Sri

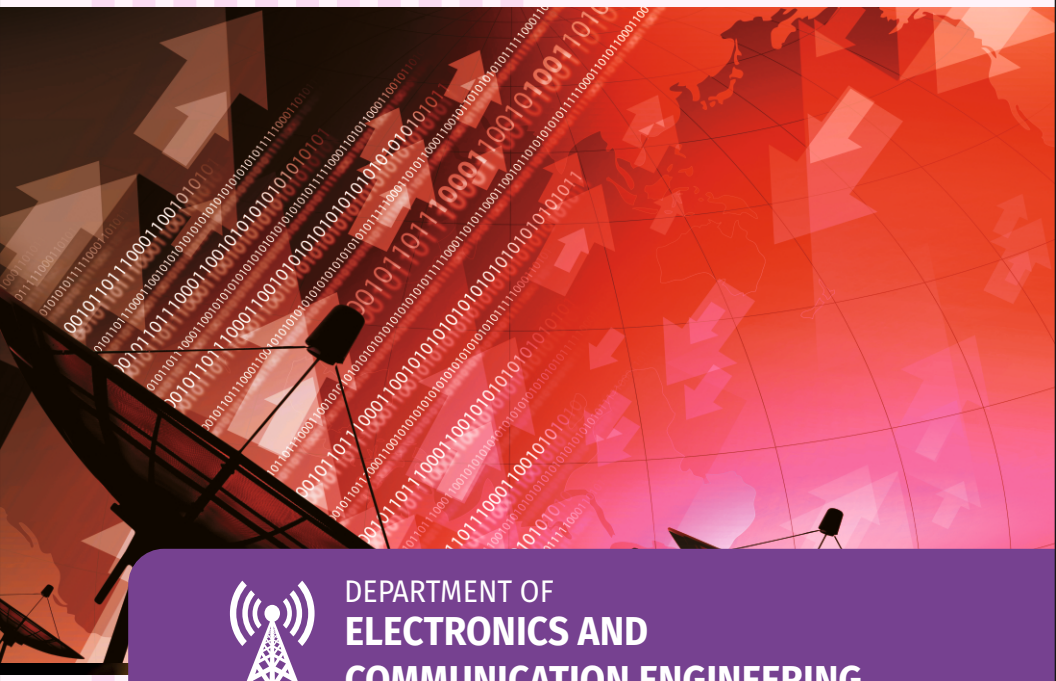
SAI RAM ENGINEERING COLLEGE

An Autonomous Institution

West Tambaram, Chennai - 44

www.sairam.edu.in

Approved by AICTE, New Delhi
Affiliated to Anna University



DEPARTMENT OF
ELECTRONICS AND COMMUNICATION ENGINEERING

REGULATIONS
2020

Academic Year 2020-21 onwards

AUTONOMOUS
CURRICULUM AND
SYLLABUS
I - VIII
SEMESTERS

SRI SAIRAM ENGINEERING COLLEGE

VISION

To emerge as a "Centre of excellence " offering Technical Education and Research opportunities of very high standards to students, develop the total personality of the individual and instil high levels of discipline and strive to set global standards, making our students technologically superior and ethically stronger, who in turn shall contribute to the advancement of society and humankind.

MISSION

We dedicate and commit ourselves to achieve, sustain and foster unmatched excellence in Technical Education. To this end, we will pursue continuous development of infra-structure and enhance state-of-the-art equipment to provide our students a technologically up-to date and intellectually inspiring environment of learning, research, creativity, innovation and professional activity and inculcate in them ethical and moral values.

QUALITY POLICY

We at Sri Sai Ram Engineering College are committed to build a better Nation through Quality Education with team spirit. Our students are enabled to excel in all values of Life and become Good Citizens. We continually improve the System, Infrastructure and Service to satisfy the Students, Parents, Industry and Society.

DEPARTMENT OF ELECTRONICS & COMMUNICATION ENGG.

VISION

To emerge as a "centre of excellence" in the field of Electronics and Communication Engineering and to mould our students to become technically and ethically strong to meet the global challenges. The Students in turn contribute to the advancement and welfare of the society.

MISSION

Department of Electronics and Communication Engineering, SRI SAIRAM ENGINEERING COLLEGE is committed to

M1 Achieve, sustain and foster excellence in the field of Electronics and Communication Engineering.

M2 Adopt proper pedagogical methods to maximize the knowledge transfer.

M3 Enhance the understanding of theoretical concepts through professional society activities

M4 Improve the infrastructure and provide conducive environment of learning and research following ethical and moral values

AUTONOMOUS CURRICULA AND SYLLABI
Regulations 2020

SEMESTER I

S. NO	COURSE CODE	COURSE TITLE	WEEK HOURS			TOTAL CONTACT HOURS	CREDITS
			L	T	P		
THEORY							
1	20BSMA101	Engineering Mathematics-I	3	1	0	4	4
2	20HSEN101	Technical English-I	3	0	0	3	3
3	20BSPH101	Engineering Physics	3	0	0	3	3
4	20BSCY101	Engineering Chemistry	3	0	0	3	3
5	20ESCS101	Problem Solving and Programming in C	3	0	0	3	3
6	20ESGE101	Engineering Graphics	1	2	0	3	3
PRACTICAL							
7	20BSPL101	Physics and Chemistry Laboratory	0	0	3	3	1.5
8	20ESPL101	Programming in C Laboratory	0	0	3	3	1.5
VALUE ADDITIONS - I							
9	20TPHS101	Skill Enhancement	0	0	2	2	1
10	20HSMG101	Personal Values	2	0	0	2	0
TOTAL						**29**	**23**

SEMESTER II

S. NO	COURSE CODE	COURSE TITLE	WEEK HOURS			TOTAL CONTACT HOURS	CREDITS
			L	T	P		
THEORY							
1	20BSMA201	Engineering Mathematics -II	3	1	0	4	4
2	20HSEN201	Technical English - II	3	0	0	3	3
3	20ESIT201	Python Programming with lab	3	0	2	5	4
4	20BSPH201	Physics of Electronic Devices	3	0	0	3	3
5	20ECPC201	Circuit Analysis	3	0	0	3	3
PRACTICAL							
6	20ESGE201	Engineering Practices Laboratory	0	0	3	3	1.5
7	20ECPL201	Circuits and Devices Laboratory	0	0	3	3	1.5
8	20ECTE201	PCB Design	0	0	2	2	1
VALUE ADDITIONS - II							
9	20TPHS201	Skill Enhancement	0	0	2	2	1
10	20HSMG201	Interpersonal Values	2	0	0	2	0
TOTAL						**30**	**22**

SEMESTER III

S. NO	COURSE CODE	COURSE TITLE	WEEK HOURS			TOTAL CONTACT HOURS	CREDITS
			L	T	P		
THEORY							
1	20ECPC301	Digital Electronics	3	0	0	3	3
2	20ECPC302	Electromagnetic Fields & Waveguides	3	1	0	4	4
3	20ECPC303	Signals and Systems	3	1	0	4	4
4	20ECPW301	R Programming with Laboratory	3	0	2	5	4
5	20BSMA301	Linear Algebra, Partial Differential Equations and Transforms	3	1	0	4	4
PRACTICAL							
6	20ECPL301	Digital Circuits Laboratory	0	0	3	3	1.5
7	20ECTE301	Live-in-Lab - I	0	0	2	2	1
VALUE ADDITIONS - III							
8	20ECTP301	Skill Enhancement	0	0	2	2	1
9	20MGMC301	Constitution of India	2	0	0	2	0
TOTAL						**28**	**22.5**

SEMESTER IV

S. NO	COURSE CODE	COURSE TITLE	WEEK HOURS			TOTAL CONTACT HOURS	CREDITS
			L	T	P		
THEORY							
1	20ECPC401	Communication Theory	3	0	0	3	3
2	20ECPW401	Electronic Circuits with Laboratory	3	0	2	5	4
3	20ECPW402	Linear integrated Circuits with Laboratory	3	0	2	5	4
4	20ECPC402	Microcontrollers & Embedded Systems	3	0	0	3	3
5	20BSMA401	Probability theory and Stochastic processes	3	1	0	4	4
6	20BSCY201	Environmental Science and Engineering	3	0	0	3	3
PRACTICAL							
7	20ECPL401	Microcontrollers & Embedded Systems Laboratory	0	0	3	3	1.5
VALUE ADDITIONS - IV							
8	20ECTE401	Live-in-Lab -II	0	0	2	2	1
9	20ECTP401	Skill Enhancement	0	0	2	2	1
TOTAL						**30**	**24.5**

SEMESTER V

S. NO	COURSE CODE	COURSE TITLE	WEEK HOURS			TOTAL CONTACT HOURS	CREDITS
			L	T	P		
THEORY							
1	20ECPC501	Digital Communication	3	0	0	3	3
2	20ECPW501	Discrete Time Signal Processing with Laboratory	3	0	2	5	4
3	20ECPC502	VLSI Design	3	0	0	3	3
4	20ECELXXX	Professional Elective-I	3	0	0	3	3
5	20XXOEXXX	Open Elective-I	3	0	0	3	3
PRACTICAL							
6	20ECPL501	Communication Systems Laboratory	0	0	3	3	1.5
7	20ECPL502	VLSI Laboratory	0	0	3	3	1.5
8	20ECTE501	Live-in-Lab III	0	0	4	4	2
VALUE ADDITIONS - V							
9	20ECTP501	Skill Enhancement	0	0	2	2	1
TOTAL						**29**	**22**

SEMESTER VI

S. NO	COURSE CODE	COURSE TITLE	WEEK HOURS			TOTAL CONTACT HOURS	CREDITS
			L	T	P		
THEORY							
1	20ECPC601	Transmission Lines & Antennas	3	0	0	3	3
2	20ECPC602	Communication Networks	3	0	0	3	3
3	20ECPC603	Wireless Communication	3	0	0	3	3
4	20ECELXXX	Professional Elective-II	3	0	0	3	3
5	20XXOEXXX	Open Elective - II	3	0	0	3	3
PRACTICAL							
6	20HSPL501	Communication and Soft Skills Laboratory	0	0	2	2	1
7	20ECPL601	Antennas Laboratory	0	0	3	3	1.5
8	20ECPL602	Networks Laboratory	0	0	3	3	1.5
9	20ECPJ601	Innovative Design Project	0	0	2	2	1
VALUE ADDITIONS - VI							
10	20ECTP601	Skill Enhancement	0	0	2	2	1
TOTAL						**27**	**21**

SEMESTER VII

S. NO	COURSE CODE	COURSE TITLE	WEEK HOURS			TOTAL CONTACT HOURS	CREDITS
			L	T	P		
THEORY							
1	20ECPC701	RF and Microwave Engineering	3	0	0	3	3
2	20ECPC702	Optical Communication	3	0	0	3	3
3	20CSPC601	Artificial Intelligence	3	0	0	3	3
4	20ECELXXX	Professional Elective-III	3	0	0	3	3
5	20HSMG601	Principles of Engineering Management	3	0	0	3	3
PRACTICAL							
6	20ECPL701	Advanced Communication Laboratory	0	0	3	3	1.5
7	20CSPL601	Artificial Intelligence Laboratory	0	0	3	3	1.5
8	20ECPJ701	Project Phase - I	0	0	4	4	2
VALUE ADDITIONS - VII							
9	20ECTP701	Skill Enhancement	0	0	2	2	1
		TOTAL				**27**	**21**

SEMESTER VIII

S. NO	COURSE CODE	COURSE TITLE	WEEK HOURS			TOTAL CONTACT HOURS	CREDITS
			L	T	P		
THEORY							
1	20ECELXXX	Professional Elective - IV	3	0	0	3	3
PRACTICAL							
2	20ECPJ801	Project Phase - II	0	0	8	8	4
TOTAL						**11**	**7**

CREDIT DISTRIBUTION

Category	BS	ES	HS	EL	PC+PL	PW	OE	TE	PJ	TP	IS	MC	TOTAL
Credit	29.5	13	10	12	57.5	16	6	5	7	7	3	Y	166
Percentage	17.8	7.8	6.0	7.2	34.6	9.6	3.6	3.0	4.2	4.2	1.8	-	

*IS-Internship

PROFESSIONAL ELECTIVES - I

S. NO	COURSE CODE	COURSE TITLE	WEEK HOURS			TOTAL CONTACT HOURS	CREDIT	STREAM
			L	T	P			
1	20ECEL501	Advanced Communication Systems and Techniques	3	0	0	3	3	Wireless
2	20ECEL502	Industrial IOT	3	0	0	3	3	Wireless
3	20ECEL503	FPGA & ASIC Design	3	0	0	3	3	VLSI
4	20ECEL504	Programmable Logic Controllers	3	0	0	3	3	VLSI
5	20ECEL505	Sensors and RFID	3	0	0	3	3	RF & Green
6	20ECEL506	Sustainable Energy and Energy Management	3	0	0	3	3	RF & Green
7	20ECEL507	Sensors and measurements	3	0	0	3	3	Signal Processing
8.	20ECEL508	Control Systems Engineering	3	0	0	3	3	Signal Processing
9.	20ECEL509	Soft Computing	3	0	0	3	3	Biomedical
10.	20ECEL510	Biosignal and Image Processing	3	0	0	3	3	Biomedical
11.	20MGEL501	Intellectual Property Rights	3	0	0	3	3	Management

PROFESSIONAL ELECTIVES - II

S. NO	COURSE CODE	COURSE TITLE	WEEK HOURS			TOTAL CONTACT HOURS	CREDIT	STREAM
			L	T	P			
1	20ECEL601	Radio Access Networks	3	0	0	3	3	Wireless
2	20ECEL602	Wireless Sensor Networks	3	0	0	3	3	Wireless
3	20ECEL603	CMOS Analog IC Design	3	0	0	3	3	VLSI
4	20ECEL604	Software for Embedded Systems	3	0	0	3	3	VLSI
5	20ECEL605	Electromagnetic Interference and Compatibility	3	0	0	3	3	RF & Green
6	20ECEL606	Green Radio Communication Networks		3	0	0	3 3	RF & Green
7	20ECEL607	Biomedical Instrumentation	3	0	0	3	3	Signal Processing
8.	20ECEL608	Pattern Recognition	3	0	0	3	3	Signal Processing
9.	20ECEL609	Machine Learning Techniques	3	0	0	3	3	Biomedical
10.	20ECEL610	Medical Electronics	3	0	0	3	3	Biomedical
11.	20MGEL601	Total Quality Management	3	0	0	3	3	Management

PROFESSIONAL ELECTIVES - III

S. NO	COURSE CODE	COURSE TITLE	WEEK HOURS			TOTAL CONTACT HOURS	CREDIT	STREAM
			L	T	P			
1	20ECEL701	Cognitive Radio	3	0	0	3	3	Wireless
2	20ECEL702	Smart Antennas for Mobile Communication and GPS	3	0	0	3	3	Wireless
3	20ECEL703	Mixed Signal IC Design	3	0	0	3	3	VLSI
4	20ECEL704	Embedded Processor for Signal Processing	3	0	0	3	3	VLSI
5	20ECEL705	Antennas for Modern Communication	3	0	0	3	3	RF & Green
6	20ECEL706	Microwave and Millimeter Wave Circuits and Systems	3	0	0	3	3	RF & Green
7	20ECEL707	DSP Processor Architecture and Programming	3	0	0	3	3	Signal Processing
8.	20ECEL708	Brain Computer interface and its applications	3	0	0	3	3	Signal Processing
9.	20ECEL709	Digital Image Processing	3	0	0	3	3	Biomedical
10.	20ECEL710	Deep Learning Principles & Practices	3	0	0	3	3	Biomedical
11.	20MGEL701	Foundation Skills in Integrated Product Development	3	0	0	3	3	Management

PROFESSIONAL ELECTIVES - IV

S. NO	COURSE CODE	COURSE TITLE	WEEK HOURS			TOTAL CONTACT HOURS	CREDIT	STREAM
			L	T	P			
1	20ECEL801	5G and 6G Wireless Communication Systems	3	0	0	3	3	Wireless
2	20ECEL802	Underwater Wireless Communication Systems	3	0	0	3	3	Wireless
3	20ECEL803	Electronic Packaging and Testing	3	0	0	3	3	VLSI
4	20ECEL804	Embedded Product Development	3	0	0	3	3	VLSI
5	20ECEL805	RF System Design and MMIC	3	0	0	3	3	RF & Green
6	20ECEL806	Photonic Networks	3	0	0	3	3	RF & Green
7	20ECEL807	Telehealth Technology	3	0	0	3	3	Signal Processing
8.	20ECEL808	Medical Informatics	3	0	0	3	3	Signal Processing
9.	20ECEL809	Robotics and Automation	3	0	0	3	3	Biomedical
10.	20ECEL810	Medical Imaging Systems	3	0	0	3	3	Biomedical
11.	20MGEL801	Professional Ethics and Values	3	0	0	3	3	Management

PROGRAM EDUCATIONAL OBJECTIVES (PEOs)

PEO1 Acquire strong foundation in Engineering, Science and Technology for a successful career in Electronics and Communication Engineering.

PEO2 Apply their knowledge and skills acquired to solve the issues in real world Electronics and Communication sectors and to develop feasible and viable systems.

PEO3 Be receptive to new technologies and attain professional competence through professional society activities.

PEO4 Participate in lifelong learning, higher education efforts to emerge as expert researchers and technologists.

PEO5 Practice the profession with ethics, integrity, leadership and social responsibilities.

PROGRAM SPECIFIC OUTCOMES (PSOs)

PSO 1 Design, implement and test Electronics and Communication systems using analytical knowledge and applying modern hardware and software tools

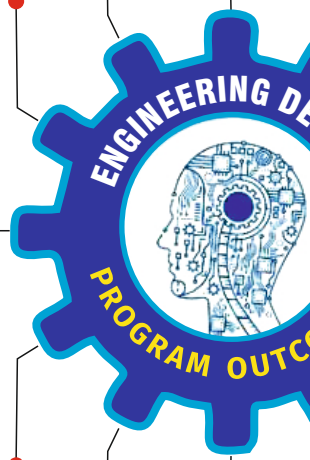
PSO2 Develop their skills to solve problems and assess social, environmental issues with ethics and manage different projects in multidisciplinary areas.

COMPONENTS OF THE CURRICULUM (COC)

Course Component	Curriculum Content (% of total number of credits of the program)	Total number of contact hours	Total Number of credits
Basic Sciences(BS)	17.7	31	29.5
Engineering Sciences(ES)	7.8	17	13
Humanities and Social Sciences (HS)	6.0	16	10
Professional Electives(EL)	9.0	15	15
Program Core+Program Lab (PC+PL)	41.0	84	68.5
Program theory with Lab (PW)	2.4	5	4
Open Electives (OE)	3.6	6	6
Talent Enhancement (TE)	2.4	8	4
Project (PJ)	4.2	14	7
Training & Placement (TP)	4.2	14	7
Internships/Seminars (IS)	1.8	-	3
Mandatory Courses (MC)	NA	2	NA
Total number of Credits		**212**	**167**

PROGRAMME OUTCOMES(POs)

PROGRAM OUTCOME REPRESENTS THE KNOWLEDGE, SKILLS AND ATTITUDES THAT THE STUDENTS WOULD BE EXPECTED TO HAVE AT THE END OF THE 4 YEAR ENGINEERING DEGREE PROGRAM



01 Engineering knowledge

Apply the basic principle and knowledge of mathematics, science and engineering principles to solve technical problems.

02 Problem Analysis

Identify and analyze complex engineering problems reaching logical conclusions using the basic principles of mathematics, science and engineering.

03 Development of solutions

Design solutions for well-defined technical problems and assist with the design of systems, components or processes to meet specified needs.

04 Investigate complex problems

Perform investigations, use research based knowledge and conduct experiments, analyze and interpret the results to provide valid conclusions.

05 Modern tool usage

Create, select and apply the latest techniques, resources and modern engineering / IT tools to develop appropriate solutions with an understanding of the limitations.

06 The Engineer and Society

Apply reasoning based on contextual knowledge to assess societal, legal and cultural issues with competency in professional engineering practices.

07 Environment & Sustainability

Demonstrate professional skills, knowledge and contextual reasoning to assess / environmental / societal issues for sustainable development.

08 Apply ethical principles

Apply ethical principles and commit to professional ethics and responsibilities based on the norms of professional engineering pratices.

09 Individual & Teamwork

Function effectively as an individual, and as a member or leader in diverse teams, and in multi-disciplinary professional settings.

10 Communicate effectively

Communicate effectively amongst the engineering community, being able to comprehend & write effective reports, make presentations & give/receive clear instructions.

11 Project management

Demonstrate knowledge and apply the principles of engineering & management in their own / team projects in multidisciplinary environments.

12 Life-long learning

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

SEMESTER - I

20BSMA101 SDG NO. 4 & 9	ENGINEERING MATHEMATICS-I	L	T	P	C
		3	1	0	4

OBJECTIVES:

The intent of the course is

- To understand and gain the knowledge of matrix algebra.
- To introduce the concepts of limits, continuity, derivatives and maxima and Minima
- To acquaint the concept of improper integrals and the properties of definite integrals.
- To provide understanding of double integration, triple integration and their application.
- To introduce the concept of sequence and series and impart the knowledge of Fourier series.

UNIT I MATRICES **12**

Symmetric, skew symmetric and orthogonal matrices; Eigenvalues and Eigenvectors of a real matrix – Characteristic equation – Properties of Eigenvalues and Eigenvectors – Cayley-Hamilton theorem (excluding proof) – Diagonalization of a Quadratic form using orthogonal transformation - Nature of Quadratic forms.

UNIT II DIFFERENTIAL CALCULUS **12**

Limits, continuity, Differentiation rules - Maxima and Minima of functions of one variable, partial derivatives (first and second order – basic problems), Taylor's series for functions of two variables, Jacobian, Maxima & Minima of functions of several variables, saddle points; Method of Lagrange multipliers.

UNIT III INTEGRAL CALCULUS **12**

Evaluation of definite integrals - Techniques of Integration-Substitution rule - Integration by parts, Integration of rational functions by partial fraction, Integration of irrational functions. Applications of definite integrals to evaluate surface area of revolution and volume of revolution. Evaluation of improper integrals.

UNIT IV MULTIPLE INTEGRALS **12**

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

UNIT V SEQUENCES AND SERIES 12

Introduction to sequences and series – power series – Taylor's series – series for exponential, trigonometric, logarithmic, hyperbolic functions – Fourier series – Half range Sine and Cosine series – Parseval's theorem.

TOTAL: 60 PERIODS

TEXTBOOKS:

1. James Stewart, "Calculus: Early Transcendentals", Cengage Learning, 7th Edition, New Delhi, 2015.
2. B. V. Ramana, "Higher Engineering Mathematics", Tata McGraw-Hill, New Delhi, 11th Reprint, 2010.

REFERENCES:

1. G.B. Thomas and R.L. Finney, "Calculus and Analytic Geometry", 9th Edition, Pearson, Reprint, 2002.
2. Erwin Kreyszig, "Advanced Engineering Mathematics", 9th Edition, John Wiley & Sons, 2006.
3. T. Veerarajan, "Engineering Mathematics for first year", Tata McGraw-Hill, New Delhi, 2008.
4. N.P. Bali and Manish Goyal, "A text-book of Engineering Mathematics", Laxmi Publications, Reprint, 2008.
5. B. S. Grewal, "Higher Engineering Mathematics", Khanna Publishers, New Delhi, 40th Edition, 2014.

WEB REFERENCES:

1. https://math.mit.edu/~gs/linearalgebra/ila0601.pdf
2. http://ocw.mit.edu/ans7870/18/18.013a/textbook/HTML/chapter30/
3. https://ocw.mit.edu/courses/mathematics/18-02sc-multivariable-calculus-fall-2010/2.-partial-derivatives/
4. http://ocw.mit.edu/ans7870/18/18.013a/textbook/HTML/chapter31/

ONLINE RESOURCES:

1. https://www.khanacademy.org/math/linear-algebra/alternate-bases/eigen-everything/v/linear-algebra-introduction-to-eigenvalues-and-eigenvectors
2. https://www.khanacademy.org/math/differential-calculus

OUTCOMES:

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

1. Diagonalize the matrix using orthogonal transformation and apply Cayley Hamilton Theorem to find the inverse and integral powers of a square matrix. (K3)
2. Evaluate the limit, examine the continuity and use derivatives to find extreme values of a function. (K3)
3. Evaluate definite and improper integrals using techniques of integration. (K3)
4. Apply double and triple integrals to find the area of a region and the volume of a surface. (K3)
5. Compute infinite series expansion of a function. (K3)

CO - PO MAPPING :

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

SEMESTER - I

20HSEN101 SDG NO. 4	TECHNICAL ENGLISH - I	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To develop the basic LSRW skills of the students
- To encourage the learners to adapt to listening techniques
- To help learners develop their communication skills and converse fluently in real contexts
- To help learners develop general and technical vocabulary through reading and writing tasks

- To improve the language proficiency for better understanding of core subjects

UNIT I INTRODUCTION 9

Listening – short texts – formal and informal conversations - **Speaking** – basics in speaking – speaking on given topics & situations – recording speeches and strategies to improve - **Reading –** critical reading – finding key information in a given text – shifting facts from opinions - **Writing –** free writing on any given topic – autobiographical writing - **Language Development** – tenses – voices- word formation: prefixes and suffixes – parts of speech – developing hints

UNIT II READING AND LANGUAGE DEVELOPMENT 9

Listening - long texts - TED talks - extensive speech on current affairs and discussions -Speaking – describing a simple process – asking and answering questions - **Reading** comprehension – skimming / scanning / predicting & analytical reading – question & answers – objective and descriptive answers –identifying synonyms and antonyms - process description - **Writing** instructions – **Language Development** – writing definitions – compound words.

UNIT III SPEAKING AND INTERPRETATION SKILLS 9

Listening - dialogues & conversations - **Speaking** – role plays – asking about routine actions and expressing opinions - **Reading** longer texts & making a critical analysis of the given text - **Writing** – types of paragraph and writing essays – rearrangement of jumbled sentences - writing recommendations - **Language Development** – use of sequence words - cause & effect expressions - sentences expressing purpose - picture based and newspaper based activities – single word substitutes

UNIT IV VOCABULARY BUILDING AND WRITING SKILLS 9

Listening - debates and discussions – practicing multiple tasks – self introduction – **Speaking** about friends/places/hobbies - **Reading** -Making inference from the reading passage – Predicting the content of the reading passage - **Writing** – informal letters/e-mails - **Language Development** - synonyms & antonyms - conditionals – if, unless, in case, when and others – framing questions.

UNIT V LANGUAGE DEVELOPMENT AND TECHNICAL WRITING 9

Listening - popular speeches and presentations - **Speaking** - impromptu speeches & debates - **Reading** - articles – magazines/newspapers **Writing** – essay writing on technical topics - channel conversion – bar diagram/ graph –

picture interpretation - process description - **Language Development** – modal verbs - fixed / semi-fixed expressions – collocations

TOTAL: 45 PERIODS

TEXT BOOKS:

1. Board of Editors. Using English: A Coursebook for Undergraduate Engineers and Technologists. Orient Blackswan Limited, Hyderabad: 2015.
2. Dhanavel, S.P. English and Communication Skills for Students of Science and Engineering. Orient Blackswan, Chennai, 2011.

REFERENCES:

1. Anderson, Paul V. Technical Communication: A Reader – Centered Approach. Cengage, New Delhi, 2008.
2. Smith-Worthington, Darlene & Sue Jefferson. Technical Writing for Success. Cengage, Mason, USA, 2007.
3. Grussendorf, Marion, English for Presentations, Oxford University Press, Oxford, 2007.
4. Chauhan, Gajendra Singh and et.al.Technical Communication (Latest Revised Edition). Cengage Learning India Pvt. Limited, 2018.

WEB REFERENCES:

1. https://swayam.gov.in/nd1_noc19_hs31/preview
2. http://engineeringvideolectures.com/course/696

ONLINE RESOURCES:

1. https://www.pearson.com/english/catalogue/business-english/technical-english.html
2. https://www.cambridgeenglish.org/learning-english/free-resources/

OUTCOMES:

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

1. Express and explain short texts on different topics with key information applying suitable vocabulary (K2)
2 Interpret and dramatize fluently in informal and formal contexts(K2)
3 Choose and apply the right syntax in comprehending diversified general and technical articles (K3)
4 Analyze and write technical concepts in simple and lucid style (K3)
5 Construct informal letters and e-mails thoughtfully (K2)
6 Demonstrate technical concepts and summaries in correct grammar and vocabulary (K2)

CO - PO MAPPING :

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	-	-	-	-	-	-	1	-	2	3	1	1
CO2	-	-	-	-	-	-	-	1	2	3	2	1
CO3	-	-	-	-	-	-	-	-	1	3	3	2
CO4	-	2	-	-	-	-	-	1	2	3	1	1
CO5	-	-	-	-	-	-	-	2	-	3	2	1
CO6	-	-	-	-	-	-	3	-	-	3	2	1

SEMESTER - I

20BSPH101 SDG NO. 4	ENGINEERING PHYSICS	L	T	P	C
		3	0	0	3

OBJECTIVES:

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

UNIT I CRYSTAL PHYSICS 9

Single crystalline, Polycrystalline and Amorphous materials - single crystals: unit cell, crystal systems, Bravais lattices, directions and planes in a crystal - Miller indices - Interplanar distance - Powder diffraction method - Debye Scherer formula - Calculation of number of atoms per unit cell - Atomic radius - Coordination number - packing factor for SC, BCC, FCC and HCP structures - Polymorphism and allotropy - Diamond and Graphite structure (qualitative) - Growth of single crystals: Solution and Melt growth Techniques.

UNIT II PROPERTIES OF MATTER 9

Elasticity - Stress - strain diagram and its uses - Poisson's ratio - Relationship between three moduli of elasticity (qualitative) - Factors affecting elastic modulus and tensile strength - Twisting couple - shaft - Torsion pendulum: theory and experiment - bending of beams - bending moment - cantilever: theory and experiment - uniform and non-uniform bending: theory and experiment - I-shaped girders - stress due to bending in beams.

UNIT III QUANTUM PHYSICS 9

Black body radiation - Planck's theory (derivation) - Compton effect: theory -

wave particle duality - electron diffraction - progressive waves - wave equation - concept of wave function and its physical significance - Schrödinger's wave equation - Time independent and Time dependent equations - particle in a box (one dimensional motion) - Tunneling (qualitative) - scanning tunneling microscope.

UNIT IV LASERS AND FIBER OPTICS **9**

Lasers: population of energy levels, Einstein's A and B coefficients derivation - pumping methods - resonant cavity, optical amplification (qualitative) - three level and four level laser - CO_2 laser - Semiconductor lasers: Homojunction and Heterojunction.

Fiber optics: Principle, Numerical aperture and Acceptance angle - Types of optical fibers (material, refractive index, mode) - Losses associated with optical fibers - Fiber Optical Communication system (Block diagram) - Fiber optic sensors: pressure and displacement.

UNIT V THERMAL PHYSICS **9**

Transfer of heat energy - thermal expansion of solids and liquids - bimetallic strips - thermal conduction, convection and radiation - heat conduction in solids (qualitative) - thermal conductivity - Forbe's and Lee's disc method: theory and experiment - conduction through compound media (series and parallel) - thermal insulation - applications: heat exchangers, refrigerators and solar water heaters.

TOTAL : 45 PERIODS

TEXT BOOKS:

1. D.K. Bhattachary & T.Poonam, "Engineering Physics". Oxford University Press, 2015.
2. R.K. Gaur& S.L. Gupta, "Engineering Physics". Dhanpat Rai Publishers, 2012.
3. B.K. Pandey & S.Chaturvedi, "Engineering Physics", Cengage Learning India, 2017.
4. V. Rajendran, "Engineering Physics", Mc Graw Hill Publications Ltd. New Delhi, 2014.
5. M.N. Avadhanulu& P.G. Kshirshagar, "A textbook of Engineering Physics", S. Chand & Co Ltd. 2016.

REFERENCES:

1. D. Halliday, . Resnick & J. Walker, "Principles of Physics", Wiley, 2015.
2. R.A. Serway, & J.W. Jewett, "Physics for Scientists and Engineers", Cengage Learning, 2010.
3. N.K. Verma," Physics for Engineers", PHI Learning Private Limited, 2014.

4. P.A. Tipler & G. Mosca "Physics for Scientists and Engineers", W.H.Freeman, 2020.
5. Brijlal and Subramanyam, "Properties of Matter", S. Chand Publishing, 2018.
6. Shatendra Sharma & Jyotsna Sharma, "Engineering Physics", Pearson, 2018.

OUTCOMES :

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

1. To understand the crystal systems and elastic properties of Materials (K2)
2. To distinguish different crystal structures and heat conduction in conductor and insulators (K4)
3. To explain powder diffractionmethod-deformation of materials in response to action load,quantum mechanics to understand wave particle dualism (K2)
4. To apply quantum theory to set up one dimensional Schrodinger's wave equation and applications to a matter wave system and principle of laser action (K3)
5. To analyze bending of beams,types of optical fiber and modes of heat transfer (K4)
6. To discuss light propagation in optical fibers and transfer of heat energy in different measures and its applications (K2)

CO - PO MAPPING :

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	3	3	-	-	-	-	-	-	-	1
CO2	3	2	3	3	-	-	2	-	-	-	-	3
CO3	3	3	3	2	-	-	3	-	-	-	-	2
CO4	3	3	3	3	-	-	-	-	-	-	-	3
CO5	3	3	3	3	-	-	3	-	-	-	-	3
CO6	3	3	3	3	-	-	3	-	-	-	-	3

SEMESTER - I

20BSCY101 SDG NO. 4,6&7	ENGINEERING CHEMISTRY	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To make the students conversant with boiler feed water requirements, related problems and water treatment techniques
- To illustrate the principles of electrochemical reactions, redox reactions in corrosion of materials and methods for corrosion prevention and protection of materials
- To categorize types of fuels, calorific value calculations, manufacture of solid, liquid and gaseous fuels
- To demonstrate the principles and generation of energy in batteries, nuclear reactors, solar cells, windmills and fuel cells
- To recognize the applications of polymers, composites and nano-materials in various fields

UNIT I WATER TECHNOLOGY AND SURFACE CHEMISTRY 9

Water Technology : Introduction – Hard water and Soft water. Hardness of water – types – expression of hardness (numerical problems). Boiler troubles – scale and sludge, priming and foaming, caustic embrittlement and boiler corrosion. Treatment of boiler feed water – Internal treatment (carbonate, phosphate, calgon, colloidal and sodium aluminate conditioning). External treatment – Ion exchange process, Zeolite process –Domestic water treatment (break point chlorination) –Desalination of brackish water – Reverse Osmosis.

Surface Chemistry: Adsorption – types – adsorption of gases on solids – adsorption of solutes from solution – applications of adsorption –role of adsorbents in catalysis and pollution abatement.

UNIT II ELECTROCHEMISTRY AND CORROSION 9

Electrochemistry: Cells – types (electrochemical and electrolytic cell) Redox reaction – single electrode potential (oxidation potential and reduction potential) – measurement and applications –Nernst equation (derivation and problems) – electrochemical series and its significance.

Corrosion: Causes, factors and types – chemical and electrochemical corrosion (galvanic, differential aeration). Corrosion control – material selection and design aspects, cathodic protection methods (sacrificial anodic and impressed current cathodic method) and corrosion inhibitors. Paints: Constituents and its functions. Electroplating of Copper and electroless plating of Nickel.

UNIT III FUELS AND COMBUSTION 9

Fuels: Introduction – classification of fuels – Coal – analysis of coal (proximate and ultimate). Carbonization – manufacture of metallurgical coke (Otto Hoffmann method) – Petroleum – manufacture of synthetic petrol (Bergius process). Knocking – octane number and cetane number – Gaseous fuels – Compressed natural gas (CNG), Liquefied petroleum gases (LPG). Biofuels – Gobar gas and Biodiesel.

Combustion of Fuels: Introduction – calorific value – higher and lower calorific values- theoretical calculation of calorific value – flue gas analysis (ORSAT Method).

UNIT IV ENERGY SOURCES AND STORAGE DEVICES 9

Energy sources: Nuclear fission – nuclear fusion – differences between nuclear fission and fusion – nuclear chain reactions – nuclear energy – light water nuclear power plant – breeder reactor – solar energy conversion – solar cells – wind energy.

Storage devices: Batteries – types of batteries – primary battery (dry cell) secondary battery (lead acid battery, lithium–ion–battery), fuel cells – H_2 -O_2 fuel cell and super capacitors.

UNIT V POLYMERS AND NANOMATERIALS 9

Polymers: Classification – types of polymerization – mechanism (Free radical polymerization) –Engineering polymers: Nylon–6, Nylon–6,6, Teflon, Kevlar and PEEK – preparation, properties and uses – Plastic and its types - Conducting polymers – types and applications. Composites – definition, types, polymer matrix composites – FRP.

Nanomaterials: Introduction – Nanoparticles, Nanoclusters, Nanorods, Nanotubes (CNT: SWNT and MWNT) and Nanowires – Properties (surface to volume ratio, melting point, optical and electrical), Synthesis (precipitation, thermolysis, hydrothermal, electrodeposition, chemical vapour deposition, laser ablation, sol-gel process) and Applications.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. S. S. Dara and S. S. Umare, "A Textbook of Engineering Chemistry", S. Chand & Company LTD, New Delhi, 2015.
2. P. C. Jain and Monika Jain, "Engineering Chemistry" DhanpatRai Publishing Company (P) LTD, New Delhi, 2015.
3. S. Vairam, P. Kalyani and Suba Ramesh, "Engineering Chemistry", Wiley India PVT, LTD, New Delhi, 2013.
4. Ravikrishnan A, 'Engineering Chemistry', Sri Krishna Hitech Publishing Company Pvt. Ltd, New Edition 2021.

REFERENCES:

1. Friedrich Emich, "Engineering Chemistry", Scientific International PVT, LTD, New Delhi, 2014.
2. Prasanta Rath, "Engineering Chemistry", Cengage Learning India PVT, LTD, Delhi, 2015.
3. Shikha Agarwal, "Engineering Chemistry-Fundamentals and Applications", Cambridge University Press, Delhi, 2015.

OUTCOMES

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

1. Identify the origin of water resources and develop innovative methods to produce soft water for industrial use and potable water at cheaper cost and recognize the basic design of adsorption systems and its industrial applications. (K2)
2. Recognize the basic concepts of electrochemistry and apply the principles of electrochemistry to corrosion process and the applications of protective coatings to overcome the corrosion. (K2)
3. Disseminating the importance of chemistry of fuels and combustion to enhance the fuel efficiency. (K2)
4. Acquire the basics of non-conventional sources of energy and illustrate the principles and the reaction mechanism of batteries and fuel cells. (K2)
5. Explain the synthesis and applications of polymers, composites and nano-materials. (K2)

CO – PO MAPPING:

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

SEMESTER - I

20ESCS101 SDG NO. 4&9	PROBLEM SOLVING AND PROGRAMMING IN C	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To understand about the programming language
- To develop C Programs using basic Programming Constructs, Loops Arrays and Strings
- To develop applications in C using Functions , Pointers and Structures
- To perform I/O operations and File Handling in C

UNIT I INTRODUCTION TO PROGRAMMING AND ALGORITHMS FOR PROBLEM SOLVING 10

The Basic Model of Computation, Programming Paradigms- Program Development Life Cycle - Algorithm –Pseudo Code – Flow Chart - Programming Languages - Compilation - Linking and Loading - Testing and Debugging - Documentation - Control Structures – Algorithmic Problem Solving- Problems Based on Sequential, Decision Making - Branching and Iteration.

UNIT II BASICS OF C PROGRAMMING 8

Structure of C program - C programming: Data Types – Storage Classes - Constants – Enumeration Constants - Keywords – Operators: Precedence and Associativity - Expressions – Input / Output Statements - Assignment Statements – Decision making Statements - Switch Statement - Looping Statements – Pre-Processor Directives - Compilation Process

UNIT III ARRAYS AND STRINGS 9

Introduction to Arrays: Declaration, Initialization – One Dimensional Array – Example Program: Computing Mean, Median and Mode - Two Dimensional Arrays – Example Program: Matrix Operations (Addition, Scaling, Determinant and Transpose) - String Operations: Length, Compare, Concatenate - Copy – Selection Sort - Linear and Binary Search.

UNIT IV FUNCTIONS AND POINTERS 9

Introduction to Functions: Function Prototype, Function Definition, Function Call, Built-in Functions (String Functions, Math Functions) – Recursion – Example Program: Computation of Sine Series - Scientific Calculator using Built-in Functions - Binary Search using Recursive Functions – Pointers – Pointer Operators – Pointer Arithmetic – Arrays and Pointers –

Array of Pointers – Example Program: Sorting of Names – Parameter Passing: Pass by Value - Pass by Reference – Example Program: Swapping of Two Numbers using Pass by Reference.

UNIT V STRUCTURES and FILE PROCESSING 9

Structure - Nested Structures – Pointer and Structures – Array of Structures – Example Program using Structures and Pointers – Self Referential Structures – Dynamic Memory Allocation - Singly Linked List – Typedef.

Files – Types of File Processing: Sequential Access, Random Access – Sequential Access File - Example Program: Finding Average of Numbers stored in Sequential Access File - Random Access File - Example Program: Transaction Processing Using Random Access Files – Command Line Arguments.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. Reema Thareja, "Programming in C", Oxford University Press, Second Edition, 2016.
2. Kernighan, B.W and Ritchie,D.M, "The C Programming language", Second Edition, Pearson Education, 2012.

REFERENCES:

1. Paul Deitel and Harvey Deitel, "C How to Program", Seventh edition, Pearson Publication.
2. Jeri R. Hanly & Elliot B. Koffman, "Problem Solving and Program Design in C", Pearson Education, 2013.
3. Pradip Dey, Manas Ghosh, "Fundamentals of Computing and Programming in C", First Edition, Oxford University Press, 2009.
4. Anita Goel and Ajay Mittal, "Computer Fundamentals and Programming in C", Dorling Kindersley (India) Pvt. Ltd., Pearson Education in South Asia, 2011.
5. Byron S. Gottfried, "Schaum's Outline of Theory and Problems of Programming with C", McGraw-Hill Education, 1996.
6. Kanetkar Y, "Let us C", BPB Publications, 2007.
7. Hanly J R & Koffman E.B, "Problem Solving and Programme design in C", Pearson Education, 2009.

WEB REFERENCES:

1. https://www.learn-c.org/
2. https://codeforwin.org/
3. https://www.cprogramming.com/

ONLINE RESOURCES:

1. https://www.linuxtopia.org/online_books/programming_books/gnu_c_programming_tutorial
2. https://nptel.ac.in/courses/106105171
3. https://swayam.gov.in/nd1_noc19_cs42/preview

OUTCOMES:

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

1. Develop efficient algorithms for solving a problem. (K2)
2. Use the various constructs in C to develop simple applications. (K3)
3. Design and Implement applications using Array & Strings. (K3)
4. Develop applications using Functions and Pointers. (K6)
5. Design and Develop applications using Structures. (K3)
6. Design and Develop applications using Files. (K4)

CO- PO MAPPING :

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	3	3	2	1	1	-	2	2	-	3	2	3
CO2	3	3	3	3	2	-	1	1	2	2	3	3	2	3
CO3	3	3	3	3	2	1	1	1	2	-	3	-	3	2
CO4	3	3	3	3	2	1	-	1	2	2	3	3	1	2
CO5	3	3	3	3	2	1	1	1	2	2	3	3	2	1
CO6	3	3	3	3	2	1	1	1	2	2	3	3	3	2

SEMESTER - I

20ESGE101 SDG NO. 4,6,7, 9, 12,14 &15	ENGINEERING GRAPHICS	L	T	P	C
		1	2	0	3

OBJECTIVES:

- To develop in students, graphic skills for communication of concepts, ideas and design of engineering products
  - To visualize the job in three dimensions
- To have a clear conception and appreciation of the shape, size, proportion and design
- To expose the student community to existing national standards related to technical drawings

CONCEPTS AND CONVENTIONS (Not for Examination) 3

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

UNIT I PLANE CURVES AND FREEHAND SKETCHING 6+9

Basic Geometrical constructions, Curves used in engineering practices: Conics – Construction of ellipse, parabola and hyperbola by eccentricity method – Construction of cycloid on Horizontal Surfaces – construction of involutes of circle for one complete revolution – Drawing of tangents and normal to the above curves.

Visualization concepts and Free Hand sketching: Visualization principles –Representation of Three Dimensional objects – Layout of views- Freehand sketching of multiple views from pictorial views of objects.

UNIT II PROJECTION OF LINES AND PLANE SURFACE 6+9

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

UNIT III PROJECTION OF SOLIDS 6+9

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

UNIT IV PROJECTION OF SECTIONED SOLIDS AND DEVELOPMENT OF SURFACES 6+9

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

UNIT V ISOMETRIC AND PERSPECTIVE PROJECTIONS 6+9

Principles of isometric projection – isometric scale –Isometric projections of simple solids and truncated solids - Prisms, pyramids, cylinder, cone- Perspective projection of simple solids-Prisms, pyramids and cylinder by visual ray method.

TOTAL: 78 PERIODS

TEXT BOOKS:

1. Venugopal K. and Prabhu Raja V., "Engineering Graphics", New Age International (P) Limited, 2008.
2. T. Jeyapoovan, "Engineering Graphics using AUTOCAD", Vikas Publishing House Pvt Ltd, 7th Edition.

REFERENCES:

1. Bhatt N.D. and Panchal V.M., "Engineering Drawing", Charotar Publishing House, 50th Edition, 2010.
2. Natrajan K.V., "A text book of Engineering Graphics", Dhanalakshmi Publishers, Chennai, 2009.
3. Basant Agarwal and Agarwal C.M., "Engineering Drawing", Tata McGraw Hill Publishing Company Limited, New Delhi, 2008.
4. Gopalakrishna K.R., "Engineering Drawing" (Vol. I&II combined), Subhas Stores, Bangalore, 2007.
5. Luzzader, Warren.J. and Duff,John M., "Fundamentals of Engineering Drawing with an introduction to Interactive Computer Graphics for Design and Production, Eastern Economy Edition, Prentice Hall of India Pvt. Ltd, New Delhi, 2005.
6. N S Parthasarathy and Vela Murali, "Engineering Graphics", Oxford University, Press, New Delhi, 2015.
7. Shah M.B., and Rana B.C., "Engineering Drawing", Pearson, 2nd Edition, 2009.

