, And Applications”, John Wiley, 2007.
2. Anna Hac, “Wireless Sensor Network Designs”, John Wiley, 2003.
3. Rappaport,T.S., “Wireless communications”,PearsonEducation,SecondEdition,2010.
4. Simon Haykin , Michael Moher, David Koilpillai, “Modern Wireless Communications”, Pearson Education, First Edition, 2013.

WEBSITE REFERENCES:

1. http://vlabs.iitkgp.ac.in/ant/8/
2. https://www.youtube.com/watch?v=GUSrkWJ_Z2g
3. https://rajivbhandari.files.wordpress.com/2018/11/nptel-4.pdf
4. https://nptel.ac.in/courses/106105160
5. https://redirect.cs.umbc.edu/~younis/Sensor_Networks/CMPE684.htm

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	1	-	-	-	-	1	1	1	1	2
CO2	3	3	2	2	2	1	-	-	-	-	1	1	3	2	1
CO3	3	2	3	2	2	1	-	-	-	-	1	1	2	1	2
CO4	3	3	3	3	2	2	-	-	-	-	1	1	1	2	2
CO5	2	3	1	1	2	2	-	-	-	-	1	2	2	3	2
AVG	**2.8**	**2.6**	**2.2**	**2**	**2.0**	**1.4**	**-**	**-**	**-**	**-**	**1**	**1.2**	**1.8**	**1.8**	**1.8**

JEC2047	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 understand the Queuing model and the effects of congestion
- To demonstrate the TCP flow control and congestion control attributes
- To illustrate the integrated services architecture
- To examine the QOS details of high speed communication protocol

UNIT I HIGH SPEED NETWORKS

Frame Relay Networks, Asynchronous Transfer Mode: ATM Protocol Architecture, ATM logical Connection, ATM Cell, ATM Service Categories, AAL, High Speed LANs: Fast Ethernet, Gigabit Ethernet, Fiber Channel, Wireless LANs: applications, requirements, Architecture of 802.11.

UNIT II CONGESTION AND TRAFFIC MANAGEMENT

Queuing Analysis: Queuing Models, Single Server Queues, Effects of Congestion, Congestion Control, Traffic Management, Congestion Control in Packet Switching Networks, Frame Relay Congestion Control.

UNIT III TCP AND ATM CONGESTION CONTROL

TCP Flow control, TCP Congestion Control, Retransmission, Timer Management, Exponential RTO back off, Window management, Performance of TCP over ATM, Traffic and Congestion control in ATM, Requirements, Attributes, ABR Traffic Management.

UNIT IV INTEGRATED AND DIFFERENTIATED SERVICES

Integrated Services Architecture: Approach, Components, Services, Queuing Discipline, FQ, PS, BRFQ, GPS, WFQ, Random Early Detection, Differentiated Services.

UNIT V PROTOCOLS FOR QOS SUPPORT

RSVP – Goals & Characteristics, Data Flow, RSVP operations, Protocol Mechanisms, Multiprotocol Label Switching, Operations, Label Stacking, Protocol details, RTP: Protocol Architecture, Data Transfer Protocol, RTCP.

TOTAL PERIODS: 45

COURSE OUTCOMES:

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

- Explain the high speed computer network architectures
- Describe the Queuing model and the effects of congestion
- Summarize the TCP flow control and congestion control attributes
- Illustrate the integrated services architecture
- Examine the QOS details of high speed communication protocol

TEXT BOOKS:

1. William Stallings, "High-speed Networks and Internets," 2012, Second Edition, Pearson Education, United Kingdom.
2. Jean Walrand and Pravinvaraiya, "High Performance Communication networks", Second 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.