WEB REFERENCES:

1. https://nptel.ac.in/courses/112/103/112103019/

ONLINE RESOURCES:

1. https://nptel.ac.in/courses/105/104/105104148/

PUBLICATION OF BUREAU OF INDIAN STANDARDS:

1. IS10711 – 2001: Technical products Documentation – Size and lay out of drawing sheets.
2. IS9609 (Parts 0 & 1) – 2001: Technical products Documentation – Lettering.
3. IS10714 (Part 20) – 2001 & SP 46 – 2003: Lines for technical drawings.
4. IS11669 – 1986 & SP 46 – 2003: Dimensioning of Technical Drawings.
5. IS15021 (Parts 1 to 4) – 2001: Technical drawings – Projection Methods

OUTCOMES:

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

1. Relate thoughts and ideas graphically in a neat fashion and ability to perform sketching of engineering curves used in engineering practices, multiple views of objects. (K1)
2. Understand the concepts of orthographic projections for basic geometrical constructions. (K2)
3. Acquire the knowledge of orthographic projection in three dimensional object. (K2)
4. Develop knowledge about Sectioning and apply interior shapes of solids. (K3)
5. Analyze the concepts of design in developing various 3 dimensional projections. (K4)
6. Build a strong foundation to analyze the design in various dimensions. (K4)

CO - PO , PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	2	-	-	-	-	-	2	2	-	2	2	2
CO2	3	2	2	-	-	-	-	-	2	2	-	2	2	2
CO3	3	2	2	-	-	-	-	-	2	2	-	2	2	2
CO4	3	2	2	-	-	-	-	-	2	2	-	2	2	2
CO5	3	2	2	-	-	-	-	-	2	2	-	2	2	2
CO6	3	2	2	-	-	-	-	-	2	2	-	2	2	2

SEMESTER - I

20BSPL101 SDG NO. 4	PHYSICS AND CHEMISTRY LABORATORY	L	T	P	C
		0	0	3	1.5

PHYSICS LABORATORY

OBJECTIVES:

- To acquaint the students with practical knowledge of physics principles in various fields such as optics, thermal physics and properties of matter for developing basic experimental skills
- To make the student to acquire practical skills in the determination of water quality parameters through volumetric and instrumental analysis

LIST OF EXPERIMENTS (Any 5 Experiments)

1. Determination of Young's modulus by non-uniform bending method.
2. Determination of rigidity modulus –Torsion pendulum.
3. Determination of velocity of sound and compressibility of liquid – Ultrasonic Interferometer.
4. (a) Determination of wavelength and particle size using Laser.
   (b) Determination of acceptance angle in an optical fiber.
5. Determination of thermal conductivity of a bad conductor – Lee's Disc method.
6. Determination of specific resistance of a given coil of wire – Carey Foster's bridge.
7. Determination of wavelength of mercury spectrum – spectrometer grating.
8. Determination of band gap of a semiconductor.
9. Determination of Hall coefficient by Hall Effect experiment.
10. Determination of solar cell characteristics.

LAB REQUIREMENTS FOR A BATCH OF 30 STUDENTS / 6 (max.) STUDENTS PER EXPERIMENT

1. Young's modulus by non-uniform bending method-experimental set-up – 12 sets
2. Rigidity modulus - Torsion pendulum experimental set-up – 12 sets
3. Ultrasonic Interferometer to determine velocity of sound and compressibility of liquid – 6 sets
4. (a) Experimental set-up to find the wavelength of light, and to find particle size using Laser – 6 sets
   (b) Experimental set-up to find acceptance angle in an optical fiber – 6 sets
5. Lee's disc method- experimental set up to find thermal conductivity of a bad conductor – 6 sets
6. Experimental set-up to find specific resistance of a coil of wire-Carey Foster's Bridge – 6 sets
7. Experimental set-up to find the wavelength of mercury spectrum-spectrometer grating – 6 sets
8. Experimental set-up to find the band gap of a semiconductor – 12 sets
9. Experimental set-up to find the Hall coefficient by Hall Effect Experiment – 6 sets
10. Experimental set-up to study characteristics of solar cells – 6 sets

TEXTBOOKS:

1. J.D. Wilson& C.A. Hernandez Hall "Physics Laboratory Experiments" Houghton Mifflin Company, New York, 2010.
2. M.N. Srinivasan, S. Balasubramanian &R. Ranganathan, "Practical Physics", S. Chand & Sons educational publications, New Delhi, 2011.
3. R. Sasikumar, "Practical Physics", PHI Learning Pvt. Ltd., New Delhi, 2011.

CHEMISTRY LABORATORY

(Any five experiments to be conducted)

OBJECTIVES:

- To acquaint the students with practical knowledge of the basic concepts of chemistry, the student faces during the course of their study in the industry and engineering field
- To make the student to acquire practical skills in the determination of water quality parameters through volumetric and instrumental analysis
- To understand and develop experimental skills for building technical competence

LIST OF EXPERIMENTS (Any five experiments to be conducted)

1. Estimation of HCl using Na_2CO_3 as primary standard and Determination of alkalinity in water samples.
2. Determination of total, temporary & permanent hardness of water by EDTA method.
3. Determination of DO content of water sample by Winkler's method.
4. Determination of chloride content of water sample by argentometric method.
5. Determination of strength of given hydrochloric acid using pH meter.
6. Conductometric titration of strong acid vs strong base.
7. Estimation of iron content of the given solution using potentiometer.
8. Estimation of iron content of the water sample using spectrophotometer (1, 10- Phenanthroline / thiocyanate method).
9. Estimation of sodium and potassium present in water using flame photometers.
10. Determination of molecular weights of polymers using Ostwald's Viscometer.

LAB REQUIREMENTS FOR A BATCH OF 30 STUDENTS / 6 (MAX.) STUDENTS PER EXPERIMENT.

1. Estimation of HCl using Na_2CO_3 as primary standard and Determination of alkalinity in water sample - 6 sets
2. Determination of total, temporary & permanent hardness of water by EDTA method - 6 sets
3. Determination of DO content of water sample by Winkler's method - 6sets
4. Determination of chloride content of water sample by argentometric method – 6 sets
5. Determination of strength of given hydrochloric acid using pH meter - 6 sets
6. Conductometric titration of strong acid vs strong base - 6 sets
7. Estimation of iron content of the given solution using potentiometer - 6 sets
8. Estimation of iron content of the water sample using spectrophotometer (1,10- Phenanthroline / thiocyanate method) - 2 sets
9. Estimation of sodium and potassium present in water using flame photometer - 2 sets
10. Determination of molecular weights of polymer using Ostwald's Viscometer. - 6 sets

TOTAL: 30 PERIODS

TEXTBOOKS:

1. Vogel's Textbook of Quantitative Chemical Analysis (8th edition, 2014).

OUTCOMES:

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

1. Apply the principles of thermal physics and properties of matter to evaluate the properties of materials and to determine the physical properties of liquid using ultrasonic interferometer. (K1)
2. Understand measurement technique and usage of new instruments in optics for real time application in engineering. (K2)
3. Apply the knowledge of semiconductor materials to evaluate the band gap and Hall coefficient of materials and to study the characteristics of solar cell for engineering solutions. (K3)
4. Interpret quantitative chemical analysis to generate experimental skills in building technical competence. (K3)
5. Analyze the quality of water for domestic and industrial purpose. (K3)

6. Standardize the solutions using volumetric titrations, conductivity, pH, redox potential and optical density measurements. (K3)

CO- PO MAPPING :

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	3	2	1	3	3	2	2	1	1	3
CO2	3	3	3	3	3	3	3	2	2	2	2	3
CO3	3	3	3	3	3	3	3	2	1	1	2	3
CO4	3	2	3	3	1	1	2	2	2	2	3	2
CO5	3	2	3	3	1	1	2	2	2	2	3	2
CO6	3	2	3	3	1	1	2	2	2	2	3	2

SEMESTER - I

20ESPL101 SDG NO. 4&9	PROGRAMMING IN C LABORATORY	L	T	P	C
		0	0	3	1.5

OBJECTIVES:

- To develop programs in C using basic Programming Constructs
- To develop applications in C using Arrays and Strings
- To design and implement applications in C using Functions, Structures
- To develop applications in C using Files

LIST OF EXPERIMENTS

1. Write a program using I/O statements and expressions.
2. Write programs using decision-making constructs.
3. Write a program to find whether the given year is leap year or not? (Hint: not every centurion year is a leap. For example 1700, 1800 and 1900 is not a leap year)
4. Write a program to perform the Calculator operations, namely, addition, subtraction, multiplication, division and square of a number.

5. Write a program to check whether a given number is Armstrong number or not?
6. Write a program tocheck whether a given number is odd or even?
7. Write a program to find the factorial of a given number.
8. Write a program to find out the average of 4 integers.
9. Write a program to display array elements using two dimensional arrays.
10. Write a program to perform swapping using function.
11. Write a program to display all prime numbers between two intervals using functions.
12. Write a program to reverse a sentence using recursion.
13. Write a program to get the largest element of an array using the function.
14. Write a program to concatenate two string.
15. Write a program to find the length of String.
16. Write a program to find the frequency of a character in a string.
17. Write a program to store Student Information in Structure and Display it.
18. The annual examination is conducted for 10 students for five subjects. Write a program to read the data and determine the following:
    (a) Total marks obtained by each student.
    (b) The highest marks in each subject and the marks of the student who secured it.
    (c) The student who obtained the highest total marks.
19. Insert, update, delete and append telephone details of an individual or a company into a telephone directory using random access file.
20. Count the number of account holders whose balance is less than the minimum balance using sequential access file.

TOTAL: 45 PERIODS

LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS:

Standalone desktops with C compiler 30 Nos.

(or)

Server with C compiler supporting 30 terminals or more.

OUTCOMES:

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

1. Solve some simple problems leading to specific applications. (K3)
2. Demonstrate C programming development environment, compiling, debugging, linking and executing a program. (K3)
3. Develop C programs for simple applications making use of basic constructs, arrays and strings. (K4)

4. Develop C programs involving functions and recursion. (K4)
5. Develop C programs involving pointers, and structures. (K6)
6. Design applications using sequential and random access file. (K4)

CO- PO, PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	3	3	2	1	1	1	2	2	3	3	2	3
CO2	3	3	3	3	2	1	-	1	2	2	3	3	1	3
CO3	3	3	-	3	2	-	1	1	-	2	-	3	3	2
CO4	3	3	3	3	2	1	1	1	2	2	3	3	1	3
CO5	3	3	3	-	2	-	1	-	2	2	3	-	2	1
CO6	3	3	3	3	2	1	1	1	2	-	3	3	3	2

SEMESTER - I

20TPHS101 SDG NO. 4&5	SKILL ENHANCEMENT	L	T	P	C
		0	0	2	1

OBJECTIVES:

- To enrich social network ethics
- To develop and enhance browsing culture
- To understand the concepts of networking
- To promote self professionalism
- To acquire knowledge about various digital identification procedures

UNIT I SOCIAL NETWORK ETIQUETTES **6**

Introduction to social network – Social Networking Etiquettes - Pros and Cons - Usage of Facebook, Instagram, WhatsApp , Telegram, Youtube, Evolution of Android and IOS, Introduction to Linkedin & Benefits. (Practicals – Official Mail id- Linkedin Id Creation, Linkedin Profile Bulilding , Facebook Id and Creation and Modifying the existing FB ID)

UNIT II BROWSING CULTURE **6**

Introduction to browsing – Search Engines-Google - Bing -Yahoo!-AOL -MSN –DuckDuckGo ,browsers, phishing – Cookies - URL – https:// extensions , browsing history, Incognito mode- VPN – Pros and Cons – Book mark.

UNIT III NETWORKING **6**

Basics of networking - LAN, MAN, WAN, Introduction to network topologies, Protocols , IP Commands (Command line prompt), Define online complier and editor (Practicals – Find Your System IP,Ping Command, Firewall Fortinet, Basic DOS Commands)

UNIT IV PROFESSIONALISM **6**

Dress Code, Body Language, Appropriate Attire ,Communication Skills, Interview preparation – Introducing yourself - How to greet Superiors, Importance of Eye Contact During conversation.

UNIT V DIGITAL IDENTIFICATION **6**

Introduction to NAD - Importance of Aadhar, PAN Card, Passport, Bank Account, Bar Code, QR scan, Payment Gateway (Gpay, Phone Pe, UPI, BHIM, Paytm), Mobile Banking (Practicals - NAD registration Step by Step, Linking bank account with netbanking , Register for payment gateway).

TOTAL : 30 PERIODS

WEB REFERENCES :

Unit I: Social Network Etiquettes:

1. https://sproutsocial.com/glossary/social-media-etiquette/
2. https://www.shrm.org/resourcesandtools/tools-and-samples/hr-qa/pages/socialnetworkingsitespolicy.aspx
3. https://www.frontiersin.org/articles/10.3389/fpsyg.2019.02711/full
4. https://medium.com/@sirajea/11-reasons-why-you-should-use-telegram-instead-of-whatsapp-ab0f80fbfa79
5. https://buffer.com/library/how-to-use-instagram/
6. https://www.webwise.ie/parents/what-is-youtube/
7. https://www.androidauthority.com/history-android-os-name-789433/
8. https://www.mindtools.com/pages/article/linkedin.htm

Unit II: Browsing Culture:

1. https://sites.google.com/site/bethanycollegeofteacheredn/unit--ict-connecting-with-world/national-policy-on-information-and-communication-technology-ict/accessing-the-web-introduction-to-the-browser-browsing-web
2. https://www.wordstream.com/articles/internet-search-engines-history
3. https://www.malwarebytes.com/phishing/
4. https://www.adpushup.com/blog/types-of-cookies/

5. https://www.eff.org/https-everywhere
6. https://www.sciencedirect.com/topics/computer-science/browsing-history\
7. https://www.vpnmentor.com/blog/pros-cons-vpn/
8. https://www.tech-wonders.com/2016/10/use-hush-private-bookmarking-extension-chrome.html

Unit III:Networking

1. https://www.guru99.com/types-of-computer-network.html
2. https://www.studytonight.com/computer-networks/network-topology-types
3. https://www.cloudflare.com/learning/network-layer/what-is-a-protocol/
4. https://www.howtogeek.com/168896/10-useful-windows-commands-you-should-know/
5. https://paiza.io/en

Unit IV : Professionalism

1. https://career.vt.edu/develop/professionalism.html
2. https://englishlabs.in/importance-dress-code/
3. https://www.proschoolonline.com/blog/importance-of-body-language-in-day-to-day-life
4. https://www.thespruce.com/etiquette-of-proper-attire-1216800
5. https://shirleytaylor.com/why-are-communication-skills-important/
6. https://www.triad-eng.com/interview-tips-for-engineers/
7. https://www.indeed.co.in/career-advice/interviewing/interview-question-tell-me-about-yourself
8. https://toggl.com/track/business-etiquette-rules/

Unit V: Digital Identification

1. https://nad.ndml.in/nad-presentation.html
2. https://www.turtlemint.com/aadhaar-card-benefits/
3. https://www.bankbazaar.com/pan-card/uses-of-pan-card.html
4. https://www.passportindex.org/passport.php
5. https://consumer.westchestergov.com/financial-education/money-management/benefits-of-a-bank-account
6. https://en.wikipedia.org/wiki/QR_code

7. https://www.investopedia.com/terms/p/payment-gateway.asp
8. https://www.paisabazaar.com/banking/mobile-banking/

OUTCOMES:

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

1. Learn and apply social network ethics. (K3)
2. Understand the browsing culture. (K2)
3. Analyze the networking concepts . (K4)
4. Develop self professionalism. (K3)
5. Gain hands-on experience in various digital identification procedures. (K2)
6. Analyse and apply the different digital payment gateway methods. (K4)

CO- PO MAPPING :

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	-	-	-	-	3	2	-	3	2	3	-	2
CO2	-	-	-	-	3	2	-	3	2	3	-	2
CO3	-	-	-	-	3	2	-	-	1	3	-	2
CO4	-	-	-	-	3	2	-	3	3	3	-	2
CO5	-	-	-	-	3	2	-	-	2	3	-	2
CO6	-	-	-	-	3	2	-	-	2	3	-	2

SEMESTER - I

20HSMG101 SDG NO. 4&5	PERSONAL VALUES	L	T	P	C
		2	0	0	0

OBJECTIVES:

- Values through Practical activities

UNIT I SELF CONCEPT **6**

Understanding self Concept – Identify Yourself – Who am I – an individual, engineer, citizen – Attitude – Measuring Behaviour – Change of Behaviour – Personality – Characteristics in personal, professional life.

UNIT II INDIVIDUAL VALUES **6**

Personal Values – Attributes –Courage – Creativity, Honesty, Perfection, Simplicity, Responsibility – Measuring personal values

UNIT III MORAL VALUES **6**

Moral – Understanding right and wrong – Positive thoughts – Respect to others – Doing good to society.

UNIT IV PHYSICAL AND MENTAL WELL-BEING **6**

Health – Physical fitness –Mental vigour – Diet management – Yoga – Meditation – Peaceful life – Happiness in life

UNIT V DECISION MAKING **6**

Goal Setting – Decision making skill – Overcome of Barriers – Success – Mental strength and weakness

TOTAL: 30 PERIODS

Note:

Each topic in all the above units will be supplemented by practice exercises and classroom activities and projects.

REFERENCE BOOKS:

1. Barun K. Mitra, "Personality Development and Soft Skills", Oxford University Press, 2016.
2. B.N.Ghosh, "Managing Soft Skills for Personality Development" McGraw Hill India, 2012.

OUTCOMES:

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

1. Become an individual in knowing the self. (K4)
2. Acquire and express Personal Values, Spiritual values and fitness. (K4)
3. Practice simple physical exercise and breathing techniques. (K2)
4. Practice Yoga asana which will enhance the quality of life. (K1)
5. Practice Meditation and get benefitted. (K1)
6. Understanding moral values and need of physical fitness. (K2)

CO – PO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
Co1	-	-	-	-	-	2	2	3	3	1	1	1
CO2	-	-	-	-	-	2	2	3	3	1	1	1
CO3	-	-	-	-	-	2	2	3	3	1	1	1
CO4	-	-	-	-	-	2	2	3	3	1	1	1
CO5	-	-	-	-	-	2	2	3	3	1	1	1
CO6	-	-	-	-	-	2	2	3	3	1	1	1

SEMESTER - II

20BSMA201 SDG NO. 4	ENGINEERING MATHEMATICS - II	L	T	P	C
		3	1	0	4

OBJECTIVES:

- The objective of this course is to familiarize the prospective engineers with techniques in Vector Calculus, Ordinary differential equations, Complex variables and Laplace transforms. It aims to equip the students to deal with advanced levels of Mathematics and applications that would be essential for their disciplines.

UNIT I VECTOR CALCULUS 12

Gradient and Directional derivatives - Divergence and Curl- Vector identities - Irrotational and Solenoidal vector fields - Line integral over a plane curve - Surface integral - Volume integral – Gauss divergence, Green's and Stoke's theorems - Verification and application in evaluating line, Surface and volume integrals.

UNIT II ORDINARY DIFFERENTIAL EQUATIONS 12

Second and higher order linear differential equations with constant coefficients - Method of variation of parameters - Homogeneous equation of Euler's and Legendre's types - System of simultaneous linear differential equations with constant coefficients.

UNIT III COMPLEX DIFFERENTIATION 12

Analytic functions- Necessary and sufficient conditions for analyticity in cartesian and polar coordinates (without proof) - Properties - Harmonic conjugate - construction of analytic functions- Conformal mapping - Mapping by functions $w = z+a, w=az, w=1/z, w=z^2$ - Bilinear transformation.

UNIT IV COMPLEX INTEGRATION 12

Contour integrals, Cauchy- Goursat theorem (without proof) - Cauchy Integral formula (without proof) - Taylor's series - Zeroes of Analytic functions - Singularities - Laurent's Series - Residues – Cauchy Residue theorem (without proof) – Application of Residue theorem for evaluation of real integrals – use of circular contour and semicircular contour(without poles on real axis).

UNIT V LAPLACE TRANSFORM 12

Existence conditions – Transforms of elementary functions – Transform of Unit step function and Unit impulse function – Basic properties – Shifting theorems – Transforms of derivatives and integrals – Initial and Final value

theorems – Convolution theorem – Transform of Periodic functions – Application of solution of linear second order ordinary differential equations with constant coefficients.

TEXT BOOKS:

1. Erwin Kreyszig, Advance Engineering Mathematics, 9th Edition, John Wiley & Sons, 2006.
2. Ramana B.V., Higher Engineering Mathematics, Tata McGraw Hill Publishing Company, New Delhi, 2008.

REFERENCES:

1. Dass, H.K., and Er. Rajnish Verma, "Higher Engineering Mathematics", S.Chand Private Ltd., 2011.
2. Glyn James, "Advanced Modern Engineering Mathematics", 3rd Edition, Pearson Education, 2010.
3. Peter V.O'Neil, "Advanced Engineering Mathematics", 7th Edition, Cengage learning, 2012.
4. E.A.Coddinton, "An Introduction to Ordinary Differential Equations", Prentice Hall India, 1995.
5. B.S. Grewal, "Higher Engineering Mathematics", Khanna Publishers, 40th Edition, 2014.
6. N.P.Bali and Manish Goyal, "A text Book of Engineering Mathematics", Laxmi Publications, Reprint 2008.

WEB COURSES:

1. https://nptel.ac.in/courses/122107036/
2. https://nptel.ac.in/courses/111105134/
3. https://ocw.mit.edu/courses/mathematics/18-04-complex-variables-with-applications-spring-2018/
4. https://ocw.mit.edu/courses/mathematics/18-02-multivariable-calculus-fall-2007/
5. https://ocw.mit.edu/resources/res-6-007-signals-and-systems-spring-2011/lecture-notes/

ONLINE RESOURCES:

1. https://ocw.mit.edu/resources/res-6-007-signals-and-systems-spring-2011/video-lectures/lecture-1-introduction/
2. http://www.nptelvideos.com/course.php?id=90

COURSE OUTCOMES:

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

1. Compute the derivatives of scalar and vector point functions. Use vector point function to establish a relation between line, surface and volume integrals. (K3)
2. Solve ordinary differential equations of second and higher order with constant coefficients, variable coefficients and simultaneous linear differential equations. (K3)
3. Construct an analytic function and apply the properties of analytic functions to check for harmonic and orthogonal functions and find the images of circle and straight lines under the standard transformations. (K3)
4. Use Cauchy's integral theorem, formula and Cauchy's Residue theorem to evaluate complex and real integrals, find the Taylor's and Laurent's series expansion. (K3)
5. Apply Laplace and inverse Laplace Transforms to solve the Linear ordinary differential equations with constant coefficients. (K3)

CO - PO MAPPING:

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

SEMESTER - II

20HSEN201 SDG NO. 4	TECHNICAL ENGLISH - II	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To strengthen the listening skills for comprehending and critically analyzing passages
- To enhance students' ability with multiple strategies and skills for making technical presentations
- To participate in group discussions for developing group attitude
- To develop skills for preparing effective job application
- To write effective technical reports

UNIT I LANGUAGE DEVELOPMENT **9**

Listening – Listening conversations involving two participants – multiple participants – **Speaking** – conversation methods in real life occurrences using expressions of different emotions and imperative usages – **Reading** passages and short stories - **Writing** – preparation of checklist – extended definition – **Language Development** – tenses - subject - verb agreement

UNIT II VOCABULARY BUILDING **9**

Listening – listening formal and informal conversation and participative exercises – **Speaking** - creating greetings/wishes/excuses and thanks – **Reading** – articles/novels-**Writing** summary of articles and concise writing identifying new words – homonyms, homophones, homographs – one-word substitutions – easily confused words - creating SMS and using emoticons - sharing information in social media. **Language Development** - reported speeches – regular and irregular verbs - idioms & phrases

UNIT III WRITING TECHNICAL REPORTS **9**

Listening – listening conversation – effective use of words and their sound aspects, stress, intonation & pronunciation – **Speaking** - practicing telephonic conversations – observing and responding. **Reading** – regular columns of newspapers/magazines - **Writing** – reports – feasibility, accident, survey and progress - preparation of agenda and minutes – **Language Development** - using connectives – discourse markers

UNIT IV TECHNICAL WRITING **9**

Listening – Model debates & documentaries - **Speaking** – expressing agreement/disagreement, assertiveness in expressing opinions – **Reading**

biographies/autobiographies – **Writing** – note-making – formal letters – inviting guests – acceptance/declining letters - **Language Development** – degrees of comparison - numerical adjectives – embedded sentences

UNIT V GROUP DISCUSSION AND JOB APPLICATION 9

Listening – Listening - classroom lectures – recommending suggestions & solutions – **Speaking** – participating in group discussion – learning GD strategies – **Reading** – journal articles - Writing – Job application – cover letter - résumé preparation – **Language Development** – purpose statement – editing – verbal analogies.

TOTAL: 45 PERIODS

TEXT BOOKS :

1. Board of editors. Fluency in English: A Course book for Engineering and Technology. Orient Blackswan, Hyderabad 2016.
2. Ashraf Rizvi. M, Effective Technical Communication. 2nd ed. McGraw Hill, New Delhi, 2018.

REFERENCES

1. Bailey, Stephen. Academic Writing: A Practical Guide for Students. Routledge, New York,2011.
2. Raman, Meenakshi and Sharma, Sangeetha. Technical Communication Principles and Practice. Oxford University Press, New Delhi, 2014.
3. Muralikrishnan& Mishra Sunitha, Communication skills for Engineers 2nd ed. Pearson, Tamilnadu, India 2011. P. Kiranmai and Rajeevan, Geetha. Basic Communication Skills, Foundation Books, New Delhi, 2013.
4. Suresh Kumar, E. Engineering English. Orient Blackswan, Hyderabad, 2015
5. Richards, Jack C. Interchange Students' Book – 2. Cambridge University Press, New Delhi, 2015.

WEB REFERENCES :

1. https://swayam.gov.in/nd1_noc20_hs21/preview
2. https://nptel.ac.in/content/storage2/nptel_data3/html/mhrd/ict/text/109106122/lec1.pdf
3. https://freevideolectures.com/course/3250/introduction-to-film-studies/10

ONLINE RESOURCES

1. https://www.ef.com/wwen/english-resources/

2. https://www.smilesforlearning.org/gclid=EAIaIQobChMI49DF9bnd6AIVSY6PCh1d_gV9EAAYASAAEgIBPvD_BwE.

OUTCOMES:

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

1. Define technical terms with the correct use of grammar (K1)
2 Identify new words, phrases, idioms and summarize articles/ write ups effectively (K2)
3 Pronounce words correctly, speak fluently and share opinions and suggestions effectively in conversations, debates and discussions (K3)
4 Construct reports convincingly and write official letters emphatically (K3)
5 Communicate confidently while speaking and writing by employing language strategies (K2)
6 Adapt group behavior, execute their role as a contributing team member and prepare winning job applications (K3)

CO - PO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	-	-	-	-	-	-	-	-	2	3	1	2
CO2	-	2	-	-	-	-	-	-	2	3	1	1
CO3	-	-	-	1	-	-	-	2	2	3	1	1
CO4	-	-	-	-	-	2	-	3	2	3	2	2
CO5	-	-	-	-	-	-	-	-	2	3	2	2
CO6	-	-	-	-	-	-	-	2	2	3	1	2

SEMESTER - II

20ESIT201 SDG NO. 4	PYTHON PROGRAMMING WITH LABORATORY	L	T	P	C
		3	0	2	4

OBJECTIVES:

- To Develop Python Programs with Conditionals and Loops
- To Use Python Data Structures – Lists, Tuples, Dictionaries, Sets
- To Define Python Functions and Work with Modules and Packages
- To Work with Python Classes, Objects and Handling Exceptions

UNIT I BASICS OF PYTHON PROGRAMMING 9

Python Interpreter and Interactive Mode - Features – History of Python – Literals – Variables and Identifiers – Data Types – Input Operation – Comments – Reserved Words – Indentation – Operators and Expressions – Operator Precedence– Operations on Strings – Other Data types – Type Conversion - Illustrative Programs: Use of various Operators, Evaluation of expressions, String Operations.

UNIT II DECISION CONTROL STATEMENTS 9

Conditionals: Boolean Values and Operators, Conditional (if) - Alternative (if-else) - Chained Conditional (if-elif-else) - Iteration: state - while - for - break - continue - pass - Illustrative Programs: Exchange the Values of Two Variables - Circulate the values of N Variables - Distance Between Two Points - Square Root - GCD - Exponentiation - Sum and Array of Numbers.

UNIT III STRING, LISTS, TUPLES, DICTIONARIES, SETS 9

Strings: String Slices - Immutability - String functions and methods - String Module - Lists: List Operations - List Slices - List methods - List Loop - Mutability - Aliasing - Cloning lists - List Parameters - Tuples: Tuple Assignment - Tuple as return value - Dictionaries: Operations and Methods - Advanced List Processing - List Comprehension - Sets: Creating Sets – Operations and Methods – Set Comprehension - Illustrative programs: Linear Search - Binary Search - Selection Sort - Insertion Sort - Merge Sort - Histogram.

UNIT IV FUNCTIONS, MODULES AND PACKAGES 9

Functions - Function Definition and Use - Flow of Execution - Parameters and Arguments - Fruitful Functions: Return values - Parameters - Local and Global Scope - Function Composition - Recursion - Modules – from-import Statement – Name of Module – Making your own modules - Packages - Standard Library Modules – globals(), locals() and reload() - Illustrative programs: Fibonacci Series using functions - Arithmetic Operations using Module - Area of different shapes using Packages.

UNIT V CLASSES, OBJECTS AND EXCEPTION HANDLING 9

Classes and Objects – Defining Classes – Creating Objects – Data Abstraction and Hiding through Classes - init() method – Class Variables and Object Variables – Introduction to Errors and Exception Handling – Handling Exceptions – Multiple Except Blocks – else Clause – Raising Exceptions – Built-in and User-defined Exceptions – Finally Block.

LIST OF EXPERIMENTS 15

1. Write a Python program to perform
   a. Linear Search
   b. Binary Search
2. Write a Python program to perform Selection Sort.
3. Write a Python program to sort the given numbers using Insertion Sort.
4. Write a Python program to do sorting using Merge sort.
5. Write a Python program to find first n prime numbers.
6. Write a Python program to Multiply two matrices.
7. Write a Python program to create Student class and instantiate its Object.
8. Write a Python License verification process using Exception handling.

TOTAL: 60 PERIODS

TEXT BOOKS:

1. ReemaThareja. "Python Programming Using Problem Solving Approach", Oxford University Press 2018.
2. Allen B. Downey, "Think Python: How to Think Like a Computer Scientist", 2nd edition, Updated for Python 3, O'Reilly Publishers, 2016.

REFERENCES:

1. Guido van Rossum and Fred L. Drake Jr, "An Introduction to Python" Revised and updated for Python 3.2, Network Theory Ltd., 2011.
2. John V Guttag, "Introduction to Computation and Programming Using Python", Revised and expanded Edition, MIT Press , 2013.
3. Robert Sedgewick, Kevin Wayne, Robert Dondero, "Introduction to Programming in Python: An Inter-Disciplinary Approach", Pearson India Education Services Pvt. Ltd., 2016.
4. Timothy A. Budd, "Exploring Python", Mc-Graw Hill Education (India) Private Ltd., 2015.
5. Kenneth A. Lambert, "Fundamentals of Python: First Programs", CENGAGE Learning, 2012.
6. Charles Dierbach, "Introduction to Computer Science using Python: A Computational Problem-Solving Focus", Wiley India Edition, 2013.
7. Paul Gries, Jennifer Campbell and Jason Montojo, "Practical Programming: An Introduction to Computer Science using Python 3", Second edition, Pragmatic Programmers, LLC, 2013.

WEB REFERENCES:

1. http://greenteapress.com/wp/think-python/
2. www.docs.python.org
3. https://nptel.ac.in/courses/106/106/106106182/

OUTCOMES:

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

1. Describe the syntax, semantics and control flow statements of Python programming. (K2)
2. Implement simple programs using control structures in Python. (K3)
3. Explain the methods to create and manipulate strings, lists, dictionaries, tuples and sets. (K2)
4. Articulate the concepts of functions, modules and packages in Python. (K2)
5. Implement simple programs using Python Data types and functions. (K3)
6. Apply the concepts of Exception handling, classes and objects. (K3)

CO - PO, MAPPING :

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	-	1	2	1	2	-	-	-	1	-	3	3
CO2	1	2	3	3	3	2	1	1	1	1	1	3
CO3	-	1	3	3	2	1	-	-	-	-	1	3
CO4	1	2	3	3	2	-	-	-	-	-	1	3
CO5	2	3	3	3	3	1	1	2	2	1	2	3
CO6	2	3	3	3	3	1	1	2	2	1	2	3

SEMESTER - II

20BSPH201 SDG NO. 4	PHYSICS OF ELECTRONIC DEVICES	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To acquaint the electrical properties of materials.
- To present the principles of semiconductor physics and its applications.
- To educate the properties of magnetic and dielectric materials and their uses.
- To introduce the bipolar junction transistors.
- To explicit the field effect transistors, power and display devices.

UNIT I ELECTRICAL PROPERTIES OF MATERIALS 9

Classical free electron theory - Expression for electrical conductivity - Thermal conductivity expression - Wiedemann-Franz law - Success and failures -

electrons in metals - Particle in a three dimensional box - degenerate states - Fermi- Dirac statistics - Density of energy states - Electron in periodic potential- Energy bands in solids - Tight binding approximation - Electron effective mass- concept of hole.

UNIT II SEMICONDUCTOR DIODES 9

Semiconductors - Intrinsic, Extrinsic semiconductor, Carrier concentration, PN junction diode- Current equations, Energy Band diagram, Diffusion and drift current densities, forward and reverse bias characteristics, Transition and Diffusion Capacitances, Switching Characteristics, Breakdown in PN Junction Diodes, Special purpose diodes - Schottky barrier diode, Zener diode, Varactor diode ,Tunnel diode, LASER diode and LDR.

UNIT III MAGNETIC AND DIELECTRIC PROPERTIES OF MATERIALS 9

Magnetism in materials - magnetic field and induction - magnetization - magnetic permeability and susceptibility - types of magnetic materials - microscopic classification of magnetic materials - Ferromagnetism: origin and exchange interaction - saturation magnetization and Curie temperature - Domain Theory - Hysteresis phenomenon - Ferrites. Dielectric materials: Polarization processes - dielectric loss - internal field - Clausius-Mosotti relation - dielectric breakdown.

UNIT IV BIPOLAR JUNCTION TRANSISTOR 9

NPN -PNP -Operations-Early effect-Current equations – Input and Output characteristics of CE, CB, CC - Hybrid -π model - h-parameter model, Ebers Moll Model- Gummel Poon- model, Multi Emitter Transistor.

UNIT V FIELD EFFECT TRANSISTORS, POWER AND DISPLAY DEVICES 9

JFETs – Drain and Transfer characteristics,-Current equations-Pinch off voltage and its significance- MOSFET- Characteristics- Threshold voltage - Channel length modulation, D- MOSFET, E-MOSFET- Characteristics – Comparison of MOSFET with JFET. Power Devices-UJT, SCR, Diac, Triac, Display Devices-LED, LCD, Photo transistor, Opto Coupler, Solar cell, CCD.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. Donald A Neaman, “Semi-conductor Physics and Devices”, Fourth Edition, TataMcGrawHill Inc.2012.
2. Salivahanan.S, Suresh Kumar. N, Vallavaraj.A, “Electronic Devices and circuits”, Third Edition, Tata McGraw- Hill,2008.

REFERENCES:

1. Robert Boylestadand Louis Nashelsky, "Electron Devices and Circuit Theory", Pearson Prentice Hall, 10th edition, July2008.
2. R.S.Sedha, "A Text Book of Applied Electronics" S.Chand Publications, 2006.
3. Yang, "Fundamentals of Semiconductor Devices", McGraw Hill International Edition, 1978.

OUTCOMES:

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

1. To acquire knowledge on electron theory of solids and apply it to determine the electrical properties of solids (K3)
2 To understand the origin of magnetism and to classify the magnetic materials based on their electron spin(K2)
3 To explain different polarisation and breakdown mechanisms in dielectric materials (K2).
4 "To understand the basic concepts of semiconducting material fundamentals and apply it to understand the principles of working of various diodes. (K3)
5 To characterize the various configurations and models of bipolar junction transistor(K3)
6 To describe the behaviour of field effect transistors, power and display devices for special applications (K2)

CO - PO, PSO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	-	2	-	1	-	-	-	-	-	1
CO2	3	3	1	2	3	1	1	-	-	-	-	2
CO3	3	3	-	2	2	-	1	1	-	-	-	1
CO4	3	3	1	2	2	2	2	-	-	-	-	3
CO5	3	3	2	2	2	-	-	-	-	-	-	2
CO6	3	3	3	2	3	3	2	-	-	-	-	2

SEMESTER - II

20ECPC201 SDG NO. 4, 9	CIRCUIT ANALYSIS	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To introduce the basic concepts of DC and AC circuits behavior.
- To study the transient and steady state response of the circuits subjected to step and sinusoidal excitations.
- To introduce different methods of circuit analysis using Network theorems, duality and topology.

UNIT I BASIC CIRCUITS ANALYSIS AND NETWORK TOPOLOGY 9

Ohm's Law – Kirchhoff's laws – Mesh current and node voltage method of analysis for D.C and A.C. circuits - Network terminology – Graph of a network - Incidence and reduced incidence matrices – Trees –Cutsets - Fundamental cut sets – Cutset matrix – Tiesets - Link currents and Tieset schedules -Twig voltages and Cutset schedules, Duality and dual networks.

UNIT II NETWORK THEOREMS FOR DC AND AC CIRCUITS 9

Network theorems -Superposition theorem, Thevenin's theorem, Norton's theorem, Reciprocity theorem, Millman's theorem, and Maximum power transfer theorem, Application of Network theorems - Network reduction: voltage and current division, source transformation – star delta conversion.

UNIT III RESONANCE AND COUPLED CIRCUITS 9

Resonance - Series resonance - Parallel resonance - Variation of impedance with frequency -Variation in current through and voltage across L and C with frequency – Bandwidth - Q factor -Selectivity. Self inductance - Mutual inductance - Dot rule - Coefficient of coupling - Analysis of multi-winding coupled circuits - Series, Parallel connection of coupled inductors - Single tuned and double tuned coupled circuits.

UNIT IV TRANSIENT ANALYSIS 9

Natural response-Forced response - Transient response of RC, RL and RLC circuits to excitation by Step Signal, Impulse Signal and exponential sources - Complete response of RC, RL and RLC Circuits to sinusoidal excitation.

UNIT V TWO PORT NETWORKS 9

Two port networks, Z parameters, Y parameters, Transmission (ABCD) parameters, Hybrid (H) Parameters, Interconnection of two port networks,

Symmetrical properties of T and π networks.

TOTAL PERIODS :45

TEXT BOOKS:

1. William H. Hayt, Jr. Jack E. Kemmerly and Steven M. Durbin, "Engineering Circuit Analysis", McGraw Hill Science Engineering, Eighth Edition, Eleventh Reprint, 2016.
2. Joseph Edminister and Mahmood Nahvi, "Electric Circuits", Schaum's Outline Series, Tata McGraw Hill Publishing Company, New Delhi, Fifth Edition Reprint 2016.

REFERENCES:

1. Charles K. Alexander, Mathew N.O. Sadiku, "Fundamentals of Electric Circuits", 5th Edition, McGraw Hill, 9th Reprint, 2015.
2. A.Bruce Carlson, "Circuits: Engineering Concepts and Analysis of Linear Electric Circuits", Cengage Learning, India Edition, 2nd Indian Reprint, 2009.
3. Allan H.Robbins, Wilhelm C.Miller, "Circuit Analysis Theory and Practice", Cengage Learning, 5th Edition, 1st Indian Reprint, 2013.
4. David Irwin et al, "Engineering Circuit Analysis", Wiley India, Tenth Edition, 2014.
5. Mahmood Nahvi, "Electric Circuits", McGraw Hill, Fifth Edition, 2009.

WEB RESOURCES:

1. https://www.khanacademy.org/science/electrical-engineering/ee-circuit-analysis-topic
2. http://homepages.wmich.edu/~miller/ECE2100.html
3. https://engineering.purdue.edu/~ee202https://engineering.purdue.edu/~ee202

ONLINE RESOURCES:

1. https://onlinecourses.nptel.ac.in/noc17_ee13/preview
2. https://www.coursera.org/learn/linear-circuits-dcanalysis
3. https://onlinecourses.nptel.ac.in/noc17_ee15/preview
4. https://swayam.gov.in/course/218-networks-and-systems

OUTCOMES:

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

1 Describe the basic circuit terminologies, Ohm's law, Kirchoff's laws, network topology using graph theory, duality concepts, source transformation, star delta conversions and simplification of complex circuits. (K3)

2 Apply the Mesh current and nodal voltage method for analyzing DC and AC circuits. (K3)

3 Apply the concepts of Superposition, Thevenin's, Norton's, Reciprocity, Millman's and Maximum power transfer theorems to analyze DC and AC electric circuits. (K3)

4 Characterize the frequency response of series & parallel resonance circuits, single & double tuned circuits and apply the concept of inductance, coupling to solve electric circuits. (K3)

5 Characterize the transient response analysis of RL, RC and RLC circuits for standard test signals like step, impulse, exponential and sinusoidal signals.(K2)

6 Implement two port Z,Y, ABCD and h parameter equivalent models for electric circuits and compare the symmetrical properties of T and π Networks. (K3)

CO - PO, PSO MAPPING :

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	2	3	-	2	-	-	-	-	-	2	3	2
CO2	3	2	2	2	-	-	-	-	-	-	-	2	3	2
CO3	3	3	2	2	-	-	-	-	-	-	-	2	3	2
CO4	3	3	2	3	-	2	-	-	-	-	-	2	3	2
CO5	3	3	2	3	-	2	-	-	-	-	-	2	3	2
CO6	3	3	2	2	-	-	-	-	-	-	-	2	3	2

SEMESTER - II

20ESGE201 SDG NO. 4,9,12	ENGINEERING PRACTICES LABORATORY	L	T	P	C
		0	0	3	1.5

OBJECTIVES:

- To provide exposure to the students with hands on experience on various basic engineering practices in Electrical and Electronics Engineering, Civil and Mechanical Engineering

ELECTRICAL ENGINEERING PRACTICE

1. Residential house wiring using switches, fuse, indicator, lamp and energy meter.

2. Fluorescent lamp wiring.
3. Stair case wiring.
4. Measurement of electrical quantities – voltage, current, power & power factor in RLC circuit.
5. Measurement of energy using single phase energy meter.
6. Measurement of resistance to earth of electrical equipment.

ELECTRONICS ENGINEERING PRACTICE

1. Study of Electronic components and equipments – 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.

CIVIL ENGINEERING PRACTICE

Buildings:

Study of plumbing and carpentry components of residential and industrial buildings, safety aspects.

Plumbing Works:

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

Carpentry using Power Tools only:

1. Study of the joints in roofs, doors, windows and furniture.
2. Hands-on-exercise: Wood work, joints by sawing, planing and cutting.

MECHANICAL ENGINEERING PRACTICE

Welding:

1. Preparation of butt joints, lap joints and T- joints by Shielded metal arc welding.
2. Gas welding practice.

Basic Machining:

1. Simple Turning and Taper turning.
2. Drilling Practice.

Sheet Metal Work:

1. Forming & Bending.
2. Model making – Trays and funnels.
3. Different type of joints.

Machine assembly practice:

1. Study of centrifugal pump.
2. Study of air conditioner.

Demonstration on:

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

Total : 45 PERIODS

LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS

1. Electrical

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

2. Electronics

1	Soldering guns	10 Nos
2	Assorted electronic components for making circuits	50 Nos
3	Small PCBs	10 Nos
4	Multimeters	10 Nos

3. Civil

1	Assorted components for plumbing consisting of metallic pipes, plastic pipes, flexible pipes, couplings, unions, elbows, plugs and other fittings.	15 Sets

2	Carpentry vice (fitted to work bench)	15 Nos
3	Standard woodworking tools	15 Sets
4	Models of industrial trusses, door joints, furniture joints	5 each
5	Power Tools:	
	Rotary Hammer	2 Nos
	Demolition Hammer	2 Nos
	Circular Saw	2 Nos
	Planer	2 Nos
	Hand Drilling Machine	2 Nos
	Jigsaw	2 Nos

4. Mechanical

1	Arc welding transformer with cables and holders	5 Nos
2	Welding booth with exhaust facility	5 Nos
3	Welding accessories like welding shield, chipping hammer, wire brush, etc	5 Sets
4	Oxygen and acetylene gas cylinders, blow pipe and other welding outfit.	2 Nos
5	Centre lathe	2 Nos
6	Hearth furnace, anvil and smithy tools	2 Sets
7	Moulding table, foundry tools	2 Sets
8	Power Tool: Angle Grinder	2 Nos
9	Study-purpose items: centrifugal pump, air-conditioner	1 each

OUTCOMES:

Upon completion of the course, the students should be able to

1. Elaborate on the components, gates, soldering practices. Calculate electrical parameters such as voltage, current, resistance and power. (K1)
2. Design and implement Rectifier and Timer circuits (K2)
3. Measure the electrical energy by single phase and three phase energy meters. (K2)
4. Prepare the carpentry and plumbing joints. (K2)
5. Perform different types of welding joints and sheet metal works (K2)
6. Perform different machining operations in lathe and drilling. (K2)

CO - PO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	1	1	2	1	-	-	1	1	1	1
CO2	3	2	1	1	2	1	-	-	1	1	1	1
CO3	2	2	1	1	1	1	-	-	1	1	1	1
CO4	1	1	1	-	-	2	-	-	1	1	1	2
CO5	2	1	1	-	-	1	1	1	1	1	1	2
CO6	2	1	1	-	-	1	-	1	1	1	1	2

SEMESTER - II

20ECPL201 SDG NO. 4	CIRCUITS AND DEVICES LABORATORY	L	T	P	C
		0	0	3	1.5

OBJECTIVES:

- Analyse the characteristics of basic electronic devices
- Design RL and RC circuits
- Verify KVL & KCL, Thevinin, Norton and Super Position Theorems
- Verify Reciprocity and Maximum Power Transfer Theorem
- Analyse the characteristics of Wave shaping circuits and Rectifier

LIST OF EXPERIMENTS :

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

TOTAL: 45 PERIODS

LAB REQUIREMENT FOR A BATCH OF 30 STUDENTS / 2 STUDENTS PER EXPERIMENT:

S.No.	EQUIPMENTS	
1.	BC 107, BC 148, 2N2646, BFW10	- 25 each
2.	1N4007, Zener diodes	- 25 each
3.	Resistors, Capacitors, Inductors	- sufficient quantities
4.	Bread Boards	- 15 Nos
5.	CRO (30MHz)	- 10 Nos
6.	Function Generators (3MHz)	- 10 Nos

OUTCOMES :

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

1 Analyze the characteristics of PN junction diode and zener diode. (K4)
2 Analyze the characteristics of BJT in CB & CE configurations. (K4)
3 Analyze the characteristics of FET and SCR. (K4)
4 Analyze the characteristics of Wave shaping circuits, Rectifiers and regulators. (K4)
5 Apply KVL, KCL,Thevenin and Norton theorem for DC electric circuits. (K3)
6 Apply Superposition, Maximum power transfer and reciprocity theorem for DC electric circuits. (K3)

CO - PO, PSO MAPPING :

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	1	3	1	-	-	-	-	-	2	3	3	2
CO2	3	3	1	3	1	-	-	-	-	-	2	3	3	2
CO3	3	3	1	3	1	-	-	-	-	-	2	3	3	2
CO4	3	3	1	3	1	-	-	-	-	-	2	3	3	2
CO5	3	3	1	3	1	-	-	-	-	-	2	3	3	2
CO6	3	3	1	3	1	-	-	-	-	-	2	3	3	2

SEMESTER - II

20ECTE201 SDG NO. 9	PCB DESIGN	L	T	P	C
		0	0	2	1

OBJECTIVES:

- Analyze and interpret test results and measurements on electric circuits
- To predict the performance of electric circuits from device characteristics
- Design an electronic printed circuit board for a specific application using industry standard software

LIST OF EXPERIMENTS :

1. Introduction to PCB and OrCAD or its equivalent software.
2. Designing of schematic.
3. Designing of capture from OrCAD or its equivalent and getting positive for PCB manufacturing.
4. Soldering shop: Fabrication of DC regulated power supply.
5. PCB Lab: (a) Artwork & printing of a simple PCB. (b) Etching & drilling of PCB.
6. Wiring & fitting shop: Fitting of power supply along with a meter in cabinet.
7. Testing of regulated power supply fabricated.