WEBSITE REFERENCES:

1. https://onlinecourses.nptel.ac.in/noc22_ee61/preview
2. https://ocw.mit.edu/courses/6-263j-data-communication-networks-fall-2002/pages/syllabus/
3. https://www.geeksforgeeks.org/karns-algorithm-for-optimizing-tcp/
4. https://www.geeksforgeeks.org/resource-reservation-protocol-in-real-time-systems/
5. https://intronetworks.cs.luc.edu/1/html/queuing.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	1	2	2	3	1	-	-	-	-	1	2	3	3	2
CO2	1	3	2	2	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**	**2.6**	**2.6**	**1**	**-**	**-**	**-**	**-**	**1**	2	**2.8**	**2.6**	**2.8**

JEC2048	OPTICAL COMMUNICATION	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To understand 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 networks and applications

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 waveguide, 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 modal dispersion, material dispersion, waveguide dispersion, polarization mode dispersion, 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 photodiodes, Photodetector 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 OPTICAL NETWORKS AND APPLICATIONS 9

Elements of optical networks, SONET/SDH, High speed light wave Links, OADM configuration, Optical Ethernet - Soliton, SONAR. Fiber to the Home, Fiber to the Curb, Fiber to the Building, Optical Sensor, Case Study - Terahertz Wireless Communication.

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 systems.
- Construct fiber optic detector and receiver systems.
- Explain about fiber optic networks and applications.

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/PSO MAPPING:

CO\PO, PSO	PO 1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	3	2	1	-	1	-	-	-	-	1	1	3	3	2
CO2	2	3	2	1	-	1	-	-	-	-	1	1	2	2	2
CO3	2	2	2	1	-	1	-	-	-	-	1	1	2	2	2
CO4	2	3	2	1	-	1	-	-	-	-	1	1	2	2	2
CO5	2	2	2	1	-	2	-	-	-	-	1	1	3	2	3
AVG	**2**	**2.6**	**2**	**1**	**-**	**1.2**	**-**	**-**	**-**	**-**	**1**	**1**	**2.4**	**2.2**	**2.2**

JEC2049	COGNITIVE RADIO NETWORKS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- Understand the fundamental concepts of cognitive radio networks.
- Explore the cognitive radio and techniques for spectrum holes detection.
- Understand the functions of MAC layer and Network layer and its various protocols
- Understand fundamental issues regarding dynamic spectrum access, the radio-resource management and trading
- Interpret the basics of security management and the various attacks & its countermeasures

UNIT I INTRODUCTION TO COGNITIVE RADIO

Cognitive Radio: History and background, Communication policy and Spectrum Management, Cognitive radio cycle, SDR architecture for cognitive radio, Spectrum sensing Single node sensing: energy detection, cyclo stationary and wavelet based sensing, Cooperative sensing: different fusion rules.

UNIT II SPECTRUM SENSING AND TRADING

Spectrum Sensing – Sensing Techniques – Comparison – Performance Measure & Design Trade-Offs: Receiver operating characteristics – Throughput Performance measure – Fundamental limits and trade-off. Introduction to spectrum trading, classification, radio resource pricing, classification of auctions.

UNIT III MAC PROTOCOLS AND NETWORK LAYER DESIGN

Functionality of MAC protocol in spectrum access –classification –Interframe spacing and MAC challenges – QOS – Spectrum sharing in CRAHN –CRAHN models – CSMA/CA based MAC protocols for CRAHN – Routing in CRN.

UNIT IV DYNAMIC SPECTRUM ACCESS AND MANAGEMENT

Spectrum broker, Dynamic spectrum access architecture- centralized dynamic spectrum access, distributed dynamic spectrum access, Inter- and intra-RAN dynamic spectrum allocation, Spectrum management, Spectrum sharing, Spectrum mobility issues.

UNIT V TRUSTED CRN AND RESEARCH CHALLENGES

Trust for CRN: Fundamentals – Models – Effects of Trust Management – Security properties in CRN – Route Disruption attacks –Jamming attacks –PU Emulation attacks. Network layer and transport layer issues, cross layer design for cognitive radio networks.

COURSE OUTCOMES:

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

- Explain the fundamental concepts of cognitive radio networks
- Interpret the basics of various spectrum sensing techniques and algorithms
- Describe the functions of MAC layer and Network layer and its various protocols
- Recognize the concepts of cooperative spectrum sensing and handoff process
- Analyze the research challenges in cognitive radio networks

TEXT BOOKS:

1. Hüseyin Arslan, "Cognitive Radio, Software Defined Radio and Adaptive Wireless Systems", Springer, ISBN 978-1-4020-5541-6 (HB), 2007.
2. Linda Doyle, "Essentials of Cognitive Radio", Cambridge University Press, 2009.

REFERENCES:

1. Kwang-Cheng Chen, Ramjee Prasad, "Cognitive radio networks", John Wiley & Sons Ltd., 2009.
2. Bruce A. Fette, "Cognitive Radio Technology", Elsevier, 2006.
3. Alexander M. Wyglinski, Maziar Nekovee, and Y. Thomas Hou, "Cognitive Radio Communications and Networks - Principles and Practice", Elsevier Inc., 2010.
4. https://download.e-bookshelf.de/download/0000/0040/80/L-G-0000004080-0002333463.pdf

WEBSITE REFERENCES:

1. https://nptel.ac.in/courses/108107107
2. https://onlinecourses.nptel.ac.in/noc22_ee78/preview
3. https://www.cs.cmu.edu/~prs/wirelessF09/
4. http://wcsp.eng.usf.edu/courses/Cognitive.html
5. https://www.sciencedirect.com/topics/engineering/cognitive-radio

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	2	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**	**2.6**	**2.6**	**1**	**-**	**-**	**-**	**-**	**1**	2	**2.8**	**2.6**	**2.8**

OPEN ELECTIVES 1

SEMESTER - IV

JEC9201	COMMUNICATION SYSTEMS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To make students understand Noise and analog communication techniques.
- To give an insight on sampling and digital communication techniques.
- To discuss the basics of mobile telecommunication systems.
- To explain the basic concept of satellite orbits & satellite link design.
- To introduce the fundamental concepts of cognitive networks.

UNIT I ANALOG COMMUNICATION 9

Introduction to Communication Systems - Modulation - Need for Modulation. Theory of Amplitude Modulation - Concepts of SSB Techniques - Theory of Frequency and Phase Modulation – Comparison of 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– Binary Frequency Shift Keying –Binary Phase Shift Keying – QPSK – Quadrature Amplitude Modulation– Bandwidth Efficiency– Comparison of ASK – FSK – PSK – QAM.

UNIT III MOBILE COMMUNICATION 9

Generations of Mobile Communication Technologies-MAC Protocols – TDMA- FDMA- CDMA-Global System for Mobile Communications (GSM) Architecture - GPRS- Wireless LANs – IEEE 802.11 Standard Architecture –Introduction of Mobile network- Mobile IP, transport layer - Mobile TCP.

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, Satellite uplink and downlink analysis.

UNIT V COGNITIVE NETWORKS 9

Architecture of SDR, Cognitive Networks, Cognitive cycle - 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 explain the analog communication techniques.
- To explain the digital communication techniques.
- To discuss the basics of mobile telecommunication system and its different layers.
- To describe the satellite orbit & satellite link.
- To explain the fundamentals of cognitive networks.

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", 3rd 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

JEC9202	DIGITAL SYSTEMS AND COMPUTING	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To explain the concepts of number systems
- To make students understand the simplification and reduction methods.
- To design combinational circuits.
- To design sequential circuits using flip flops.
- To familiarize memory and introduce the 8 and 16 bit processor.

UNIT I DATA AND INFORMATION 9

Features of Digital Systems, Number Systems - Representation of Data: Signed Magnitude, 1's and 2's complement, Fixed and Floating point representation - BCD, XS-3, Gray code, hamming code, alphanumeric codes Error detecting and correcting codes.

UNIT II BOOLEAN ALGEBRA AND LOGIC REDUCTION 9

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 III COMBINATIONAL CIRCUITS 9

Half adder, full adder, subtractor, code converters, combinational circuit design, Multiplexers and demultiplexers, encoders, decoders, Combinational design using mux and demux.

UNIT IV SEQUENTIAL CIRCUITS 9

Flip flops: RS, Clocked RS, D, JK, JK Master Slave, T, Counters, Shift registers and their types, Counters: Synchronous and Asynchronous counters.

UNIT V COMPUTER MEMORY AND BASIC PROCESSOR 9

Basic Organisation, Memory: ROM, RAM, PROM, EPROM, EEPROM, Secondary Memory: Hard Disk and optical Disk, Cache Memory, I/O devices- Introduction to 8bit and 16bit processor

TOTAL PERIODS: 45

COURSE OUTCOMES:

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

- Explain digital number systems.
- Use Boolean laws and explain reduction methods.
- Design and implement combinational circuits.
- Design and implement sequential circuits.
- Discuss memory design and basics of processors.