TOTAL: 30 PERIODS

LAB REQUIREMENT FOR A BATCH OF 30 STUDENTS / 2 STUDENTS PER EXPERIMENT:

S.No.	EQUIPMENTS	
1.	Copper cladded base board	-15 Nos.
2.	Hand Drilling machine	-15 Nos.
3.	Soldering guns	-15 Nos.
4.	Assorted electronic components for making circuits	-50 Nos.
5.	OrCAD software	(15 users)
6.	Copper solvent	-as required
7.	PCs - 15 Nos	-15 Nos.

OUTCOMES:

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

1 Perform the chemical processes by using negative/positive masks(K3)

2. Design the PCB mask using ORCAD software(K6)

3. Perform the routing optimization processes by using ORCAD or its equivalent software.(K3)
4. Apply the mechanical processes by using drilling and etching machines on raw PCB(K3)
5. Perform the soldering process(K3)
6. Design and test the PCB for regulated power supply(K6)

CO - PO, PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	3	3	-	2	2	-	3	2	3	2	3	2
CO2	3	2	2	2	3	1	-	-	3	2	3	2	3	2
CO3	3	2	2	2	3	1	-	-	3	2	3	2	3	2
CO4	3	2	2	2	-	1	-	-	3	2	3	2	3	2
CO5	3	2	2	2	-	1	-	-	3	2	3	2	3	2
CO6	3	2	3	2	-	1	-	-	3	2	3	2	3	2

SEMESTER - II

20TPHS201 SDG NO. 4&5	SKILL ENHANCEMENT	L	T	P	C
		0	0	2	1

OBJECTIVES:

- To understand the nuances in resume building
- To explore various virtual meeting tools
- To gain knowledge about online certification courses
- To develop knowledge in Google Suite products
- To enhance presentation skills

UNIT I RESUME BUILDING **6**

Your Strength, Projects, Internship, Paper Presentation, uploading your coding in github, Introduction to HackerRank, HackerEarth virtual online assessment (Auto Proctored) (Practicals - Construct a resume, Register for a online Mock Assessment / Contest)

UNIT II VIRTUAL MEETINGS **6**

Basic Etiquette of virtual meeting – Introduction to Skype - Zoom - Webex - Google Meet - Gotowebinar - Jio meet – Screen Share - Jamboard - Feedback polling - Chatbox

(Practicals - Accept and Register for a mock class to attend - How to host a meeting).

UNIT III ONLINE LEARNING **6**

Online Certification - Coursera – Udemy – Edx – Cisco – Online Practice Platforms - SkillRack – Myslate - FACEprep - BYTS - aptimithra - Contest Registrations - TCS Campus Commune - HackwithInfy, InfyTQ - Virtusa NurualHack - Mindtree Osmosis – Online assessment - AMCAT-PGPA.

(Practicals - Campus Commune Registration , Coursera registration - Mock Registration (KAAR Technologies as sample).

UNIT IV GOOGLE SUITE **8**

Define google suite - Benefits of google suite - Google Search - Sheet - Docs - Forms - Calender - Drive - Slide - Translate - Duo - Earch - Maps - Hangouts- Sites - Books - Blogger

(Practicals – Create google sheets and share - Create google Forms and share, Create Google Slide and share , Google drive creation and share (Knowledge of Rights), Create poll and share.

UNIT V PRESENTATION SKILLS **4**

Email Writing – Group Discussion - Power Point Presentation

(Practicals- Create a self SWOT Analysis report. A PowerPoint Slide Preparation)

TOTAL : 30 PERIODS

WEB REFERENCES :

Unit I: Resume Building:

1. https://zety.com/blog/resume-tips
2. https://resumegenius.com/blog/resume-help/how-to-write-a-resume
3. https://www.hackerearth.com/recruit/
4. https://www.hackerrank.com/about-us

Unit – II:Virtual Meetings

1. https://www.claphamschool.org/our-community/blog/online-learning-etiquette-guide-14-principles-to-guide-students
2. https://online.hbs.edu/blog/post/virtual-interview-tips?c1=GAW_SE_NW&source=IN_GEN_DSA&cr2=search__-__nw__-__in__-__dsa__-__general&kw=dsa__-__general& cr5=459341920955&cr7=c&gclid=Cj0KCQjw8fr7BRDSARIsAK0Qqr4dRRbboL3kltrwDsr7hm8oIHtN5dfjD3NIFZULuzNwEXxhjpNFQ2caApn5EALw_wcB

3. https://hygger.io/blog/top-10-best-group-meeting-apps-business/
4. https://www.zdnet.com/article/best-video-conferencing-software-and-services-for-business/

Unit – III:Online Learning

1. https://www.coursera.org/browse
2. https://support.udemy.com/hc/en-us/articles/229603868-Certificate-of-Completion
3. https://www.edx.org/course/how-to-learn-online
4. https://www.cisco.com/c/en/us/training-events/training-certifications/certifications.html
5. https://campuscommune.tcs.com/en-in/intro
6. https://www.freshersnow.com/tcs-campus-commune-registration/
7. https://www.infosys.com/careers/hackwithinfy.html
8. https://www.mindtree.com/blog/osmosis-2013-my-experiences
9. https://www.myamcat.com/knowing-amcat
10. https://www.admitkard.com/blog/2020/02/06/amcat/

Unit IV: Google Suite

1. https://www.inmotionhosting.com/blog/what-is-g-suite-and-why-should-i-consider-using-it/
2. https://en.wikipedia.org/wiki/G_Suite
3. https://blog.hubspot.com/marketing/google-suite
4. https://kinsta.com/blog/g-suite/

Unit V: Presentation Skills

1. https://www.mindtools.com/CommSkll/EmailCommunication.htm
2. https://www.grammarly.com/blog/email-writing-tips/
3. https://business.tutsplus.com/articles/how-to-write-a-formal-email--cms-29793
4. https://www.softwaretestinghelp.com/how-to-crack-the-gd/
5. https://www.mbauniverse.com/group-discussion/tips
6. https://slidemodel.com/23-powerpoint-presentation-tips-creating-engaging-interactive-presentations/
7. https://business.tutsplus.com/articles/37-effective-powerpoint-presentation-tips--cms-25421
8 https://blog.prezi.com/9-tips-on-how-to-make-a-presentation-a-success/
9. http://www.garrreynolds.com/preso-tips/design/

OUTCOMES:

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

1. Construct a suitable resume and registration procedure for online mock assessments. (K1)
2. Handle various virtual meeting tools. (K3)
3. Acquire exposure about online certification courses. (K4)
4. Get involved and work in a collaborative manner. (K2)
5. Gain knowledge in various presentation methodologies. (K1)
6. Apply knowledge to practice Google suite features and SWOT analysis. (K3)

CO – PO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	-	-	-	-	3	2	-	3	2	3	-	2
CO2	-	-	-	-	3	2	-	3	2	3	-	2
CO3	-	-	-	-	3	2	-	-	1	3	-	2
CO4	-	-	-	-	3	2	-	3	3	3	-	2
CO5	-	-	-	-	3	2	-	-	2	3	-	2
CO6	-	-	-	-	3	2	-	-	2	3	-	2

SEMESTER - II

20HSMG201 SDG NO. 4 & 5	INTERPERSONAL VALUES	L	T	P	C
		2	0	0	0

OBJECTIVES:

- Values through Practical activities

UNIT I INTERPERSONAL VALUES **6**

Interpersonal Relationships and Values – Importance and Barriers – Building and maintain relationships – Mutual understanding – Respect to others.

UNIT II EFFECTIVE COMMUNICATION **6**

Communication skills –Importance and Barriers - Impressive formation and management – Public speaking

UNIT III GROUP DYNAMICS **6**

Group formation –Teamwork – Identify others attitude and behaviour –

Formation of relationship – Personal and professional.

UNIT IV MUTUAL RELATIONSHIP **6**

Building mutual understanding and cooperation – Enhancing decision making skills – Problem solving skills – Comparative Appraisal – Interpersonal needs.

UNIT V POSITIVE ATTITUDE **6**

Fostering trust and cooperation – Developing and maintain positive attitude – Improving socialization – Development of security and comfort.

TOTAL: 30 PERIODS

Note: Each topic in all the above units will be supplemented by practice exercises and classroom activities and projects.

REFERENCE BOOKS:

1. Barun K. Mitra, "Personality Development and Soft Skills", Oxford University Press, 2016.
2. B.N.Ghosh, "Managing Soft Skills for Personality Development", McGraw Hill India, 2012.

OUTCOMES:

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

1. Develop a healthy relationship & harmony with others. (K1)
2. Practice respecting every human being. (K3)
3. Practice to eradicate negative temperaments. (K3)
4. Acquire Respect, Honesty, Empathy, Forgiveness and Equality. (K4)
5. Manage the cognitive abilities of an Individual. (K5)
6. Understanding the importance of public speaking and teamwork. (K2)

CO – PO MAPPING :

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	-	-	-	-	-	2	2	3	3	1	1	1
CO2	-	-	-	-	-	2	2	3	3	1	1	1
CO3	-	-	-	-	-	2	2	3	3	1	1	1
CO4	-	-	-	-	-	2	2	3	3	1	1	1
CO5	-	-	-	-	-	2	2	3	3	1	1	1
CO6	-	-	-	-	-	2	2	3	3	1	1	1

SEMESTER - III

20ECPC301 SDG NO. 4, 9	DIGITAL ELECTRONICS	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To introduce basic postulates of Boolean algebra and shows the correlation between Boolean expressions.
- To introduce the methods for simplifying Boolean expressions.
- To outline the formal procedures for the analysis and design of combinational circuits and sequential circuits.
- To introduce the concept of memories and programmable logic devices.
- To illustrate the concept of synchronous and asynchronous sequential circuits.

UNIT I LOGIC SIMPLIFICATION 9

Review of number systems and number representation – Binary codes – Code Conversion; Logic Simplification: Review of Boolean Algebra and De Morgan's Theorem – SOP and POS forms – Canonical forms – Karnaugh maps up to 5 variables- QuineMcClusky method - Implementation using logic gates.

UNIT II COMBINATIONAL LOGIC DESIGN 9

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

UNIT III SYNCHRONOUS SEQUENTIAL CIRCUITS 9

Flip- Flops: Bistable elements, Latches, Flip flops – SR, JK, T, D– operation and excitation tables, Triggering of Flip Flop- Master/Slave Flip flop.

Registers and Counters: Shift registers -SISO, SIPO, PISO and PIPO, Universal Shift Register; up/down Counters; Design of Synchronous counters, Modulus-N Counter - Shift Register Counters -Ring Counters and Johnson Counter.

Clocked Sequential Circuit: Analysis of clocked sequential circuits – concept of state – state diagram - state table, state reduction procedures by partitioning and implication chart- Moore/Mealy models; Design of synchronous sequential circuits- Serial Adder- Sequence detector.

UNIT IV ASYNCHRONOUS SEQUENTIAL CIRCUITS 9

Introduction to asynchronous sequential circuits - fundamental mode and pulse mode circuits - State Diagram and Excitation Table - Ripple Counters-cycles and races, state reduction, race free assignments –Pulse mode

sequential circuits- Design. Hazards, Essential Hazards, Design of Hazard free circuits

UNIT V MEMORY DEVICES AND PROGRAMMABLE LOGIC DEVICES 9

Memory Devices: Basic memory structure – ROM - PROM – EPROM – EEPROM –EAPROM, RAM – Static and dynamic RAM

PLDs: PLA, PAL, PROM, Field Programmable Gate Arrays (FPGA) - Implementation of combinational logic circuits using PLA, PAL. – CPLD.

Digital integrated circuits: Logic levels, propagation delay, power dissipation, fan-out and fan-in, noise margin, logic families and their characteristics-RTL, TTL, ECL, CMOS

TOTAL: 45 PERIODS

TEXT BOOKS:

1. M. Morris Mano and Michael D. Ciletti, "Digital Design", Fifth Edition, Pearson, 2014.
2. S. Salivahanan, S. Arivazhagan, "Digital Circuits and Design", Oxford Press India, 2018 (Fifth Edition).
3. R P Jain, "Modern Digital Electronics", McGraw Hill India, 2009 (Fourth Edition).

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. S.Salivahanan and S.Arivazhagan, "Digital Electronics", Ist Edition, Vikas Publishing House pvt Ltd, 2012.
4. Anil K.Maini, "Digital Electronics", Wiley, 2014.
5. A.Anand Kumar, "Fundamentals of Digital Circuits", 4th Edition, PHI Learning Private Limited, 2016.
6. Soumitra Kumar Mandal, "Digital Electronics", McGraw Hill Education Private Limited, 2016.
7. Donald P Leach, Albert Paul Malvino and GoutamSaha, "Digital Principles and Applications" McGraw Hill, India – 2014 (8th Edition – SIE).
8. R P Jain, "Modern Digital Electronics", McGraw Hill India, 2009- fourth Edition

WEB REFERENCES:

1. http://nptel.ac.in/courses/117106086/1
2. http://web.iitd.ac.in/~shouri/eel201/lectures.php
3. https://www.allaboutcircuits.com/textbook/digital/
4. http://nptel.ac.in/courses/117103064/

ONLINE RESOURCES:

1. https://www.adelaide.edu.au/course-outlines/108280/1/sem-2/ - University of Adelaide
2. http://jjackson.eng.ua.edu/courses/ece480/- The University of Alabama
3. http://www.ee.ic.ac.uk/pcheung/teaching/ee2_digital/index.html - Imperial College London

OUTCOMES:

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

1 Apply the basic postulates of Boolean algebra, Karnaugh map method (limited to 5 variables only) and tabulation method on minimization of Boolean expressions and implement the expressions using logic gates and recall number systems and their representation. (K3)
2. Explain the design procedure of standard combinational arithmetic circuits, multiplexers, decoders and encoders and apply it to design combinational circuits for the specifications provided. (K3)
3. Explain the Triggering of FF, structure, function of SR, JK, T, D and Master/Slave FF, SISO, SIPO, PISO and PIPO, Universal Shift Register; up/down Counters, Shift Register Counters -Ring Counters and Johnson Counter. (K2)
4. Apply the design procedures to model synchronous and asynchronous counters, serial adder and sequence detector, Moore model, Mealy model, Fundamental and Pulse mode digital circuits and hazard free circuits for the specifications provided. (K3)
5. Interpret the behavior of the synchronous Moore, Mealy models and Asynchronous Fundamental and Pulse mode sequential circuits from the analysis procedures. (K2)
6. Describe the function, characteristics and structure of different memory systems, FPGA, PAL, PLA, CPLDs, digital integrated circuits with logic families and apply the design procedure on combinational circuits design using Programmable logic devices.(K3)

CO - PO, PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	2	1	2	-	-	-	1	-	-	-	2	3	2
CO2	3	3	3	3	-	-	-	1	2	2	-	2	3	2
CO3	2	2	3	3	-	-	-	-	2	2	-	1	3	2
CO4	3	1	2	1	-	-	-	2	1	1	-	1	3	2
CO5	3	2	3	1	-	-	-	1	2	1	-	1	3	2
CO6	3	2	3	1	-	-	-	1	2	1	-	1	3	2

SEMESTER - III

20ECPC302 SDG NO. 3,4,7,15	ELECTROMAGNETIC FIELDS AND WAVEGUIDES	L	T	P	C
		3	1	0	4

OBJECTIVES:

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

UNIT I INTRODUCTION **12**

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

UNIT II ELECTROSTATICS **12**

Electric charge, Coulomb's law, Electric field due to Line, Surface, Volume charge densities, Electric flux, Electric flux density, Gauss's law and applications, Electric potential, Potential gradient-Conductors in static electric field, Dielectrics in static electric field, Electric flux density and dielectric constant, Boundary conditions, Capacitance, Parallel, cylindrical and spherical capacitors, Electrostatic energy and energy density, Poisson's and Laplace's equations, Uniqueness of electrostatic solutions, Current density and Point form of Ohm's law, Electromotive force and Kirchhoff's voltage law, Equation of continuity and Kirchhoff's current law .

UNIT III MAGNETOSTATICS **12**

Lorentz force equation, Law of no magnetic monopoles, Ampere's law, Biot-Savart law and applications, Magnetic field intensity, Magnetic flux density, Gauss's law, Magnetic vector potential, Lorentz force equation, Boundary conditions and idea of relative permeability, Magnetic circuits, Behaviour of magnetic materials, Boundary conditions, Inductance and inductors, Magnetic energy and Magnetic energy density, Magnetic forces and torques

Applications – CRT – magnetic deflection, Magnetic brake, Linear motor, Time Varying Field: Induction, Faraday's law, Lenz's law.

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

Faraday's law, Lenz's law, Displacement current and Maxwell-Ampere law, Maxwell's equations, Potential functions, Electromagnetic boundary conditions, Wave equations and solutions, Plane waves in lossless media, Plane waves in lossy media (low-loss dielectrics and good conductors), Group velocity, Electromagnetic power flow and Poynting vector.

UNIT V WAVEGUIDES 12

Introduction to Rectangular and Circular Waveguides, Solutions of field Equations in Rectangular Co-ordinates, TEmn & TMmn Modes in Rectangular Waveguides, solutions of a field equations in cylindrical coordinates, TEmn & TMmn Modes in Circular Waveguides, Impossibility of TEM waves in Rectangular wave guides, Waveguide Parameters — Cut-off wavelength, Guide wavelength, Free space Wavelength, Phase velocity, Group velocity, Dominant and Degenerated Modes, Power Transmission and Power losses in Rectangular and Circular Waveguides

TOTAL : 60 PERIODS

TEXT BOOKS

1. D.K. Cheng, "Field and Wave Electromagnetics", 2nd Edition, Pearson (India), 1989.
2. John. D. Ryder, "Network Lines and Fields", 2nd Edition, PHI Learning,2005..

REFERENCES:

1. D.J. Griffiths, "Introduction to Electrodynamics", 4th Edition, Pearson (India), 2013.
2. M.N.O. Sadiku and S.V. Kulkarni, "Principles of Electromagnetics", 6th Edition, Oxford (Asian Edition), 2015.
3. E. C. Jordan and K.G. Balmain, "Electromagnetic Waves and Radiating Systems", Prentice Hall of India, 2006.

WEB RESOURCES :

1. https://ocw.mit.edu/resources/res-6-002-electromagnetic-field-theory-a-problem-solving-approach-spring-2008/textbook-contents/

ONLINE RESOURCES :

1. https://freevideolectures.com/course/2340/electromagnetic-fields
2. https://ocw.mit.edu/resources/res-6-001-electromagnetic-fields-and-energy-spring-2008/index.htm

OUTCOMES:

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

1. Apply fundamentals of Vector analysis in 3D coordinate systems. (K1)
2. Review the basic concepts and laws in Electromagnetics to Compute the field quantities. (K2)
3. Examine the behavior of materials in Electric and Magnetic fields. (K3)
4. Derive Maxwell's equations and wave equations for static and time varying fields. (K3)
5. Discuss propagation of Electromagnetic waves in lossy and lossless mediums. (K3)
6. Analyze the characteristics of TE and TM waves in rectangular and cylindrical waveguides. (K3)

CO - PO, PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	2	-	-	-	-	1	1	-	1	1	1	1
CO2	3	2	2	-	-	-	-	1	1	-	1	1	1	1
CO3	3	2	2	-	-	-	-	1	1	-	1	1	1	1
CO4	3	2	2	-	-	-	-	1	1	-	1	1	1	1
CO5	3	2	2	-	-	-	-	1	1	-	1	1	1	1
CO6	3	2	2	-	-	-	-	1	1	-	1	1	1	1

SEMESTER - III

20ECPC303 SDG NO. 3,4,11	SIGNALS AND SYSTEMS	L	T	P	C
		3	1	0	4

OBJECTIVES:

- To understand the fundamentals and properties of signal & systems
- To know the methods of characterization of LTI systems in time domain and frequency domain
- To analyze continuous time signals and system using Fourier and Laplace transforms
- To analyze discrete time signals and system using Fourier and Z transforms
- To analyze analog and discrete time systems, connected in series and parallel

UNIT I CLASSIFICATION OF SIGNALS AND SYSTEMS 12

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

UNIT II ANALYSIS OF CONTINUOUS TIME SIGNALS 12

Fourier series representation of continuous time periodic signals - properties of continuous time Fourier series, Fourier Transform of continuous time aperiodic signals and periodic signals, properties of continuous time Fourier transform - Laplace Transforms and properties.

UNIT III LINEAR TIME INVARIANT CONTINUOUS TIME SYSTEMS 12

Impulse response - convolution integrals- Properties of continuous time LTI system - Differential Equation- Causal continuous time LTI system described by differential equations -Fourier and Laplace transforms in Analysis of CT systems - Systems connected in series / parallel.

UNIT IV ANALYSIS OF DISCRETE TIME SIGNALS 12

Baseband signal Sampling – properties of discrete time LTI system, Causal discrete time LTI system described by difference equations. Fourier series

representation of discrete time periodic signals, properties of discrete time Fourier series, Fourier Transform of discrete time signals (DTFT) – Properties of DTFT - Z Transform & Properties.

UNIT V LINEAR TIME INVARIANT-DISCRETE TIME SYSTEMS 12

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

TOTAL: 60 PERIODS

TEXT BOOKS:

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

REFERENCES:

1. B. P. Lathi, "Principles of Linear Systems and Signals", Second Edition, Oxford, 2009.
2. 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 REFERENCES:

1. https://www.tutorialspoint.com/signals_and_systems/index.htm

ONLINE RESOURCES:

1. https://ocw.mit.edu/resources/res-6-007-signals-and-systems-spring-2011/lecture-notes/
2. https://ocw.mit.edu/resources/res-6-007-signals-and-systems-spring-2011/assignments/

OUTCOMES:

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

1. Predict the different types of signals and systems to represent in time domain. (K3)
2. Interpret the Continuous time signals in frequency domain using Fourier series and its properties. (K2)
3. Examine the Continuous time signals using Fourier Transform and Laplace Transform to analyze their properties. (K3)
4. Determine the response of the Continuous LTI system in the time domain and frequency domain and realize their interconnections. (K3)

5. Interpret the Continuous time signals in terms of discrete time signals and examine the Discrete time signals using Fourier and Z transform to analyze their properties. (K2)
6. Determine the response of the Discrete LTI system in the time domain and frequency domain and realize their interconnections. (K3)

CO - PO, PSO MAPPING :

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	1	-	-	-	-	-	-	-	-	2	2	-
CO2	3	2	1	-	-	-	-	-	-	-	-	-	2	1
CO3	3	3	2	3	-	-	-	-	-	-	-	1	2	1
CO4	3	3	2	2	2	-	-	-	-	-	-	1	2	1
CO5	3	3	3	2	2	-	-	-	-	-	-	1	2	1
CO6	3	3	3	2	2	-	-	-	-	-	-	1	2	1

SEMESTER - III

20ECPW301 SDG NO. 4 & 9	R PROGRAMMING WITH LABORATORY	L	T	P	C
		3	0	2	4

OBJECTIVES:

- To Understand the environment of R programming
- To obtain knowledge in the various structural aspects of R
- To utilize the libraries in the R programming for various mathematical functions
- To use the libraries for real time analysis of data and its plotting prospects
- To study the basics of machine learning and its implementation using R

UNIT I INTRODUCTION **9**

Introduction, How to run R, R Sessions, and Functions, Basic Math, Variables, Data Types, Vectors, Conclusion, Advanced Data Structures, Data Frames, Lists, Matrices, Arrays, Classes.

UNIT II BASIC OF R PROGRAMMING 9

R Programming Structures, Control Statements, Loops, Looping Over Nonvector Sets, If-Else, Arithmetic and Boolean Operators and values, Default Values for Argument, Return Values, Deciding Whether to explicitly call return- Returning Complex Objects, Functions are Objective, No Pointers in R, Recursion, A Quicksort Implementation-Extended Extended Example: A Binary SearchTree.

UNIT III MATHEMATICAL RELATIONS IN R 9

Doing Math and Simulation in R, Math Function, Extended Example Calculating Probability - Cumulative Sums and Products - Minima and Maxima - Calculus, Functions For Statistical Distribution, Sorting, Linear Algebra operation on Vectors and Matrices, Extended Example: Vector cross Product - Extended Example: Finding Stationary Distribution of Markov Chains, Set Operation, Input /output, Accessing the Keyboard and Monitor, Reading and writer Files.

UNIT IV VISUALISATION USING AND BASICS OF MACHINE LEARNING 9

Graphics, Creating Graphs, The Workhorse of R Base Graphics, the plot ( ) Function – Customizing Graphs, Saving Graphs to Files. Machine learning - Introduction- Classifications - Supervised learning-unsupervised learning - reinforcement learning - Algorithms - Case studies.

UNIT V STATISTICAL MODELS AND ITS IMPLEMENTATION 9

Probability Distributions, Normal Distribution - Binomial Distribution - Poisson Distributions Other Distribution, Basic Statistics, Correlation and Covariance, T-Tests, ANOVA. Linear Models, Simple Linear Regression, Multiple Regression Generalized Linear Models, Logistic Regression, Poisson Regression - other Generalized Linear Models - Survival Analysis, Nonlinear Models, Splines - Decision- Random Forests.

R PROGRAMMING LAB-LIST OF EXPERIMENTS: 15

1. Datatypes
2. Functions
3. Creating and manipulating a vector
4. Creating and manipulating matrix
5. Creating and operations on Factors
6. Data Frames-Lists-Operators-PLOT Function in R to customize graphs.

TOTAL: 60 PERIODS

TEXT BOOKS:

1. The Art of R Programming, Norman Matloff, CengageLearning.
2. Siegel, S. (1956), Nonparametric Statistics for the Behavioral Sciences, McGraw-Hill International, Auckland.

REFERENCES:

1. Lander, "R for Everyone", Pearson
2. Venables, W. N., and Ripley, B. D. (2000), "S Programming", Springer-Verlag, NewYork.
3. Weisberg, S. (1985), "Applied Linear Regression", 2nd ed., John Wiley & Sons, NewYork.
4. Zar, J. H. (1999), "Biostatistical Analysis", Prentice Hall, Englewood Cliffs,NJ

WEB REFERENCES:

1. https://www.cs.upc.edu/~robert/teaching/estadistica/rprogramming.pdf.
2. https://link.springer.com/content/pdf/10.1007%2F978-0-387-79054-1.pdf3.https://link.springer.com/content/pdf/10.1007%2F978-0-387-93837-0.pdf

ONLINE RESOURCES:

1. https://www.statmethods.net/r-tutorial/index.html
2. https://www.javatpoint.com/r-tutorial

OUTCOMES:

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

1 Explain data structures and mathematical operations in R (K2)
2 Describe the programming concepts of control and loop statements, function call and recursion in R (K2)
3 Implement in R studio mathematical relations with extended examples (K3)
4 Interpret the Statistical models and distributions using different plots (K2)
5 Describe the operation of I/O accessing and graphics in R (K2)
6 Demonstrate R codes for Machine Learning Algorithms for various applications (K3)

CO - PO - PSO MAPPING :

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	2	-	-	-	-	1	1	-	1	1	1	1
CO2	3	2	2	-	-	-	-	1	1	-	1	1	1	1
CO3	3	2	2	-	-	-	-	1	1	-	1	1	1	1
CO4	3	2	2	-	-	-	-	1	1	-	1	1	1	1
CO5	3	2	2	-	-	-	-	1	1	-	1	1	1	1
CO6	3	2	2	-	-	-	-	1	1	-	1	1	1	1

SEMESTER - III

20BSMA301 SDG NO. 4	LINEAR ALGEBRA, PARTIAL DIFFERENTIAL EQUATIONS AND TRANSFORMS	L	T	P	C
		3	1	0	4

OBJECTIVES:

- The aim of this course is to impart knowledge in the concepts of linear algebra as a prerequisite for the recent thrust areas of technological advancement
- To know the importance of partial differential equations in modeling various engineering problems
- To introduce the techniques of Fourier transform and Z- Transforms to analyze continuous and discrete signals

UNIT I VECTOR SPACES 15

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

UNIT II LINEAR TRANSFORMATION AND INNER PRODUCT SPACES 15

Linear transformation - Null and range spaces - Dimension theorem (Statement only) - Matrix of a linear transformation - Inner product - Norm - Gram Schmidt orthogonalization process.

UNIT III PARTIAL DIFFERENTIAL EQUATIONS 12

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

UNIT IV FOURIER TRANSFORMS 9

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

UNIT V Z - TRANSFORMS AND DIFFERENCE EQUATIONS 9

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

TOTAL: 60 PERIODS

TEXTBOOKS:

1. Friedberg A.H., Insel A.J. and Spence L., "Linear Algebra", Prentice Hall of India, New Delhi, 2004. Unit I (Sec. 1.2, 1.3, 1.4 (linear combinations only), 1.5 & 1.6), Unit II (Sec. 2.1, 2.2, 6.1 & 6.2) (In Units I & II to include theorem statements only).
2. Veerarajan T., "Transforms and Partial Differential Equations", Tata McGraw Hill Education Pvt. Ltd., 3rd Edition, New Delhi. Unit III (Sec. 1.2, 1.5, 1.7, 1.11, 1.13, 1.14), Unit IV (Sec. 4.1, 4.2, 4.3, 4.6), Unit V(Sec. 5.1, 5.2, 5.3, 5.4, 5.5).

REFERENCES:

1. Strang G., "Linear Algebra and its applications", Thomson (Brooks/Cole), New Delhi, 2005.
2. Lay D. C., "Linear Algebra and its Applications", 5th Edition, Pearson Education, 2015.
3. Kumaresan S., "Linear Algebra – A Geometric Approach", Prentice – Hall of India, New Delhi, Reprint, 2010.
4. James G., "Advanced Modern Engineering Mathematics", Pearson Education, 2007.
5. O'Neil, P.V., "Advanced Engineering Mathematics", Cengage Learning, 2011.

WEB RESOURCES

1. https://ocw.mit.edu/resources/res-6-007-signals-and-systems-spring-2011/lecture-notes/
2. https://nptel.ac.in/courses/111/106/111106135/
3. https://nptel.ac.in/courses/111/103/111103021/

ONLINE RESOURCES:

1. https://www.khanacademy.org/math/linear-algebra
2. https://ocw.mit.edu/courses/mathematics/18-06-linear-algebra-spring-2010/video-lectures/
3. https://freevideolectures.com/course/3244/advanced-engineering-mathematics

OUTCOMES:

Upon completion of the course, the students should be able to

1. Identify a vector space, subspace and construct the basis and dimension of a vector space. (K3)
2. Compute the rank and nullity of a linear transformation and construct an orthonormal basis using the Gram Schmidt orthogonalization process. (K3)
3. Solve first order linear partial differential equations and higher order homogeneous and non - homogeneous partial differential equations. (K3)
4. Find Fourier transforms and Fourier sine and cosine transforms of simple functions. (K3)
5. Solve difference equations using Z-transforms. (K3)

CO - PO MAPPING:

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

SEMESTER - III

20ECPL301 SDG NO. 3,4,9	DIGITAL CIRCUITS LABORATORY	L	T	P	C
		0	0	3	1.5

OBJECTIVES:

- Get practical experience in design, realisation and verification of Demorgan's Theorem
- Design Full/Parallel Adders and Subtractors

- Design and learn Multiplexer using logic gates, Demultiplexer and Decoder
- Verify the function of Flip-Flops
- Design Shift registers and Counters using Flip flops

LIST OF ANALOG EXPERIMENTS:

1. To realize Basic gates (AND, OR, NOT) From Universal Gates (NAND & NOR).
2. To verify
   (a) Demorgan's Theorem for 2 variables
   (b) The sum-of product and product-of-sum expressions using universal gates
3. To design and implement 4-bit Parallel Adder/ subtractor using IC 7483
4. To realize (a) 4:1 Multiplexer using gates
   (b) 3-variable function using IC 74151 (8:1 MUX)
5. To realize (a) 1:8 Demultiplexer and
   (b) 3:8 Decoder using IC74138
6. To design 4 bit comparator circuit using logic gates
7. To realize the following flip-flops using NAND Gates:
   (a) Clocked SR Flip-Flop
   (b) JK Flip-Flop
8. To realize the following shift registers using Ic7474:
   (a) SISO (b) SIPO
   (c) PISO (d) PIPO
9. To realize the Ring Counter and Johnson Counter using Ic7476
10. To realize the Mod-N Counter using Ic7490
11. To design 4 bit synchronous Counter using JK Flip flops - Ic7476
12. To design 4 bit Ripple counter using JK Flip flops - Ic7476

TOTAL: 45 PERIODS

LAB REQUIREMENT FOR A BATCH OF 30 STUDENTS / 2 STUDENTS PER EXPERIMENT:

S.No.	EQUIPMENTS
1.	IC7404, IC7408, IC 7432, IC7486, IC 7400 & IC 7402
2.	IC 7483- 4 bit Parallel Adder/ Subtractor
3.	IC 7476- JK Flip flops
4.	IC 7474- D Flip flops
5.	Digital Trainer Kit- 15 Nos

VIRTUAL LAB:

1. http://vlabs.iitkgp.ernet.in/dec/
2. http://cse15-iiith.vlabs.ac.in/Introduction.html

OUTCOMES:

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

1. Justify NAND and NOR as Universal gates and verify SOP and POS expressions using them.(K4)
2. Verify De Morgan's Theorem for 2 variables using logic gates.(K3)
3. Design, Build and test combinational circuits such asadders, subtractors, comparators, multiplexers demultiplexers.and decoders (K4)
4. Construct flips-flops using NAND gates and verify their functionality. (K4)
5. Realize synchronous and asynchronous counters and its applications using flip-flop IC's (K4)
6. Construct the types of shift registers using flip-flop IC's and verify their functionality. (K4)

CO - PO, PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	2	3	-	-	-	1	2	-	-	-	3	3
CO2	3	3	2	3	-	-	-	1	2	-	-	-	3	3
CO3	3	3	2	2	-	-	-	1	2	-	-	-	3	3
CO4	3	3	2	3	-	-	-	1	2	-	-	-	3	3
CO5	3	3	2	3	-	-	-	1	2	-	-	-	3	3
CO6	3	3	2	3	-	-	-	1	2	-	-	-	3	3

SEMESTER - III

20ECTE301 SDG NO. 4,11,15	LIVE-IN-LAB - I	L	T	P	C
		0	0	2	1

OBJECTIVES:

- To provide opportunities for the students, expose to Industrial environment and real time work
- To enable hands-on experience in the electronics hardware/Software domain
- To enable development of skill set for designing and realizing prototype electronic systems/simulation model

COURSE METHODOLOGY

- This initiative is designed to inculcate ethical principles of research and to get involve in life-long learning process for the students.
- The project work must involve engineering design with realistic constraints. It must also include appropriate elements of the following: Engineering standards, design analysis, modeling, simulation, experimentation, prototyping, fabrication, correlation of data, and software development.
- Project can be individual work or a group project, with maximum of 3 students. In case of group project, the individual project report of each student should specify the individual's contribution to the group project.
- On completion of the project, the student shall submit a detailed project report. The project should be reviewed and the report shall be evaluated and the students shall appear for a viva-voce oral examination on the project approved by the Coordinator and the project guide.

EVALUATION

- First evaluation (Immediately after first internal examination) : 20 marks
- Second evaluation (Immediately after second internal examination): 30marks
- Final evaluation Last week of the semester) : 50marks

Note: All the three evaluations are mandatory for course completion and for awarding the final grade

TOTAL: 30 PERIODS

OUTCOMES:

Upon completion of the course, the students should be able to

1 Perform literature survey to identify the gap and an application oriented research problem in the specific domain (K2)
2 Design and validate the proposed system using simulation (K3)
3 Implement the proposed system (K3)
4 Examine the obtained results and prepare a technical report (K4)
5 Publish the work in journals and apply for the patents.(K3)
6 Prepare for industrial environment and real time work (K3)

CO- PO & PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	2	2	2	2	2	2	3	2	2	3	3	3
CO2	3	3	3	2	3	3	2	2	3	3	3	3	3	3
CO3	2	2	2	1	2	1	1	1	3	2	3	3	3	2
CO4	2	2	2	1	2	1	1	1	3	2	3	3	3	2
CO5	2	2	2	1	2	1	1	1	3	2	3	3	3	2
CO6	2	2	2	2	3	2	2	2	2	2	3	3	3	3

SEMESTER - III

20ECTP301 SDG NO. 4	SKILL ENHANCEMENT	L	T	P	C
		0	0	2	1

APTITUDE & COGNITIVE SKILLS – PHASE 1

OBJECTIVE:

- To educate and enrich the students on quantitative ability, reasoning ability, and verbal ability.
- Improve their quantitative ability.
- Improve the ability of arithmetic reasoning
- Enhance their verbal ability through vocabulary building and grammar
- Equip with creative thinking and problem solving skills

UNIT I QUANTITATIVE ABILITY – I **10**

Problems on Trains - Time and Distance - Height and Distance - Time and Work

UNIT II QUANTITATIVE ABILITY – II **10**

Problems on Ages - Alligation or Mixture - Chain Rule - Simple Interest - Simple Equation - Theory Of Equation.

UNIT III REASONING ABILITY – I **8**

Analytical Reasoning - Pipes and Cistern - Logical Problems - Logical Games - Logical Deduction - Data Sufficiency - Arithmetic Reasoning

UNIT IV VERBAL ABILITY – I **10**

Idioms & Phrases - Synonyms - Antonyms - Classification

UNIT V CREATIVITY ABILITY – I **7**

Venn Diagrams -Cube and Cuboids - Dice - Cubes and Dice - Figure Matrix.

TOTAL : 45 PERIODS

REFERENCES:

1. Quantitative Aptitude for Competitive Exams by R. S. Agarwal
2. Quantum CAT by Sarvesh Verma
3. A Modern Approach to Logical Reasoning by R. S. Agarwal
4. Verbal Ability and Reading Comprehension by Arun sharma

PROBLEM SOLVING USING C PROGRAMMING AND EMBEDDED C PROGRAMMING – PHASE 2

COURSE OBJECTIVE:

- To provide exposure to problem-solving through programming.
- To train the student to the basic concepts of the C-programming language.
- To provide exposure to problem-solving through programming.
- To train the student to the basic concepts of the C-programming and MATLAB programming language.
- To give the student hands-on experience with the concepts

UNIT I INTRODUCTION TO PRINCIPLES OF PROGRAMMING **6**

Introduction to Programming - Programing Domain : Artificial Intelligence-Systems Programming - Assembly Level Languages - Problem solving using Algorithms and Flowcharts.

UNIT II INTRODUCTION TO C PROGRAMMING **6**

Features of C and its Basic Structure - Simple C programs - Constants - Integer Constants - Real Constants - Character Constants - String Constants Floating-point Numbers - The type cast Operator - Interactive Programming.

Operators Expressions and Control statement - The goto statement - The if statement - The if-else statement - Nesting of if statements - The conditional expression - The break statement and continue statement.

UNIT III ARRAYS, STRINGS AND POINTERS **6**

Arrays - Multidimensional Arrays - Strings, Basics of Pointers - Pointer Arithmetic - Similarities between Pointers and One-dimensional Arrays Structures - Unions And Functions - Basics of Structures - Arrays of Structures -

Pointers to Structures - Function Basics - Function Prototypes and Passing Parameters - Structures and Functions Recursion.

UNIT IV BASICS OF EMBEDDED C **6**

Introduction to Embedded C Programming Language - Difference between C and Embedded C- Variables -Control Structure in Embedded C - Functions and constants in Embedded C - Data Types - Arithmetic operations - program structure - Operators - Bit masking - Bit Extracting- Bit monitoring.

UNIT V MICROCONTROLLER PROGRAMMING **6**

Introduction of Microprocessor- Microcontroller - 8051 Architecture - Programming 8051 microcontroller -Port Register- Basic Embedded C Program - Keil IDE Software Installation - Proteus Simulation software Installation -Steps to burn/embed a program in the microcontroller 8051 microcontroller programming using embedded C.

TOTAL : 30 PERIODS

REFERENCES:

1. Balagurusamy, "Programming in ANSI C", Tata McGraw-Hill Education, 2008.
2. Stephen G. Kochan, "Programming in C" (3rd Edition), Sams, 2004 .
3. Stephen G. Kochan, "Programming in C", III Edition, Pearson Education.
4. Pond, "Embedded C", 1e Pearson Edition.
5. MAZIDI "The 8051 Microcontroller and Embedded Systems: Using Assembly and C" Pearson.
6. Ashok K.Pathak, "Advanced Test in C and Embedded System Programming" BPB publication.
7. AVR Microcontroller and Embedded Systems: Using Assembly and C, 1e,azidi/ Naimi / Naimi.
8. Muhammed Ali Mazidi The 8051 Microcontroller and Embedded Systems, Pearson.

ONLINE RESOURCES

1. https://nptel.ac.in/courses/108/102/108102045/
2. https://www.coursera.org/courses?query=embedded%20systems

WEB RESOURCES

1. https://www.tutorialspoint.com/embedded_systems/index.htm

COURSE OUTCOMES :

Upon completion of this course, the students should be able to:

1. Analyze their quantitative ability. (K4)
2. Understand the ability of arithmetic reasoning along with creative thinking and problem solving skills. (K2)
3. Create their verbal ability through vocabulary building and grammar. (K6)
4. Evaluate the situations to analyse the computational methods in order to identify and abstract the programming task involved. (K5)
5. Analyse tasks in which the numerical techniques are applicable in order to apply them to write, edit, compile, debug, correct, recompile and run programs. (K4)
6. Understanding a step by step process to burn/embed a program in the controller. (K2)

CO- PO & PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	-	-	-	-	3	2	-	3	2	3	-	2	-	-
CO2	-	-	-	-	3	2	-	3	2	3	-	2	-	-
CO3	-	-	-	-	3	2	-	-	1	3	-	2	-	-
CO4	-	-	-	-	3	2	-	3	3	3	-	2	2	2
CO5	-	-	-	-	3	2	-	-	2	3	-	2	2	2
CO6	-	-	-	-	3	2	-	-	2	3	-	2	2	2

SEMESTER - III

20MGMC301 SDG NO. 4	CONSTITUTION OF INDIA	L	T	P	C
		2	0	0	0

OBJECTIVES:

At the end of the course, the student is expected to

- To know about Indian constitution
- To know about central government functionalities in India
- To know about state government functionalities in India
- To know about Constitution function
- To Know about Constitutional remedies

UNIT I INTRODUCTION 6

Historical Background – Constituent Assembly of India – Philosophical foundations of the Indian Constitution – Preamble – Fundamental Rights – Directive Principles of State Policy – Fundamental Duties

UNIT II STRUCTURE AND FUNCTION OF CENTRAL GOVERNMENT 6

Union Government – Structures of the Union Government and Functions – President – Vice President – Prime Minister – Cabinet – Parliament – Supreme Court of India.

UNIT III STRUCTURE AND FUNCTION OF STATE GOVERNMENT 6

State Government – Structure and Functions – Governor – Chief Minister – Cabinet – State Legislature – Judicial System in States – High Courts and other Subordinate Courts.

UNIT IV CONSTITUTION FUNCTIONS 6

Indian Federal System – Centre – State Relations – President's Rule – Constitutional Amendments – Constitutional Functionaries.

UNIT V CONSTITUTIONAL REMEDIES 6

Enforcement of fundamental rights - Power of parliament to modify the rights the conferred by this part in their application to forces.

TOTAL: 30 PERIODS

TEXT BOOKS:

1. Durga Das Basu, "Introduction to the Constitution of India ", Prentice Hall of India, New Delhi.
2. R.C. Agarwal, (1997) "Indian Political System", S. Chand and Company, New Delhi.
3. M.V. Pyle (2019) , "An Introduction to The Constitution of India, 5/e", Vikas Publishing, New Delhi.
4 P.M. Bakshi, (2018) , "Constitution of India", Universal Law Publishing, New Delhi.