TEXTBOOKS:

1. S.Salivahanan and S.Arivazhagan "Digital Electronics", I Edition, Vikas Publishing House Pvt Ltd, 2012.
2. Krishna Kant, "Microprocessor and Microcontrollers, Architecture, Programming and System Design 8085, 8086, 8051", Second Edition, PHI Learning Private Limited, 2014.

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. Rajkamal, “Microcontrollers - Architecture, Programming, Interfacing and System Design, 2nd edition, Pearson, 2012.

WEBSITE REFERENCES:

1. https://www.youtube.com/watch?v=juJR_JDJRa0 - Prof. S. Srinivasan,Department of Electrical Engineering, IIT Madras
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.digimat.in/nptel/courses/video/108105102/L01.html
6. http:// freevideolectures.com/courses/3018/microprocessors-and-microcontrollers

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	2	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	-	-	-	-	2	2

JEC9203	SIMULATION TOOLS IN ELECTRONICS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To illustrate simulation using electronic workbench
- To explain simulation using PSpice
- To demonstrate simulation using ModelSim.
- To illustrate simulation using Matlab
- To explain 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 demonstrate using PSpice
- To practice using ModelSim.
- To demonstrate 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"

WEBSITE REFERENCES:

1. https://www.youtube.com/watch?v=iAeSrP54JTU
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 ELECTIVES 2
SEMESTER V

JEC9204	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 describe different classification of signals.
- To make students understand the basic properties of signal
- To illustrate continuous time signals by using Fourier transform and Laplace transform
- To explain discrete time signals in the Discrete time Fourier and Z transform domain

UNIT I INTRODUCTION TO SIGNALS 9

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 9

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 9

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 9

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 9

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:

- Explain the fundamental concept of signals and different classification of signals
- Classify different signals
- Explain various properties of signals
- List various properties of continuous time signals and its frequency domain representation
- State 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. https://nptel.ac.in/courses/108/104/108104100/, Prof.K.Aditya Jaganath, IIT-Kanpur.
2. https://nptel.ac.in/courses/108/106/108106163/, Dr.Khusal Shah , IISER Bhopal
3. https://nptel.ac.in/courses/108/106/108106163/, Dr.Khusal Shah , IISER Bhopal
4. https://nptel.ac.in/courses/108/106/108106163/, Dr.Khusal Shah , IISER Bhopal
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

JEC9205	MICROCONTROLLER AND ITS APPLICATIONS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To explain the architecture and addressing modes of 16-bit microprocessor
- To discuss the interfacing concepts of of microprocessor.
- To describe architecture and programming of 8-bit microcontroller.
- To explain the interfacing concepts of the microcontroller.
- To discuss the application development using microcontrollers.

UNIT I INTRODUCTION TO 16-BIT MICROPROCESSOR 9

Introduction, Microprocessors and Microcontrollers – 8-bit and 16-bit processor – Difference between microprocessor and microcontrollers – Architecture of 8086 – Instruction sets – Addressing modes – assembly language programming.

UNIT II I/O INTEFACING 9

Memory Interfacing and I/O interfacing - Parallel communication interface – Serial communication interface – D/A and A/D Interface - Timer – Keyboard /display controller – Interrupt controller – DMA controller.

UNIT III 8051 MICROCONTROLLERS 9

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

UNIT IV INTERFACING MICROCONTROLLER 9

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

UNIT V ADVANCED CONTROLLERS AND CASE STUDIES 9

PIC and ARM processors, Case studies: Traffic Light control, LED display , LCD display, Keyboard display interface and Alarm Controller.

TOTAL PERIODS: 45

COURSE OUTCOMES:

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

- Understand and execute programs based on 8086 microprocessors
- Design and interface I/O circuits.
- Analyze 8051 Addressing modes and use the 8051 instruction set
- Program the on-chip peripherals in 8051
- Design and develop applications using microprocessors and controllers

TEXTBOOKS:

3. Sunil Mathur & Jeebananda Panda, “Microprocessor and Microcontrollers”, PHI Learning Pvt. Ltd, 2016.
4. Krishna Kant, “Microprocessor and Microcontrollers, Architecture, Programming and System Design 8085, 8086, 8051”, Second Edition, PHI Learning Private Limited, 2014.

REFERENCES:

4. R.S. Gaonkar, "Microprocessor Architecture Programming and Application", with 8085, Wiley Eastern Ltd., New Delhi, 2013.
5. Mohamed Ali Mazidi, Janice Gillispie Mazidi, Rolin McKinlay, "The 8051 Microcontroller and Embedded Systems: Using Assembly and C", Second Edition, Pearson education, 2011.
6. Rajkamal, "Microcontrollers - Architecture, Programming, Interfacing and System design, 2nd edition, Pearson, 2012.

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

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

JEC9206	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 explain about ARM processor, architecture and its instruction set
- To make students understand about various, I/O devices and concept of interfacing.
- To state the concepts of real time operating systems (RTOS).
- To give an outline about 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 discuss concepts of interfacing and various I/O devices.
- To explain the basic concepts of real time Operating system design.
- To use 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.

WEBSITE REFERENCES:

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

OPEN ELECTIVES 3
SEMESTER - VI

JEC9207	INTRODUCTION TO MOBILE COMMUNICATION	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To make students understand the basics of wireless transmission systems
- To explain the various wireless mobile networks
- To outline mobile network and transport layers techniques and protocols.
- To discuss fundamentals of GSM and 3G Services, its protocols and applications
- To describe evolution of 4G Networks, its architecture and applications

UNIT I INTRODUCTION TO WIRELESS TRANSMISSION 9

Introduction to mobile communication, 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 802.11, HIPERLAN1/2, Bluetooth, WPAN-802.15.4, Wireless USB, Zigbee, 6LoWPAN, LoRaWAN, WiMAX.

UNIT III MOBILE NETWORK AND TRANSPORT LAYER 9

Network Layer: Mobile IP, Registration, Tunneling and encapsulation, IPv6, DHCP, Adhoc Routing Protocols, Transport Layer: Traditional TCP, Classical TCP improvements, TCP over 2.5/3G wireless networks, 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, 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
- Discuss fundamentals of GSM and 3G Services, its protocols and applications
- State 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.

WEBSITE REFERENCES:

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
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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

JEC9208	DRONE TECHNOLOGY	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To describe the basics of drone concepts
- To state the fundaments of design, fabrication and programming of drone
- To impart the knowledge of flying and operation of the drone
- To describe about the various applications of drone
- To discuss the safety risks and guidelines for flying safely

UNIT I INTRODUCTION TO DRONE TECHNOLOGY 9

Drone Concept - History of drone - Types of current generation of drones based on their method of propulsion- Drone technology impact on the businesses- Drone business through entrepreneurship and opportunities for employability

UNIT II DRONE DESIGN, FABRICATION AND PROGRAMMING 9

Classifications of the UAV -Overview and Technical characteristics of the component parts - Assembling a drone- The energy sources- Level of autonomy- Drones configurations -The methods of programming drone- Multirotor stabilization- Flight modes -Wi-Fi connection.

UNIT III DRONE FLYING AND OPERATION 9

Concept of operation for drone -Flight modes- Operate a small drone in a controlled environment- Drone controls Flight operations –management tool –Sensors-On board storage capacity -Removable storage devices- Linked mobile devices and applications

UNIT IV DRONE COMMERCIAL APPLICATIONS 9

Choosing a drone based on the application -Drones in the insurance sector- Drones in delivering mail, parcels and other cargo- Drones in agriculture- Drones in inspection of transmission lines and power distribution -Drones in filming and panoramic picturing.