REFERENCES:

1. Sharma, Brij Kishore, "Introduction to the Constitution of India", Prentice Hall of India, New Delhi.
2. U.R.Gahai, "Indian Political System", New Academic Publishing House, Jalandhar.

OUTCOMES:

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

1. Explain the Constitution and Fundamental rights of citizens (K2)
2. Discuss the structure, hierarchy and functions of Central Government (K2)
3. Explain the functions of Supreme Court and Judiciary Systems in the state (K2)
4. Discuss the structure, hierarchy and functions of State Government (K2)
5. Recall the Centre-State relationship, constitutional amendments and functionaries (K1)
6. Discuss the remedies and rights available to India Citizens (K2)

CO – PO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	-	-	-	-	-	1	1	-	-	-	-	-
CO2	-	-	-	-	-	1	1	-	-	-	-	-
CO3	-	-	-	-	-	1	1	-	-	-	-	-
CO4	-	-	-	-	-	1	1	-	-	-	-	-
CO5	-	-	-	-	-	2	1	3	-	-	-	-
CO6	-	-	-	-	-	2	1	2	3	-	-	-

SEMESTER - IV

20ECPC401 SDG NO. 4	COMMUNICATION THEORY	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To introduce the concepts of various amplitude modulations and their spectral characteristics
- To study the concepts of various angle modulation and their spectral characteristics
- To understand the properties of random process
- To know the effect of noise on communication systems
- To study the fundamentals of sampling, quantization and pulse modulation techniques

UNIT I AMPLITUDE MODULATION 9

Elements of Communication systems – Communication Channels – Need for Modulation - Amplitude Modulation- DSBSC, DSBFC, SSB, ISB, VSB - Modulation index, Spectra, Power relations and Bandwidth of AM – AM Generation – Square law and Switching modulator, DSBSC Generation – Balanced and Ring Modulator, SSB Generation – Filter, Phase Shift and Third Methods, VSB Generation – Filter Method, Hilbert Transform, Pre-envelope & complex envelope – comparison of different AM techniques, AM Demodulators: Envelope Detector, Coherent Detection of DSB – SC, SSB – SC – Costas Receiver – Frequency Translation - Superheterodyne Receiver.

UNIT II ANGLE MODULATION 9

Phase and frequency modulation, Narrow Band and Wide band FM – Modulation index, Spectra, Power relations and Transmission Bandwidth of FM – PM to FM Conversion – and FM to PM Conversion – FM Generation: Direct and Indirect methods, FM Demodulation – FM to AM conversion, FM Discriminator – Balanced Slope Detector, Foster Seeley Discriminator, Ratio Detector, PLL Demodulator, Quadrature FM Demodulator – FM Receivers.

UNIT III RANDOM PROCESS 9

Random variables, Random Process, Stationary Processes, Mean, Correlation & Covariance functions, Power Spectral Density, Ergodic Processes, Gaussian Process, Transmission of a Random Process Through a LTI filter.

UNIT IV NOISE CHARACTERIZATION 9

Noise sources – Noise figure, noise temperature and noise bandwidth – Noise in cascaded systems. Representation of Narrow band noise –In-phase and quadrature components, Envelope and Phase Components – Noise performance analysis in AM & FM systems – Threshold effect, Pre-emphasis and deemphasis for FM.

UNIT V SAMPLING & QUANTIZATION 9

Low pass sampling – Aliasing- Signal Reconstruction-Quantization - Uniform & non-uniform quantization - quantization noise - Logarithmic Companding –PAM, PPM, PWM, PCM – TDM, FDM.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. J.G.Proakis, M.Salehi, "Fundamentals of Communication Systems", Pearson Education, 2014.
2. Simon Haykin, "Communication Systems", Fourth Edition, Wiley, 2014

REFERENCES:

1. B.P.Lathi, "Modern Digital and Analog Communication Systems", Third Edition, Oxford University Press, 2007.
2. D.Roody, J.Coolen, "Electronic Communications", Fourth Edition, PHI, 2006.
3. A.Papoulis, "Probability, Random variables and Stochastic Processes", McGraw Hill, Third Edition, 1991.
4. B.Sklar, "Digital Communications Fundamentals and Applications", Second Edition, Pearson Education, 2007.
5. H P Hsu, "Schaum Outline Series – Analog and Digital Communications", TMH, 2006.
6. Couch.L., "Modern Communication Systems", Pearson, 2001.

WEB REFERENCES :

1. https://swayam.gov.in/nd1_noc20_ee16/preview
2. https://nptel.ac.in/courses/117102059/

ONLINE RESOURCES:

1. https://freevideolectures.com/course/2590/introduction-to-communication-theory

OUTCOMES:

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

1 Discuss the elements of the communication system, various amplitude modulation schemes and its generation methods. (K2)

2 Characterize frequency, phase modulation schemes and explain its generation methods. (K2)

3 Explain AM and FM demodulators and distinguish various analog modulation techniques.(K2)

4 Describe the various types of noise in communication systems and illustrate the properties of random processes to generate a mathematical model.(K2)

5 Explain the representation of narrowband noise, AM and FM receivers and its noise performance. (K2)

6 Elucidate the fundamentals of sampling, Quantization and various Pulse modulation techniques. (K2)

CO - PO, PSO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	1	-	1	-	-	3	-	-	-	-	-	1
CO2	3	3	3	-	3	-	-	3	-	-	-	-	-	1
CO3	3	3	3	-	3	-	-	3	-	-	1	1	-	1
CO4	3	-	1	-	1	-	-	1	-	-	-	-	-	1
CO5	3	3	3	-	1	-	-	3	-	-	1	1	-	1
CO6	3	3	3	-	3	-	-	3	-	-	3	3	-	1

SEMESTER - IV

20ECPW401 SDG NO. 4	ELECTRONIC CIRCUITS WITH LABORATORY	L	T	P	C
		3	0	2	4

OBJECTIVES:

- To understand the methods of biasing BJT and FET
- To design and analyze single stage and multistage amplifier circuits
- To impart knowledge about feedback amplifiers and oscillators
- To inculcate knowledge about tuned amplifier
- Explore the characteristics of Power amplifier

UNIT I BIASING **9**

Need for biasing - DC load line analysis of biasing circuits - Operating point-Design of biasing circuits: Fixed bias configuration, Emitter bias configuration, Voltage divider bias configuration- Bias stabilization - Stability factors.

UNIT II SINGLE AND MULTI STAGE AMPLIFIERS **9**

AC load line - BJT small signal model- Analysis of CE, CB, CC amplifier-Gain and frequency response-FET small signal model-Analysis of CS and Source follower-Gain and frequency response-High frequency analysis-Need of multistage amplifier-Cascade, Cascode and Differential amplifier.

UNIT III FEEDBACK AMPLIFIERS AND OSCILLATORS **9**

Basic principles and types of feedback-Gain of an amplifier employing feedback-Effect of feedback (negative) on gain, stability, distortion and bandwidth of an amplifier. Voltage series, voltage shunt, Current series and current shunt Feedback configurations. Use of positive feedback-Barkhausen criterion for oscillations-Different oscillator circuits-tuned collector-Hartley, Colpitts, Phase shift, Wien Bridge and Crystal oscillator.

UNIT IV TUNED AMPLIFIERS AND MULTIVIBRATORS **9**

Small signal tuned amplifiers – Analysis of capacitor coupled single tuned amplifier – double tuned amplifier - effect of cascading single tuned and double tuned amplifiers on bandwidth – Stagger tuned amplifiers - Stability of tuned amplifiers – Neutralization - Hazeltine neutralization method.

Analysis and Design of Bistable, Monostable, Astable, Multivibrators and Schmitt Trigger using Transistors.

UNIT V LARGE SIGNAL AMPLIFIERS **9**

Difference between voltage and Power amplifier- Importance of impedance matching in amplifiers- Class A, Class B, Class AB and Class C amplifiers-Single ended power amplifiers-Push pull amplifier and Complementary symmetry push-pull amplifier.

LIST OF EXPERIMENTS : **15**

1. Frequency Response of CE, CB, CC and CS amplifiers.
2. Cascode and Cascade amplifiers.
3. Analysis of frequency response FET, MOSFET with fixed bias, self-bias and voltage divider bias using simulation software using spice.
4. Analysis of Cascode and Cascade amplifiers using Spice.

5. Analysis of Frequency Response of BJT and FET using Spice.
6. Series and Shunt feedback amplifiers-Frequency response, Input and output impedance.

TOTAL: 60 PERIODS

TEXT BOOKS

1. Robert L. Boylestad and Louis Nashelsky ,"Electron Devices and Circuits: Theory and Practice", Prentice Hall of India, 10th Edition, 2009.
2. David A. Bell, "Electronic Devices and Circuits", Prentice Hall of India, 5th Edition, 2008.
3. Adel S.Sedra and Kenneth Smith ,"Microelectronic Circuits", Oxford University Press, Sixth edition,2009.

REFERENCES:

1. Millman and Halkias.C, "Integrated Electronics", Tata McGraw Hill, 2nd Edition, 2010.
2. Millman. J and Taub H, "Pulse Digital and Switching Waveforms'', Tata McGraw Hill, 3rd Edition, 2011.
3. S.Salivahanan, N.Suresh Kumar, A.Vallavaraj, Electronic Devices and Circuits, Tata McGraw Hill ltd., 2nd Edition, 2009.
4. Thomas.L.Floyd, "Electronic Devices: Conventional Current version", Pearson, 9th Edition, 2015.
5. B. Visvesvara Rao, K.Raja Rajeswari, P.Chalam Raju Pantulu and K.Bhaskara Rama, "Electronic Circuit Analysis", Pearson,1st Edition, 2012.

WEB REFERENCES:

1. https://nptel.ac.in/courses/108107142/
2. https://www.digimat.in/nptel/courses/video/108102095/L41.html
3. https://nptel.ac.in/courses/108102095/

ONLINE RESOURCES:

1. https://www.coursera.org/learn/transistor-field-effect-transistor-bipolar-junction-transistor
2. https://www.tutorialspoint.com/amplifiers/tuned_amplifiers.htm
3. https://www.udemy.com/course/introduction-to-semiconductor-diodes-and-transistors/
4. https://www.electronics-tutorials.ws/amplifier/amp_1.html

OUTCOMES:

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

1. Explain the biasing characteristics, different biasing techniques of BJT and FET. (K2)

2 Apply the small signal model to construct a multi stage amplifier using BJT and FET and demonstrate the Output response. (K3)
3 Design and analyze feedback amplifiers and Oscillators. (K2)
4 Illustrate the performance of tuned amplifiers and examine the output response. (K2)
5 Illustrate the principle of different Multivibrators and sketch the output characteristics. (K2)
6 Classify the different power amplifiers and explain the techniques to enhance the efficiency. (K2)

CO - PO, PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	1	-	-	-	-	-	-	-	-	-	-	1	-
CO2	3	2	-	2	-	-	-	-	-	-	-	-	2	1
CO3	3	2	-	2	-	-	-	-	-	-	-	-	2	1
CO4	3	-	-	2	2	-	-	-	-	-	-	-	2	1
CO5	3	2	2	2	2	-	-	-	-	-	-	-	2	1
CO6	3	2	2	2	2	-	-	-	-	-	-	1	2	1

SEMESTER - IV

20ECPW402 SDG NO. 4	LINEAR INTEGRATED CIRCUITS WITH LABORATORY	L	T	P	C
		3	0	2	4

OBJECTIVES:

- To learn the basic building blocks and characteristics of Operational Amplifiers
- To learn and design applications using Operational Amplifiers
- To introduce the theory and applications of analog multipliers, PLL and Timer ICs
- To learn the theory of ADC and DAC
- To Design waveform generators using operational amplifiers, voltage regulators and filters

UNIT I BASICS OF OPERATIONAL AMPLIFIERS 9

Basic information about op-amps – Ideal Operational Amplifier - General operational amplifier stages -and internal circuit diagrams of IC 741, DC and AC performance characteristics, slew rate, Open and closed loop configurations. Operational Amplifiers – LF155 and TL082.

UNIT II APPLICATIONS OF OPERATIONAL AMPLIFIERS 9

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

UNIT III ANALOG MULTIPLIER, PLL AND TIMER ICS 9

Analog multiplier ICs and their applications, Operation of the basic PLL, Closed loop analysis, Voltage controlled oscillator, Monolithic PLL IC 565, application of PLL for AM detection, FM detection, FSK modulation and demodulation and Frequency synthesizing and clock synchronisation. Timer IC 555 and Multivibrators using 555 IC.

UNIT IV ANALOG TO DIGITAL AND DIGITAL TO ANALOG CONVERTERS 9

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

UNIT V FILTERS WAVEFORM GENERATORS AND VOLTAGE REGULATORS 9

Sine-wave generators, Multivibrators, Triangular wave generator and Saw-tooth wave generator, ICL8038 function generator, IC Voltage regulators: Three terminal fixed and adjustable voltage regulators - IC 723 general purpose regulator - Monolithic switching regulator, Low Drop – Out(LDO) Regulators - Low-pass, high-pass and band-pass Butterworth filters, Switched capacitor filter IC MF10.

LIST OF EXPERIMENTS 15

Design and test the following circuits

1. Instrumentation amplifier and Schmitt Trigger using op-amp.
2. Active low-pass, High-pass and band-pass filters.
3. Phase shift and Wien bridge oscillators using Op-amp.

4. Astable and Monostable multivibrators using NE555 Timer.
5. DC power supply using LM317 and Lm723.
6. Simulate using PSPICE Full wave precision rectifier using Op-amp, Astable and Monostable using 741 Timer and A/D converter.
7. Design and simulate using PSPICE Voltage Controlled Oscillator, Analog Multiplier, and PLL as frequency multiplier.

TOTAL: 60 PERIODS

TEXT BOOKS:

1. D.RoyChoudhry, Shail Jain, "Linear Integrated Circuits", New Age International Pvt. Ltd., 2018, Fifth Edition. (Unit I – V).
2. Sergio Franco, "Design with Operational Amplifiers and Analog Integrated Circuits", 4th Edition, Tata McGraw Hill, 2016 (Unit I –V).

REFERENCES:

1. Ramakant A.Gayakwad, "OPAMP and Linear ICs", 4thEdition, Prentice Hall / Pearson Education, 2015.
2. S.Salivahanan, V.S.KanchanaBhaskaran, ""Linear Integrated Circuits", TMH, 2nd Edition, 4th Reprint, 2016.
3. Robert F.Coughlin, Frederick F.Driscoll, "Operational Amplifiers and Linear Integrated Circuits", 6th Edition, PHI, 2001.
4. B.S.Sonde, "System Design using Integrated Circuits", 2ndEdition, New Age Pub, 2001.
5. Gray and Meyer, "Analysis and Design of Analog Integrated Circuits", Wiley International, 5th Edition, 2009.
6. William D.Stanley, "Operational Amplifiers with Linear Integrated Circuits", Pearson Education,4th Edition, 2001.

WEB REFERENCES:

1. https://swayam.gov.in/nd1_noc20_ee13/preview
2. https://nptel.ac.in/courses/108108111/
3. http://web.iitd.ac.in/~shouri/eel782/lectures.php

ONLINE RESOURCES:

1. https://freevideolectures.com/course/2915/linear-integrated-circuits
2. https://e-box.co.in/linear-integrated-circuits.shtml

OUTCOMES:

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

1. Explain the configurations and performance characteristics of IC741, IC LF155 and TL082. (K2)
2. Describe the linear and nonlinear applications using Op-Amps. (K2)
3. Explain the operation and applications of Analog multiplier IC AD633JN, IC 565 PLL and 555 Timer ICs. (K2)
4. Describe the direct and indirect types of D/A and A/D data convertors using operational amplifiers. (K2)
5. Design Butterworth filters, Sine, Square, Triangular and sawtooth waveform generators and IC723 voltage regulators and explain the principle of operation of ICL803, IC MF10. (K3)
6. Design and demonstrate the performance of linear and non-linear applications of operational amplifiers using IC 741, IC555 and simulate the same in PSPICE.(K3)

CO - PO, PSO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	1	2	2	-	2	-	-	-	-	2	2	3	2
CO2	3	1	3	2	-	2	-	-	-	-	2	2	3	2
CO3	3	1	3	2	-	2	-	-	-	-	2	2	3	2
CO4	3	1	3	2	-	2	-	-	-	-	2	2	3	2
CO5	3	1	3	2	3	2	-	-	2	3	2	2	3	2
CO6	3	1	3	2	3	2	-	-	2	3	2	2	3	2

SEMESTER - IV

20ECPC402 SDG NO. 4, 11	MICROCONTROLLERS AND EMBEDDED SYSTEMS	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To understand the Architecture of 8086 microprocessor.
- To learn the design aspects of I/O and Memory Interfacing circuits.
- To interface microprocessors with supporting chips.
- To study the Architecture of 8051microcontroller and ARM processor.
- To design a microcontroller based system.

UNIT I MICROPROCESSOR 9

Introduction to 8086 – Microprocessor architecture – Addressing modes - Instruction set and assembler directives – Assembly language programming – Modular Programming - Linking and Relocation - Stacks - Procedures – Macros – Interrupts and interrupt service routines – Byte and String Manipulation.

UNIT II MICROCONTROLLER 9

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

UNIT III I/O INTERFACING 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 – Programming and applications Case studies: Traffic Light control, LED display , LCD display, Keyboard display interface and Alarm Controller.

UNIT IV INTRODUCTION TO EMBEDDED SYSTEM DESIGN AND REAL TIME SYSTEMS 9

Embedded system design process –Design example: Model train controller- Design methodologies- Design flows - Requirement Analysis – Specifications- System analysis and architecture design – Structure of a Real Time System –- Estimating program run times – Task assignment and scheduling.

UNIT V ARM PROCESSOR AND PERIPHERALS 9

ARM Architecture Versions – ARM Architecture – Instruction Set – Stacks and Subroutines – Features of the LPC 214X Family – Peripherals – The Timer Unit – Pulse Width Modulation Unit – UART – Block Diagram of ARM9 and ARM Cortex M3MCU.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. Yu-Cheng Liu, Glenn A.Gibson, "Microcomputer Systems: The 8086 / 8088 Family - Architecture, Programming and Design", 2nd Edition, Prentice Hall of India, 2007. (UNIT I & III).
2. Mohamed Ali Mazidi, Janice GillispieMazidi, RolinMcKinlay, "The 8051 Microcontroller and Embedded Systems: Using Assembly and C", 2nd Edition, Pearson education, 2011. (UNIT II).
3. Marilyn Wolf, "Computers as Components - Principles of Embedded Computing System Design", 3rd Edition, Morgan Kaufmann Publisher (An imprint from Elsevier), 2012. (UNIT IV, V).

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

REFERENCES:

1. DoughlasV.Hall, "Microprocessors and Interfacing, Programming andHardware",TMH, 2012.
2. A.K.Ray,K.M.Bhurchandi, "Advanced Microprocessors and Peripherals", 3rd Edition, Tata McGraw Hill, 2012.
3. Lyla B.Das, "Embedded Systems: An Integrated Approach", Pearson Education, 2013.
4. C.M.Krishna, Kang G.Shin, "Real-Time Systems", International Editions, McGraw Hill, 2017.

WEB REFERENCES:

1. https://swayam.gov.in/nd1_noc20_ee42/preview
2. https://nptel.ac.in/courses/108105102/

ONLINE RESOURCES:

1. https://freevideolectures.com/course/3018/microprocessors-and-microcontrollers
2. http://www.satishkashyap.com/2012/02/video-lectures-on-microprocessors-and.html

OUTCOMES:

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

1. Explain the architecture of 8086,instruction set, concepts of modular programming,interrupt service routine and write basic Assembly Language Programs in 8086. (K2)
2. Explain the internal organization of 8051,Port structures instruction set and write Assembly Language Programs in 8051.(K2)
3. Describe the architecture of peripheral ICs(8255, 8253, 8251, 8259, 8257, 8279 ,8080, DAC and ADC0080). (K2)
4. Apply the interfacing concepts to develop programs for interfacing LED LCD, ADC/DAC, keyboard,traffic light controller and alarm controller with 8086 and 8051. (K3)
5. Describe the design process and scheduling concepts of real time embedded systems.(K2)
6. Illustrate the features, peripheral units and instruction set of ARM9, LPC214X, ARM Cortex M3MCU processors.(K2)

CO - PO, PSO MAPPING :

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	1	3	2	1	3	3	2	-	-	-	2	2	3
CO2	3	1	3	1	2	3	2	1	-	-	-	2	2	3
CO3	2	1	3	2	1	2	3	2	-	-	-	2	2	2
CO4	2	1	2	3	2	2	3	2	2	-	-	2	2	3
CO5	3	1	3	1	2	3	3	2	-	-	-	3	2	3
CO6	3	1	2	2	1	3	3	2	-	-	-	2	2	2

SEMESTER - IV

20BSMA401 SDG NO. 4	PROBABILITY THEORY AND STOCHASTIC PROCESSES	L	T	P	C
		3	1	0	4

OBJECTIVES:

- To provide the mathematical background of random variables, standard distributions and random processes for application to signal processing and Communication theory

UNIT I RANDOM VARIABLES AND STANDARD DISTRIBUTIONS 12

Discrete and continuous random variables – Moments – Moment generating functions – Binomial, Poisson, Geometric, Uniform, Exponential and Normal Distributions - Functions of Random variables.

UNIT II TWO - DIMENSIONAL RANDOM VARIABLES 12

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

UNIT III INTRODUCTION TO STOCHASTIC PROCESS 12

Classification – Auto correlation functions – Cross correlation functions - Stationary process –Ergodic process-Power Spectral Density.

UNIT IV MODELS OF RANDOM PROCESSES 12

The Bernoulli process - The Gaussian process - Poisson process - Markov process - Markov chain.

UNIT V LINEAR SYSTEMS WITH RANDOM INPUTS 12

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

TOTAL: 60 PERIODS

TEXTBOOKS:

1. Ibe O.C., "Fundamentals of Applied Probability and Random Processes", Elsevier, 1st Indian Reprint, 2007. Unit-I Chapter-2, Chapter-3 (Sections 3.1-3.5), Chapter-4 (Sections 4.1-4.8,4.10 & 4.11), Chapter 6 (Section 6.2) Unit-II Chapter 5 (Sections 5.1-5.7), Chapter 6 (6.8 & 6.10) Unit-III Chapter-8 (8.1-8.6), Chapter -10 (10.5, 10.5.4) Unit-IV Chapter 10 (Section 10.2,10.4, 10.5.5, 10.5.6, 10.6, 10.7) Unit-V Chapter 9 (Sections 9.1-9.3)

REFERENCES:

1. Peebles P.Z., "Probability, Random Variables and Random Signal Principles", Tata Mc Graw Hill, 4th Edition, New Delhi, 2002.
2. VeerarajanT.,"Probability and Statistics, Random Processes and Queueing theory", TataMc-Graw Hill Education Pvt. Ltd., New Delhi.
3. Athanasios Papoulis and S. Unnikrishna Pillai, "Probability, Random Variables and Stochastic Processes"PHI, 4th Edition, 2002.
3. Davenport, Probability and Random Processes for Scientist and Engineers, McGraw-Hill.
4. H. Stark &J.W. Woods: Probability, Random Processes and Estimations Theory for Engineers, (2/e), Prentice Hall.
5. E.Wong: Introduction to Random Processes, Springer Verlag.
6. W.A.Gardner: Introduction to Random Processes, (2/e), McGraw Hill

WEB REFERENCES:

1. https://swayam.gov.in/nd1_noc19_ma30/preview
2. https://nptel.ac.in/courses/111102111/
3. https://nptel.ac.in/courses/111/104/111104032/
4. http://www.ifp.illinois.edu/~hajek/Papers/probabilityJan13.pdf
5. https://www.ee.iitb.ac.in/~bsraj/courses/ee325/

ONLINE RESOURCES:

1. https://freevideolectures.com/course/2324/probability-and-random-processes.
2. http://www.nptelvideos.com/course.php?id=572.

OUTCOMES:

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

1. Apply the concepts of probability in one-dimensional discrete, continuous functions of random variables and standard distributions and also calculate the statistical constants. (K3)
2. Compute probabilities and statistical parameters of two-dimensional random variables, use transformation of random variables to find probability density functions and compute probabilities using Central Limit theorem. (K3)
3. Calculate the autocorrelation, cross correlation and power spectral densities with classification of random processes including ergodic process. (K3)
4. Apply the properties of Markov, Poisson, Gaussian and Bernoulli processes in real-time scenario based problems. (K3)
5. Determine the spectral properties of output when the input function is given to a linear system. (K3)

CO - PO MAPPING:

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

SEMESTER - IV

20BSCY201 SDG NO. 4,17	ENVIRONMENTAL SCIENCE AND ENGINEERING	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To study the nature and facts about environment
- To find and implement scientific, technological, economic and political solutions to environmental problems

- To study the interrelationship between living organism and environment
- To provide the importance of environment by assessing its impact on the human world; envision the surrounding environment, its functions and its value
- To study the integrated themes and biodiversity, natural resources, pollution control and waste management.

UNIT I ENVIRONMENT, ECOSYSTEMS AND BIODIVERSITY 9

Definition, scope and importance of environment – need for public awareness – Ecosystem: concept of an ecosystem – structure and functions of an ecosystem – Biotic and abiotic components – Biogeochemical cycle (C, N & P) – energy flow in the ecosystem – food chains, food webs and ecological pyramids – ecological succession - keystone species. Introduction to biodiversity definition: genetic, species and ecosystem diversity – values of biodiversity – IUCN Red list species classification - endemic, endangered, rare, vulnerable, extinct and exotic species – Biodiversity at global, national and local levels – India as a mega-diversity nation – hot-spots of biodiversity – threats to biodiversity – man-wildlife conflicts. Conservation of biodiversity: In-situ and ex-situ conservation of biodiversity. Field study of Terrestrial (Forest, Grassland, Desert) and Aquatic ecosystem (Pond, Lake, River, Estuary and Marine)

UNIT II ENVIRONMENTAL POLLUTION 9

Definition – causes, effects and control measures of: Air pollution, Water pollution, Soil pollution Marine pollution, Noise pollution, Thermal pollution and Nuclear pollution – solid waste management: causes, effects and control measures of municipal solid wastes (MSW) – role of an individual in prevention of pollution – Case studies related to environmental pollution.

Disaster management: floods, earthquake, cyclone and landslides – nuclear holocaust – Case studies.

UNIT III NATURAL RESOURCES 9

Forest resources: Use and over – exploitation, deforestation – Land resources: land degradation, man induced landslides, soil erosion and desertification – Water resources: Use and over- utilization of surface and groundwater – dams-benefits and problems, conflicts over water – Mineral resources: Environmental effects of extracting and using mineral resources – Food resources: World food problems, changes caused by agriculture and overgrazing, effects of modern agriculture – fertilizer – pesticide problems, water logging and salinity. Energy resources: Renewable energy (Solar energy, Wind energy, Tidal energy, Geothermal energy, OTE, Biomass energy) and non renewable energy (Coal, Petroleum, Nuclear energy) sources. – role of an

individual in conservation of natural resources. Case studies – timber extraction, mining, dams and their effects on forests and tribal people.

UNIT IV SOCIAL ISSUES AND THE ENVIRONMENT 10

Atmospheric Chemistry - Composition and structure of atmosphere. Climate change - greenhouse effect- role of greenhouse gases on global warming. Chemical and photochemical reactions in the atmosphere - Formation of smog, PAN, acid rain (causes, effect and control measures). Oxygen and ozone chemistry - Ozone layer depletion (causes, effect and control measures). environmental ethics: Issues and possible solutions – Green chemistry - 12 principles of green chemistry.

Urbanisation - Urban problems related to energy - Water conservation: rain water harvesting, watershed management – resettlement and rehabilitation of people; its problems and concerns - case studies. Environment Legislations and Laws : Environment (protection) act – 1986. Air (Prevention and Control of Pollution) act – Water (Prevention and control of Pollution) act – Wildlife protection act – Forest conservation act. Biomedical Waste(Management and Handling rules):1998 and amendments- scheme of labelling of environmentally friendly products (Ecomark) - Issues involved in enforcement of environmental legislation - central and state pollution control boards, role of non-governmental organization – Public awareness - Environmental Impact Assessment (EIA).

UNIT V HUMAN POPULATION AND THE ENVIRONMENT 8

Population growth, variation among nations – population explosion – family welfare programme – women and child welfare environment and human health – HIV / AIDS – Role of Information Technology in environment and Human health – Case studies – human rights – value education – Sustainable Development – Need for sustainable development – concept – 17 SDG goals – 8 Millennium Development Goals(MDG).

TOTAL: 45 PERIODS

TEXTBOOKS:

1. Benny Joseph, 'Environmental Science and Engineering', Tata McGraw-Hill, New Delhi, 2006.
2. Gilbert M.Masters, 'Introduction to Environmental Engineering and Science', 2nd edition, Pearson Education, 2004.
3. Ravikrishnan A, 'Environmental Science and Engineering', Sri Krishna Hitech Publishing Company Pvt. Ltd, Revised Edition 2020.

REFERENCES :

1. Dharmendra S. Sengar, "Environmental law", Prentice hall of India Pvt Ltd, New Delhi, 2007.

2. Erach Bharucha, "Textbook of Environmental Studies", Universities Press(I) Pvt Ltd., Hydrabad, 2015.
3. G. Tyler Miller and Scott E. Spoolman, "Environmental Science", Cengage Learning India Pvt. Ltd., Delhi, 2014.
4. Rajagopalan. R, "Environmental Studies-From Crisis to Cure", Oxford University Press, 2005.

OUTCOMES:

Upon successful completion of this course, student should be able to

1. Explain the different components of environment, structure and function of an ecosystem, importance of biodiversity and its conservation. (K1)
2. Aware about problems of environmental pollution, its impact on human and ecosystem, control measures and basic concepts in Disaster Management. (K2)
3. Disseminate the need for the natural resources and its application to meet the modern requirements and the necessity of its conservation. (K2)
4. Illustrate the various aspects of atmospheric chemistry with a focus on climate change and recognize the principles of green chemistry. Describe suitable scientific, technological solutions and Protection Acts to eradicate social and environmental issues. (K2)
5. Recognize the need for population control measures and the environmental based value education concepts to achieve the Sustainable Development Goals. (K2)

CO - PO MAPPING :

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

SEMESTER - IV

20ECPL401 SDG NO. 4, 11	MICROCONTROLLERS AND EMBEDDED SYSTEMS LABORATORY	L	T	P	C
		0	0	3	1.5

OBJECTIVES:

- To Introduce ALP concepts, features and Coding methods
- Write ALP for arithmetic and logical operations in 8086 and 8051
- Interface different I/Os with Microprocessors
- Be familiar with MASM
- Write programs for ARM

LIST OF EXPERIMENTS:

8086 Programs using kits and MASM

1. Basic arithmetic and Logical operations.
2. Move a data block without overlap.
3. Code conversion, decimal arithmetic and Matrix operations.
4. Floating point operations, string manipulations, sorting and searching.

8051 Experiments using kits and MASM

1. Basic arithmetic and Logical operations.
2. Square and Cube program, Find 2's complement of a number.
3. Unpacked BCD to ASCII.

Peripherals and Interfacing Experiments

1. Traffic light controller.
2. Stepper motor control.
3. Digital clock.

ARM programs

1. Interfacing ADC and DAC.
2. Interfacing LED and PWM.
3. Interfacing LCD.

TOTAL: 45 PERIODS

OUTCOMES

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

1. Write ALP for fixed and Floating Point and Arithmetic operations.(K3)
2. Execute Programs in 8051 (K5)

3. Interface various peripherals in 8086/8051.(K3)
4. Execute Programs in ARM.(K5)
5. Interface memory, A/D and D/A convertors with ARM system(K3)
6. Formulate a mini project.(K6)

CO - PO, PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	1	2	3	2	2	-	-	-	2	2	1	2	2
CO2	3	1	2	3	1	2	-	-	-	2	2	3	2	2
CO3	3	2	2	2	1	2	-	-	-	2	2	2	3	2
CO4	3	2	2	3	3	2	-	-	-	2	2	1	3	2
CO5	2	2	2	2	5	2	-	-	-	3	1	2	3	3
CO6	2	2	2	3	1	2	-	-	-	2	3	2	3	3

SEMESTER - IV

20ECTE401 SDG NO. 4,11,15	LIVE-IN-LAB - II	L	T	P	C
		0	0	2	1

OBJECTIVES:

- To provide opportunities for the students, expose to Industrial environment and real time work
- To enable hands-on experience in the electronics hardware/Software domain
- To enable development of skill set for designing and realizing prototype electronic systems/simulation model

COURSE METHODOLOGY

- This initiative is designed to inculcate ethical principles of research and to get involve in life-long learning process for the students.
- The project work must involve engineering design with realistic constraints. It must also include appropriate elements of the following: Engineering standards, design analysis, modeling, simulation, experimentation, prototyping, fabrication, correlation of data, and software development.
- Project can be individual work or a group project, with maximum of 3 students. In case of group project, the individual project report of each student should specify the individual's contribution to the group project.

- On completion of the project, the student shall submit a detailed project report. The project should be reviewed and the report shall be evaluated and the students shall appear for a viva-voce oral examination on the project approved by the Coordinator and the project guide.

EVALUATION

- First evaluation (Immediately after first internal examination) : 20 marks
- Second evaluation (Immediately after second internal examination): 30marks
- Final evaluation Last week of the semester) : 50marks

Note: All the three evaluations are mandatory for course completion and for awarding the final grade.

TOTAL: 30 PERIODS

OUTCOMES:

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

1 Perform literature survey to identify the gap and an application oriented research problem in the specific domain (K2)
2 Design and validate the proposed system using simulation (K3)
3 Implement the proposed system (K3)
4 Examine the obtained results and prepare a technical report (K4)
5 Publish the work in journals and apply for the patents.(K3)
6 Prepare for industrial environment and real time work (K3)

CO- PO & PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	2	2	2	2	2	2	3	2	2	3	3	3
CO2	3	3	3	2	3	3	2	2	3	3	3	3	3	3
CO3	2	2	2	1	2	1	1	1	3	2	3	3	3	2
CO4	2	2	2	1	2	1	1	1	3	2	3	3	3	2
CO5	2	2	2	1	2	1	1	1	3	2	3	3	3	2
CO6	2	2	2	2	3	2	2	2	2	2	3	3	3	3

SEMESTER - IV

20ECTP401 SDG NO. 4	SKILL ENHANCEMENT	L	T	P	C
		0	0	2	1

PROBLEM SOLVING SKILLS – PHASE 1

COURSE OBJECTIVE:

- Improve their quantitative ability.
- Improve their reasoning ability.
- Enhance their verbal ability through vocabulary building and grammar
- Equip with creative thinking and problem solving skills

UNIT I QUANTITATIVE ABILITY – III **6**

Compound Interest - Profit and Loss - Partnership - Percentage - Set Theory

UNIT II QUANTITATIVE ABILITY – IV **6**

True Discount - Ratio and Proportion - Simplification - Problems on H.C.F and L.C.M

UNIT III REASONING ABILITY – II **6**

Course of Action - Cause and Effect - Statement and Conclusion - Statement and Argument - Data Sufficiency (DS) - Statement and Assumption - Making Assumptions.

UNIT IV VERBAL ABILITY – II **6**

Change of Voice - Change of Speech - Letter and Symbol Series - Essential Part - Verbal Reasoning - Analyzing Arguments.

UNIT V CREATIVITY ABILITY – II **6**

Seating Arrangement - Direction Sense Test - Character Puzzles - Missing Letters Puzzles - Mirror &Water Images.

TOTAL : 30 PERIODS

REFERENCES:

1) R. S. Agarwal, "Quantitative Aptitude for Competitive Exams"
2) Sarvesh Verma, "Quantum CAT"
3) R. S. Agarwal, "A Modern Approach to Logical Reasoning"
4) Arun sharma, "Verbal Ability and Reading Comprehension"

ADVANCED C PROGRAMMING AND MATLAB AND SIMULINK PROGRAMMING - PHASE 2

COURSE OBJECTIVE:

- To improve C programming skills with understanding of code organization and functional hierarchical decomposition with using complex data types.
- To understand procedural programming methods using MATLAB & SIMULINK.

UNIT I INTRODUCTION TO RECURSION AND GROWTH FUNCTIONS 6

Introduction to Recursion - Recurrence Relation - Deriving time complexity and space complexity using recurrence relation Polynomial Equations - Compare growth functions - Nth Fibonacci Number - Exponent Function - Taylor Series - Tower of Hanoi.

UNIT II STORAGE CLASSES, THE PREPROCESSOR AND DYNAMIC MEMORY ALLOCATION 6

Storage Classes and Visibility - Automatic or local variables - Global variables - Macro Definition and Substitution - Conditional Compilation - Dynamic Memory Allocation - Allocating Memory with malloc and callo Allocating Memory with calloc - Freeing Memory - The Concept of linked list - Inserting a node by using Recursive Programs - Deleting the Specified Node in a Singly Linked List.

UNIT III FILE MANAGEMENT AND BIT MANIPULATION 6

Defining and Opening a file - Closing Files - Input/output Operations on Files - Predefined Streams - Error Handling during I/O Operations - Random Access to Files - Command Line Arguments - The hexadecimal number system - C bitwise operators - How to generate all the possible subsets of a set - Tricks with Bits - Applications of bit operations.

UNIT IV BASICS OF PROGRAMMING IN MATLAB 6

Variables - array - matrices - programming structure- Script files- Functions - Debugging programs - Loops, branches and control flow - Relational and logical operations - 2D and 3D graphics - Multiple plots, Plot properties- Numerical analysis: Non-linear equations and optimization - Differential equations.

UNIT V SIMULINK AND MATLAB OPTIMIZATION TOOLBOX 6

Introduction SIMULINK models - blocks - Systems and sub-systems - Simulating Dynamic System - Solving a model - Solvers - MATLAB SIMULINK for signal processing - Solving linear and quadratic optimization problems.

TOTAL : 30 PERIODS

REFERENCES:

1. R. G. Dromey, "How to Solve It By Computer", Pearson, 1982
2. A.R. Bradley, "Programming for Engineers", Springer, 2011
3. Kernighan and Ritchie, "The C Programming Language", (2nd ed.) Prentice Hall, 1988
4. Amos Gilat, "Matlab, An Introduction With Applications", Wiley Publication, 4th edition
5. Brian R. Hunt, Jonathan Rosenberg, and Ronald L Lipsman, "A Guide to MATLAB", Cambridge University press.

REFERENCES

1. Agam Kumar Tyagi, "Matlab and Simulink for Engineering" Oxford Higher Education
2. Rudra Pratap "Getting Started with MATLAB" Oxford Higher Education
3. Stephen J Chapman, "MATLAB Programming for Engineers", 6E, CENGAGE

ONLINE RESOURCES

1. https://matlabacademy.mathworks.com/
2. https://www.tutorialspoint.com/matlab/index.htm
3. https://medium.com/quick-code/top-tutorials-to-learn-matlab-for-beginners-d19549ecb7b7
4. https://nptel.ac.in/courses/103/106/103106118/

WEB RESOURCES

1. https://www.mathworks.com/academia/books.html
2. https://in.mathworks.com/support/learn-with-matlab-tutorials.html

COURSE OUTCOMES :

Upon completion of this course, the students should be able to:

1. Analyze their quantitative ability. (K4)
2. Understand the ability of arithmetic reasoning along with creative thinking and problem solving skills. (K2)
3. Create their verbal ability through vocabulary building and grammar. (K6)

4. Evaluate code organization and functional hierarchical decomposition with complex data types. (K5)
5. Understand to improve C programming skills to apply advance structured and procedural programming. (K2)
6. Apply the Matlab Simulink and optimization toolbox for signal processing applications. (K3)

CO- PO & PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	-	-	-	-	3	2	-	3	2	3	-	2	-	-
CO2	-	-	-	-	3	2	-	3	2	3	-	2	-	-
CO3	-	-	-	-	3	2	-	-	1	3	-	2	-	-
CO4	-	-	-	-	3	2	-	3	3	3	-	2	2	2
CO5	-	-	-	-	3	2	-	-	2	3	-	2	2	2
CO6	-	-	-	-	3	2	-	-	2	3	-	2	2	2

SEMESTER - V

20ECPC501 SDG NO. 4,8,9	DIGITAL COMMUNICATION	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To know the principles of sampling and quantization
- To study the various waveform coding schemes
- To learn the various baseband transmission schemes
- To understand the various band pass signaling schemes
- To know the fundamentals of channel coding

UNIT I INFORMATION THEORY 9

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

UNIT II WAVEFORM CODING & REPRESENTATION 9

Prediction filtering and DPCM - Delta Modulation - ADPCM & ADM principles-Linear Predictive Coding - Properties of Line codes - Power Spectral Density of Unipolar / Polar RZ & NRZ – Bipolar NRZ – Manchester.

UNIT III BASEBAND TRANSMISSION & RECEPTION 9

ISI – Nyquist criterion for distortion less transmission – Pulse shaping – Correlative coding - Eye pattern – Receiving Filters - Matched Filter, Correlation receiver, Adaptive Equalization.

UNIT IV DIGITAL MODULATION SCHEME 9

Geometric Representation of signals - Generation, detection, PSD & BER of Coherent BPSK, BFSK & QPSK - QAM - Carrier Synchronization - Structure of Non-coherent Receivers - Principle of DPSK.

UNIT V ERROR CONTROL CODING 9

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

TOTAL: 45 PERIODS

TEXT BOOKS:

1. S.Haykin, "Digital Communications", John Wiley, 2005. (Unit I –V).
2. J.G Proakis, "Digital Communication", 4th Edition,Tata McGraw Hill Company, 2001.

REFERENCES:

1. B. Sklar, "Digital Communication Fundamentals and Applications", Second Edition, Pearson Education, 2009.
2. B.P.Lathi, "Modern Digital and Analog Communication Systems", Third Edition, Oxford University Press. 2007.
3. H P Hsu, "Schaum Outline Series — Analog and Digital Communications", TMH, 2006.

WEB REFERENCES::

1. https://swayam.gov.in/nd1_noc20_ee17/preview
2. https://nptel.ac.in/courses/117/105/117105077/
3. http://www.ee.iitm.ac.in/~andrew/videolectures/EE419/index.html

ONLINE RESOURCES:

1. https://freevideolectures.com/course/4763/nptel-digital-communication/37
2. https://freevideolectures.com/course/2311/digital-communication/3
3. https://nptel.ac.in/courses/117/101/117101051/
4. https://www.youtube.com/watch?v=3ekWsXeZ8TM&list=PLgwJf8NK-2e5PngHbdEadEun5XPvnn00N&index=115

OUTCOMES:

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

1. Explain the basic concepts of Information theory (K2)
2. Apply the source coding techniques such as Shannon Fano and Huffman coding.(K3)
3. Illustrate and compare the Encoding schemes such as DPCM, DM, ADPCM, ADM & LPC and different waveform coding schemes.(K3)
4. Explain the base band transmission and Reception techniques. (K2)
5. Explain the performance of digital modulation schemes such as BPSK, BFSK, QPSK, DPSK & QAM. (K2)
6. Apply the channel coding theorem, error control coding and decoding schemes like block codes, hamming codes, cyclic codes, convolutional codes and viterbi decoder (K3)

CO - PO, PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	-	-	-	-	-	-	-	-	-	-	2	-
CO2	3	2	1	-	-	-	-	-	-	-	-	-	2	1
CO3	3	3	2	1	-	-	-	-	-	-	-	1	2	1
CO4	3	3	2	2	-	-	-	-	-	-	-	1	2	1
CO5	3	3	3	2	2	-	-	-	-	-	-	1	2	1
CO6	3	3	3	2	2	-	-	-	-	-	-	1	2	1

SEMESTER - V

20ECPW501 SDG NO. 4, 9	DISCRETE TIME SIGNAL PROCESSING WITH LABORATORY	L	T	P	C
		3	0	2	4

OBJECTIVES:

- To learn discrete Fourier transform, fast Fourier transform, properties of DFT and its application to linear filtering
- To understand the characteristics of digital filters, design digital IIR filters and apply these filters to filter undesirable signals in various frequency bands
- To understand the characteristics of digital linear phase FIR filters, design digital FIR filters and apply these filters to filter undesirable signals in various frequency bands
- To understand the effects of finite precision representations on digital filters and obtain knowledge and ability to use the digital Signal Processors to build DSP systems for real time problems
- Perform basic operations on signal processing and design filters using MATLAB, and to study the architecture of DSP Processor and Implement certain DSP algorithms on Digital Signal Processors

UNIT I DISCRETE FOURIER TRANSFORM 9

Summary of analysis & synthesis equations for FT & DTFT, frequency domain sampling, Discrete Fourier transform (DFT) - deriving DFT from DTFT, properties of DFT - periodicity, symmetry, circular convolution. Linear filtering using DFT. Filtering long data sequences - overlap save and overlap add method. Fast computation of DFT - Radix-2 Decimation-in-time (DIT) Fast

Fourier transform (FFT), Decimation-in-frequency (DIF), Fast Fourier transform (FFT). Linear filtering using FFT.

UNIT II INFINITE IMPULSE RESPONSE FILTERS 9

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

UNIT III FINITE IMPULSE RESPONSE FILTERS 9

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 and Hanning window), Frequency sampling method. FIR filter structures - linear phase structure, direct form realizations.

UNIT IV FINITE WORD LENGTH EFFECTS 9

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

UNIT V INTRODUCTION TO DIGITAL SIGNAL PROCESSORS 9

DSP functionalities - circular buffering – DSP architecture – Fixed and Floating point architecture principles – Programming – Application examples.

LAB COMPONENT – LIST OF EXPERIMENTS 15
MATLAB / EQUIVALENT SOFTWARE PACKAGE

1. Generation of elementary Discrete-Time sequences, Linear and Circular convolutions, Auto correlation and Cross Correlation.
2. Frequency Analysis using DFT and FFT.
3. Design of FIR filters (LPF/HPF/BPF/BSF) and demonstrates the filtering operation.
4. Design of Butterworth and Chebyshev IIR filters (LPF/HPF/BPF/BSF) and demonstrate the filtering operations.

DSP PROCESSOR BASED IMPLEMENTATION

1. Study of the architecture of Digital Signal Processor and Perform MAC operation using various addressing modes.
2. Generation of signals – Square, Triangular, Sawtooth.
3. Convolution.

TOTAL: 60 PERIODS

TEXT BOOKS:

1. John G Proakis and Manolakis, "Digital Signal Processing Principles, Algorithms and Applications", Pearson, Fifth Edition, 2021.
2. A.V.Oppenheim, R.W. Schafer and J.R. Buck, "Discrete Time Signal Processing", Eighth Indian Reprint, Pearson, 2004.

REFERENCES:

1. Emmanuel C. Ifeachor & Barrie. W. Jervis, "Digital Signal Processing", Second Edition, Pearson Education / Prentice Hall, 2002.
2. Sanjit K. Mitra, "Digital Signal Processing – A Computer Based Approach", Tata McGraw Hill, 2007.
3. Andreas Antoniou, "Digital Signal Processing", Tata Mc Graw Hill, 2006.
4. K. P. Soman and K. I. Ramachandran, "Insight into Wavelets - From Theory to Practice", Prentice Hall of India, Third Edition, 2010.
5. B. Venkataramani, M. Bhaskar, "Digital Signal Processors: Architecture, Programming and Application", Tata McGraw Hill Education, 2002.

WEB REFERENCES:

1. https://www.tutorialspoint.com/digital_signal_processing/index.htm
2. https://www.analog.com/en/design-center/landing-pages/001/beginners-guide-to-dsp.html
3. https://101science.com/dsp.htm

ONLINE RESOURCES:

1. https://swayam.gov.in/nd1_noc20_ee31https://nptel.ac.in/courses/117105134/
2. https://nptel.ac.in/courses/117105134/
3. https://www.edx.org/course/discrete-time-signal-processing-4

OUTCOMES:

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

- Examine the signals in the frequency domain using DFT, DIT, DIF - FFT algorithms and compute the response of the system using linear filtering. (K3)

- Apply Butterworth and Chebyshev methods to design analog IIR filters. (K3)
- Use approximation of derivatives, impulse invariance mapping, and bilinear transformation methods to design a digital IIR filter. (K3)
- Use the Fourier series method, windowing technique, and frequency sampling methods to design a digital FIR filter. (K3)
- Summarize the effect of finite word length in digital filters to compute the quantization noise. (K2)
- Illustrate the architecture of Digital signal processors and program the DSP processors for signal processing applications. (K3)

CO - PO, PSO MAPPING :

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	1	1	3	-	-	-	1	-	-	2	3	-
CO2	3	3	2	2	2	-	-	-	1	-	-	3	3	2
CO3	3	1	2	1	2	-	-	-	1	-	-	3	3	1
CO4	3	2	2	3	2	2	-	-	1	-	-	3	3	2
CO5	3	3	2	2	2	2	-	-	-	-	-	3	3	2
CO6	3	3	2	2	2	2	-	-	-	-	3	2	3	2

SEMESTER - V

20ECPC502 SDG NO. 4, 9	VLSI DESIGN	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To study the fundamentals of CMOS circuits and its characteristics
- To design and realize of combinational digital circuits
- To design and realize of sequential digital circuits
- To study the fundamentals of HDL
- Architectural choices and performance trade-offs involved in designing and realizing the circuits in CMOS technology are discussed

UNIT I INTRODUCTION TO MOS TRANSISTOR 9

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

UNIT II COMBINATIONAL MOS LOGIC CIRCUITS 9

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

UNIT III SEQUENTIAL CIRCUIT DESIGN 9

Static latches and Registers Dynamic latches and Registers, Pulse Registers, Sense Amplifier Based Register, Pipelining, Schmitt Trigger, Monostable Sequential Circuits, Astable Sequential Circuits. Timing Issues: Timing Classification of Digital System, Synchronous Design.

UNIT IV INTRODUCTION TO HDL 9

Introduction to HDLs, Basic Concepts of Verilog, Data Types, System Tasks and Compiler Directives, Gate Level Modeling: Gate Types and Gate Delays. Dataflow Modeling: Continuous assignment and delays. Design of Stimulus Block.

UNIT V DESIGN OF ARITHMETIC BUILDING BLOCKS AND SUBSYSTEM 9

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

TOTAL: 45 PERIODS

TEXT BOOKS:

1. Neil H.E. Weste, David Money Harris, "CMOS VLSI Design: A Circuits and Systems Perspective", Fourth Edition, Pearson, 2017 (UNIT I,II).
2. Jan M. Rabaey, Anantha Chandrakasan, Borivoje. Nikolic, "Digital Integrated Circuits: A Design Perspective", Second Edition, Pearson, 2016 (UNIT III,V).
3. Samir Palnitkar, "Verilog HDL: A guide to Digital design and synthesis", Second Edition, Pearson Education, 2008 (UNIT IV).

REFERENCES:

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

ONLINE RESOURCES:

1. https://freevideolectures.com/course/3507/digital-vlsi-system-design
2. https://www.tutorialspoint.com/vlsi_design/vlsi_design_useful_resources.html

COURSE OUTCOMES:

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

1. Illustrate the Fundamentals of CMOS Circuits, delay models and its Characteristics. (K2)
2. Construct MOS logic circuit families for implementing Combinational and Sequential Circuits.(K3)
3. Examine the Power and Timing Issues of Combinational and Sequential CMOS Circuits. (K2).
4. Develop the hardware description language code for different applications. (K3)
5. Apply the Architectural Choices for data path circuits and determine the performance Trade-off involved and realizing the circuits in CMOS Technology. (K3).
6. Describe the Various Memory Architectures, Memory Core and Peripheral Circuits for VLSI Application. (K2)

CO - PO, PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	2	2	1	1	-	-	-	-	1	1	3	2
CO2	3	2	2	2	1	1	-	-	-	-	1	1	3	2
CO3	3	2	2	2	1	1	-	-	-	-	1	1	3	2
CO4	3	2	2	2	1	1	-	-	-	-	1	1	3	2
CO5	3	2	2	2	1	1	-	-	-	-	1	1	3	2
CO6	3	2	2	2	1	1	-	-	-	-	1	1	3	2

SEMESTER - V

20ECPL501 SDG NO. 4, 9	COMMUNICATION SYSTEMS LABORATORY	L	T	P	C
		0	0	3	1.5

OBJECTIVES:

- To visualize the effects of sampling and TDM
- To Implement AM & FM modulation and demodulation
- To implement PCM &DM
- To simulate Digital Modulation schemes
- To simulate Error control coding schemes

LIST OF EXPERIMENTS:

1. Signal Sampling and reconstruction.
2. Time Division Multiplexing.
3. AM Modulator and Demodulator.
4. FM Modulator and Demodulator.
5. Pulse Code Modulation and Demodulation.
6. Delta Modulation and Demodulation.
7. Line coding schemes.
8. Simulation of ASK, FSK, and BPSK generation schemes.
9. Simulation of DPSK, QPSK and QAM generation schemes.
10. Simulation of signal constellations of BPSK, QPSK and QAM.
11. Simulation of ASK, FSK and BPSK detection schemes.
12. Simulation of Linear Block and Cyclic error control coding schemes.
13. Simulation of Convolutional coding scheme.
14. Communication link simulation.

TOTAL: 45 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.
3. Function Generators – 15 Nos.
4. MATLAB or equivalent software package for simulation experiments
5. PCs - 15 Nos.

OUTCOMES:

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

1. Perform signal sampling and multiplexing schemes for baseband signals and reconstruct the signals. (K3)
2. Construct and test Analog modulation and demodulation circuits. (K5)
3. Generate various line coding schemes using PCM and DM techniques. (K3)
4. Simulate digital modulation and demodulation schemes such as ASK, BFSK, BPSK, QPSK, QAM and DPSK and their constellations. (K3)
5. Implement various channel coding schemes and demonstrate the improvement of noise performance. (K3)
6. Simulate and evaluate the various functional modulus of communication systems. (K4)

CO - PO, PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	2	1	-	-	-	-	1	-	-	-	-	-
CO2	3	2	2	1	-	-	-	-	1	-	-	-	-	2
CO3	3	3	2	1	1	-	-	-	1	-	-	1	2	2
CO4	3	3	3	2	2	-	-	-	1	-	-	1	2	2
CO5	3	3	3	2	2	-	-	-	1	-	-	2	2	2
CO6	3	3	3	2	2	-	-	-	1	-	-	2	2	2

SEMESTER - V

20ECPL502 SDG NO. 4, 9	VLSI LABORATORY	L	T	P	C
		0	0	3	1.5

OBJECTIVES:

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

LIST OF EXPERIMENTS:

Part I: Digital System Design using HDL & FPGA **9**

1. Design an Adder (Min 8 Bit) using HDL. Simulate it using Xilinx/Altera Software and implement by Xilinx/Altera FPGA.
2. Design a Multiplier (4 Bit Min) using HDL. Simulate it using Xilinx/Altera Software and implement by Xilinx/Altera FPGA.
3. Design an ALU using HDL. Simulate it using Xilinx/Altera Software and implement by Xilinx/Altera FPGA.
4. Design a Universal Shift Register using HDL. Simulate it using Xilinx/Altera Software and implement by Xilinx/Altera FPGA.
5. Design Finite State Machine (Moore/Mealy) using HDL. Simulate it using Xilinx/Altera Software and implement by Xilinx/Altera FPGA.
6. Design Memories using HDL. Simulate it using Xilinx/Altera Software and implement by Xilinx/Altera FPGA.

Part-II: Digital Circuit Design

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

Part-III Analog Circuit Design

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

TOTAL: 45 PERIODS

LAB REQUIREMENTS :

Xilinx ISE/Altera Quartus/ equivalent EDA Tools	10 User License
Xilinx/Altera/equivalent FPGA Boards	10 nos
Cadence/Synopsis/ Mentor Graphics/Tanner/ equivalent EDA Tools	10 User License
Personal Computer	30 nos

OUTCOMES:

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

1. Illustrate the syntax of HDL code and design digital integrated circuits by writing codes in HDL.(K3)
2. Build and verify analog circuits using the EDA tools. (K3)

3. Implement the knowledge of Xilinx software to develop and import the logic modules into FPGA boards. (K3)
4. Analyze and synthesize the digital ICs and based on the synthesis done, determine the critical paths and power consumption in digital circuits. (K4)
5. Create the place and route design of digital ICs. (K3)
6. Design, simulate and evaluate the layouts of analog IC blocks using EDA tools. (K3)

CO - PO - PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	2	3	3	1	-	-	-	-	1	2	3	2
CO2	2	2	2	2	3	1	-	-	-	-	1	2	3	2
CO3	1	1	3	1	3	1	-	-	-	-	2	2	3	2
CO4	2	2	1	2	3	2	-	-	-	-	1	2	3	2
CO5	2	2	2	2	3	1	-	-	-	-	2	2	3	2
CO6	2	2	2	1	3	1	-	-	-	-	1	2	3	2

SEMESTER - V

20ECTE501 SDG NO. 4,11,15	LIVE-IN-LAB - III	L	T	P	C
		0	0	3	2

OBJECTIVES:

- To provide opportunities for the students, expose to Industrial environment and real time work
- To enable hands-on experience in the electronics hardware/Software domain
- To enable development of skill set for designing and realizing prototype electronic systems/simulation model

COURSE METHODOLOGY:

- This initiative is designed to inculcate ethical principles of research and to get involve in life-long learning process for the students.
- The project work must involve engineering design with realistic constraints. It must also include appropriate elements of the following: Engineering standards, design analysis, modeling, simulation, experimentation, prototyping, fabrication, correlation of data, and software development.

- Project can be individual work or a group project, with maximum of 3 students. In case of group project, the individual project report of each student should specify the individual's contribution to the group project.
- On completion of the project, the student shall submit a detailed project report. The project should be reviewed and the report shall be evaluated and the students shall appear for a viva-voce oral examination on the project approved by the Coordinator and the project guide.

EVALUATION

- First evaluation (Immediately after first internal examination) : 20 marks
- Second evaluation (Immediately after second internal examination): 30marks
- Final evaluation Last week of the semester) : 50marks

Note: All the three evaluations are mandatory for course completion and for awarding the final grade.

TOTAL: 60 PERIODS

OUTCOMES:

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

1 Perform literature survey to identify the gap and an application oriented research problem in the specific domain (K2)
2 Design and validate the proposed system using simulation (K3)
3 Implement the proposed system (K3)
4 Examine the obtained results and prepare a technical report (K4)
5 Publish the work in journals and apply for the patents.(K3)
6 Prepare for industrial environment and real time work (K3)

CO - PO, PSO MAPPING :

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	2	2	2	2	2	2	3	2	2	3	3	3
CO2	3	3	3	2	3	3	2	2	3	3	3	3	3	3
CO3	2	2	2	1	2	1	1	1	3	2	3	3	3	2
CO4	2	2	2	1	2	1	1	1	3	2	3	3	3	2
CO5	2	2	2	1	2	1	1	1	3	2	3	3	3	2
CO6	2	2	2	2	3	2	2	2	2	2	3	3	3	3

SEMESTER - V

20ECTP501 SDG NO. 4,11,15	SKILL ENHANCEMENT	L	T	P	C
		0	0	3	1

APTITUDE & COGNITIVE SKILLS – PHASE 1

OBJECTIVES:

- Enhance their quantitative ability.
- Enhance their reasoning ability
- Enhance their verbal ability.
- Equip with creative thinking and problem solving skills

UNIT I QUANTITATIVE ABILITY – V **6 Hours**

Square Root And Cube Root, Logarithm, Volume and Surface Area, Permutation and Combination

UNIT II QUANTITATIVE ABILITY – VI **6 Hours**

Probability, Averages, Area, Odd Man Out, Crypt Arithmetic, Flowcharts

UNIT III REASONING ABILITY – III **6 Hours**

Data Interpretation Table Charts, Data Interpretation Bar Charts, Blood Relationship, Puzzles

UNIT IV VERBAL ABILITY – III **6 HOURS**

Spellings, Selecting Words, Spotting Errors, Ordering of Words, Logical Sequence of Words

UNIT V CREATIVITY ABILITY – III **6 Hours**

Logical Puzzles, Playing Cards Puzzles, Clock Puzzles, Number Puzzles, Sudoku

TOTAL : 30 PERIODS

REFERENCES

- Quantitative Aptitude for Competitive Exams by R. S. Agarwal
- Quantum CAT by Sarvesh Verma
- A Modern Approach to Logical Reasoning by R. S. Agarwal
- Verbal Ability and Reading Comprehension by Arun Sharma

PYTHON PROGRAMMING AND CCNA - PHASE 2

OBJECTIVES

To enable students to,

- The course is designed to provide Strong knowledge of Python. Python programming is intended for software engineers, system analysts, program managers and user support personnel who wish to learn the Python programming language.
- To understand the fundamentals of CISCO packet Tracer and implement the routing methods for various network topologies.

UNIT I INTRODUCTION, DATA TYPES AND STRINGS, LIST & TUPLES 10

DataTypes - Integer , Float , Boolean , String , List , Tuple , Dictionary and Sets. String - Concatenation and Replication, isalnum functions, Slicing Operation sorted() , reversed() , min() , max() , index() and count() function, packing and unpacking of data in a tuple

UNIT II DICTIONARY AND SETS and HANDLING 10

Dictionary - del Keyword,. Sets - Frozen sets, Internal working of sets, add() , union() , intersection() and difference() method, symmetric_difference, clear() method, Operators in sets, Higher Order Functions - map , filter , reduce and lambda function, Random Library

UNIT III EXCEPTIONAL HANDLING, REGULAR EXPRESSIONS AND OBJECT ORIENTED PROGRAMMING 10

Exception Handling - All Error Categories, try , except , finally blocks, Raising an exception, Regular Expression, Object Oriented Programming - Types of Inheritence, Data encapsulation and Abstraction, Polymorphism, Method OverRiding, Operator overloading, operator overRiding,

UNIT IV CCNA TOPOLOGY AND CONFIGURATION 8

Introduction to Cisco Packet Tracer- Configure the basic switch and router settings- Forming a simple network - Implementing various network topology - Securing switch ports - Configure EtherChannel - Configuration of IPv4 - Configuration of IPv6

UNIT V ROUTING AND NETWORKING 7

Subnetting a network - Implementing static routing - Implementing dynamic routing - Implementing VLAN - Configuring DHCP

TOTAL : 45 PERIODS

REFERENCES:

1. Python-(Mark Lutz)
2. Python Training guide (BPB Publications)
3. Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest, and Clifford Stein, "Introduction to Algorithms", Third Edition, MIT Press.
4. Thomas H. Cormen, "Algorithms Unlocked", MIT Press.
5. Behrouz A Forouzan, "Data Communications and Networking", fourth edition, Mc Graw Hill.

ONLINE RESOURCES

1. https://www.tutorialandexample.com/ccna-tutorial
2 https://www.computernetworkingnotes.com/ccna-study-guide/types-of-static-routes-explained.html
3. https://www.ibm.com/cloud/learn/networking-a-complete-guide
4. https://archive.nptel.ac.in/courses/117/105/117105148/

OUTCOMES

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

1. Define the syntax and semantics of python programming language and Understand control flow statements, strings and functions. [K1]
2. Determine the methods to create and manipulate python programs by utilizing the data structures like lists, dictionaries, tuples and sets. [K3]
3. Annotate the concepts of functions, modules and packages in python. [K2]
4. Understand the concepts of files, exception handling and also apply the object oriented programming concept by creating classes and objects. [K3]
5. Understand the fundamentals of networking and cisco packet tracer. [K2]
6. Implement the routing methods for various network topology.[K3]

CO - PO - PSO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	-	-	-	-	3	2	-	3	2	3	-	2	-	-
CO2	-	-	-	-	3	2	-	3	2	3	-	2	-	-
CO3	-	-	-	-	3	2	-	-	1	3	-	2	-	-
CO4	-	-	-	-	3	2	-	3	3	3	-	2	2	2
CO5	1	2	2	-	3	1	-	1	2	3	-	2	2	2
CO6	1	2	2	2	3	2	-	1	2	3	-	2	2	2

SEMESTER - VI

20ECPC601 SDG NO. 1,4,9,11	TRANSMISSION LINES AND ANTENNAS	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To introduce the various types of transmission lines and its characteristics
- To impart technical knowledge in impedance matching using smith chart
- Determine the radiation fields of different wired antennas, array antennas and analyze its fundamental parameters
- Analyze the fields of different travelling wave antennas and compute the radiation fields of the Huygens source, aperture, slot and complementary dipole antennas
- To create awareness about the different types of propagation of radio waves at different frequencies

UNIT I TRANSMISSION LINES 9

Transmission line equations from source and load end. The finite and infinite lines. Velocity of propagation, input impedance. Open and short circuited lines, telephone cables, distortion less transmission, loading of cables, Campbell's formula. Properties of Transmission lines at UHF, Reflection co-efficient, Standing waves and SWR, Distribution of voltages and currents on loss less line. Characteristics of half wave, Quarter-wave and one eighth wave lines. Construction and applications of Smith chart. Transmission line matching. Single and double stub matching using Smith Chart.

UNIT II FUNDAMENTALS OF RADIATION 9

Concept of radiation - Types of antennas - Current distribution - Fundamental parameters: Radiation Pattern-Radiation Power Density - Radiation Intensity - Beamwidth - Gain - Directivity-Bandwidth Polarization - Antenna efficiency - Effective aperture -Friis transmission equation - Field regions separation - Monopole antenna - Half wave dipole: Field components - Total radiated power - Radiation resistance - Folded dipole

UNIT III ANTENNA ARRAYS 9

Need for antenna arrays - Design of two element array - Multiplication of pattern - N-element linear array : Uniform amplitude and spacing - Design of broadside & end fire arrays : Non-uniform amplitude and equal spacing -

Design of binomial array - Phased array design - Yagi Uda antenna - Concept of smart antenna.

UNIT IV APERTURE AND SLOT ANTENNAS 9

Radiation from rectangular apertures, Uniform and Tapered aperture, Horn antenna, Reflector antenna, Aperture blockage, Feeding structures, Slot antennas, Microstrip antennas – Radiation mechanism – Application ,Numerical tool for antenna analysis.

UNIT V SPECIAL ANTENNAS AND WAVE PROPAGATION 9

Loop Antennas, Principle of frequency independent antennas –Spiral antenna, Helical antenna, Log periodic. Modern antennas- Reconfigurable antenna, Active antenna, Dielectric antennas, Electronic band gap structure.

and applications,

Wave Propagation : Modes of propagation - Structure of atmosphere - Ground wave propagation - Sky wave propagation - Virtual height - Maximum usable frequency - Skip distance - Space wave propagation.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. C.A.Balanis, "Antenna Theory: Analysis and Design", John Wiley & Sons Inc., Fourth Edition, 2015.
2. John D.Kraus, Ronald J.Marhefka, Ahmad S Khan, "Antennas and Wave Propagation" Tata McGraw Hill, Fifth Edition 2017.

REFERENCES:

1. Warren L. Stutzman, Gary A. Thiele, "Antenna theory and design", John Wiley and Sons Ltd., Third Edition, 2013.
2. Edward C.Jordan, Keith G.Balmain, “Electromagnetic Waves and Radiating Systems”, Pearson, Second Edition, 2015.
3. R.E.Collin, “Antennas and Radio Wave Propagation”, McGraw Hill 1985.
4. A.R.Harish, M.Sachidananda, "Antennas and Wave Propagation", Oxford University Press, First Edition 2007.
5. S.Drabowitch, A.Papiernik, J. Encinas, H,Griffiths, G.Smith, "Modern Antennas", Springer Science, 2013.
6. Handbooks/ Manuals of Simulation software packages like HFSS, CST and ADS.

WEB REFERENCES:

1. https://www.itu.int/dms_pub/itu-r/opb/hdb/R-HDB-59-2014-PDF-E.pdf

ONLINE RESOURCES:

1. https://nptel.ac.in/courses/108101092/

OUTCOMES:

Upon completion of the course, the student will be able to

1. Explain the characteristics of transmission lines and its losses (K1)
2. Interpret the standing wave ratio, impedance and impedance matching using circuit concept and smith chart. (K2)
3. Applying basic principles, analyze and measure the performance characteristics of antennas (K2)
4. Derive and Determine Array factor, Beam width & null angles of N-element linear arrays with uniform and non uniform amplitude and spacing. - (K2)
5. Analyze the radiation from wire, aperture and slots. (K2)
6. Explain the different modes of propagation of EM waves. (K1)

CO - PO, PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	1	2	2	-	2	-	-	-	-	2	2	3	2
CO2	3	1	3	2	-	2	-	-	-	-	2	2	3	2
CO3	3	1	3	2	-	2	-	-	-	-	2	2	3	2
CO4	3	1	3	2	3	2	-	-	-	-	2	2	3	2
CO5	3	1	3	2	3	1	1	-	1	-	2	2	3	2
CO6	3	1	1	1	2	1	-	-	-	-	1	1	2	1

SEMESTER - VI

20ECPC602 SDG NO. 4,9	COMMUNICATION NETWORKS	L	T	P	C
		3	0	0	3

OBJECTIVES:

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

UNIT I FUNDAMENTALS & LINK LAYER 9

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

UNIT II MEDIA ACCESS & INTERNETWORKING 9

Overview of Data link Control and Media access control - Ethernet (802.3) - Wireless LANs – Available Protocols – Bluetooth – Bluetooth Low Energy – WiFi – 6LowPAN–Zigbee - Network layer services – Packet Switching – IPV4 Address – Network layer protocols (IP, ICMP, Mobile IP).

UNIT III ROUTING 9

Routing - Unicast Routing – Algorithms – Protocols – Multicast Routing and its basics – Overview of Intradomain and interdomain protocols – Overview of IPv6 Addressing – Transition from IPv4 to Ipv6.

UNIT IV TRANSPORT LAYER 9

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

TOTAL: 45 PERIODS

TEXT BOOK:

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

REFERENCES:

1. James F. Kurose, Keith W. Ross, "Computer Networking - A Top-Down Approach Featuring the Internet", Pearson, Seventh Edition, 2017.
2. Nader F. Mir, "Computer and Communication Networks", Pearson Prentice Hall Publishers, Second Edition, 2014.
3. Ying-Dar Lin, Ren-Hung Hwang, Fred Baker, "Computer Networks: An Open Source Approach", McGraw Hill Education, 2011.

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

WEB REFERENCES:

1. https://www.youtube.com/watch?v=HEEnLZV2wGI/
2. https://www.youtube.com/watch?v=vv4y_uOneC0

ONLINE RESOURCES:

1. https://nptel.ac.in/courses/106/105/106105080/
2. https://nptel.ac.in/courses/106/106/106106091/
3. https://www.coursera.org/specializations/computer-communications

OUTCOMES:

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

1. Understanding the different types of networks and networks layer (K2)
2. Apply the different WLAN technology depending upon the coverage area and number of nodes (k3)
3. Illustrate the network layer services, packet switching, IPV4 addressing and different network layer protocols (K3)
4. Analyse and trace the flow of information from one node to another node in the network. (K4)
5. Demonstrate the Transport layer with UDP and TCP. (K3)
6. Explain the application layer with client server programming, WWW, HTTP, Different Electronic mail protocols with security aspects. (K3)

CO - PO, PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	3	2	2	2	-	-	-	-	2	-	-	3	3
CO2	2	1	1	1	-	-	-	-	-	2	-	-	2	2
CO3	2	2	1-	2	-	-	-	-	-	2	-	-	2	2
CO4	3	2	2	2	2	-	-	-	-	2	-	-	2	2
CO5	3	3	3	2	2	-	-	-	-	2	-	-	2	2
CO6	3	2	2	2	2	-	-	-	-	2	-	-	3	3

SEMESTER - VI

20ECPC603 SDG NO. 9, 12	WIRELESS COMMUNICATION	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To study the characteristic of wireless channel
- To understand the design of a cellular system
- To study the various digital signaling techniques and multipath mitigation techniques
- To understand the concepts of multiple antenna techniques

UNIT I WIRELESS CHANNELS 9

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

UNIT II CELLULAR ARCHITECTURE 9

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

UNIT III DIGITAL SIGNALING FOR FADING CHANNELS 9

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

UNIT IV MULTIPATH MITIGATION TECHNIQUES 9

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

UNIT V MULTIPLE ANTENNA TECHNIQUES 9

MIMO systems – spatial multiplexing -System model -Pre-coding - Beam

forming - transmitter diversity, receiver diversity- Channel state information-capacity in fading and non-fading channels.

TOTAL: 45 PERIODS

TEXTBOOKS:

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

REFERENCES:

1. Andrea Goldsmith, "Wireless Communication", Cambridge University Press, 2011.
2. Van Nee, R., Ramji Prasad, "OFDM for Wireless Multimedia Communications", Artech House, 2000.
3. David Tse, Pramod Viswanath, "Fundamentals of Wireless Communication", Cambridge University Press, 2005.
4. Upena Dalal, "Wireless Communication and Networks", Oxford University Press, 2015.

WEB REFERENCES:

1. https://nptel.ac.in/courses/106/106/106106167/
2. https://nptel.ac.in/courses/117/104/117104115/
3. https://nptel.ac.in/courses/117/105/117105132/

ONLINE RESOURCES:

1. https://ocw.mit.edu/courses/electrical-engineering-and-computer-science/6-452-principles-of-wireless-communications-spring-2006/

OUTCOMES:

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

1. Explain the different path loss models for Large and small scale propagation to design the Link Budget for wireless Channel in different scenarios. (K2)
2. Describe the multiple access Techniques that includes TDMA, FDMA, CDMA, OFDMA to derive the capacities of the systems. (K2)
3. Explain the cellular system with hand off strategies and the techniques to improve its capacity. (K2)
4. Explain the operation of transmitter and receiver pertaining to various signalling schemes used in Fading Channels to analyze the bit error probability. (K2)

5. Compare and interpret the different multipath mitigation techniques like Diversity, equalization with their performance. (K2)
6. Design the MIMO system with transmit and receive diversity and elucidate its performance using Channel State Information. (K3)

CO - PO, PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	3	-	2	1	1	-	-	1	-	1	3	3
CO2	3	3	3	1	3	-	1	1	-	1	-	2	3	3
CO3	3	3	2	-	3	2	1	-	-	1	-	2	3	3
CO4	2	2	2	-	3	1	1	-	-	1	-	2	3	3
CO5	2	2	2	-	3	2	1	-	-	1	-	2	3	3
CO6	3	3	2	-	2	1	1	-	-	1	-	2	3	3

SEMESTER - VI

20HSPL501 SDG NO. 4, 8	COMMUNICATION AND SOFT SKILLS LABORATORY	L	T	P	C
		0	0	2	1

OBJECTIVES:

- To develop effective communication and presentation skills
- To enhance the employability and career skills of the learners
- To enable the learners for preparing job application and e-portfolio
- To make the learners use soft skills efficiently
- To develop their confidence and help them in attending interviews successfully

UNIT I LISTENING AND SPEAKING SKILLS 6

Conversational skills participate in formal and informal talks – general, – group discussion – time management – group dynamics – GD strategies - making effective presentations - listening/watching interviews conversations, documentaries - listening to lectures, discussions from social media – improving articulation.

UNIT II ADVANCED READING AND WRITING SKILLS **6**

Reading different genres of texts - writing job applications – cover letter – résumé – emails – memos - writing abstracts – summaries – interpreting visual texts - e-portfolio.

UNIT III SKILLS FOR COMPETITIVE EXAMS **6**

Reading passages for competitive exams – language focus exercise – building vocabulary tasks - FAQs related to competitive exams – current affairs - improving global reading skills – elaborating ideas – summarizing – understanding arguments – identifying opinion/attitude and making inferences - critical reading.

UNIT IV SOFT SKILLS **6**

Motivation – emotional intelligence – managing changes – stress management – leadership straits – team work – career planning – intercultural communication – creative and critical thinking

UNIT V INTERVIEW SKILLS **6**

Different types of interview – personal interview – panel interview – telephone/online interview - interview etiquette - answering questions – offering information – mock interviews – FAQs related to job interviews

TOTAL: 30 PERIODS

REFERENCES:

1. Business English Certificate Materials, Cambridge University Press.
2. Comfort, Jeremy, et al. Speaking Effectively: Developing Speaking Skills for Business English. Cambridge University Press, Cambridge, 2011.
3. International English Language Testing System Practice Tests, Cambridge University Press.
4. Personality Development (CD-ROM), Times Multimedia, Mumbai.

WEB REFERENCES:

1. https://nptel.ac.in/courses/109/107/109107121/
2. https://swayam.gov.in/nd1_noc19_hs33/preview
3. https://ict.iitk.ac.in/courses/enhancing-soft-skills-and-personality/

ONLINE RESOURCES:

1. https://www.britishcoucil.my/english/courses-adults/learning-tips/importance-of-soft-skills
2. https://www.skillsoft.com/content-solutions/business-skills-training/soft-skills-training/

OUTCOMES:

Upon completion of the course learners should be able to

1. Demonstrate a better understanding of the communication process by articulating effectively(K2)
2. Exhibit soft skills & technical skills and construct e-portfolio effectively(K3)
3. Apply critical thinking abilities and perform well in group discussions(K2)
4. Adapt the skills towards grooming as a professional continuously(K2)
5. Identify different types of personal interview skills through mock interviews and practices(K2)
6. Execute the employability and career skills in their chosen profession(K3)

CO - PO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	-	-	-	-	-	-	-	1	2	3	1	1
CO2	-	-	-	-	-	-	-	2	3	3	2	1
CO3	-	-	-	-	-	-	-	2	3	2	-	1
CO4	-	-	-	-	-	-	-	1	1	3	2	2
CO5	-	-	-	-	-	2	-	1	2	3	-	1
CO6	-	-	-	-	-	-	-	1	1	3	2	2

SEMESTER - VI

20ECPL601 SDG NO. 4, 9	ANTENNAS LABORATORY	L	T	P	C
		0	0	3	1.5

OBJECTIVES:

- To understand the measurement of antenna parameters
- Design and implement antennas using EM tools

LIST OF EXPERIMENTS : **9**

1. Study of structure and operation of wired, aperture, planar and array antennas.
2. Measurement of Radiation Pattern of Half wave dipole.
3. Measurement of radiation pattern of 5 element Yagi uda Antenna.

4. Measurement of Radiation Pattern of Planar Antennas.
5. Plot the radiation pattern of helical antenna.
6. Measurement of Radiation Pattern of broad side antenna array.
7. Measurement of Radiation Pattern of End fire antenna array.
8. Measurement of Radiation Pattern Reflector antennas.
9. Design and Simulation of Micro strip antenna using CST Tool.
10. Measurement of antenna parameters using network analyzer.

TOTAL: 45 PERIODS

OUTCOMES:

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

1. Demonstrate the structure and operation of various antennas and describe their parameters. (K2)
2. Measure the radiation pattern of wired antennas. (K2)
3. Analyze the antenna parameters using Network Analyzer.(K3)
4. Plot the radiation pattern of an array of antennas. (K2)
5. Familiar with EM tools to implement antenna prototypes. (K1)
6. Simulate and test Microstrip antennas. (K3)

CO - PO - PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	1	2	1	1	-	-	-	-	-	-	2	3	1
CO2	3	1	2	3	3	-	-	-	-	-	-	2	3	-
CO3	3	1	2	3	3	-	-	-	-	-	-	2	3	1
CO4	3	11	2	3	3	-	-	-	-	-	-	2	3	1
CO5	3	3	3	3	3	-	-	-	-	-	-	2	3	1
CO6	3	1	3	3	3	-	-	-	-	-	-	2	3	1

SEMESTER - VI

20ECPL602 SDG NO. 4, 9	NETWORKS LABORATORY	L	T	P	C
		0	0	3	1.5

OBJECTIVES:

- Learn to communicate between two desktop computers.
- Learn to implement the different protocols.

- Be familiar with IP Configuration.
- Be familiar with the various routing algorithms.
- Be familiar with simulation tools.

LIST OF EXPERIMENTS :

1. Implementation of Error Detection / Error Correction Techniques
2. Implementation of Stop and Wait Protocol and sliding window
3. Implementation and study of Goback-N and selective repeat protocols
4. Implementation of High Level Data Link Control
5. Implementation of IP Commands such as ping, Traceroute, nslookup.
6. Implementation of IP address configuration.
7. To create scenario and study the performance of network with CSMA / CA protocol and compare with CSMA/CD protocols.
8. Network Topology - Star, Bus, Ring .
9. Implementation of distance vector routing algorithm.
10. Implementation of Link state routing algorithm.
11. Study of Network simulator (NS) and simulation of Congestion Control Algorithms using NS.
12. Implementation of Encryption and Decryption Algorithms using any programming language.

TOTAL: 45 PERIODS

LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS

SOFTWARE

- C / Python / Java / Equivalent Compiler.
- MATLAB SOFTWARE (Few experiments can be practiced with MATLAB)
- Standard LAN Trainer Kits - 4 Nos
- Network simulator like NS2/ NS3 / Glomosim / OPNET - 30 Equivalent

HARDWARE

- Standalone Desktops - 30 Nos

OUTCOMES:

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

1. Communicate between two desktop computers.(k1)
2. Implement different Protocols such as Stop & Wait, Go back N/Sliding window, Selective repeat.(k2)

3. Study the performance of network with CSMA/CA protocol and compare with CSMA/CD protocols.(k1)
4. Program using Sockets –Client server model, Echo/Ping/Talk commands/nslookup/ IP Configuration.(k2)
5. Implement and compare Distance vector and Link state routing, algorithms and congestion control algorithm.(k2)
6. Use simulation tool such as NS2/OPNET. (k2)

CO – PO, PSO MAPPING :

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	3	2	3	1	-	-	1	-	2	3	2	1
CO2	3	3	3	3	3	1	-	-	-	-	2	1	3	-
CO3	3	3	3	3	3	1	-	-	-	-	2	1	3	-
CO4	3	3	2	2	3	-	-	-	-	-	2	2	3	-
CO5	3	3	3	2	3	-	-	-	-	-	2	2	2	-
CO6	3	3	3	3	3	-	-	-	-	-	2	2	3	1

SEMESTER - VI

20ECPJ601 SDG NO. 4,11,15	INNOVATIVE DESIGN PROJECT	L	T	P	C
		0	0	2	1

OBJECTIVES:

- To understand the engineering aspects of design with reference to simple products
- To foster innovation in design of products
- To develop design that add value to products and solve technical problems

COURSE PLAN

Study: Take minimum three simple products, processes or techniques in the area of specialization, study, analyze and present them. The analysis shall be focused on functionality, construction, quality, reliability, safety, maintenance, handling, sustainability, cost etc. whichever are applicable. Each student in the group has to present individually; choosing different products, processes or techniques.

Design: The project team shall identify an innovative product, process or technology and proceed with detailed design. At the end, the team has to document it properly and present and defend it. The design is expected to concentrate on functionality; design for strength is not expected.

Note: *The one hour/week allotted for tutorial shall be used for discussions and presentations. The project team (not exceeding four) can be students from different branches, if the design problem is multidisciplinary.*

TOTAL: 30 PERIODS

EVALUATION

1. First evaluation (Immediately after first internal examination) : 20 marks
2. Second evaluation (Immediately after second internal examination): 20 marks
3. Final evaluation (Last week of the semester) : 60 marks

Note: *All the three evaluations are mandatory for course completion and for awarding the final grade.*

OUTCOMES:

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

1. Demonstrate innovatively on the development of components, products, processes or technologies in the engineering field. (K3)
2. Analyze the problem requirements and arrive workable design solutions. (K4)

CO - PO, PSO MAPPING :

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	3	3	3	3	2	2	3	3	3	2	3	3
CO2	3	3	3	3	3	3	2	2	3	3	3	2	3	3

SEMESTER - VI

20ECTP601 SDG NO. 4,11,15	SKILL ENHANCEMENT	L	T	P	C
		0	0	2	1

APTITUDE & COGNITIVE SKILLS – PHASE 1

OBJECTIVES:

- Enhance their quantitative ability.
- Enhance their reasoning ability
- Enhance their verbal ability.

UNIT I QUANTITATIVE ABILITY – VII **10**

Races And Games, Boats and Streams, Surds and Indices, Pipes and Cistern, Alligations And Mixtures

UNIT II QUANTITATIVE ABILITY – VIII **10**

Numbers, Problems on Numbers, Pick Wrong Number, Missing Number, Areas, Shapes, Perimeter.

UNIT III REASONING ABILITY – IV **8**

Data Interpretation Pie Charts, Data Interpretation Line Charts, Data Sufficiency (DS), Data Arrangements, LR – Arrangements, LR – Ranking.

UNIT IV VERBAL ABILITY – IV **10**

Sentence Correction, Sentence Improvement, Completing Statements, Sentence Formation, Paragraph Formation.

UNIT V CREATIVITY ABILITY – IV **7**

Dot Situation, Rule Detection, Embedded Images, Grouping Of Images, Image Analysis.

TOTAL : 45 PERIODS

REFERENCES

- Quantitative Aptitude for Competitive Exams by R. S. Agarwal
- Quantum CAT by Sarvesh Verma
- A Modern Approach to Logical Reasoning by R. S. Agarwal
- Verbal Ability and Reading Comprehension by Arun Sharma

PROBLEM SOLVING USING BASIC DATA STRUCTURES AND CST - PHASE 2

COURSE OBJECTIVES

To enable students to

- The objective of the course is to familiarize students with basic data structures and their use in fundamental algorithms.
- To understand CST modeling Techniques and simulation.
- To design and fabricate an antenna using suitable materials.

UNIT I LINKED LIST & STACK, QUEUE & HEAP 10

Linked List - Doubly Linked List Traversal, Circular Linked List, Structure, Node creation, Traversal Stack, Stack –Time Complexities of the Operations, Infix to Postfix/Prefix Conversation, Histogram Problem, Implementation - Using Array, Using Linked List, Queue Implementation - Queue using Stack

UNIT II BINARY TREE AND HASHING 6

Binary Tree - Types of Binary Tree,Balanced Tree, Degenerate or pathological Tree, Binary Search Tree, Inorder , Preorder , PostOrder and LevelOrder Traversal, Hashing, Linear Probing for Collision Handling, Union and Intersection of two Linked Lists

UNIT III TREES AND GRAPH 10

AVL Tree -Right-Left Imbalance, Left and Right Rotation, - Red Black Tree, Rules of coloring Left and Right Rotation,Graph terminology –Representation of graphs –Path matrix –Graph Traversal –BFS (breadth first search) –DFS (depth first search) –Minimum spanning Tree –Kruskal's Algorithm & Prim's Algorithm –Warshall's algorithm (shortest path algorithm).

UNIT IV CST MODELING TECHNIQUE AND SOLVER OVERVIEW 8

CST Microwave Studio Workflow- Basics View Options – Construct Objects - Component Library- Curves - Create Cone Structure Picks – Advanced -CAD Import Handling - CST Time and Frequency Domain Solvers- Time Domain Simulation -Time Domain vs. Frequency Domain Frequency Domain Simulation - CST Microwave Studio Solvers

UNIT V PORTS, MATERIALS AND BOUNDARIES 6

Ports -Ports for S-Parameter Computation- Discrete Ports -Waveguide Ports - Materials- Material Library Creating A New Material- Normal Materials - Metals -Surface/Transfer Impedance Models

TOTAL : 45 PERIODS

REFERENCES

1. Weiss, Mark. A. (2012), Data structures and algorithm analysis in Java. 3 edition. Harlow, Essex : Pearson (632 p).
2. Zobel, Justin (2014), Writing for Computer Science. 3 edition. Springer Verlag London Ltd (270 p).

ONLINE RESOURCES

1. https://www.digimat.in/nptel/courses/video/108101112/L58.html
2. http://www.nitttrc.edu.in/nptel/courses/video/108101112/lec55.pdf

OUTCOMES

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

1. Analyze the applications of linear data structure using Stack and Queue implementation. (K4)
2. Define the various hash functions and its implementation. (K2)
3. Apply the basic concepts of the Non Linear Data Structure - Trees and Graph. (K3)
4. Understand the basic principle of CST studio and simulation methods. [K2]
5. Design and analysis of radiating structures, filters and cavities.[K3]
6. Implementation of antenna models with suitable materials.[K4]

CO – PO, PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	-	2	-	-	-	-	-	-	-	-	-	-	-
CO2	3	-	2	-	-	-	-	-	-	-	-	-	-	-
CO3	3	2	2	2	-	-	-	-	-	-	-	-	-	-
CO4	3	2	1	2	3	1	1	1	1	2	-	-	1	2
CO5	1	1	3	2	3	2	3	1	-	-	-	-	2	1
CO6	1	3	1	1	1	2	1	2	-	-	1	-	2	2

SEMESTER - VII

20ECPC701 SDG NO. 4,7,9,11	RF AND MICROWAVE ENGINEERING	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To enhance the student knowledge in various parameters of microwave networks
- To equip the students with sound technical knowledge in microwave tubes
- To understand the fundamental concepts about microwave semiconductor devices

UNIT I HIGH FREQUENCY NETWORK THEORY AND PASSIVE DEVICES 10

Types of Interconnection of two port networks , Formulation of S Parameters, Properties of S-Parameters,Reciprocal and Lossless network, Transmission Matrix, RF Passive Components: Resistor, Inductor and Capacitor at high frequency, Chip Resistor, Chip capacitor and microstrip lines. Passive Devices: Waveguide corners- Bends - Twist - matched loads and movable shorts, Waveguide Tees, Circulator, Isolator, Directional Coupler and Hybrid Rings.

UNIT II MICROWAVE SIGNAL GENERATION 9

Review of Conventional Vacuum Triodes, Tetrodes and Pentodes, High Frequency effects in Vacuum Tubes, Two Cavity Klystron Amplifier - Transit time- velocity modulation - bunching - efficiency, Reflex Klystron, Slow wave structures, Helix Travelling wave tube amplifier, Magnetrons.

UNIT III MICROWAVE MEASUREMENTS 7

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

UNIT IV MICROWAVE SEMICONDUCTOR DEVICES 9

Tunnel Diode, Varactor diode, Crystal and Schottkey diode detector and mixers, Gunn diode oscillator, IMPATT diode oscillator and amplifier, RF Bipolar Junction Transistor, RF Field Effect Transistor: Construction, High Electron Mobility Transistor: Functionality, Frequency Response, Temperature Behaviour and Noise Performance.

UNIT V RADIO FREQUENCY CIRCUITS **10**

Amplifier Design: Characteristics, Power Relations, Stability considerations, Constant Gain, Noise Figure and Constant VSWR circles. Filter Design : Insertion loss methods, filter transforms and filter implementation.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. David M.Pozar, "Microwave Engineering", Wiley, 4th Edition, 2012.
2. Reinhold Ludwig and Gene Bogdanov, "RF Circuit Design - Theory and Applications", Prentice Hall, 2nd Edition, 2009.

REFERENCES:

1. Annapurna Das and Sisir K.Das, "Microwave Engineering", McGraw Hill Education (India) ,3rd Edition, 2015.
2. Robert.E.Colin, "Foundations of Microwave Engineering", John Wiley and Sons, 2nd Edition, 2007.
3. R.S. Rao, "Microwave Engineering", Prentice Hall of India, 2nd Edition, 2015.
4. Liao Y S, “Microwave devices and circuits”, Prentice Hall of India, New Delhi,2008.

WEB REFERENCES:

1. https://www.tutorialspoint.com/microwave_engineering

ONLINE RESOURCES:

1. https://nptel.ac.in/courses/117101119/
2. https://nptel.ac.in/courses/108101112/

OUTCOMES:

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

1. Analyze and characterize the given system or network based on its S-parameters. (K2)
2. Analyze the performance of Passive microwave components. (K2)
3. Analyze the working and performance of Microwave signal generators. (K2)
4. Knowledge on test & measurement methods for measuring power, frequency, losses,VSWR, Scattering and spectral parameters. (K3)
5. Analyze the working of high frequency semiconductor devices. (K2)

6. Design RF amplifiers to meet criteria based on stability, gain and noise figure requirements and also to design RF filters and Knowledge to implement using microstrip lines. (K3)

CO - PO, PSO MAPPING :

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	1	1	-	1	-	-	-	-	2	2	3	2
CO2	3	2	0	1	-	1	-	-	-	-	2	2	3	2
CO3	3	2	0	2	-	2	-	-	-	-	2	2	3	2
CO4	1	1	2	3	-	1	-	-	-	-	2	2	3	2
CO5	1	1	3	1	-	-	-	-	-	-	2	2	3	2
CO6	3	3	3	2	-	-	-	-	-	-	2	2	3	2

SEMESTER - VII

20ECPC702 SDG NO. 9, 11	OPTICAL COMMUNICATION	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To study about the various optical fiber modes, configuration and transmission characteristics of optical fibers
- To learn about the transmission characteristics associated with dispersion and polarization techniques
- To learn about the various optical sources, detectors and transmission techniques
- To explore various idea about optical fiber measurements and various coupling techniques
- To enrich the knowledge about optical communication systems and networks

UNIT I INTRODUCTION TO OPTICAL FIBERS 9

Introduction, need for optical communication, salient features of optical fibers, Ray theory of light guidance, Basic optical laws and definitions, Total internal reflection, Acceptance angle, Numerical aperture, Modes of a fiber, single and multimode fibers, Step-index and graded-index fibers, Fiber fabrication techniques. Electromagnetic nature of light, Boundary Conditions,

Reflection and transmission of waves at a boundary, Modal analysis of optical fibers, Linearly polarized modes.