UNIT V FUTURE DRONES AND SAFETY 9

The safety risks- Guidelines to fly safely -Specific aviation regulation and standardization- Drone license- Miniaturization of drones- Increasing autonomy of drones -The use of drones in swarms.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

Upon successful completion of the course, students should be able to

- Explain about a various type of drone technology, drone fabrication and programming.
- Execute the suitable operating procedures for functioning a drone
- Select appropriate sensors and actuators for Drones
- Develop a drone mechanism for specific applications
- Write the programs for various drones

TEXT BOOKS:

1. Daniel Tal and John Altschuld, "Drone Technology in Architecture, Engineering and Construction: A Strategic Guide to Unmanned Aerial Vehicle Operation and Implementation", 2021 John Wiley & Sons, Inc.
2. Terry Kilby and Belinda Kilby, "Make:Getting Started with Drones ",Maker Media, Inc, 2016

REFERENCES:

1. John Baichtal, "Building Your Own Drones: A Beginners' Guide to Drones, UAVs, and ROVs", Que Publishing, 2016
2. Zavrsnik, "Drones and Unmanned Aerial Systems: Legal and Social Implications for Security and Surveillance", Springer, 2018.

WEBSITE REFERENCES:

1. https://www.indiascience.in/videos/history-of-drone-technology-e#google_vignette
2. https://cfdflowengineering.com/working-principle-and-components-of-drone/#google_vignette
3. https://uavcoach.com/how-to-fly-a-quadcopter-guide/#Controls
4. https://www.auav.com.au/articles/what-is-a-drone-used-for/
5. https://ideaforgetech.com/blogs/future-of-military-drones-in-india

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

JEC9209	VERILOG HDL FOR DIGITAL CIRCUIT DESIGN	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To list the different programming methodologies adopted in verilog
- To explain basic building blocks of writing verilog program
- To make students understand the concepts of delay in verilog HDL
- To illustrate how the data is transversed /handled in verilog HDL
- To summarize 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

- Explain the different programming methodologies adopted in verilog
- Use the basic building blocks of writing verilog program
- Discuss the concepts of delay in verilog HDL
- Describe how the data is transverse /handled in verilog HDL
- Explain how to handle the system function in verilog Module

TEXT BOOKS:

1. J. Bhasker, “A Verilo HDL Primer”, Third Edition, Star Galaxy Publishing, 2018
2. Samir Planitkar, “Verilog HDL- A Guide to Digital Design and Synthesis”, Sun Soft Press 1992.

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

WEBSITE REFERENCES:

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

OPEN ELECTIVES 5

SEMESTER VII

JEC9210	INTRODUCTION TO SATELLITE COMMUNICATION	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To define the basics of satellite orbits
- To explain the satellite space segment and subsystem
- To describe satellite link design
- To list and explain the various methods of satellite access
- To discuss 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:

- State the satellite orbits
- Explain the space segment and subsystem
- Describe the satellite Link design
- Comprehend the satellite Access
- Discuss 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.

WEBSITE REFERENCES:

1. https://nptel.ac.in/courses/117/105/117105131/ .Prof. Kalyan Kumar Bandyopadhyay, IIT Kharagpur.
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
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

JEC9211	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 give knowledge about the variety of measuring instruments, their methods of measurement and the use of different sensors.
- To explain about special purpose sensors
- To discuss the concepts associated with actuators.
- To describe 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
- Discuss different resistive, inductive and capacitive sensors and utilize them for suitable applications.
- Select a sensor for specific application
- Explain Actuators and its types
- Describe 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	-
CO2	3	3	2	1	2	-	-	-	-	1	1	-
CO3	3	3	2	1	2	-	-	-	-	1	1	-
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	-

JEC9212	TOOLS FOR COMPUTING AND DESIGN PLATFORM	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To make students understand the basics of electronic circuit assembly
- To discuss Xilinx ISE design suite for programming and simulation of HDL designs.
- To explain the implementation of VHDL and simulation using Altera Quartus.
- To introduce the technologies associated ARM, DSP and embedded processors.
- To discuss 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

- Use the fundamentals electronic circuit build, Arduino board programming and simulation
- Illustrate of HDL design, spartan family of FPGA and CPLD.
- Discuss the VHDL and Verilog
- Describe the IDE for the Texas Instruments processors, ARM and embedded processors.
- Explain the latest evolution cloud in the development of IOT based embedded system.

TEXTBOOKS:

1. Tinkercad For Dummies, "by Shaun C. Bryant", John Wiley & sons, 2018.
2. J MichaelKavis, "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.

WEBSITE REFERENCES:

- https://www.tinkercad.com/- Tinkercad
- 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

CO - PO MAPPING

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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