UNIT II SIGNAL DEGRADATION IN OPTICAL FIBER 9

Attenuation, Absorption, Scattering losses, Bending losses, Core and Cladding losses, Signal dispersion, Inter symbol interference and bandwidth, Intra model dispersion, Material dispersion, Waveguide dispersion, Polarization mode dispersion, Intermodal dispersion. Pulse broadening In GI fibers, Mode Coupling, Design optimization of single mode fiber, Characteristics of single mode fiber, RI Profile cutoff wave length, Dispersion calculations, Mode field diameter.

UNIT III OPTICAL SOURCES AND DETECTORS 9

Sources and Deectors: Intrinsic and extrinsic materials, Direct and indirect band gaps, 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. PIN photo detector, Avalanche photo diodes, Photo detector noise, Noise sources, SNR, Detector response time, Avalanche multiplication noise.

UNIT IV OPTICAL RECEIVER, MEASUREMENTS AND COUPLING 9

Fundamental receiver operation, preamplifiers, error sources, Front end amplifiers, Digital receiver performance, Probability of error, Receiver sensitivity, Quantum limit. Optical power measurement, Attenuation measurement (Cut back & Insertion loss Methods), Dispersion measurement, Fiber Numerical Aperture Measurements, Fiber cut-off Wave length Measurements, Fiber diameter measurements, OTDR Field Applications: OTDR Trace-Attenuation Measurements and Fiber fault location.

Coupling: Source to Fiber Power Launching, Lensing Schemes for coupling improvement, Fiber-to-Fiber Joints, LED Coupling to Single mode Fibers-Fiber Splicing, Optical Connectors.

UNIT V OPTICAL COMMUNICATION SYSTEMS AND NETWORKS 9

Digital Transmission Systems, System design consideration, Point–to–Point links, Link power budget, Rise time budget, WDM Concepts and Components, Elements of optical networks, SONET/SDH, Optical Interfaces, SONET/SDH Rings and Networks, Broadcast and select WDM Networks, Wavelength Routed Networks, Optical ETHERNET, Solitons, All-Optical Networking, Evolution, Benefits, Challenges, and Future Vision.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. Gred Keiser, "Optical Fiber Communication", McGraw Hill Education (India) Private Limited, Fifth Edition, Reprint 2013.
2. John M. Senior, "Optical Fiber Communication", Pearson Education, Second Edition, 2007.

REFERENCES:

1. Rajiv Ramaswami, "Optical Networks", Second Edition, Elsevier, 2004.
2. J.Gower, "Optical Communication System", Prentice Hall of India, 2001.
3. Govind P. Agrawal, "Fiber Optic Communication Systems", Third Edition, John Wiley & sons, 2004.

WEB REFERENCES:

1. https://ieeexplore.ieee.org/abstract/document/6166843

ONLINE REFERENCES

1. https://onlinecourses.nptel.ac.in/noc18_ph06

OUTCOMES:

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

1. Realize basic elements in optical fibers, different modes and configurations. (K2)
2. Analyze the transmission characteristics associated with dispersion and polarization techniques. (K2)
3. Discuss optical sources, detectors, with their use in optical communication system. (K2)
4. Construct fiber optic receiver systems, and coupling techniques. (K3)
5. Measure Optical fiber parameters and performance (K2)
6. Design optical communication systems and its networks. (K3)

CO - PO, PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	3	3	2	1	1	-	-	-	-	2	2	1
CO2	3	3	2	2	3	1	-	-	-	-	-	2	2	1
CO3	3	3	3	1	2	-	1	-	-	-	-	-	2	1
CO4	3	3	3	1	2	-	-	-	1	1	-	-	2	1
CO5	3	2	2	1	1	1	-	-	-	-	-	-	2	1
CO6	2	1	-	-	-	-	2	1	-	-	-	-	2	1

SEMESTER - VII

20CSPC601 SDG NO. 4	ARTIFICIAL INTELLIGENCE	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To understand the various characteristics of Intelligent agents
- To learn the different search strategies in AI
- To learn to represent knowledge in solving AI problems
- To understand the different ways of designing software agents and about the various applications of AI

UNIT I INTRODUCTION 9

Introduction - Definition - Future of Artificial Intelligence – Characteristics of Intelligent Agents – Typical Intelligent Agents – Problem Solving Approach to Typical AI Problems – Search Strategies - Uninformed - Heuristics - Informed.

UNIT II PROBLEM SOLVING METHODS 9

Local Search Algorithms and Optimization Problems - Searching with Partial Observations – Constraint Satisfaction Problems – Constraint Propagation - Backtracking Search - Game Playing – Optimal Decisions in Games – Alpha-Beta Pruning - Stochastic Games.

UNIT III REPRESENTATION OF KNOWLEDGE 9

First Order Predicate Logic – Prolog Programming – Unification – Forward

Chaining - Backward Chaining – Resolution – Knowledge Representation - Ontological Engineering - Categories and Objects - Events - Mental Events and Mental Objects - Reasoning Systems for Categories - Reasoning with Default Information.

UNIT IV PLANNING AND LEARNING 9

Planning – Planning with State Space Search- Partial Order Planning Algorithm – Planning Graphs - Logical Formulation of Learning - Knowledge in Learning - Explanation-based Learning - Learning using Relevance Information.

UNIT V NATURAL LANGUAGE PROCESSING 9

Language models - Phrase Structure Grammars - Syntactic Analysis – Augmented Grammars and Semantic Interpretation - Application with NLP: Developing a Simple Chatbot - Types of Chatbot.

TOTAL: 45 PERIODS

TEXT BOOKS:

1 Stuart J Russell and Peter Norvig, "Artificial Intelligence: A Modern Approach", Prentice Hall, Third Edition, 2009.

2 Elaine Rich, Kevin Knight, Shivashankar B. Nair, "Artificial Intelligence", Tata McGraw-Hill Education, Third Edition, 2008.

REFERENCES:

1. M. Tim Jones, "Artificial Intelligence: A Systems Approach(Computer Science)", Jones and Bartlett Publishers, Inc.; First Edition, 2008.
2. Nils J. Nilsson, "The Quest for Artificial Intelligence", Cambridge University Press, 2009.
3. William F. Clocksin and Christopher S. Mellish, "Programming in Prolog: Using the ISO Standard", Springer, Fifth Edition, 2003.
4. George F Luger, "Artificial Intelligence: Structures and Strategies for Complex Problem Solving", Pearson Education, New Delhi, Fifth Edition, 2017.
5. Steven Bird, Ewan Klein and Edward Loper, "Natural Language Processing with Python", O'Reilly, 2009, https://www.nltk.org/book/.
6. I. Bratko, "Prolog: Programming for Artificial Intelligence", Addison-Wesley Educational Publishers Inc., Fourth Edition, 2011.

WEB REFERENCES:

1. https://books.google.co.in/books?id=uSvYmki2yg0C&printsec=frontcover&dq=Supervised+Learning&hl=en&sa=X&ved=0ahUKE

wigkNa1xN3oAhWawjgGHe8hAzoQ6AEIKDAA#v=onepage&q=Supervised% 20Learning&f=false

OUTCOMES:

Upon completion of the course, the students should be able to

1. Infer the agent characteristics and its problem solving approaches.(K2)
2. Select appropriate search algorithms for any AI problem.(K1)
3. Apply the principles of AI in game playing.(K3)
4. Construct and solve a problem using first order and predicate logic.(K3)
5. Identify the methods of solving problems using planning and learning.(K3)
6. Implement applications for Natural Language Processing that use Artificial Intelligence.(K3)

CO- PO, PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	3	2	3	2	1	1	-	1	-	-	1	2	3
CO2	2	3	2	3	2	1	1	-	1	-	-	1	3	3
CO3	2	3	2	3	2	1	1	-	1	-	-	1	3	2
CO4	2	3	2	3	2	1	1	-	1	-	-	1	3	3
CO5	2	3	2	3	3	1	1	-	2	-	-	1	2	2
CO6	2	3	2	3	3	1	1	-	2	-	-	1	2	3

SEMESTER - VII

20HSMG601 SDG NO. 4,8,9,10,12	PRINCIPLES OF ENGINEERING MANAGEMENT	L	T	P	C
		3	0	0	3

OBJECTIVES:

At the end of the course, the student is expected to

- Enable the students to study the evolution of Management
- Study the functions and principles of management
- Learn the application of the principles in an organization

UNIT I INTRODUCTION TO MANAGEMENT AND ORGANIZATIONS 9

Management – Science or Art – Manager Vs Entrepreneur – types of managers – Engineers as Managers. Evolution of Management – Scientific, human

relations, system and contingency approaches – Types of Business organization – Sole proprietorship, partnership, company-public and private sector enterprises – Organization culture and Environment – Current issues and future trends in Management; Industry 4.0 – Engineering management in modern business.

UNIT II PLANNING **9**

Planning, Technology Planning - Nature and purpose of planning – planning process – types of planning – objectives – setting objectives – policies – Planning premises – MBO – process - Principles and functions of engineering management – Planning Tools and Techniques – Decision making steps and process.

UNIT III ORGANISING **9**

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

UNIT IV DIRECTING AND CONTROLLING **9**

Foundations of individual and group behaviour – Motivation – theories and techniques–Leadership – Level 5 leadership - theories – Leadership as a determinant of Engineering management - Communication – process and barriers – effective communication – Communication and IT - System and process of controlling – budgetary and non-budgetary control techniques.

UNIT V INNOVATION AND TECHNOLOGY MANAGEMENT **9**

Innovation management of Product and Services, Role of R & D in Entrepreneurship, Breakthrough Innovation, Disruptive Innovation – Modern approaches in Engineering management – Green management, Lean management, Managing diversity. IPR – Principles of Ethics for Engineering Managers.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. Tripathy.P.C and Reddy.P.N, "Principles of Management", Tata McGraw Hill, 1999.

REFERENCES:

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

2. JAF Stoner, Freeman R. E. and Daniel R Gilbert, "Management", Pearson Education, 6th Edition, 2004.
3. Stephen A. Robbins and David A. Decenzo and Mary Coulter, "Fundamentals of Management", Pearson Education, 7th Edition, 2011.
4. Robert Kreitner and Mamata Mohapatra, "Management", Biztantra, 2008.
5. Harold Koontz and Heinz Weihrich, "Essentials of Management", Tata McGraw Hill,1998.

WEB RESOURCES:

1. https://www.managementstudyguide.com/organization-management.htm
2. https://nptel.ac.in/courses/110/105/110105034/
3. https://courses.lumenlearning.com/boundless-management/chapter/principles-of-management/

ONLINE RESOURCES:

1. https://nptel.ac.in/courses/110/105/110105033/

OUTCOMES:

Upon completion of the course, the students should be able to

1. Understand the evolution and basic concepts of engineering management. (K2)
2. Demonstrate the planning concepts for effective decision making process. (K2)
3. Describe the basic concepts of organization and its function. (K2)
4. Describe the ability to direct, leadership and communicate effectively. (K2)
5. Apply the concepts of innovation and technology management.(K3)

CO – PO, PSO MAPPING :

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

SEMESTER - VII

20ECPL701 SDG NO. 4,11,15	ADVANCED COMMUNICATION LABORATORY	L	T	P	C
		0	0	3	1.5

OBJECTIVES:

The student should be made to:

- Understand the working principle of optical sources, detector, fibers.
- Develop understanding of simple optical communication link.
- Understand the measurement of BER and Pulse broadening.
- Understand and capture an experimental approach to digital wireless communication.
- Understand actual communication waveforms that will be sent and received across wireless channel.

LIST OF OPTICAL EXPERIMENTS

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

LIST OF WIRELESS COMMUNICATION EXPERIMENTS

1. Wireless Channel Simulation including fading and Doppler effects.
2. Simulation of Channel Estimation, Synchronization & Equalization techniques.
3. Analysing Impact of Pulse Shaping and Matched Filtering using Software Defined Radios.
4. OFDM Signal Transmission and Reception using Software Defined Radios.

LIST OF MICROWAVE EXPERIMENTS

1. VSWR, Impedance Measurement and Impedance Matching.
2. Characterization of Directional Couplers, Isolators, Circulators.
3. Gunn Diode Characteristics.
4. Microwave IC – Filter Characteristics.
5. S parameters Characterization of RF/ Microwave components using Vector Network Analyzer (VNA).
6. Analysis of RF Signals using Spectrum Analyzer.

TOTAL: 45 PERIODS

LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS 3 STUDENTS PER EXPERIMENT:

S.NO	NAME OF THE EQUIPMENT	REQUIRED
1.	Trainer kit for carrying out LED and PIN diode characteristics, Digital multi meter and optical power meter	2
2.	Trainer kit for determining the mode characteristics and losses in optical fiber	2
3.	Trainer kit for analyzing Analog and Digital link performance, 2 Mbps PRBS Data source, 10 MHz signal generator and 20 MHz Digital storage Oscilloscope	2
4.	Kit for measuring Numerical aperture and Attenuation of fiber	2
5.	Advanced Optical fiber trainer kit for PC to PC communication, BER Measurement and Pulse broadening.	2
6.	MM/SM Glass and plastic fiber patch chords with ST/SC/E2000 connectors	2
7.	LEDs with ST / SC / E2000 receptacles – 650 / 850 nm	2
8.	PIN PDs with ST / SC / E2000 receptacles – 650 / 850 nm	2
9.	Digital Communications Teaching Bundle	2
10.	LabVIEW/MATLAB/Equivalent software tools	2
11.	Transmit/ Receive pair of NI USRP-2920 transceivers (50 MHz to 2.2 GHz)	2

OUTCOMES:

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

1. Analyze the performance of simple optical link by measurement of losses and analyzing the mode characteristics of fiber.(K2)
2. Understand the Eye Pattern, Pulse broadening of optical fiber and the impact on BER.(K3)
3. Estimate the Wireless Channel Characteristics and analyze the performance of the Wireless Communication System.(K2)
4. Understand the intricacies in Microwave System design.(K3)
5. Interpret the characteristics of active and passive microwave components using measurable parameters.(K3)
6. Solve the problem of operation inefficiency by measuring and tabulating the S-matrix.(K3).

CO - PO, PSO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	3	1	3	2	2	1	2	1	-	1	3	2
CO2	3	3	2	-	-	-	1	-	-	-	-	-	2	1
CO3	3	3	2	-	-	-	1	1	-	1	-	1	3	1
CO4	3	3	2	-	1	-	1	1	-	1	-	-	2	2
CO5	3	3	2	-	-	-	1	1	-	1	-	1	3	2
CO6	3	3	2	1	1	-	1	2	-	1	-	1	3	2

SEMESTER - VII

20CSPL601 SDG NO. 4	ARTIFICIAL INTELLIGENCE LABORATORY	L	T	P	C
		0	0	3	1.5

OBJECTIVES:

- To learn Prolog Program
- To Implement in Prolog, C and its working environment
- To Implement N-Queen problem and puzzle problem using Prolog
- To Analyze the problem using BFS and DFS algorithm

LIST OF EXPERIMENTS :

1. Study of Prolog.
2. Write simple fact for the statements using Prolog.
3. Write predicates - one converts centigrade temperature to Fahrenheit, other checks if a temperature is below freezing.
4. Write a program to solve 4-Queen problem.
5. Write a program to solve 8-Puzzle problem.
6. Write a program to solve any problem using Breadth First Search.
7. Write a program to solve any problem using Depth First Search.
8. Write a program to solve Travelling Salesman Problem.
9. Write a program to solve Water Jug problem.
10. Write a program to solve Missionaries and Cannibal problem.
11. Write a program to implement Library Management System.

TOTAL: 45 PERIODS

LAB REQUIREMENTS :

SOFTWARE : Prolog, Turbo C

OUTCOMES:

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

1 Interpret the concepts of Turbo and Prolog programming in AI.(K3)
2 Examine First order predicate logic to solve AI problems. (K4)
3 Apply Informed search strategies to solve AI problems.(K3)
4 Apply Uninformed search strategies to solve AI problems.(K3)
5 Select State Space Searching method to solve AI problems.(K3)
6 Demonstrate an application using Natural Language Processing. (K3)

CO - PO, PSO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1	2	-	1	-	1	-	-	-	-	-	1	2
CO2	3	2	2	1	1	-	-	-	-	-	-	-	2	2
CO3	3	2	1	-	2	-	-	-	-	-	-	1	2	1
CO4	3	2	1	-	2	-	-	-	-	-	-	1	2	1
CO5	2	2	2	-	1	-	1	-	-	-	-	-	2	2
CO6	2	2	1	2	2	-	-	-	-	-	-	-	2	1

SEMESTER - VII

20ECPJ701 SDG NO. 4, 6,7,8, 9,11,12,13, 17	PROJECT PHASE - I	L	T	P	C
		0	0	4	2

OBJECTIVES:

- To develop the ability to solve a specific problem right from its identification and literature review till the successful solution of the same.
- To train the students face reviews and viva voce examination.

GUIDELINES TO BE FOLLOWED:

The students may be grouped into 3 to 4 and work under a project supervisor and prepare a comprehensive project report after completing the work to the satisfaction of the supervisor (faculty member). The progress of the project is evaluated based on a minimum of three reviews. The review committee may be constituted by the Head of the Department. A project report is required at the end of the semester. The project work is evaluated based on oral presentation

and the project report jointly by external and internal examiners constituted by the Head of the Department. The Project Work Phase-I will have the following Sequence:

I. Problem Identification

1. A statement of system / process specifications proposed to be developed (Block Diagram / Concept tree)
2. List of possible solutions including alternatives and constraints
3. Cost benefit analysis
4. Time Line of activities

II. A report highlighting the design finalization [based on functional requirements and standards (if any)]

III. A presentation including the following:

1. Implementation Phase (Hardware / Software / both)
2. Testing and Validation of the developed system
3. Learning in the Project

IV. Consolidated report preparation

TOTAL: 60 PERIODS

OUTCOMES:

Upon completion of the course, the students should be able to

1. Comprehend an industrial or real life problem and identify right/ real issue with solution. (K2)
2. Analyze the necessary studies and review the literature, design a setup of equipment, complete the analysis. (K3)
3. Compose a project report based on the findings. (K6)

CO- PO, PSO MAPPING :

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
Co1	3	3	2	2	2	2	2	2	3	2	2	3	3	3
CO2	3	3	3	2	3	3	2	2	3	3	3	3	3	3
CO3	2	2	2	1	2	1	1	1	3	2	3	3	3	2

SEMESTER - VII

20ECTP701 SDG NO. 4 & 9	SKILL ENHANCEMENT	L	T	P	C
		0	0	2	1

APTITUDE & TECHNICAL REFRESHER & COMPANY SPECIFIC TRAINING AND TENSOR FLOW

OBJECTIVES:

- Enhance their quantitative ability.
- Enhance their reasoning ability
- Enhance their verbal ability.
- Understand the various layers and data loaders of Tensorflow
- Simulate various neural network models using tensor flow

UNIT I PRODUCT COMPANY SPECIFIC TRAINING – I 10

Product Specific Training for Amazon, Microsoft, IBM, ThoughtWorks, Juspay, Paypal, Mu Sigma, Zoho Corporation, VM Ware, Directi, Oracle, Wells Fargo, Goldman Sachs, Chargebee, Coda Global, Temenos, Freshworks, Adobe Systems., Ernst and Young, BA Continuum, Standard Chartered, AON Hewitt, Soliton Technologies, Payoda Technologies, Infoview Technologies, Athena Health Technology.

UNIT II PRODUCT COMPANY SPECIFIC TRAINING – II 10

Product Specific Training for TCS, Wipro, TechMahindra, InfoView, RobertBosch, NTT Data, Verizon, Payoda Technologies. CTS, Accenture, MindTree, MPhasis, Odessa Technologies, Vuram Technologies, Hewlett Packard, HCL.

UNIT III SERVICE COMPANY SPECIFIC TRAINING - I 10

Capgemini, Infosys, IBM, UGAM Solutions, Skava Systems, L&T Infotech, Bahwan Cybertech, Dhyan Infotech.

UNIT IV BASICS OF TENSOR FLOW 8

Tensors- Create a Tensor - Tensor Operations - The nn.Module -A word about Layers - Datasets and DataLoaders - Understanding Custom Datasets - Understanding Custom DataLoaders

UNIT V TRAINING A NEURAL NETWORK 7

Training a Neural Network - Loss functions - Custom Loss Function - Optimizers - Using GPU/Multiple GPUs

TOTAL : 45 PERIODS

REFERENCES :

1. Quantitative Aptitude for Competitive Exams by R. S. Agarwal
2. Quantum CAT by Sarvesh Verma
3. A Modern Approach to Logical Reasoning by R. S. Agarwal
4. Verbal Ability and Reading Comprehension by Arun Sharma
5 Neural Networks a Comprehensive Foundations, Simon Haykin, PHI edition
6 Learn TensorFlow 2.0 by Pramod Singh, 1 st Edition Apress publisher.

ONLINE RESOURCES

1. https://www.tensorflow.org/guide/basics
2. https://www.javatpoint.com/tensorflow-introduction

OUTCOMES

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

1. Apply quantitative and reasoning skills. (K3)
2. Improve verbal ability (K6)
3. Inculcate the training to the students in various MNCs. (K1)
4. Understand the various layers and data loaders of Tensorflow. [K2]
5. Design and implementation of neural networks with different functions [K4]
6. Simulating the neural network models with tensor flow. [K3]

CO - PO - PSO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	2	3	2	2	1	-	2	1	-	2	1	-
CO2	-	-	-	-	1	1	1	1	-	1	-	1	-	-
CO3	1	2	2	3	1	3	-	1	2	1	-	2	2	-
CO4	2	2	2	3	2	2	1	-	2	1	1	2	2	2
CO5	2	2	2	3	3	2	1	-	1	1	1	2	2	2
CO6	2	2	2	3	3	2	1	-	2	1	1	2	2	2

SEMESTER - VIII

20ECPJ801 SDG NO. 4,6,7, 8, 9,11,12,13,17	PROJECT PHASE-II	L	T	P	C
		0	0	8	4

OBJECTIVES:

- To develop the ability to solve a specific problem right from its identification and literature review till the successful solution of the same.
- To train the students face reviews and viva voce examination

GUIDELINES TO BE FOLLOWED:

The students may be grouped into 3 to 4 and work under a project supervisor and prepare a comprehensive project report after completing the work to the satisfaction of the supervisor (faculty member). The progress of the project is evaluated based on a minimum of three reviews. The review committee may be constituted by the Head of the Department. A project report is required at the end of the semester. The project work is evaluated based on oral presentation and the project report jointly by external and internal examiners constituted by the Head of the Department. The Project Work Phase-II will have the following Sequence:

I. Problem Identification

1. A statement of system / process specifications proposed to be developed (Block Diagram / Concept tree)
2. List of possible solutions including alternatives and constraints
3. Cost benefit analysis
4. Time Line of activities

II. A report highlighting the design finalization [based on functional requirements and standards (if any)]

III. A presentation including the following

1. Implementation Phase (Hardware / Software / both)
2. Testing and Validation of the developed system
3. Learning in the Project

IV. Consolidated report preparation

TOTAL: 120 PERIODS

OUTCOMES :

Upon completion of the course, the students should be able to

1. Comprehend an industrial or real life problem and identify right/ real issue with solution. (K2)
2. Analyze the necessary studies and review the literature, design a setup of equipment, complete the analysis. (K3)
3. Compose a project report based on the findings. (K6)

CO- PO, PSO MAPPING :

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	2	2	2	2	2	2	3	2	2	3	3	3
CO2	3	3	3	2	3	3	2	2	3	3	3	3	3	3
CO3	2	2	2	1	2	1	1	1	3	2	3	3	3	2

PROFESSIONAL ELECTIVES - I

20ECEL501 SDG NO. 4, 9	ADVANCED COMMUNICATION SYSTEMS AND TECHNIQUES	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To learn about modern communication systems and techniques
- To deal with Information theory and channel capacity
- To learn source and channel coding techniques
- To acquire knowledge about Television systems
- To understand Satellite systems & orbits

UNIT I MODERN COMMUNICATION SYSTEMS 9

Introduction to modern communication system, techniques and frequency band allocation

UNIT II INFORMATION THEORY 9

Concept of amount of information, information units Entropy: marginal, conditional, joint and relative entropies, relation among entropies Mutual information, information rate, channel capacity.

UNIT III SOURCE CODING AND CHANNEL CODING 9

Introduction to source coding and channel coding techniques, Shannon Fano coding, Shannon Fano Elias coding, Huffman coding, Parity check coding.

UNIT IV BASIC CONCEPT OF TELEVISION SYSTEM 9

Image characteristics; Interlaced scanning, horizontal and vertical resolution, video bandwidth; Luminance and chrominance signals, composite video signal; TV camera; Transceiver architecture for TV; Smart TVs: Digital TV and video compression, HDTV, LED, LCD and Plasma TV.

UNIT V BASIC CONCEPT OF SATELLITE COMMUNICATION SYSTEM 9

Introduction to satellite systems; Orbital period and velocity; Coverage angle and slant range; Satellite link design; Multiple access techniques used in satellite systems.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. Haykin, S., "Communication Systems", Fourth Edition, John Wiley & Sons, 2001.

2. Tomasi W., "Advanced Electronic Communication Systems", Pearson/Prentice-Hall, Sixth Edition. 2004.

REFERENCE BOOKS:

1. Kennedy G., Davis B., "Electronic Communication Systems", Tata McGraw-Hill, Fourth Edition 2008.
2. Proakias, J.G., and Salehi, M., "Communication Systems Engineering", Second Edition, Pearson Education. 2002
3. Roddy, D. and Coolen, V., "Electronic Communications", Fourth Edition Prentice-Hall of India 1997.
4. B.P.Lathi, "Modern Digital and Analog Communication Systems", Third Edition, Oxford University Press, 2007.
5. B.Sklar, "Digital Communications Fundamentals and Applications", Second Edition, Pearson Education, 2007.

WEB REFERENCES:

1 https://nptel.ac.in/courses/108/102/108102117/
2 https://nptel.ac.in/courses/117/108/117108097/
3 https://www.udemy.com/share/102l8U/

ONLINE RESOURCES:

1 https://www.coursera.org/learn/information-theory
2 https://ocw.mit.edu/courses/electrical-engineering-and-computer science/ 6-441-information-theory-spring-2016/

OUTCOMES:

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

1. Discuss advanced communication systems and techniques(K2)
2. Demonstrate the measurement of Information theory and coding (K2)
3. Explain Channel capacity and Entropy of modern communication systems(K2)
4. Interpret the characteristics of television (K2)
5. Generalize the concept of satellite communication systems (K2)
6. Illustrate Smart TV systems (K2)

CO- PO, PSO MAPPING :

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	2	2	1	1	-	-	-	-	1	1	3	2
CO2	3	3	3	3	3	1	-	-	-	-	1	1	3	2
CO3	3	3	2	2	3	2	-	-	-	-	2	2	3	2
CO4	3	3	3	2	3	2	-	-	-	-	2	2	3	2
CO5	3	3	3	2	3	2	-	-	-	-	2	2	3	2
CO6	3	3	3	2	3	2	-	-	-	-	2	2	3	2

PROFESSIONAL ELECTIVES - I

20ECEL502 SDG NO. 3,4,11,15	INDUSTRIAL IoT	L	T	P	C
		3	0	0	3

OBJECTIVES:

- Introduce how IoT has become a game changer in the new economy where the customers are looking for integrated value
- Bring the IoT perspective in thinking and building solutions
- Introduce the tools and techniques that enable IoT solution and Security aspects

UNIT I INTRODUCTION **9**

Introduction to IOT, IOT Vs. IIOT, History of IIOT, Components of IIOT -Sensors, Interface, Networks, People &Process, Hype cycle, IOT Market, Trends& future Real life examples, Key terms – IOT Platform, Interfaces, API, clouds, Data Management Analytics, Mining &Manipulation; Role of IIOT in Manufacturing Processes Use of IIOT in plant maintenance practices, Sustainability through Business excellence tools; Challenges & Benefits in implementing IIOT.

UNIT II ARCHITECTURES **9**

Overview of IOT components; Various Architectures of IOT and IIOT, Advantages & disadvantages, Industrial Internet - Reference Architecture; IIOT System components: Sensors, Gateways, Routers, Modem, Cloud brokers, servers and its integration, WSN,WSN network design for IOT.

UNIT III SENSOR AND INTERFACING **9**

Introduction to sensors, Transducers, Classification, Roles of sensors in IIOT, Various types of sensors, Design of sensors, sensor architecture, special requirements for IIOT sensors, Role of actuators, types of actuators. Hardwire the sensors with different protocols such as HART, MODBUS-Serial & Parallel, Ethernet, BACNet , Current, M2M etc.

UNIT IV PROTOCOLS AND CLOUD **9**

Need of protocols; Types of Protocols, Wi-Fi, Wi-Fi direct, Zigbee, Z wave, Bacnet, BLE,Modbus, SPI , I2C, IIOT protocols –COAP, MQTT,6lowpan, lwm2m, AMPQ IIOT cloud platforms : Overview of cots cloud platforms, predix, thingworks, azure etc. Data analytics, cloud services, Business models: Saas, Paas, Iaas.

UNIT V PRIVACY, SECURITY AND GOVERNANCE **9**

Introduction to web security, Conventional web technology and relationship with IIOT, Vulnerabilities of IoT, Privacy, Security requirements, Threat analysis, Trust, IoT security tomography and layered attacker model, Identity establishment, Access control, Message integrity, Non-repudiation and availability, Security model for IoT, Network security techniques Management aspects of cyber security.

TOTAL: 45 PERIODS

TEXT BOOKS:

1 Daniel Minoli, "Building the Internet of Things with IPv6 and MIPv6: The Evolving World of M2M Communications", ISBN: 978-1-118-47347-4, Willy Publications

2 Bernd Scholz-Reiter, Florian 2. Michahelles, "Architecting the Internet of Things", ISBN 978-3- 642- 19156-5 e-ISBN 978-3-642-19157-2, Springer

REFERENCES:

1. Hakima Chaouchi, " The Internet of Things Connecting Objects to the Web" ISBN : 978-1-84821-140-7, Willy Publications
2. Olivier Hersent, David Boswarthick, Omar Elloumi, The Internet of Things: Key Applications and Protocols, ISBN: 978-1-119-99435-0, 2 nd Edition, Willy Publications
3. Inside the Internet of Things (IoT), Deloitte University Press
4. Internet of Things- From Research and Innovation to Market Deployment;By Ovidiu & Peter; River Publishers Series
5. Five thoughts from the Father of the Internet of Things; by By Phil Wainewright – Kevin Ashton

6. How Protocol Conversion Addresses IIoT Challenges: White Paper By RedLion.

WEB REFERENCES:

1 https://nptel.ac.in/courses/106/105/106105195/

2 https://freevideolectures.com/course/4231/nptel-introduction-industry-industrial-internet-things

ONLINE RESOURCES:

1 https://www.coursera.org/lecture/digital-thread-implementation/the-industrial-internet-of-things-iiot-za9wH

2 https://swayam.gov.in/nd1_noc20_cs24/preview

OUTCOMES:

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

1. Review the components and key terms in IOT (K1)
2. Describe the architectures of IOT, IIOT (K1)
3. Understand, design and develop the real life IoT applications using off the shelf hardware and software (K1)
4. Understand various IoT layers and their relative importance (K1)
5. Study various IoT platforms and Security (K1)
6. Realize the importance of Data Analytics in IoT (K1)

CO – PO, PSO MAPPING :

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	1	-	-	-	-	-	-	-	-	1	1	1	1
CO2	3	1	2	2	-	2	-	-	-	-	2	2	3	2
CO3	3	1	3	2	-	2	-	-	-	-	2	2	3	2
CO4	3	1	3	2	-	2	-	-	-	-	2	2	3	2
CO5	3	1	3	2	2	2	-	-	-	-	2	2	3	2
CO6	3	1	3	2	2	2	-	-	2	3	2	2	3	2

PROFESSIONAL ELECTIVES - I

20ECEL503 SDG No. 04,09	FPGA AND ASIC DESIGN	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To learn the architecture of different types of FPGA
- To familiarize the different types of programming technologies and logic devices.
- To study the design flow of different types of ASIC.
- To analyze the synthesis, Simulation and testing of systems.
- To understand the design issues of SOC.

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 and their speed performance Case studies: Altera MAX 5000 and 7000 - Altera MAX 9000 – Spartan II and Virtex II FPGAs - Apex and Cyclone FPGAs

UNIT II OVERVIEW OF ASIC AND PLD **9**

Types of ASICs - Design flow – CAD 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 ASIC PHYSICAL DESIGN **9**

System partition -partitioning - partitioning methods – interconnect delay models and measurement of delay - floorplanning - placement – Routing : global routing - detailed routing - special routing - circuit extraction - DRC

UNIT IV LOGIC SYNTHESIS, SIMULATION AND TESTING **9**

Design systems - Logic Synthesis - Half gate ASIC -Schematic entry - Low level design language - PLA tools -EDIF- CFI design representation. Verilog and logic synthesis -VHDL and logic synthesis - types of simulation -boundary scan test - fault simulation - automatic test pattern generation.

UNIT V SOC DESIGN **9**

Design Methodologies – Processes and Flows - Embedded software development for SOC – Techniques for SOC Testing – Configurable SOC –

Hardware / Software codesign Case studies: Digital camera, Bluetooth radio / modem, SDRAM and USB.

TOTAL: 45 PERIODS

TEXT BOOKS:

1 John V. Oldfield, Richard C Dore, Field Programmable Gate Arrays, Wiley Publications1995.

2 M.J.S .Smith, "Application Specific Integrated Circuits, Addison -Wesley Longman Inc.,1997

3 R. Rajsuman, System-on-a-Chip Design and Test. Santa Clara, CA: Artech House Publishers, 2000.

REFERENCES:

1 S. Trimberger, Field Programmable Gate Array Technology, Edr, Kluwer Academic Publications, 1994.

2 John V.Oldfield, Richard C Dore, Field Programmable Gate Arrays, Wiley Publications1995

3 P.K.Chan & S. Mourad, Digital Design Using Field Programmable Gate Array, Prentice Hall, 1994.

4 Parag.K.Lala, Digital System Design using Programmable Logic Devices , BSP, 2003.

5 S. Brown, R. Francis, J. Rose, Z. Vranesic, Field Programmable Gate Array, Kluwer Pubin, 1992.

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

WEB REFERENCES:

1. https://nptel.ac.in/courses/117108040/
2. https://nptel.ac.in/courses/117106092/
3. https://freevideolectures.com/course/2327/vlsi-circuits/23
4. https://freevideolectures.com/course/2327/vlsi-circuits/51

ONLINE RESOURCES:

1. https://www.intel.com/content/dam/www/programmable/us/en/pdfs/literature/an/an311.pdf
2. https://www.intrinsix.com/soc-design-fpga-design
3. https://hardwarebee.com/fpga-vs-asic-difference/

OUTCOMES:

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

1 Describe the basic architecture types in FPGA.(K2

2 Interpret different types of programming technologies and logic devices.(K2)
3 Analyze the synthesis, Simulation and testing of systems.(K4)
4 Describe the basic architecture types in ASIC. (K2)
5 Apply different high performance algorithms in ASICs.(K3)
6 Discuss the design issues of SOC.(K2)

CO - PO, PSO MAPPING :

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	2	1	-	1	-	-	-	-	-	2	3	2
CO2	3	2	2	3	3	1	2	-	1	-	1	2	2	2
CO3	3	2	1	3	3	1	-	-	1	-	-	2	2	2
CO4	3	2	2	1	-	1	-	-	-	-	-	2	3	2
CO5	3	2	1	2	1	2	-	-	-	-	-	2	2	1
CO6	3	2	1	3	3	2	2	-	-	-	1	2	3	2

PROFESSIONAL ELECTIVES - I

20ECEL504 SDG NO 04,09	PROGRAMMABLE LOGIC CONTROLLERS	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To impart knowledge on the principle and working of Programmable Logic Controllers
- To learn PLC programming.
- To study Ladder Logic Diagrams.
- To implement Counter and Timer logic.
- To understand PLC Functions.

UNIT I PLC BASICS AND PROGRAMMING 9

PLC system, I/O modules and interfacing, CPU processor, programming Equipment, programming formats, construction of PLC ladder diagrams, Devices connected to I/O modules. Input instructions, outputs, operational procedures, programming examples using contacts and coils.

UNIT II LADDER DIAGRAMS AND REGISTERS 9

Digital logic gates, programming in the Boolean algebra system, conversion examples Ladder Diagrams for process control: Ladder diagrams & sequence listings, ladder diagram construction and flowchart for spray process system. PLC Registers: Characteristics of Registers, module addressing, holding registers, Input Registers, Output Registers.

UNIT III PLC FUNCTIONS 9

Timer functions & Industrial applications, counters, counter function industrial applications, Arithmetic functions, Number comparison functions, number conversion functions. Data Handling functions: SKIP, Master control Relay, Jump, Move, FIFO, FAL, ONS, CLR & Sweep functions and their applications.

UNIT IV ANALOG PLC OPERATION 9

Analog modules & systems, Analog signal processing, Multi bit Data Processing, Analog output Application Examples, PID principles, position indicator with PID control, PID Modules, PID tuning, PID functions.

UNIT V TIMERS AND COUNTERS 9

Timer Instructions: ON Delay timer instruction, Retentive Timer, Cascading Timers, Example: Industrial Applications, Industrial Process Timing Applications. Counter Instructions: Up counter, Down Counter and Up/Down Counter instructions, Cascading Counters, Combining counter and Timer Functions.

TOTAL: 45 PERIODS

TEXT BOOKS:

1 Programmable Logic Controllers- Principles and Applications by John W. Webb & Ronald A. Reiss, Fifth Edition, PHI, 2009.

2 Programmable Logic Controllers- Programming Method and Applications JR. Hackworth &F.D Hackworth Jr. Pearson, 2004.

REFERENCES:

1 Programmable logic controller by Frank D. Petruzella, Tata McGraw-Hill publication,2007.

2 Introduction to programmable logic controller by Gary dunning,Thomson Asia Pte Ltd.Publication, Singapore

3 Sinha, Priyabrata," Speech Processing in Embedded Systems",Springer 2010.

4 Programmable Logic Controllers: Principles and Applications by John W. Webb and Ronald A.Reis,Prentice – Hall India publication,Fifth edition,2009
5 Programmable Logic Controllers by W. Bolton, Elsevier Newnes publication, Fourth edition,2007.
6 Programmable Controllers An engineer's guide by E.A.Parr, Elsevier Newnes publication Third edition 2008.

WEB REFERENCES:

1 https://electrical-engineering-portal.com/resources/plc-programming-training
2 https://udemy.com/plc
3 https://www.solisplc.com/tutorials/how-to-read-ladder-logic

ONLINE RESOURCES:

1 https://www.intechopen.com/books/programmable-logic-controller
2 https://www.intechopen.com/books/programmable-logic-controller/new -applications -using-plcs-in-access-netWorks

OUTCOMES:

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

1 Describe the working of PLCs. (K2)
2 Develop programs for simple applications(K3)
3 Design Ladder Diagrams for the process.(K3)
4 Write PLC programs using Functions (K3)
5 Create Analog PLC systems.(K4)
6 Define the Timer and Counter Functions.(K2)

CO - PO, PSO MAPPING :

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	3	1	-	1	-	-	-	-	-	2	3	2
CO2	3	3	3	3	3	1	-	-	-	-	-	2	2	2
CO3	3	3	3	3	3	1	-	-	-	-	-	2	2	2
CO4	3	3	3	2	1	2	--	-	-	-	-	2	2	2
CO5	3	3	3	3	3	2	-	-	-	--	-	2	3	2
CO6	3	3	3	3	1	2	-	-	-	-	-	2	3	2

PROFESSIONAL ELECTIVES - I

20ECEL505 SDG NO. 4, 9, 11	SENSORS AND RFID	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To acquire knowledge in different types passive sensors
- To get insight about self generating sensor.
- To realize the applications of sensors
- To Understand and designing Radio frequency identification (RFID) systems, middleware architectures for real-world applications.

UNIT I PASSIVE SENSORS 9

Sensor classification, primary sensors, magnetoresistors, light dependent resistors, resistive hygrometers, resistive gas sensors, liquid conductivity sensors, capacitive sensors, inductive sensors, electromagnetic sensors.

UNIT II SELF GENERATING, DIGITAL AND INTELLIGENT SENSORS 9

Thermoelectric sensor, Piezoelectric sensor, Pyroelectric sensor, Photovoltaic sensor, electrochemical sensors, position encoder, resonant sensors, SAW sensors, Digital flow meter.

UNIT III SENSORS BASED ON SEMICONDUCTORS 9

Thermometer based on semiconductor junction, magnetodiode, magnetotransistor, photodiode phototransistor, sensors based on MOSFET, Charge coupled sensors, CCD imaging sensors, Ultrasonic based sensors.

UNIT IV OVERVIEW OF RFID TECHNOLOGY 9

Introduction- Core components of RFID systems-RFID Tags- RFID Interrogators- RFID Controllers- Frequency- selection criteria for RFID systems- Automatic identification and data capture systems- Smart Tags vs. Barcodes- RFID technology in supply chain management.

UNIT V RFID MIDDLEWARE AND INFORMATION TECHNOLOGY INTEGRATION 9

RFID Middleware- Recent focus on middleware- Core functions of RFID middleware- Middle ware as part of an RFID system-The EPC architecture-Present state of middleware development-Applications of RFID Technology.

TOTAL: 45 PERIODS

TEXT BOOKS:

1 Sensors and Signal Conditioning, Ramón Pallás-Areny, John G. Webster, Second Edition published by Wiley 2012

2 Amin Rida and Manos M. Tentzeris, RFID-Enabled Sensor Design and Applications (Artech House Integrated Microsystems), 2011, First edition, Artech House Publishers, UK.

REFERENCES:

1 Miodrag Bolic, David Simplot-Ryl, and Ivan Stojmenovic, RFID Systems: Research Trends and Challenges, 2011,First edition., Wiley, USA

2 John Vetelino, Aravind Reghu, Introduction to Sensors, 2020, First edition., 2011, CRC Press

OUTCOMES:

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

1 Design sensor systems (K2)

2 Describe a smart systems (K1)

3 Explain the operating principles and applications of sensors (K1)

4 Design systems using Sensors based on Semiconductors. (K3)

5 Understand the components of RFID technology and its concepts (K1)

6 Design a RF component or a product applying the standards and with realistic constraints at a rudimentary level. (R3)

CO - PO - PSO MAPPING :

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	2	1	1	1	1	-	1	1	1	1	3	2
CO2	3	3	3	1	1	1	1	-	1	1	1	1	3	2
CO3	3	3	3	1	1	2	2	1	1	1	1	1	3	3
CO4	3	2	3	1	1	2	2	1	1	1	1	1	2	2
CO5	3	3	3	1	1	1	2	-	1	1	1	1	3	2
CO6	3	3	3	1	1	1	2	-	1	1	1	1	3	2

PROFESSIONAL ELECTIVES - I

20ECEL506 SDG NO. 4, 9, 11	SUSTAINABLE ENERGY AND ENERGY MANAGEMENT	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To provide students with a general awareness on the importance of energy and its conservation, its impact on society.
- To enable students with different backgrounds to understand the different aspects of energy engineering.
- To understand the various energy sources, energy conversion processes
- To understand the energy management, energy audit and energy conservation measures
- To understand the economic aspects of renewable energy based power generation.

UNIT I SUSTAINABLE ENERGY RESOURCES 9

Energy resources, Energy conversion processes and devices – Energy conversion plants – Conventional - Thermal, Hydro, Nuclear fission , and Non – conventional – Solar, Wind Biomass, Fuel cells, Magneto Hydrodynamics and Nuclear fusion. Energy from waste, Energy plantation.

UNIT II ENERGY MANAGEMENT 9

Energy Management – Definitions and significance – objectives –Characterizing of energy usage – Energy Management program – Energy strategies and energy planning Energy Audit – Types and Procedure – Optimum performance of existing facilities – Energy management control systems – Computer applications in Energy management.

UNIT III ENERGY CONSERVATION 9

Energy conservation – Principles – Energy economics – Energy conservation technologies – cogeneration – Waste heat recovery – Combined cycle power generation – Heat Recuperators – Heat regenerators – Heat pipes – Heat pumps – Pinch Technology Energy Conservation Opportunities.

UNIT IV SOCIO-ECONOMICAL ASPECTS OF ENERGY RESOURCES 9

General concepts-Economical impacts Rural development, Poverty alleviation, Employment; Security of supply and use Environmental and ethical concerns Economical aspects of renewable energy systems vs large hydro and thermal power projects.

UNIT V SUSTAINABILITY ISSUES OF ENERGY USE AND INTERNATIONAL TREATIES & CONVENTION ON ENVIRONMENTAL MITIGATION **9**

Externalities - Future Energy Systems – Clean Energy Technologies United Nations Frameworks Convention on climate change (UNFCC) Various convention and treaties at international level aiming at CO2 mitigation

TOTAL: 45 PERIODS

TEXT BOOKS:

1. Amlan Chakrabarti, Energy Engineering and Management, Prentice Hall India, 2011
2. Rai G. D., Non-conventional Energy Sources, Khanna Publishers, 2011.
3. Eastop T. D. and D. R. Croft, Energy Efficiency for Engineers & Technologists, Longman, 1990.
4. Albert Thumann P. E. and W. J. Younger, Handbook of Energy Audits, Fairmont Press, 2008

REFERENCES:

1. Ristinen RA. Kraushaar JJ. Energy and the Environment, Second edition, John Wilet & Sons, 2006
2. Banerjee BP. Handbook of Energy and Environment in India, Oxford University Press, 2005.
3. MC Dass, Fundamentals of Ecology, Tata McGraw Hill, 1994
4. Kaushik ND. Kaushik K. Energy, Ecology & Environment, Capital Publishing, 2004.
5. De AK. Environmental hemistry, New Age International Publishers, 2005

OUTCOMES:

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

1 Realize the impact of energy on society (K2)
2 Describe the need for sustainable energy, global and Indian energy policies. (K1)
3 Gain knowledge on various techniques of energy management and conservation. (K1)
4 Explain the basic ideas of renewable energy sources. (K1)
5 Gain insight in specialist manpower required to meet the challenges of the energy sector. (K1)
6 Understand the economic aspects of renewable energy based power generation. (K1)

CO - PO, PSO MAPPING :

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	2	2	2	1	1	-	2	3	2	2	3	2
CO2	3	3	3	3	2	1	1	-	2	3	3	3	3	2
CO3	3	3	3	2	3	2	2	1	3	2	3	3	3	3
CO4	3	2	3	2	3	2	2	1	3	2	2	2	2	2
CO5	3	3	3	3	2	1	2	-	2	2	2	3	3	2
CO6	3	3	3	3	2	1	2	-	2	2	2	3	3	2

PROFESSIONAL ELECTIVES - I

20ECEL507 SDG NO. 4, 9, 11	SENSORS AND MEASUREMENTS	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To understand the purpose of measurement, the methods of measurements, errors associated with measurements.
- To know the principle of transduction, classifications and the characteristics of different transducers and study its biomedical applications.
- To know the different display and recording devices.

UNIT I SCIENCE OF MEASUREMENT 9

Measurement System – Instrumentation – Classification and Characteristics of Transducers – Static and Dynamic – Errors in Measurements – Calibration – Primary and secondary standards.

UNIT II DISPLACEMENT, PRESSURE, TEMPERATURE SENSORS 9

Resistive Transducers: Strain Gauge: Gauge factor, sensing elements, configuration, biomedical applications; strain gauge as displacement & pressure transducers, RTD materials & range, Characteristics, thermistor characteristics, biomedical applications of Temperature sensors Capacitive transducer, Inductive transducer, LVDT, Active type: Thermocouple –characteristics.

UNIT III PHOTOELECTRIC AND PIEZOELECTRIC SENSORS 9

Phototube, scintillation counter, Photo Multiplier Tube (PMT), photovoltaic,

Photoconductive cells, photo diodes, phototransistor, comparison of photoelectric transducers, spectrophotometric applications of photo electric transducers. Piezoelectric active transducer and biomedical applications as pressure & Ultrasound transducer.

UNIT IV SIGNAL CONDITIONING & SIGNAL ANALYSER 9

AC and DC Bridges – Wheatstone bridge, Kelvin, Maxwell, Hay, Schering – Concepts of filters, Pre-amplifier – impedance matching circuits – isolation amplifier. Spectrum analyzer.

UNIT V DISPLAY AND RECORDING DEVICES 9

Digital voltmeter – Multimeter – CRO – block diagram, CRT – vertical & horizontal deflection system, DSO, LCD monitor, PMMC writing systems, servo recorders, photographic recorder, magnetic tape recorder, Inkjet recorder, thermal recorder. Demonstration of the display and recording devices.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. Doebelin E.O. and Manik D.N., "Measurement Systems", Tata McGraw-Hill Education Pvt. Ltd., Sixth Edition, 2011.
2. L.A Geddes and L.E.Baker, "Principles of Applied Biomedical Instrumentation", John Wiley and sons, Third Edition, Reprint 2008.

REFERENCES:

1. A.K.Sawhney, "Electrical & Electronics Measurement and Instrumentation", Dhanpat Rai&Co, New Delhi, Seventeenth Edition, 2004.
2. Khandpur R.S, "Handbook of Biomedical Instrumentation", Tata McGraw Hill, New Delhi, Third Edition, 2014.
3. Leslie Cromwell, Fred J. Weibell, Erich A. Pfeiffer, "Biomedical Instrumentation and Measurement", Prentice Hall India Pvt. Ltd, New Delhi, Second Edition, Reprint, 2013.
4. Albert D.Helfrickand William D.Cooper, "Modern Electronic Instrumentation and Measurement Techniques", Prentice Hall of India, 2007
5. John G.Webster,Medical Instrumentation Application and Design,fourth edition,Wiley India Pvt Ltd,New Delhi.

ONLINE RESOURCE

1. https://nptel.ac.in/courses/108/108/108108147/

WEB RESOURCES

1. https://www.youtube.com/watch?v=q8UuRkOQ9A0
2. https://www.youtube.com/watch?v=7TabKYSbdH4

COURSE OUTCOMES:

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

1 Classify different methods of measurements.(K2)
2 Discuss the principle of different sensors and its applications.(K2)
3 Analyze the characteristics of different transducers.(K4)
4 Analyse the function of various signal conditioning circuits. (K4)
5 Distinguish different display and recording devices for various applications.(K2)
6 Classify the application of sensors and transducer on biomedical applications.(K2)

CO – PO, PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	-	-	-	-	2	-	-	-	-	-	2	1	1
CO2	3	3	3	3	-	-	–	–	-	2	-	2	1	1
CO3	3	3	3	3	-	-	–	–	-	–	-	2	1	1
CO4	3	3	3	3	–	–	-	-	-	-	-	2	1	1
CO5	3	–	–	3	-	-	–	–	-	–	-	3	1	1
CO6	3	2	2	2	–	3	–	–	-	–	–	2	1	1

PROFESSIONAL ELECTIVES - I

20ECEL508 SDG NO. 4, 9, 11	CONTROL SYSTEMS ENGINEERING	L	T	P	C
		3	0	0	3

OBJECTIVES:

- Describe the Modeling of Electrical & Mechanical systems & representation of systems
- Test the time domain analysis of control systems required for stability analysis
- Test the frequency domain analysis
- Examine the stability analysis of control systems
- Design of compensators

UNIT I SYSTEM MODELLING AND REPRESENTATION 9

Control System: Terminology and Basic Structure-Feedforward and Feedback control theory- Electrical and Mechanical Transfer Function Models-AC and DC servomotors-Block diagram Models-Signal flow graphs models.

UNIT II TIME RESPONSE ANALYSIS 9

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

UNIT III FREQUENCY RESPONSE AND SYSTEM ANALYSIS

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

UNIT IV STABILITY ANALYSIS 9

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

UNIT V COMPENSATOR DESIGN AND STATE VARIABLE MODEL 9

Compensators: Performance criteria – Lag and Lead compensators networks– Design of Lag, Lead and Lag-Lead compensators using Bode plot method. Concepts of State, State variable, State model-State models for simple electrical system– Phase variable model – Canonical model- Controllability and Observability using Kalman's test method.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. M.Gopal, "Control System–Principles and Design", Tata McGraw Hill, Fourth Edition, 2012.
2. Norman Nise, "Control System Engineering" John Wiley & Sons, Sixth Edition, 2011.

REFERENCES:

1. J.Nagrath and M.Gopal, "Control System Engineering", New Age International Publishers, Fifth Edition, 2007.
2. Katsuhiko Ogata, "Modern Control Engineering", Fifth Edition, Prentice Hall of India, 2012.
3. S.K.Bhattacharya, "Control System Engineering", Third Edition, Pearson, 2013.

4. Benjamin.C.Kuo, "Automatic Control Systems", Prentice Hall of India, 7th Edition, 1995.
5. Katsuhiko Ogata, "Discrete time control systems", Second Edition, Prentice Hall of India, 1995.

WEB REFERENCES:

1. https://nptel.ac.in/courses/108106098/
2. https://nptel.ac.in/courses/108101037/

ONLINE RESOURCES:

1. https://lecturenotes.in/notes/15854-note-for-control-system-engineering-cse-by-amity-kumar
2. https://lecturenotes.in/notes/23763-note-for-control-system-engineering-cse-by-suman-kumar-acharya

OUTCOMES:

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

1 Develop a mathematical model for a given system in Laplace domain and time domain.(K2)
2 Compute transfer function of systems modeled as block diagram/signal flow graph/state space representation.(K2)
3 Derive the output response and steady state error of first order and second order control systems for standard input signals.(K2)
4 Find the closed loop frequency response and open loop frequency response using Bode plot/ Polar plot/ Nyquist plot.(K3)
5 Determine stability of a system using Routh Hurwitz / Root locus/ Nyquist criterion.(K3)
6 Design controllers, lag and lead compensator for desired system performance.(K3)

CO - PO - PSO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	2	3	-	-	-	-	-	2	-	-	1	2	2
CO2	2	2	3	-	-	-	-	-	2	-	-	1	2	2
CO3	2	2	3	-	-	-	-	-	2	-	-	1	2	2
CO4	2	2	3	-	-	-	-	-	2	-	-	1	2	2
CO5	2	2	2	-	-	-	-	-	2	-	-	1	2	2
CO6	2	2	2	-	-	-	-	-	2	-	-	1	2	2

PROFESSIONAL ELECTIVES - I

20ECEL509 SDG NO. 4, 9, 11	SOFT COMPUTING	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To learn the basic concepts of Soft Computing
- To become familiar with various techniques like neural networks, genetic algorithms and fuzzy systems.
- To apply soft computing techniques to solve problems.

UNIT I INTRODUCTION TO SOFT COMPUTING **9**

Introduction-Artificial Intelligence-Artificial Neural Networks-Fuzzy Systems-Genetic Algorithm and Evolutionary Programming-Swarm Intelligent Systems-Classification of ANNs-McCulloch and Pitts Neuron Model-Learning Rules: Hebbian and Delta- Perceptron Network-Adaline Network-Madaline Network.

UNIT II ARTIFICIAL NEURAL NETWORKS **9**

Back propagation Neural Networks - Kohonen Neural Network -Learning Vector Quantization -Hamming Neural Network - Hopfield Neural Network-Bi-directional Associative Memory -Adaptive Resonance Theory Neural Networks- Support Vector Machines - Spike Neuron Models.

UNIT III FUZZY SYSTEMS **9**

Introduction to Fuzzy Logic, Classical Sets and Fuzzy Sets - Classical Relations and Fuzzy Relations -Membership Functions -Defuzzification - Fuzzy Arithmetic and Fuzzy Measures - Fuzzy Rule Base and Approximate Reasoning - Introduction to Fuzzy Decision Making.

UNIT IV GENETIC ALGORITHMS **9**

Basic Concepts- Working Principles -Encoding- Fitness Function - Reproduction - Inheritance Operators - Cross Over - Inversion and Deletion - Mutation Operator - Bit-wise Operators -Convergence of Genetic Algorithm.

UNIT V HYBRID SYSTEMS **9**

Hybrid Systems -Neural Networks, Fuzzy Logic and Genetic -GA Based Weight Determination - LR-Type Fuzzy Numbers - Fuzzy Neuron - Fuzzy BP Architecture - Learning in Fuzzy BP- Inference by Fuzzy BP - Fuzzy ArtMap: A Brief Introduction - Soft Computing Tools - GA in Fuzzy Logic Controller Design

- Fuzzy Logic Controller

TOTAL :45 PERIODS

TEXT BOOKS:

1. S.N.Sivanandam , S.N.Deepa, "Principles of Soft Computing", Wiley India Pvt.Ltd., Second Edition, 2011.
2. S.Rajasekaran, G.A.Vijayalakshmi Pai, "Neural Networks, Fuzzy Logic and Genetic Algorithm, Synthesis and Applications ", PHI Learning Pvt.Ltd., 2017.

REFERENCES:

1 Jyh-Shing Roger Jang, Chuen-Tsai Sun, Eiji Mizutani, "Neuro-Fuzzy and Soft Computing", Prentice-Hall of India, 2002.
2 Kwang H.Lee, "First course on Fuzzy Theory and Applications", Springer, 2005.
3. James A. Freeman and David M. Skapura, "Neural Networks Algorithms, Applications, and Programming Techniques", Addison Wesley, 2003.
4. George J. Klir and Bo Yuan, "Fuzzy Sets and Fuzzy Logic-Theory and Applications", Prentice Hall, 1996.
5. N.P.Padhy, S.P.Simon, "Soft Computing with MATLAB Programming", Oxford University Press, 2015.

WEB REFERENCES:

1. https://www.sciencedirect.com/science/article/pii/S1877050916325467
2. https://www.worldscientific.com/worldscibooks/10.1142/3706

ONLINE COURSES.

1. https://onlinecourses.nptel.ac.in/noc22_cs54/preview
2. https://www.youtube.com/watch?v=K9gjuXjJeEM

OUTCOMES:

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

1. Differentiate the principle behind Soft computing techniques and conventional AI techniques (K2)
2. Describe Artificial neural network, fuzzy logic and Genetic algorithm concepts (K2)
3. Demonstrate evolutionary and fuzzy techniques to provide human like expertise.(K3)

4. Apply ANN models and Fuzzy logic principles for industrial and societal application(K3)
5. Apply hybrid soft computing techniques to handle uncertain and imprecise environment(K3)
6. Apply soft computing tools to provide solutions to complex real life problems.(K3)

CO - PO - PSO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1	1	2	2	2	1	-	-	-	2	2	3	2
CO2	3	2	3	2	1	2	1	-	-	-	2	2	3	2
CO3	3	3	3	3	2	3	-	-	-	-	2	2	3	2
CO4	3	3	3	2	3	2	1	-	-	-	2	2	3	2
CO5	3	3	3	2	3	2	2	-	-	-	2	2	3	2
CO6	3	3	3	2	3	2	2	-	-	-	2	2	3	2

PROFESSIONAL ELECTIVES - I

20ECEL510 SDG NO. 4, 9, 11	BIOSIGNAL AND IMAGE PROCESSING	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To understand the characteristics of standard and biomedical signals
- To gain knowledge about the various electrical and non electrical physiological parameters and methods of recording and transmitting these parameters.
- To gain knowledge in removing the noise and artifacts in biomedical signals.
- To provide fundamentals of the image in time and frequency domain
- To understand the basic concepts of image enhancement, image restoration, image segmentation, feature extraction in medical images

UNIT I CLASSIFICATION OF BIOMEDICAL SIGNALS 10

Introduction- Overview of CT and DT signals, Sources and recording systems of biomedical signals- Electrocardiogram (ECG), Electroencephalogram (EEG), Electromyogram (EMG), Electrooculogram (EOG), Electroretinogram (ERG), Types of electrodes.

UNIT II TIME SERIES ANALYSIS AND SPECTRAL ESTIMATION 7

Time series analysis-linear prediction models-Time variant systems- Adaptive segmentations - spectral Estimation-Blackman Tuckey method - Periodogram and model based estimation.

UNIT III FILTERING TECHNIQUES 10

Time-domain Filters - synchronized averaging, Moving Average Filters, Derivative-based operators to remove low-frequency artifacts. Frequency-domain filters - Removal of High Frequency noise, Removal of low frequency noise.

UNIT IV FUNDAMENTALS OF IMAGE PROCESSING 9

Image perception, MTF of the visual system, Image fidelity criteria, Image model, Image sampling and quantization – two dimensional sampling theory, Image quantization, Optimum mean square quantizer, Image transforms – 2D-DFT and other transforms.

UNIT V BIO-MEDICAL IMAGE PROCESSING 9

Principles behind X-ray, CT,MRI and Ultrasound imaging process, pre-processing- Image Enhancement operations – Image noise and modelling, Image restoration – Image degradation model, Inverse and Weiner filtering, Geometric transformations and correction, Overview of image segmentation and Feature extraction

TOTAL:L+T=45PERIODS

TEXT BOOKS:

1. Allan V.Oppenheim, S.Wilsky and S.H.Nawab, "Signals and Systems", Pearson, 2015
2. Leslie Cromwell, "Biomedical Instrumentation and Measurement", Prentice Hall of India, New Delhi, 2007.
3. Rafael C.Gonzalez and Richard E.Woods, "Digital Image Processing", Third Edition, Pearson Education, 2008, New Delhi
4. Anil J Jain, "Fundamentals of Digital Image Processing", Prentice Hall of India 2006

REFERENCES:

1. Khandpur, R.S., "Handbook of Biomedical Instrumentation", TATA Mc Graw-Hill, New Delhi, 2003.
2. John G.Webster, "Medical Instrumentation Application and Design", Third Edition, Wiley India Edition, 2007.

3. Joseph J.Carr and John M.Brown, "Introduction to Biomedical Equipment Technology", JohnWiley and Sons, New York, 2004.
4. https://www.physio-pedia.com/Medical_Imaging.
5. Atam P.Dhawan, "Medical Image Analysis", Wiley Interscience Publication.
6. NJ S.Sridhar, "Digital Image Processing", Oxford University Press, 2011, New Delhi.
7. Alasdair McAndrew, "Introduction to Digital Image Processing with Matlab", Cengage Learning 2011, India.
8. John L.Semmlow, "Biosignal and Biomedical Image Processing Matlab Based applications", Marcel Dekker Inc., New York,2004

WEB REFERENCES:

1. https://youtu.be/cebsXYLw4V4
2. https://youtu.be/4fPFBUsk6ec
3. https://youtu.be/UhgedHMxvjw

ONLINE RESOURCES:

1. https://nptel.ac.in/courses/108/105/108105101/
2. https://www.digimat.in/nptel/courses/video/108105101/L12.html
3. https://www.digimat.in/nptel/courses/video/108105101/L34.html

OUTCOMES:

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

1 Summarize the fundamental concepts of various biomedical signals and images(K2)
2 Identify the amplitude and frequency of ECG, EEG, EMG & PCG and employ various time series analysis (K2)
3 Examine the lead systems and recording setup of ECG, EEG, EMG & PCG for diagnosis.(K2)
4 Apply appropriate time domain and frequency domain filters on biomedical signals and biomedical images to remove artifacts and to enhance images. (K3)
5 Apply appropriate degradation and restoration models on medical images to recover the original image from degraded image.(K3)
6 Discuss types of image segmentation and feature extraction of medical images for analysis and classification.(K2)

CO - PO - PSO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	3	2	3	3	3	2	2	-	-	2	1	2	2
CO2	3	3	2	3	2	3	2	2	-	-	2	1	3	2
CO3	3	3	2	3	2	2	2	2	-	-	1	2	2	2
CO4	3	3	3	3	2	2	2	1	-	-	2	2	2	3
CO5	3	3	3	3	2	2	2	2	-	-	2	1	3	2
CO6	2	2	2	3	3	1	2	2	-	-	2	1	2	2

PROFESSIONAL ELECTIVES - I

20MGEL501 SDG NO. 4,89,12	INTELLECTUAL PROPERTY RIGHTS	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To get an introductory insight about the IPR in national and international context
- To understand the procedures for IPR, registration and its enforcement

UNIT I INTRODUCTION **9**

Intellectual property: Introduction, Meaning, Nature and significance types of intellectual property, importance of intellectual property rights, Protection of human innovations by IPR such as Patents, Trademarks, Copyright, Industrial Designs Geographical Indications, and Trade Secrets

UNIT II AGREEMENTS AND TREATIES **9**

International Treaties and Conventions on IPRs, TRIPS Agreement, PCT Agreement, Patent Act of India, General agreement on trade and tariff (GATT), Ben convention, Rome convention ,Role of WTO and WIPO

UNIT III PATENTS **9**

Concept of Patent – Historical view of Patent system in India and International Scenario, patent searching process, ownership rights and transfer, compulsory licenses, Procedure for filing of patents, Grants of patent , Benchmarks for patentability of inventions, Recent key changes and development.

UNIT IV TRADEMARKS AND COPYRIGHTS **9**

Concept of Trademarks and copyrights – Rationale behind the protection-Purpose, function and acquisition, ownership issues, Procedure for Registration, Industrial design and integrated circuits, protection of geographical indications and plant varieties, Recent Trends in copyrights and Trademark., Trade secrets -liability for misappropriations of trade secrets

UNIT V LEGAL ASPECTS AND NEW DEVELOPMENTS **9**

Infringements of patents– Criteria of Infringement – Modes of Infringement-remedies and modification Protection against unfair competition, enforcement of intellectual property rights, Intellectual property audits, New developments of intellectual property, Impact of international instruments relating to the protection of intellectual properties Future of IPR in National and International levels.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. S.V. Satarkar, Intellectual Property Rights and Copy Rights, Ess Ess Publications, New Delhi, 2002.
2. V. Scople Vinod, Managing Intellectual Property, Prentice Hall of India pvt Ltd, 2012
3. P.Narayanan, Intellectual property rights Eastern law house-2018, Third Edition (revised and updated)
4. Deborah, E. Bouchoux, Intellectual property right, Cengage learning-2018 5th Edition

REFERENCES

1. Sterling, J. L. A., World copyright law, (2008) Third Edition, London, Sweet & Maxwell
2. GP Reddy, Intellectual property rights & other laws, Gogia law agency
3. Barrett, Margreth, Intellectual Property, (2009) Third Edition, New York Aspen publishers
4. Inventing the Future: An introduction to Patents for small and medium sized Enterprises; WIPO publication
5. Cornish, William Intellectual Property: Patents, Copyright, Trademarks and allied rights, (2010) Seventh Edition, London Sweet & Maxwell.
6. Kankanala and Kalyan.C : Indian Patent Law and Practice (2010), India, Oxford University Press

WEB RESOURCES:

1. https://www.wipo.int/edocs/lexdocs/laws/en/ws/ws020en.pdf

2. http://caaa.in/Image/34_Hb_on_IPR.pdf
3. http://www.ipindia.nic.in/patents.htm
4. http://www.ipindia.nic.in/trade-marks.htm
5. https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/627956/IP-Rights-in-India.pdf
6. https://economictimes.indiatimes.com/small-biz/resources/startup-handbook/intellectual-property-rights- registration/articleshow/59126802.cms?from=mdr

ONLINE RESOURCES:

1. https://www.coursera.org/learn/introduction-intellectual-property
2. https://www.edx.org/course/intellectual-property-law-and-policy-part-1
3. https://www.classcentral.com/tag/intellectual-property
4. https://swayam.gov.in/nd1_noc19_mg58/preview

OUTCOMES:

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

1 Describe the concepts of Intellectual property rights. (K2)
2 Explain the agreements and treaties of Intellectual property rights. (K2)
3 Identify the needs and avenues for patents. (K2)
4 Discuss the necessity of Trade marks and Copy rights. (K2)
5 Explain the legal context and developments of Intellectual property rights. (K2)

CO - PO, PSO MAPPING

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

PROFESSIONAL ELECTIVES - II

20ECEL601 SDG NO. 4, 8, 9	RADIO ACCESS NETWORKS	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To introduce the concept of RAN.
- To bring awareness on recent developments in radio communication
- To impart knowledge on the working of RANs.
- To introduce the concept of 5G and CRAN
- To understand the fundamental theory and potential applications of CRAN.

UNIT I RAN ARCHITECTURE FOR UMTS **9**

Evolution of RAN- Architectures for UMTS, flow of data, channel types, Non access stratum, iubTransport network, signalling procedures, planning.

UNIT II RADIO TECHNOLOGIES **9**

Linearizing transmitters- superconducting filters and cryogenic Receiver front end - Remote Radio Head and Radio over fiber - software Radio Base stations.

UNIT III OVERVIEW OF 5G **9**

5G concepts- objectives, activities, deployment strategies, wireless spectrum for 5G, channel access methods, Architecture requirements and principles, 5G system architecture, Network slicing

UNIT IV 5G RAN **9**

Frameless Network architecture for user centric 5G RAN, Energy efficient control and user plane adaptation, routing strategy- Distributed Architecture of 5g mobile networks-RAN slicing

UNIT V CLOUD RADIO ACCESS NETWORKS **9**

Basics of C-RAN, Evolved C-RAN with NGFI, Deployment cases and Standardization activities, Advanced C-RAN architecture and Add-on cells, C-RAN System Model, Link Adaptation, Resource Allocation

TOTAL: 45 PERIODS

TEXT BOOKS

1. Chris Johnson, "Radio Access Networks for UMTS, Principles and Practice", John Wiley & Sons, Ltd, 2008.
2. Mugen Peng, Tony Q. S. Quek, Osvaldo Simeone, Wei Yu, "Cloud Radio Access Networks: Principles, Technologies, and Applications", Cambridge University Press,2017

REFERENCES

1. Yingjie Jay Guo,"Advances in Mobile Radio Access Networks", Boston, London, 2004.
2. Mugen Peng, Yaohua Sun, and Zhongyuan Zhao,"Fog Radio Access Networks (F-RAN): Architectures, Technologies, and Applications", Springer, 2020.
3. Devaki Chandramouli, Juho Pirskanen, Rainer Liebhart, "5G for the connected world", John Wiley &Sons, Ltd, 2008.
4. Quek, T. Q., Peng, M., Simeone, O., & Yu, W. (Eds.). (2017). Cloud radio access networks: Principles, technologies, and applications. Cambridge University Press.
5. Sirotkin, S. (2021). 5G Radio Access Network Architecture: The Dark Side of 5G. Wiley-IEEE Press.

WEB REFERENCES:

1. https://www.youtube.com/watch?v=1_x9axf0jlk
2. https://www.youtube.com/watch?v=xngK7p5Stww&list=RDCMUCQLQxPH8mL0bnA7B3lIfNww&index=4
3. https://www.youtube.com/watch?v=Yh04DJnU1rg&list=RDCMUCQLQxPH8mL0bnA7B3lIfNww&index=5
4. https://www.youtube.com/watch?v=RWOSYJgAXBw&list=RDCMUCQLQxPH8mL0bnA7B3lIfNww&start_radio=1&t=89

ONLINE RESOURCES:

1. https://www.sciencedirect.com/topics/computer-science/radio-access-network
2. https://www.tutorialspoint.com/5g/5g_architecture.htm

OUTCOMES:

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

1. Explain the architecture and signaling mechanisms in Radio Access Networks (K2)
2. Describe the transmitter receiver and filter structures in radio over fiber (K2)

3. Identify the different channel access methods and deployment strategy in 5G Architecture (K2)
4. Interpret the energy efficient control and routing strategy in 5G architecture (K2)
5. Elucidate the basic C-RAN architecture and activities (K2)
6. Explain the advance C- RAN architecture and the resource allocation(K2)

CO - PO, PSO MAPPING :

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	-	3	-	1	-	-	-	-	3	3	2	2
CO2	3	3	3	1	2	1	-	-	-	-	3	3	2	2
CO3	3	3	2	1	3	1	-	-	-	-	3	3	2	2
CO4	3	3	2	1	3	1	-	-	-	-	3	3	2	2
CO5	3	3	2	1	1	3	1	-	-	-	3	3	2	2
CO6	3	3	2	1	1	-	-	-	-	-	3	3	2	2

PROFESSIONAL ELECTIVES - II

20ECEL602 SDG NO. 4,9,11,15	WIRELESS SENSOR NETWORKS	L	T	P	C
		3	0	0	3

OBJECTIVES:

- Learn ad hoc network and sensor network fundamentals
- To understand the wireless sensor architecture.
- Have an in-depth knowledge on sensor network and design issues.
- To understand the infrastructure establishment of sensor networks.
- Have an exposure to mote programming platforms and tools

UNIT I OVERVIEW OF WIRELESS SENSOR NETWORKS 9

Introduction to ad hoc and Wireless Sensor Networks, Commercial applications of Sensor Networks- Challenges of Wireless Sensor Networks, Types of Wireless Sensor Networks, Enabling Technologies for Wireless Sensor Networks.

UNIT II SENSOR NETWORK 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.

UNIT III WSN NETWORKING CONCEPTS AND PROTOCOLS 9

Physical Layer and Transceiver Design Considerations, MAC Protocols for Wireless Sensor Networks, Low Duty Cycle Protocols and Wakeup radio Concepts - S-MAC, The Mediation Device Protocol, Address and Name Management, Assignment of MAC Addresses, Routing Protocols, Energy-Efficient 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 – TinyOS, nesC, CONTIKIOS, Node-level Simulators – NS2 and its extension to sensor networks, COOJA, TOSSIM.

TOTAL: 45 PERIODS

TEXT BOOKS:

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

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.

WEB REFERENCES:

1. https://www.sciencedirect.com/topics/computer-science/wireless sensor-networks
2. https://www.elprocus.com/architecture-of-wireless-sensor-network and-applications/

ONLINE RESOURCES:

1. https://www.digimat.in/nptel/courses/video/106105160/L01.html
2. www.tfb.edu.mk › Kniga-w02PDF

OUTCOMES:

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

1. Explain Ad Hoc networks and Wireless Sensor Networks (K2).
2. Discuss the architecture and networking scenarios of Sensor Networks (K2).
3. Summarize the performance of MAC Protocols. (K2)
4. Describe the functionalities of Routing protocols in Wireless Sensor Networks (K2)
5. Illustrate the infrastructure establishment and network management (K2).
6. Examine Sensor network platforms and the tools used to establish wireless connectivity (K3).

CO - PO, PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	-	-	-	-	-	-	-	-	-	-	2	-
CO2	3	3	2	1	-	-	-	-	-	-	-	-	2	1
CO3	3	2	1	1	-	-	-	-	-	-	-	1	2	1
CO4	3	3	2	2	-	-	-	-	-	-	-	1	2	1
CO5	3	3	2	2	2	-	-	-	-	-	-	1	2	1
CO6	3	2	2	2	3	-	-	-	-	-	-	1	2	1

PROFESSIONAL ELECTIVES - II

20ECEL603 SDG NO. 4	CMOS ANALOG IC DESIGN	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To study the fundamentals of analog circuits and MOS device models
- To gain knowledge on various configurations of MOS transistors and feedback concepts
- To study the characteristics of noise and frequency response of the amplifier
- To learn the concepts of Op-Amp frequency compensation, capacitor switches and PLLs

UNIT I INTRODUCTION TO ANALOG IC DESIGN AND CURRENT MIRRORS 9

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

UNIT II AMPLIFIERS AND FEEDBACK 9

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

UNIT III FREQUENCY RESPONSE OF AMPLIFIERS AND NOISE 9

General considerations- Miller Effect and Association of Poles with Nodes, Common source stage- Source followers- Common gate stage- Cascode stage- Differential pair. Noise- Statistical characteristics of noise- Types of noise- Representation of noise in circuits- Noise in single stage amplifiers- Noise in differential pairs- Noise Bandwidth.

UNIT IV OPERATIONAL AMPLIFIER STABILITY AND FREQUENCY COMPENSATION 9

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

UNIT V SWITCHED CAPACITOR CIRCUITS AND PLLS 9

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

TOTAL:45 PERIODS

TEXT BOOK:

1. Behzad Razavi, "Design of Analog CMOS Integrated Circuits", Tata McGraw Hill, 2001, Thirty Third re-print, 2016.

REFERENCES:

1. Phillip Allen and Douglas Holmberg "CMOS Analog Circuit Design" Second Edition, Oxford University Press, 2004.
2. Paul R. Gray, Paul J. Hurst, Stephen H. Lewis, Robert G. Meyer, Analysis and Design of Analog Integrated Circuits, Fifth Edition, Wiley, 2009
3. Grebene, "Bipolar and MOS Analog Integrated circuit design", John Wiley & sons, Inc., 2003
4. Erik Brunn – CMOS Analog IC Design Fundamentals, Bookboon
5. R. J. Baker, CMOS: Circuit Design, Layout, and Simulation. USA: Wiley, 2010.

WEB REFERENCES:

1. https://nptel.ac.in/content/storage2/courses/117101105/downloads/L1.pdf
2. https://nptel.ac.in/content/storage2/nptel_data3/html/mhrd/
3. ict/text/117106030/lec1.pdf
4. https://swayam.gov.in/nd1_noc20_ee26

ONLINE REFERENCES

1. https://aicdesign.org/
2. https://nptel.ac.in/courses/117101105/
3. https://ocw.tudelft.nl/courses/analog-integrated-circuit-design/

OUTCOMES :

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

1. Realize the concepts of Analog MOS devices and current mirror circuits (K2).
2. Design different configurations of Amplifiers and feedback circuits. (K3)
3. Analyze the characteristics of frequency response of the amplifier. (K3)
4. Perform noise analysis in the amplifiers. (K4)
5. Perform stability analysis and frequency compensation techniques of Op- Amp Circuits.(K4)
6. Construct switched capacitor circuits and PLLs. (K3)

CO – PO, PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	1	-	2	2	-	-	-	2	-	-	2	3	2	2
CO2	1	2	2	2	2	-	1	2	-	-	2	3	2	2
CO3	1	-	2	2	2	-	1	2	-	-	2	3	1	2
CO4	1	-	2	2	2	-	1	2	-	-	2	3	1	2
CO5	1	-	2	2	2	2	-	2	2	2	2	3	1	2
CO6	1	-	2	2	2	-	-	2	-	-	2	3	1	2

PROFESSIONAL ELECTIVES - II

20ECEL604 SDG NO. 4	SOFTWARE FOR EMBEDDED SYSTEMS	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To expose the students to the fundamentals of embedded Programming
- To Introduce the GNU C Programming Toolchain in Linux.
- To study basic concepts of embedded C, Embedded OS & Python Programming
- To introduce time driven architecture, Serial Interface with a case study
- To involve Discussions/ Practice/Exercise onto revising & familiarizing the concepts acquired over the 5 Units of the subject for improved employability skills

UNIT I EMBEDDED PROGRAMMING **9**

C and Assembly - Programming Style - Declarations and Expressions - Arrays, Qualifiers and Reading Numbers - Decision and Control Statements - Programming Process - More Control Statements - Variable Scope and Functions - C Preprocessor - Advanced Types – Simple Pointers -Debugging and Optimization – In-line Assembly.

UNIT II C PROGRAMMING TOOLCHAIN IN LINUX **9**

C preprocessor - Stages of Compilation - Introduction to GCC - Debugging with GDB - The Make utility - GNU Configure and Build System - GNU Binary utilities- Profiling - using gprof - Memory Leak Detection with valgrind - Introduction to GNU C Library

UNIT III EMBEDDED C **9**

Embedded C-Adding Structure to 'C' Code: Object oriented programming with C, Header files for Project and Port, Examples. Meeting Real-time constraints: Creating hardware delays - Need for timeout mechanism - Creating loop timeouts - Creating hardware timeouts- Industrial real time applications

UNIT IV EMBEDDED OS **9**

Creating embedded operating system: Basis of a simple embedded OS, Introduction to sEOS, Using Timer 0 and Timer 1, Portability issue, Alternative system architecture, Important design considerations when using sEOS-Memory requirements - embedding serial communication & scheduling data transmission - Case study: Integrated alarm system.

UNIT V PYTHON PROGRAMMING **9**

Basics of PYTHON Programming Syntax and Style – Python Objects– Dictionaries – comparison with C & C++, programming on Conditionals and Loops – Files-Functions – Input and Output – Errors and Exceptions –Functions – Modules – Classes and OOP – Execution Environment.

TOTAL : 45 HOURS

TEXT BOOKS:

1. Steve Oualline, 'Practical C Programming Third Edition', O'Reilly Media, Inc, 2006.
2. Michael J Pont, "Embedded C", Pearson Education, 2007.
3. Christian Hill, Learning Scientific Programming with Python, CAMBRIDGE UNIVERSITY PRESS ,2016.
4. Wesley J.Chun, "Core python application Programming Third Edition '', Pearson Educat, 2016.
5. Mark J.Guzdial,``Introduction to computing and programming in python – a Multimedia approach ,Fourth Edition, Pearson Education, 2015.

REFERENCES:

1. Stephen Kochan, "Programming in C", Third Edition, Sams Publishing, 2009.
2. Mark Lutz,"Learning Python, Powerful OOPs,O'reilly,2011.
3. Peter Prinzs, Tony Crawford, "C in a Nutshell", O'Reilly, 2016.
4. Dr. Bandu Meshram, "Object Oriented Paradigm C++ Beginners Guide CC + +", SPD, 2016.
5. David Griffiths, Dawn Griffiths, "Head First C", O'reilly, 2015.

ONLINE RESOURCES:

1. https://nptel.ac.in/courses/117106112/
2. https://nptel.ac.in/content/storage2/nptel_data3/html/mhrd/ict/text/108102045/lec19.pdf
3. https://swayam.gov.in/nd1_noc20_cs14/preview
4. https://www.coursera.org/learn/introduction-embedded-systems

WEB RESOURCES

1. https://www.youtube.com/watch?v=IY4xrpJQwOY
2. https://www.youtube.com/watch?v=tE7cP-Xyfzw

OUTCOMES:

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

1. Use GNU C to develop embedded software.(K3)
2. Explain fundamental embedded systems design paradigms, architectures, possibilities and challenges, both with respect to software and hardware. (K2)
3. Improve Employability and entrepreneurship capacity due to knowledge upgradation on recent trends in embedded systems design. (K3)
4. Analyze the concepts of operating systems to design embedded systems. (K3)
5. Program an embedded system using python.(K4)
6. Develop Embedded C programs. (K4)

CO – PO, PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1	2	1	1	1	-	-	-	-	-	2	2	1
CO2	3	2	2	2	2	1	-	-	-	-	-	1	2	1
CO3	3	2	3	3	3	2	-	-	-	-	-	1	2	2
CO4	3	2	3	3	3	2	-	-	-	-	-	1	2	2
CO5	3	3	3	3	3	2	-	-	-	-	-	1	2	1
CO6	3	3	3	3	3	1	-	-	-	-	-	1	2	2

PROFESSIONAL ELECTIVES - II

20ECEL605 SDG NO. 4 & 9	ELECTROMAGNETIC INTERFERENCE AND COMPATIBILITY	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To introduce and discuss various issues related to the system packaging
- To introduce about CAD used in designing wiring boards and testing

UNIT I OVERVIEW OF ELECTRONIC SYSTEMS PACKAGING 9

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

UNIT II ELECTRICAL ISSUES IN PACKAGING 9

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

UNIT III CHIP PACKAGES 9

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

UNIT IV PCB, SURFACE MOUNT TECHNOLOGY AND THERMAL CONSIDERATIONS 9

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

UNIT V TESTING **9**

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

TOTAL: 45 PERIODS

TEXT BOOK:

1. V. P. Kodali, "Engineering EMC Principles, Measurements and Technologies", IEEE Press, New York, 1996.
2. Henry W. Ott, "Noise Reduction Techniques in Electronic Systems", A Wiley Inter Science Publications, John Wiley and Sons, New York, 1988.

REFERENCES:

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

WEB REFERENCES:

1. https://nptel.ac.in/courses/112105267/
2. https://nptel.ac.in/courses/108108031/
3. http://www.nptelvideos.in/2012/11/an-introduction-to-electronics-system.html

ONLINE RESOURCES:

1. https://www.classcentral.com/course/swayam-electronic-packaging-and-manufacturing- 13021
2. https://advancedengineering.umd.edu/electronic-packaging
3. https://www.ipcindia.org.in/fundamentals-of-electronics-systems-packaging-esp

OUTCOMES:

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

1. Identify the various types and mechanisms of Electromagnetic Interference (K1)
2. Learn various types of EMI Coupling mechanisms. (K1)
3. Propose suitable EMC techniques for the identified EMI. (K2)
4. Adopt various EMI control mechanisms in PCB Design. (K2)
5. Describe the various EMC measurement techniques and devices. (K1)
6. Impart comprehensive insight about the current EMC standards. (K2)

CO - PO, PSO MAPPING :

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	3	3	3	2	2	1	-	-	-	1	3	2
CO2	3	3	3	3	3	2	2	1	-	-	-	1	3	2
CO3	3	3	3	3	2	2	2	1	-	-	2	1	3	2
CO4	3	3	3	3	3	2	2	1	-	-	2	1	3	2
CO5	3	3	3	3	3	2	2	1	-	-	2	1	3	2
CO6	3	3	3	3	3	2	2	1	-	-	2	1	3	2

PROFESSIONAL ELECTIVES - II

20ECEL606	GREEN RADIO COMMUNICATION NETWORKS	L	T	P	C
SDG NO. 4,8,9,12		3	0	0	3

OBJECTIVES:

- To understand green communication concepts
- To understand model architectures and algorithms
- To understand power Consumption methodology
- To understand carbon emission impact on the environment
- To understand model test-beds

UNIT I COMMUNICATION ARCHITECTURES AND MODEL 9

Fundamental trade-offs on the design of green radio networks-Introduction, Insight from Shannon's capacity formula-SE-EE trade-off, BW-PW trade-off,

DL-PW trade-off & DE-EE trade-off, Impact of practical constraints. Algorithms for energy harvesting Wireless networks-Technologies, Point to point channel, MAC policies and multi-hop networks, Introduction to physical layer design.

UNIT II PHYSICAL COMMUNICATIONS TECHNIQUES 9

Green modulation and coding schemes in energy constrained wireless networks-Introduction, System model and assumptions, Energy consumption of uncoded scheme, Energy consumption analysis of LT coded modulation, Energy efficiency metrics for wireless networks, Energy efficient cooperative networks.

UNIT III BASE STATION POWER MANAGEMENT TECHNIQUES 9

Opportunistic spectrum and load management concepts, Assessment of power saving potential, Energy saving techniques-Energy consumption model of RBS, EE metric, RBS energy saving methods, Power management for a wireless base station, Power consumption model of a base station, Optimization of power management.

UNIT IV GREEN COMMUNICATIONS FOR CARBON EMISSION REDUCTIONS 9

Architectures and Standards: Introduction, Network Architectures and Technologies to Reduce Carbon Emissions - Networks and Protocols, Integrated Optical-Wireless Access, Test beds -Green star, SAVI, NetVirt, Carbon Standards for Communications Technologies- Power and Performance Measurement Challenges- Network and System Operation Challenges.

UNIT V GREEN RADIO TEST- BED AND STANDARDS 9

Introduction, Energy efficiency evaluation framework(E3F),Power model, Traffic model, Case study : Energy efficiency of LTE, Green metrics, Fundamental challenges and future potential, Standardization fora –ETSI,3GPP,TIA and 3GPP2,ATIS.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. Ekram Hossain,Vijay K.Bhargava, Gerhard P.Fettweis, "Green Radio Communication Networks " Cambridge University Press, 2012.
2. Jinsong Wu Sundeep Rangan, Honggang Zhang, "Green Communications Theoretical fundamentals ,Algorithms and Applications " CRC press,2013.

REFERENCES:

1. Richard Yu F, Zhang Xi and Victor Leung C M, "Green Communications and Networking", First Edition, CRC press, 2012.

2. Mazin Al Noor, "Green Radio Communication Networks Applying Radio-Over-Fibre Technology for Wireless Access", GRINVerlag, 2012.
3. Mohammad Obaidat S, Alagan Anpalagan and Isaac Woungang, "Handbook of Green Information and Communication Systems", First Edition, Academic Press, 2012.
4. Ramjee Prasad, Shingo Ohmori, Dina Simunic, "Towards Green ICT", River Publishers, 2010.

WEB REFERENCES:

1. http://www.comsoc.org/webcasts/view/wireless
2. http://www.comsoc.org/webcasts/view/wireless
3. http://www.comsoc.org/webcasts/view/wireless

ONLINE RESOURCES:

1. https://youtu.be/d4-uWmash04

OUTCOMES:

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

1 Understand Green Communication Concepts and related architectures(K2)
2 Compare Different modulation and coding schemes(K2)
3 Develop the power consumption models(K2)
4 Explore Architectures and Technologies to Reduce Carbon Emissions(K2)
5 Explore test-beds and standards(K2)
6 Demonstrate various base station power management techniques (K2)

CO - PO - PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	2	1	-	2	-	-	-	-	2	2	3	2
CO2	3	2	3	1	-	1	-	-	-	-	1	2	3	2
CO3	3	2	3	1	-	2	-	-	-	1	2	2	3	2
CO4	3	2	2	1	3	1	-	-	-	-	2	2	3	2
CO5	3	2	2	1	3	2	-	-	2	3	2	2	3	2
CO6	3	2	2	1	3	2	-	-	2	3	2	2	3	2

PROFESSIONAL ELECTIVES - II

20ECEL607 SDG NO. 4,8,9,12	BIOMEDICAL INSTRUMENTATION	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To describe the basic theory of Bio potential Electrodes
- To describe the Bio potential measurement.
- To design Bio potential amplifiers for acquisition of bio signals.
- To measure the various non-electrical physiological parameter measurements and biochemical measurements.

UNIT I BIOPOTENTIAL ELECTRODES 9

Origin of bio potential and its propagation. Electrode-electrolyte interface, electrode– skin interface, half-cell potential, impedance, polarization effects of electrode – non polarizable electrodes. Types of electrodes - surface, needle and micro electrodes and their equivalent circuits. Recording problems - measurement with two electrodes.

UNIT II BIOPOTENTIAL MEASUREMENT 9

Bio signal characteristics– frequency and amplitude ranges. ECG – Einthoven's triangle, standard 12 lead system, block diagram. Measurements of heart sounds - PCG. EEG – 10-20 electrode system, unipolar, bipolar and average mode, Functional block diagram. EMG – unipolar and bipolar mode, block diagram, EOG and ERG.

UNIT III BIOPOTENTIAL AMPLIFIER 8

Need for bio-amplifier - single ended bio-amplifier, differential bio-amplifier – right leg driven ECG amplifier. Band pass filtering, isolation amplifiers – transformer and optical isolation - isolated DC amplifier and AC carrier amplifier. Artifacts and removal.

UNIT IV NON ELECTRICAL PHYSIOLOGICAL PARAMETER MEASUREMENT 10

Temperature, respiration rate and pulse rate measurements, Plethysmography, Pulse oximetry, Blood Pressure: direct methods - Pressure amplifiers - systolic, diastolic, mean detector circuit, indirect methods - auscultatory method, oscillometric method, ultrasonic method. Blood flow - Electromagnetic and ultrasound blood flow measurement. Cardiac output measurement- Indicator dilution, dye dilution and thermodilution method.

UNIT V BIOCHEMICAL MEASUREMENT 9

Biochemical sensors - pH, pO2 and pCO2, Ion selective Field Effect Transistor (ISFET), immunologically sensitive FET (IMFET), Blood glucose sensors - Blood gas analyzers, colorimeter, flame photometer, spectrophotometer, blood cell counter, auto analyzer.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. Joseph J. Carr and John M. Brown, "Introduction to Biomedical equipment technology", Pearson Education, Fourth Edition, 2014.
2. John G.Webster, "Medical Instrumentation Application and Design", John Wiley and Sons, New York, Fourth Edition, 2009.

REFERENCES:

1. Khandpur R.S, "Handbook of Biomedical Instrumentation", Tata McGraw Hill, New Delhi, Third Edition, 2014.
2. L.A Geddes and L.E.Baker, "Principles of Applied Biomedical Instrumentation", John Wiley and Sons, Third Edition, Reprint 2008.
3. Leslie Cromwell, Fred J. Weibell, Erich A. Pfeiffer, Biomedical Instrumentation and Measurements, Pearson Education India, Second Edition, 2015.
4. Myer Kutz, "Standard Handbook of Biomedical Engineering & Design", McGraw-Hill Publisher, 2003.

WEB REFERENCES:

1. https://www.youtube.com/watch?v=49CWbXNJ3WE
2. https://www.youtube.com/watch?v=cNYBk0_fbb0

COURSE OUTCOMES:

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

1. Explain the electrode behavior and circuit models (K2)
2. Apply the fundamentals of Bio potential recording (K3)
3. Construct the various bio amplifiers (K2)
4. Illustrate various nonelectrical physiological parameters (K2)
5. Describe the Cardiac output measurement (K2)
6. Identify various biochemical parameters (K3)

CO – PO, PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	2	2	1	-	-	-	-	-	-	-	2	2
CO2	3	3	2	2	1	1	-	-	-	-	-	1	2	1
CO3	3	3	2	2	2	-	-	-	-	-	-	-	3	2
CO4	2	3	2	2	2	3	-	-	-	-	-	1	2	1
CO5	2	2	3	2	2	2	2	-	-	-	-	-	2	1
CO6	2	2	3	2	2	2	3	1	-	-	-	-	2	1

PROFESSIONAL ELECTIVES - II

20ECEL608 SDG NO. 4, 9	PATTERN RECOGNITION	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To Study the fundamentals of pattern classifiers.
- To know about various clustering concepts.
- To originate the various structural pattern recognition and feature extraction.
- To understand the basics of concept learning and decision trees.
- 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 – C-means algorithm – Hierarchical clustering procedures -Graph theoretic approach to pattern clustering -Validity of clusters.

UNIT III FEATURE EXTRACTION AND STRUCTURAL PATTERN RECOGNITION 9

KL Transforms – Feature selection through functional approximation – Binary selection -Elements of formal grammars - Syntactic description - Stochastic grammars –Structural representation.

UNIT IV INTRODUCTION, CONCEPT LEARNING AND DECISION TREES 9

Learning Problems – Designing Learning Systems, Perspectives and Issues – Concept Learning – Version Spaces and Candidate Elimination Algorithm – Inductive bias – Decision Tree learning – Representation – Algorithm – Heuristic Space Search.

UNIT V RECENT ADVANCES 9

Neural network structures for pattern recognition -Neural network based pattern associators – Unsupervised learning in neural pattern recognition - Self organizing networks -Fuzzy logic -Fuzzy pattern classifiers -Pattern classification using Genetic Algorithms.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. Tom M. Mitchell, "Machine Learning", McGraw-Hill Education (Indian Edition), 2013.
2. Tou and Gonzalez, Pattern Recognition Principles, Wesley Publication Company, London, 1974

REFERENCES:

1. Duda R.O., Hart.P.E., Pattern Classification and Scene Analysis, Wiley, New York,1973.
2. Morton Nadier, Eric Smith P., Pattern Recognition Engineering, John Wiley & Sons, New York, 1993.
3. Narasimha Murty M, Susheela Devi V, "Pattern Recognition – An Algorithmic Approach", Springer, Universities Press, 2011.
4. Robert J.Schalkoff, "Pattern Recognition: Statistical, Structural and Neural Approaches", John Wiley &Sons Inc., New York, 2007.

WEB REFERENCES:

1. https://nptel.ac.in/courses/117108048/
2. https://cedar.buffalo.edu/~srihari/CSE555/

3. https://sites.cs.ucsb.edu/~yfwang/courses/cs290i_prann/lecture.html

ONLINE RESOURCES:

1. https://freevideolectures.com/course/3194/pattern-recognition
2. https://www.classcentral.com/course/swayam-pattern-recognition-and-application-14228

OUTCOMES:

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

1. Understand the principles of pattern recognition (K2)
2. Illustrate the algorithm to classify the data and to identify the patterns(K2)
3. Utilize the given data set to extract and select features for Pattern recognition.(K3)
4. Interpret the decision tree and concept learning.(K2)
5. Illustrate the neural network structure for pattern recognition.(K2)
6. Illustrate the fuzzy logic in pattern recognition.(K2)

CO – PO, PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	2	3	1	2	2	-	-	-	2	2	3	2
CO2	3	2	3	2	1	2	1	-	-	-	2	2	3	2
CO3	3	3	3	3	2	3	-	-	-	-	2	2	3	3
CO4	3	3	3	2	3	2	1	-	-	-	2	2	3	3
CO5	3	3	3	2	3	2	2	-	2	3	2	2	3	3
CO6	3	3	3	2	3	2	2	-	2	3	2	2	3	3

PROFESSIONAL ELECTIVES - II

20ECEL609 SDG NO. 9	MACHINE LEARNING TECHNIQUES	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To understand the need for machine learning for various problem solving
- To study the various supervised, semi-supervised and unsupervised learning algorithms in machine learning
- To learn the new approaches in machine learning
- To design appropriate machine learning algorithms for problem solving

UNIT I INTRODUCTION **11**

Machine Learning- Definition, Types of machine learning - Supervised, Unsupervised, Reinforcement learning, Deep learning and Deep reinforcement learning, Learning Problems – Perspectives and Issues – Concept Learning – Version Spaces and Candidate Eliminations – Inductive bias – Decision Tree learning – Representation – Algorithm – Heuristic Space Search tools for ML - Matlab,WEKA and Google Colab

UNIT II NEURAL NETWORKS AND GENETIC ALGORITHMS **9**

Neural Network Representation – Problems – Perceptrons – Multilayer Networks and Back Propagation Algorithms – Advanced Topics – Genetic Algorithms – Hypothesis Space Search – Genetic Programming – Models of Evaluation and Learning, Case Study-Travelling salesman problem using Genetic algorithm

UNIT III BAYESIAN AND COMPUTATIONAL LEARNING **9**

Bayes Theorem – Concept Learning – Maximum Likelihood – Minimum Description Length Principle – Bayes Optimal Classifier – Gibbs Algorithm – Naïve Bayes Classifier – Bayesian Belief Network – EM Algorithm – Probability Learning – Sample Complexity – Finite and Infinite Hypothesis Spaces – Mistake Bound Model, Case study

UNIT IV INSTANT BASED LEARNING **7**

K-Nearest Neighbour Learning - Weighted Regression -Radial base Function-Case based Learning, Case study

UNIT V ADVANCED LEARNING **9**

Learning Sets of Rules – Sequential Covering Algorithm – Learning Rule Set – First Order Rules – Sets of First Order Rules – Induction on Inverted Deduction – Inverting Resolution – Analytical Learning – Perfect Domain Theories – Explanation Base Learning – FOCL Algorithm – Reinforcement Learning – Task – Q-Learning – Temporal Difference Learning

TOTAL:L+T=45PERIODS

TEXT BOOKS:

1. Tom M. Mitchell, "Machine Learning", McGraw-Hill Education (India) Private Limited, 2013
2. Shai Shalev-Shwartz, Shai Ben-David, "Understanding Machine Learning from Theory to Algorithms", Cambridge University press,2015

.

REFERENCES:

1. Ethem Alpaydin, "Introduction to Machine Learning (Adaptive Computation and Machine Learning)", MIT Press 2004.
2. Stephen Marsland, "Machine Learning: An Algorithmic Perspective", CRC Press, 2009.
3. Trevor Hastie, Robert Tibshirani & Jerome H. Friedman, "The Elements of Statistical Learning", Springer series in statistics, Second Edition, 2009.
4. Christopher M.Bishop ,"Pattern Recognition and Machine Learning", Springer, 2006.

WEB REFERENCES:

1. https://youtu.be/ukzFI9rgwfU
2. https://youtu.be/GwIo3gDZCVQ
3. https://youtu.be/r0168kd5r34

ONLINE RESOURCES:

1. https://nptel.ac. in/courses/106/106/106106139/
2. https://youtu.be/PPLop4L2eGk

OUTCOMES:

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

1 Differentiate between supervised, unsupervised, semi-supervised machine learning approaches.(K2)

2 Select appropriate tools for real time data and application. (K3)

3 Apply specific supervised or unsupervised machine learning algorithms for appropriate data.(K3)

4 Analyse and suggest the appropriate machine learning approach for the various types of problem. (K4)

5 Design and modify existing machine learning algorithms to suit an individual application. (K5)

6 Provide useful case studies on the advanced machine learning algorithms. (K3)

CO – PO, PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	2	3	3	2	-	-	2	1	1	3	2	2
CO2	2	3	3	3	3	3	-	-	1	2	1	3	2	3
CO3	2	3	3	2	2	2	-	-	1	1	2	3	3	2
CO4	3	3	3	3	3	2	-	-	3	2	2	3	2	2
CO5	2	3	3	3	3	2	-	-	2	2	2	3	2	2
CO6	2	3	3	3	3	3	-3	-	1	1	1	2	2	2

PROFESSIONAL ELECTIVES - II

20ECEL610 SDG NO. 3,4	MEDICAL ELECTRONICS	L	T	P	C
		3	0	0	3

OBJECTIVES:

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

UNIT I ELECTRO-PHYSIOLOGY AND BIO-POTENTIAL RECORDING 9

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

UNIT II BIO-CHEMICAL AND NON ELECTRICAL PARAMETER MEASUREMENT 9

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

UNIT III ASSIST DEVICES 9

Cardiac pacemakers, DC Defibrillator, Dialyzer, Ventilators, Magnetic Resonance Imaging Systems, Ultrasonic Imaging Systems, Heart lung machine

UNIT IV PHYSICAL MEDICINE AND BIOTELEMETRY 9

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

UNIT V RECENT TRENDS IN MEDICAL INSTRUMENTATION 9

Telemedicine, Insulin Pumps, Radio pill, Endomicroscopy, Brain machine interface, Lab on a chip, Laser in medicine, cryogenic application.

TOTAL: 45 PERIODS

TEXT BOOKS:

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

REFERENCES:

1. Myer Kutz, "Standard Handbook of Biomedical Engineering and Design", McGraw Hill Publisher, 2003.
2. John G.Webster, "Medical Instrumentation Application and Design", 3rd Edition, Wiley India Edition, 2007.
3. Joseph J.Carr and John M.Brown, "Introduction to Biomedical Equipment Technology", John Wiley and Sons, New York, 2004.
4. R.D.Lele, "Computers in Medicine," Tata McGraw Hill, NewDelhi-1989.
5. Onkar N. Pandey, Rakesh Kumar, "Medical Electronics", S.K. Kataria & Sons, 2009

WEB REFERENCES:

1. https://books.google.co.in/books/about/Principles_of_Medical_Electronics_and_Bi.html?id=Uu1_6V7H5n8C
2. https://www.youtube.com/watch?v=JOMsijqtHps

3. https://www.youtube.com/watch?v=i2mZylgP1Fk
4. https://www.youtube.com/watch?v=R8obTqD9MBY

ONLINE RESOURCES:

1. https://academicearth.org/biomedical-engineering/ww.youtube
2. https://www.ecs.soton.ac.uk/undergraduate/biomedical-electronic-engineering
3. https://www.sciencedirect.com/topics/engineering/medical-electronics
4. https://study.com/articles/Biomedical_Instrumentation_Courses_and_Training_Programs.html

OUTCOMES:

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

1. Identify the amplitude and frequency of ECG, EEG, EMG & PCG. (K3)
2. Sketch the lead systems and recording setup of ECG, EEG, EMG & PCG for diagnosis. (K2)
3. Describe the measurement techniques for biochemical and non-electrical parameters for the purpose of screening. (K2)
4. Illustrate the working of assist devices and application of therapeutic instruments on different diseased conditions. (K2)
5. Explain the functioning of MRI and Ultrasound imaging for diagnosis. (K2)
6. Summarize the working principle of Bio -Telemetry, Tele-medicine and recent trends in various diagnostic equipment. (K2)

CO – PO, PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	2	2	1	1	-	-	-	-	-	1	2	1
CO2	2	2	2	1	1	-	-	-	-	-	-	-	1	1
CO3	2	2	2	2	2	2	2	-	-	-	-	-	2	1
CO4	2	2	2	2	-	2	-	-	-	-	-	-	2	2
CO5	2	2	-	1	-	1	-	-	-	-	-	-	1	1
CO6	-	2	2	1	1	-	-	-	-	-	-	-	2	1

PROFESSIONAL ELECTIVES - II

20MGEL601 SDG NO. 4,8,9,12	TOTAL QUALITY MANAGEMENT	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To understand the concepts and philosophies of Quality Management
- To know the impact and significance of TQM principles on organizations in recent times.

UNIT 1 INTRODUCTION **8**

Need and Evolution of Quality, Quality-Definitions, statements and dimensions of product and service quality TQM-concepts, Elements and Framework, Benefits & Obstacles of TQM , TQM-Culture, Stategic Quality Management, Costs of Quality.

UNIT II CONTRIBUTIONS AND APPROACHES TO QUALITY MANAGEMENT **9**

Renowned quality gurus- Deming, Juran, Crosby and Ishikawa, Contributions of Taguchi – Loss Function, Signal to Noise Ratio and design of experiments, Kaizen -principles and practices-5 S tools, Poka Yoke-8Discipline Methodology, Just in time, Continous process improvement-PDCA cycle and 5 why analysis

UNIT III CUSTOMER FOCUS AND TEAMWORK **8**

Identifying Customer Needs, QFD - Process, Building HoQ, Customer Satisfaction Measurement Techniques. Employee Involvement Practices. Individual Participation - Suggestion Systems & Empowerment, Motivation, Leadership, Partnerships - Cross-Functional Teams, Supplier/Customer Partnerships, Problem -Solving Teams - Quality Circles.

UNIT IV STATISTICAL TOOLS & TECHNIQUES **11**

SQC - Tools For Data Collection And Analysis – Seven tools(old and new), Statistical Process Control (SPC) – Construction of Control Chart – Variables and Attributes. Process Capability – concepts and measurement. Six Sigma models ,Lean six sigma, BPR, TPM, FMEA and Benchmarking.

UNIT V QUALITY SYSTEMS AND STANDARDS **9**

Need for ISO 9000- ISO 9001: 2015 quality system-guidelines and clausewise requirements, Quality audits-types and responsibilities, ISO 14001:2004 EMS,

ISO / TS 16949:2002, ISO 27001:2005 ISMS, SEI – CMMIand Awards - Demings Prize, MBNQA and criteria.

TEXT BOOKS

1. Besterfield, Total Quality Management, 3rd Edition, Pearson India
2 Shridhara K Bhat, Total Quality Management. Himalaya Publishing House, 2010.

REFERENCE BOOKS

1. Bedi Kanishka, Quality Management, Oxford University Press
2. Kiran D.R., Total Quality Management - Key Concepts and Case Studies, Butterworth-Heinemann, 2016.
3. Poornima M Charantimath, Total Quality Management. Pearson India, 2017
4. Sharma DD, Total Quality Management, Principles, Practice and Cases, Sultan Chand and Sons.
5. Douglas C. Montgomory, Introduction to Statistical Quality Control, Wiley Student Edition, 4th Edition, Wiley India Pvt Limited, 2008

MOOC REFERENCES

1. https://www.coursera.org/lecture/supply-chain-management/total-quality-management-wLrvy
2. https://swayam.gov.in/nd1_noc20_mg34/preview
3. https://www.openlearning.com/courses/total-quality-management/
4. https://www.udemy.com/course/tqm-in-academics/

ONLINE RESOURCES

1. https://www.unido.org/sites/default/files/2009-04/A_roadmap_to_quality_volume_1_0.pdf
2. https://www.investopedia.com/terms/t/total-quality-management-tqm.asp
3. https://www.researchgate.net/publication/237006071_Total_Quality_Management_in_Academic_Libraries_A_Study
4. https://www.isixsigma.com/methodology/total-quality-management-tqm/introduction-and-implementation-total-quality-management-tqm/
5. https://study.com/academy/lesson/five-principles-of-total-quality-management-tqm.html

OUTCOME:

1 Understand quality concepts and philosophies of TQM. (K2)
2 Apply TQM principles and concepts of continuous improvement. (K3)
3 Explain the quality tools, management tools and statistical fundamentals to improve quality. (K2)
4 Demonstrate the various TQM tools as a means to improve quality. (K2)
5 Illustrate quality tools and procedures for better quality output. (K3)

CO – PO, PSO MAPPING:

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

PROFESSIONAL ELECTIVES - III

20ECEL701 SDG NO. 4	COGNITIVE RADIO	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To understand the evolving software defined radio and cognitive radio techniques and their essential functionalities.
- To study the basic architecture and standard for cognitive radio.
- To understand the physical, MAC and Network layer design of cognitive radio.
- To expose the student to evolve applications and advanced features of cognitive radio

UNIT I INTRODUCTION TO SOFTWARE-DEFINED RADIO AND COGNITIVE RADIO 9

Evolution of Software Defined Radio and Cognitive radio: goals, benefits, definitions, architectures, relations with other radios, issues, enabling technologies, radio frequency spectrum and regulations.

UNIT II COGNITIVE RADIO ARCHITECTURE 9

Cognition cycle – orient, plan, decide and act phases, organization; SDR as a platform for Cognitive Radio – Hardware and Software Architectures; Overview of IEEE 802.22 standard for broadband wireless access in TV bands.

UNIT III SPECTRUM SENSING AND DYNAMIC SPECTRUM ACCESS 9

Introduction – Primary user detection techniques – energy detection, feature detection, matched filtering, cooperative detection and other approaches; Fundamental Tradeoffs in spectrum sensing; Spectrum Sharing Models of Dynamic Spectrum Access - Unlicensed and Licensed Spectrum Sharing; Fundamental Limits of Cognitive Radio.

UNIT IV MAC AND NETWORK LAYER DESIGN FOR COGNITIVE RADIO 9

MAC for cognitive radios – Polling, ALOHA, slotted ALOHA, CSMA, CSMA / CA; Network layer design – routing in cognitive radios, flow control and error control techniques.

UNIT V ADVANCED TOPICS IN COGNITIVE RADIO 9

Overview of security issues in cognitive radios, auction based spectrum

markets in cognitive radio networks, public safety and cognitive radio, cognitive radio for Internet of Things.

TOTAL: 45 PERIODS

TEXT BOOKS:

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

REFERENCES:

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

WEB REFERENCES:

1. https://www.classcentral.com/course/swayam-basics-of-software-defined-radios-and-practical-applications-10088
2. https://nptel.ac.in/courses/108107107/
3. https://www.ofcom.org.uk/research-and-data/technology/general/emerging-tech/cognitive-radio

ONLINE RESOURCES:

1. https://link.springer.com/chapter/10.1007/978-981-10-4280-5_68
2. https://www.sciencedirect.com/topics/computer-science/cognitive-radio-network

OUTCOMES:

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

1. Elaborate on the architecture implications of software defined radio along with its radio frequency spectrum and regulations (K2)
2. Devise a Smart agent model in CR (K3)
3. Enumerate the Physical and Link layer parameters to improve the performance of communication link in CR (K3)
4. Discuss about the MAC schemes related to cognitive radio networks in detail (K2)

5. Make use of the concept of wireless networks to build next generation networks (K3)
6. Provide a review of security issues in cognitive network and CR- IoT framework with neat diagram (K2)

CO - PO, PSO MAPPING :

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1	3	3	2	1	3	1	1	2	1	3	3	-
CO2	3	2	3	3	1	1	3	1	1	2	1	3	2	-
CO3	2	2	2	3	1	1	2	1	1	2	1	2	3	3
CO4	3	2	3	3	2	1	3	1	1	2	1	2	-	3
CO5	3	1	3	3	1	1	3	1	1	2	1	2	-	3
CO6	2	2	2	3	1	1	2	1	1	2	1	2	3	3

PROFESSIONAL ELECTIVES - III

20ECEL702	SMART ANTENNA FOR MOBILE	L	T	P	C
SDG NO. 4,9,11,15	COMMUNICATION AND GPS	3	0	0	3

OBJECTIVES:

- To understand the applications of antenna arrays to Mobile Communications.
- To learn the architecture of smart antenna systems.
- To learn the Smart Antennas Techniques for CDMA
- To acquire knowledge on GPS and GPS Signals
- To understand GPS orbits and GPS position determination

UNIT I INTRODUCTION TO SMART ANTENNAS 9

Spatial Processing for Wireless Systems, Key Benefits of Smart Antennas, Smart antenna introduction, smart antenna configuration, SDMA, architecture of smart antenna systems.

UNIT II APPLICATIONS OF SMART ANTENNAS IN MOBILE COMMUNICATIONS 9

Mobile communication systems with smart antennas, Application of Antenna Arrays to Mobile Communications, Beam Forming and Direction-of-Arrival Considerations.

UNIT III SMART ANTENNAS TECHNIQUES FOR CDMA 9

Non-Coherent CDMA Spatial Processors, Coherent CDMA Spatial Processors and the Spatial Processing Rake Receiver, Multi-User Spatial Processing, Dynamic Re-sectoring Using Smart Antennas, Downlink Beamforming for CDMA.

UNIT IV OVERVIEW OF GPS & GPS SIGNALS 9

Overview of GPS- Global Positioning Systems: Basic concept, system architecture, space segment, user segment, GPS aided Geo-augmented navigation (GAGAN) architecture. Signal structure, anti-spoofing (AS), selective availability, Difference between GPS and GALILEO satellite construction.

UNIT V GPS ORBITS AND SATELLITE POSITION DETERMINATION 9

GPS orbital parameters, description of receiver independent exchange format (RINEX) – Observation data and navigation message data parameters, GPS position determination. GPS / GNSS Smart antennas.

TOTAL: 45 PERIODS

REFERENCE BOOKS:

1. T.S. Rappaport and J.C. Liberti, "Smart Antennas for Wireless Communications", Prentice Hall India. 1999
2. Tapan K Sarkar ," Smart Antennas ", IEEE Press, John Wiley & Sons Publications,2003
3. B. Hoffman – Wellenhof, H. Liehtenegger and J. Collins, "GPS – Theory and Practice", Springer – Wien, New York (2001).
4. Gottapu Sasibhushana Rao , "Global Navigation Satellite Systems", Mc-Graw Hill Education, New Delhi, 2010.

WEB REFERENCES:

1. https://onlinecourses.nptel.ac.in/noc20_ce51/preview
2. https://www.coursera.org/lecture/state-estimation-localization-self-driving-cars/lesson-3-the-global-navigation-satellite-systems-gnss-TDlnE

ONLINE RESOURCES:

1. https://www.edn.com/millimeter-wave-beamforming-and-antenna-design/
2. https://www.memoireonline.com/08/08/1453/study-of-smart-antennas-on-mobile-communications.html

5. https://www.rohde-schwarz.com/mea/solutions/test-and-measurement/rf-microwave-components/antennas/over-the-air-ota-beamforming-applications_253908.html

OUTCOMES:

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

1 Examine the application of smart antennas to Mobile Communications(K3)

2 Analyze Beam forming considerations and Spatial Processing for Wireless Systems (K4)

3 Discuss smart antenna configurations for mobile communication and GPS(K2)

4 Describe Smart Antennas Techniques for SDMA and CDMA (K2)

5 Explain Global Positioning Systems and Orbital Parameters (K2)

6 Design GPS/GNSS smart antennas for the satellite position, navigation, timing and Signal corrections (K4)

CO - PO, PSO MAPPING :

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	2	2	1	1	-	-	-	-	1	1	3	2
CO2	3	3	3	3	3	1	-	-	-	-	1	1	3	2
CO3	3	3	2	2	3	2	-	-	-	-	2	2	3	2
CO4	3	3	3	2	3	2	-	-	-	-	2	2	3	2
CO5	3	3	3	2	3	2	-	-	-	-	2	2	3	2
CO6	3	3	3	2	3	2	-	-	-	-	2	2	3	2

PROFESSIONAL ELECTIVES - III

20ECEL703 SDG NO. 4	MIXED SIGNAL IC DESIGN	L	T	P	C
		3	0	0	3

OBJECTIVES:

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

UNIT I SUBMICRON CMOS CIRCUIT DESIGN 9

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

UNIT II INTEGRATOR BASED CMOS FILTERS 9

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

UNIT III DATA CONVERTER ARCHITECTURES 9

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

UNIT IV DATA CONVERTER MODELING AND SNR 9

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

UNIT V OSCILLATORS AND PLL 9

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

TOTAL: 45 PERIODS

TEXT BOOK:

1. David A. Johns, Ken Martin, "Analog Integrated Circuit Design", Wiley Student Edition, 2013

REFERENCES:

1. R.Jacob Baker, "CMOS Mixed Signal Circuit Design", Wiley India, IEEE Press, Reprint, 2008.
2. R.Jacob Baker, "CMOS Circuit Design, Layout and Simulation", Wiley India, IEEE Press, 2nd Edition, Reprint, 2009.
3. Behzad Razavi, "Design of Analog CMOS Integrated Circuits", McGraw Hill, 33rd Reprint, 2016.

WEB REFERENCES:

1. https://nptel.ac.in/courses/117106030/
2. https://www.youtube.com/playlist?list=PLLDC70psjvq5vtrb0EdII4xIKA15ec-Ij
3. https://www.ee.iitb.ac.in/web/academics/courses/EE719

ONLINE RESOURCES:

1. https://engineering.tamu.edu/electrical/academics/degrees/ graduate/mixed-signal-integrated-circuit-design-online-certificate.html
2. https://www.classcentral.com/course/swayam-analog-ic-design-10032
3. https://extension.berkeley.edu/public/category/courseCategoryCertificateProfile.do?method=load&certificateId=54012374

OUTCOMES:

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

1. Apply the concepts for mixed signal MOS circuits.(K3)
2. Analyze the characteristics of IC based CMOS filters.(K3)
3. Design various data converter architecture circuits.(K3)
4. Illustrate the signal to noise ratio and modeling of mixed signals.(K3)
5. Design oscillators and phase lock loop circuits.(K3)
6. Extend the Mixed Signal Design to Different Applications(K3)

CO - PO, PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	1	2	3	3	-	-	-	-	-	-	-	-	1	2
CO2	1	2	3	3	-	-	-	-	-	-	-	-	1	2
CO3	1	2	3	3	-	-	-	-	-	-	-	-	1	2
CO4	1	2	3	3	-	-	-	-	-	-	-	-	1	2
CO5	1	2	3	3	-	-	-	-	-	-	-	-	1	2
CO6	1	2	3	3	-	-	-	-	-	-	-	-	1	2

PROFESSIONAL ELECTIVES - III

20ECEL704 SDG NO. 4,9	EMBEDDED PROCESSOR FOR SIGNAL PROCESSING	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To study the architecture of embedded processor
- To introduce the number formats and quantization in real time processing.
- To learn the memory systems and data transfer in Blackfin Processor.
- To introduce the concept of code optimization and power management.

UNIT I INTRODUCTION TO EMBEDDED PROCESSOR 9

Embedded Processor: Micro Signal Architecture -Real-Time Embedded Signal Processing. The Blackfin Processor: An Architecture for Embedded Media Processing - Overview of the Blackfin Processor Architecture: Hardware Processing Units and Register Files-Bus Architecture and Memory-Basic Peripherals.

UNIT II REAL-TIME DSP FUNDAMENTALS AND IMPLEMENTATION 9

Number Formats Used in the Blackfin Processor-Fixed-Point Formats -Fixed-Point Extended Format -Fixed-Point Data Types -Emulation of Floating-Point Format - Block Floating-Point Format-Dynamic Range, Precision, and Quantization Errors - Incoming Analog Signal and Quantization -Dynamic Range, Signal-to-Quantization Noise Ratio, and Precision -Sources of Quantization Errors in Digital Systems Overview of Real-Time Processing.

UNIT III MEMORY SYSTEM AND DATA TRANSFER 9

Overview of Signal Acquisition and Transfer to Memory-DMA Operations and Programming-Using Cache in the Blackfin Processor-Comparing and Choosing Between Cache and Memory DMA- Scratchpad Memory of Blackfin Processor.

UNIT IV CODE OPTIMIZATION AND POWER MANAGEMENT 9

Using Assembly Code for Efficient Programming - Using Hardware Loops - Using Dual MACs -Using Parallel Instructions -Special Addressing Modes: Separate Data Sections - Using Software Pipelining- Power Consumption and Management in the Blackfin Processor.

UNIT V DSP APPLICATIONS 9

Overview of Audio Compression -Audio Encoding -Audio Decoding- Digital Image Processing- Overview of Image Representation- Color Conversion-Image Enhancement.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. Woon-Seng Gan,Sen M.Kuo," Embedded Signal Processing with the Micro Signal Architecture", Wiley-IEEE Press,January 2007.
2. Proakis and Manolokis, "Digital Signal Processing: Principles, Algorithms, and Applications, Pearson, July 2013

REFERENCES:

1. S.K. Mitra ,"Digital Signal Processing", Mc-Graw Hill,. Third Edition, 2006.
2. Sinha, Priyabrata," Speech Processing in Embedded Systems", Springer 2010.
3. Phil Lapsley, Jeff Bier, Amit Shoham, Edward A. Lee, "DSP Processor Fundamentals: Architectures and Features", Wiley-IEEE Press, 2017.
4. Edward Ashford Lee and Sanjit Arunkumar Seshia, "Introduction To Embedded Systems", Second Edition, 2017

WEB REFERENCES:

1. https://youtu.be/D-TM91xLZY4?t=171
2. https://youtu.be/_wTAd5nr05g?t=23
3. https://www.mouser.in/new/analog-devices/adi-adsp-bf609-processors/

ONLINE RESOURCES:

1. https://www.analog.com/media/en/technical-documentation/application-notes/EE-213.pdf
2. https://www.analog.com/en/technical-articles/fixed-point-vs-floating-point-dsp.html
3. https://www.analog.com/media/en/technical-documentation/application-notes/EE367.pdf

OUTCOMES:

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

1 Describe the architectural features, DSP computational building blocks and memory interfacing of Blackfin Processor.(K2)

2 Differentiate the number formats, fixed and floating-point representation, types of errors used in Blackfin processor.(K2)

3 Analyze and implement the real time digital signal processing fundamentals.(K3)

4 Compare DMA Operations and Cache in Blackfin Processor (K3)

5 Optimize the interaction of Embedded hardware designs with their software(K4)

6 Model real-time applications using embedded system concepts.(K4)

CO - PO, PSO MAPPING :

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	2	1	-	-	-	-	-	-	-	2	3	2
CO2	3	2	2	3	3	-		-	-	-	-	2	2	2
CO3	3	2	1	3	3	-	-	-	1	1	`1	2	2	2
CO4	3	2	1	2	1	-	-	-	-	-	-	2	2	1
CO5	3	2	1	3	3	-		-	-	-	-	2	3	2
CO6	2	2	3	2	3	-	-	-	2	2	2	2	2	3

PROFESSIONAL ELECTIVES - III

20ECEL705 SDG NO. 4,9,11	ANTENNAS FOR MODERN WIRELESS COMMUNICATION	L	T	P	C
		3	0	0	3

OBJECTIVES:

- Enhance the knowledge in applications of Mobile Handset Antennas
- Understand the radiation concepts in Fractal, Millimeter Antennas
- Gain basic knowledge of different types of materials and methods used for fabrication of flexible electronics.
- Understand and designing Radio frequency identification (RFID) systems, middleware architectures for real-world applications.
- To make use of antenna measurement methods

UNIT I MOBILE HANDSET ANTENNAS 9

Review of antenna basic parameters - Frequency bands for commercial applications - Cellular handset antenna design issues - Helical wire antennas and variants - Evolution of the PIFA - Ceramic chip and resonator antennas - SAR measurement and minimization - Provision for GPS and Bluetooth

UNIT II FRACTAL and MILLIMETER WAVE ANTENNAS 9

Fractal antenna geometries - Iterated function systems - Fractal antenna elements - Radiation characteristics - Fractal antenna arrays - Antenna arrays based on aperiodic tilings. Millimeter wave and Terahertz applications - Waveguide antennas - Printed planar antennas - On-chip antennas - Sub millimeter wave antennas - Vivaldi antenna & long slot array for ultra wideband characteristics.

UNIT III BROADBAND PLANAR and SMART ANTENNA 9

Suspended plate antennas - Techniques for broad impedance bandwidth - Techniques for enhanced radiation performance - Planar monopole antennas - Applications in high speed wireless communications -Beam steering - Degree of freedom - Key benefits of smart antennas technology - Narrow band processing: Signal model- Conventional beam former-Null steering beam former-Optimal beam former-Optimization using reference signal-Optimal beam space processor.

UNIT IV EBG STRUCTURES DESIGN 9

Parametric study of a mushroom-like EBG structure: Patch width effect, Gap width effect, Substrate thickness effect, Substrate permittivity effect - Comparison of mushroom and uni planar EBG designs - Polarization dependent EBG surface designs: Rectangular patch EBG surface, Slot loaded

EBG surface, EBG surface with offset vias, PDEBG reflector - Compact spiral EBG designs: - Single, Double and Four arm spiral design - Dual layer EBG design.

UNIT V FABRICATION AND MEASUREMENT TECHNIQUES OF FLEXIBLE ANTENNAS 9

Introduction, Material Selection - Conductive and substrate materials and its characterization, Antenna Fabrication method and impedance matching strategy in wearable and flexible antennas, Measurement Techniques.

TOTAL: 45 PERIODS

TEXT BOOK:

1. Modern Antennas, S.Drabowitch, A. Papiernik, H.D. Griffiths, J.Encinas and B.L.Smith, Second Edition, Springer-
2. Innovation in Wearable and Flexible antennas, Haider R. Khaleel California State University, Sonoma, USA, Published by WIT Press Ashurst Lodge, Ashurst, Southampton, SO40 7AA, UK, WIT Press 2015.
3. John.L.Volakis, "Antenna Engineering Handbook", Tata McGraw Hill, Fourth Edition, 2007.
4. Amin Rida and Manos M. Tentzeris, RFID-Enabled Sensor Design and Applications (Artech House Integrated Microsystems), 2011, First edition, Artech House Publishers, UK.

REFERENCE:

1. Antenna Theory - C.A. Balanis, John Wiley & Sons, Third edition., 2005
2. Antennas – John D. Kraus, McGraw-Hill (International Edition), Second edition. 1988

OUTCOMES:

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

1 Illustrate SAR value measurement & minimization methods for mobile handset. (K1)
2 Design and explain radiation parameters of simple Fractal antenna and Fractal array (K2)
3 Analyze Waveguide, Printed planar, Vivaldi antennas & long slot array (K2)
4 Illustrate the performance and applications of antenna for high speed wireless communication. (K2)
5 Design an EBG structures. (K3)
6 Explain the fabrication and measurement techniques of flexile antennas. (K1)

CO - PO, PSO MAPPING :

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	2	-	-	-	-	1	1	-	1	1
CO2	3	2	2	-	-	-	-	1	1	-	1	1
CO3	3	2	2	-	-	-	-	1	1	-	1	1
CO4	3	2	2	-	-	-	-	1	1	-	1	1
CO5	3	2	2	-	-	-	-	1	1	-	1	1
CO6	3	2	2	-	-	-	-	1	1	-	1	1

PROFESSIONAL ELECTIVES - III

20ECEL706 SDG NO. 9, 12	MICROWAVE AND MILLIMETER WAVE CIRCUITS AND SYSTEMS	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To study trend in the designing and modeling of Microwave and mm wave circuits.
- To Summarize the applications of Microwave and mm wave circuits and systems.
- To analyze modeling of noise for UWB systems.
- To illustrate concept of MIOS and SIW technologies.
- To outline the design of RF circuits and RF Mems.

UNIT I DESIGN AND MODELING TRENDS 9

Introduction to Low Coefficient Accurate Nonlinear Microwave and Millimeter Wave Nonlinear Transmitter Power Amplifier Behavioural Models, Artificial Neural Network in Microwave Cavity Filter Tuning, Wideband Directive Antennas with High Impedance Surfaces - AMC Characterization, 2 Antenna over AMC, Wideband Directive Antenna Using AMC with a Lumped Element Wideband Directive Antenna Using a Hybrid AMC

UNIT II MODELLING OF SUBSTRATE NOISE AND MITIGATION SCHEMES FOR UWB SYSTEMS 9

Ultra Wideband Systems – Developments and Challenges, Impact Evaluation of Substrate Noise, Analytical Modelling of Switching Noise in Lightly Doped Substrate, Substrate Noise Suppression and Isolation for UWB Systems.

UNIT III APPLICATIONS 9

Short-Range Tracking of Moving Targets by a Handheld UWB Radar System - Handheld UWB Radar System, UWB Radar Signal Processing, Advances in the Theory and Implementation of GNSS Antenna Array Receivers - GNSS: Satellite-Based Navigation Systems, Challenges in the Acquisition and Tracking of GNSS Signals, Design of Antenna Arrays for GNSS, Multiband RF Front-Ends for Radar and Communications Applications- Minimum Sub-Nyquist Sampling , Design of Signal-Interference Multiband Bandpass Filters, Building and Testing of Direct-Sampling RF Front-Ends

UNIT IV RECONFIGURABLE RF CIRCUITS AND RF-MEMS 9

Reconfigurable RF Circuits – Transistor-Based Solutions, Design Example: Tunable Band Pass filter, Beamforming Network, LNA and VCO, Reconfigurable RF Circuits Using RF-MEMS

UNIT V MIOS and SIW TECHNOLOGIES 9

Quiet-Sun Spectral Flux Density, Radiation Mechanism in Flares, Solar Flares Flux Density, Solar Flares Peak Flux Distribution, Atmospheric Variability, Ionospheric Variability, Antenna Design - Antenna e (SIW) Technology - Substrate Integrated Waveguide Technology, Passive SIW Cavity-Backed Antennas, Design of Coupled Oscillator Systems for Power Combining, Coupled Oscillator Array with Beam-Scanning Capabilities.

TOTAL: 45 PERIODS

TEXT BOOK:

1 Apostolos Georgiadis, Hendrik Rogier, Luca Roselli, Paolo Arcioni Microwave and Millimeter Wave Circuits and Systems: Emerging Design, Technologies and Applications, 2012, Wiley

REFERENCE:

1 Joy Laskar, Babak Matinpour, Sudipto Chakraborty, "Modern Receiver Front- Ends Systems, Circuits, and Integration", Wiley- Interscience, 2004.

WEB REFERENCES:

1 https://www.everythingrf.com/
2 https://nptel.ac.in/courses/117/105/117105139/#

ONLINE RESOURCES:

1 https://www.youtube.com/watch?v=kYp0ipC-wtE
2 https://mtt.org/webinar-library/microwave-and-millimeter-wave-power-amplifiers-technology-applications-and-future-trends/

OUTCOMES:

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

1 Summarize the trend in the designing and modeling of Microwave and mm wave circuits (K1)

2 Apply the Microwave and mm wave circuits and systems to various communication technologies (K2)

3 Model and suppress various noise sources in communication systems. (K2)

4 Illustrate concept of MIOS and SIW technologies (K1)

5 Design RF circuits and RF Mems (K3)

6 Illustrate the design and applications of Microwave and mm wave circuits and systems (K2)

CO - PO, PSO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	2	1	1	1	1	-	1	1	1	1	3	2
CO2	3	3	3	1	1	1	1	-	1	1	1	1	3	2
CO3	3	3	3	1	1	2	2	1	1	1	1	1	3	3
CO4	3	2	3	1	1	2	2	1	1	1	1	1	2	2
CO5	3	3	3	1	1	1	2	-	1	1	1	1	3	2
CO6	3	3	3	1	1	1	2	-	1	1	1	1	3	2

PROFESSIONAL ELECTIVES - III

20ECEL707 SDG NO. 4,8,9,12	DSP PROCESSOR ARCHITECTURE AND PROGRAMMING	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To learn the basics on Digital Signal Processors
- To design the Programmable DSP's Architecture, On-chip Peripherals and Instruction set
- To design and simulate programming for signal processing applications
- To learn and design Advanced Programmable DSP Processors
- To design and compare the features of different family Processors

UNIT I FUNDAMENTALS OF PROGRAMMABLE DSPs 9

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

UNIT II INFINITE IMPULSE RESPONSE FILTERS 9

Architecture of C5X Processor – Addressing modes – Assembly language Instructions - Pipeline structure, On-chip peripherals – Block Diagram of DSP starter.

UNIT III TMS320C6X PROCESSOR 9

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

UNIT IV ADSP PROCESSORS 9

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

UNIT V ADVANCED PROCESSORS 9

Study of TI's advanced processors - TMS320C674x and TMS320C55x DSPs,

ADSP's Black fin and Sigma DSP Processors, NXP's DSP56Fxx Family of DSP Processors, Comparison of the features of TI, ADSP and NXP DSP family processors. **TOTAL: 45 PERIODS**

TEXT BOOKS:

1. B. Venkataramani and M. Bhaskar, "Digital Signal Processors – Architecture, Programming and Application" Tata McGraw – Hill Publishing Company Limited, New Delhi, 2003.
2. John G Proakis and Manolakis, "Digital Signal Processing Principles, Algorithms and Applications", Pearson, Fourth Edition, 2007

REFERENCES:

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

WEB REFERENCES:

1. https://www.ti.com
2. https://www.analog.com/media/en/technical-documentation

ONLINE RESOURCES:

1. https://www.academia.edu/38043202/Architecture_of_ TMS320C50_ DSP_Processor
2. http://www.ti.com/general/docs/gencontent.tsp?contentId=46898

OUTCOMES:

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

1 Design and analyze the concept of Digital signal Processor. (K3)
2 Demonstrate their ability to Program the DSP Processor for signal processing applications (K3)
3 Demonstrate the On-chip Peripherals and Instruction set.(K3)
4 Discuss, Compare and select the suitable advanced DSP Processor for real time Processing applications. (K2)
5 Apply and analyze the concept of Advanced Programmable DSP processor. (K3)
6 Explain the fundamental concept of Programmable architecture (K2)

CO - PO, PSO MAPPING :

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	2	1	1	1	-	-	-	1	-	2	2	1
CO2	3	3	2	2	3	-	-	-	-	2	-	2	2	1
CO3	3	3	2	1	3	-	-	-	-	2	-	2	2	2
CO4	3	3	1	2	3	-	-	-	-	2	-	2	2	1
CO5	3	3	2	1	3	-	-	-	-	1	-	2	2	1
CO6	3	3	2	1	3	-	-	-	-	1	-	2	2	1

PROFESSIONAL ELECTIVES - III

20ECEL708 SDG NO. 4, 9	BRAIN COMPUTER INTERFACE AND ITS APPLICATIONS	L	T	P	C
		3	1	0	3

OBJECTIVES:

- To understand the basic concepts of brain computer interface
- To study the various signal acquisition methods
- To describe about the signal processing methods used in BCI
- To understand the various machine learning methods of BCI.
- To explain the various applications of BCI

UNIT I INTRODUCTION TO BCI **9**

Introduction - Brain structure and function, Brain Computer Interface Types - Synchronous and Asynchronous -Invasive BCI -Partially Invasive BCI - Non Invasive BCI, Structure of BCI System, BCI Monitoring Hardware, EEG, ECOG, MEG, FMRI.

UNIT II BRAIN ACTIVATION **9**

Brain activation patterns - Spikes, Oscillatory potential and ERD, Slow cortical potentials, Movement related potentials-Mu rhythms, motor imagery, Stimulus related potentials - Visual Evoked Potentials – P300 and Auditory Evoked Potentials, Potentials related to cognitive tasks.

UNIT III FEATURE EXTRACTION METHODS **9**

Data Processing – Spike sorting, Frequency domain analysis, Wavelet analysis, Time domain analysis, Spatial filtering -Principal Component Analysis (PCA),

Independent Component Analysis (ICA), Artifacts reduction, Feature Extraction - Phase synchronization and coherence.

UNIT IV MACHINE LEARNING METHODS FOR BCI 9

Classification techniques –Binary classification, Ensemble classification, Multiclass Classification, Evaluation of classification performance, Regression - Linear, Polynomial, RBF's, Perceptron's, Multilayer neural networks, Support vector machine, Graph theoretical functional connectivity analysis.

UNIT V APPLICATIONS OF BCI 9

Case Studies - Invasive BCIs: decoding and tracking arm (hand) position, controlling prosthetic devices such as orthotic hands, Cursor and robotic control using multi electrode array implant, Cortical control of muscles via functional electrical stimulation. Noninvasive BCIs:P300 Mind Speller, Visual cognitive BCI, Emotion detection. Ethics of Brain Computer Interfacing.

TOTAL:L+T=45PERIODS

TEXT BOOKS:

1. Tom M. M1. Rajesh.P.N.Rao, "Brain-Computer Interfacing: An Introduction", Cambridge University Press, First edition, 2013.
2. 2. Jonathan Wolpaw, Elizabeth Winter Wolpaw, "Brain Computer Interfaces: Principles and practice", Oxford University Press, USA, First Edition , January 2012.

REFERENCES:

1. Ella Hassianien, A & Azar.A.T (Editors), "Brain-Computer Interfaces Current Trends and Applications", Springer, 2015.
2. Bernhard Graimann, Brendan Allison, GertPfurtscheller, "Brain-Computer Interfaces: Revolutionizing Human-Computer Interaction", Springer, 2010
3. Ali Bashashati, MehrdadFatourechi, Rabab K Ward, Gary E Birch," A survey of signal Processing algorithms in brain–computer interfaces based on electrical brain signals" Journal of Neural Engineering, Vol.4, 2007, PP.32-57
4. Arnon Kohen, "Biomedical Signal Processing", Volume I and II, CRC Press Inc, Boca Rato, Florida.
5. Bishop C.M., "Neural networks for Pattern Recognition", Oxford, Clarendon Press, 1995.
6. Andrew Webb, "Statistical Pattern Recognition", Wiley International, Second Edition, 2002.

OUTCOMES:

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

1. Comprehend and appreciate the significance and role of this course in the present contemporary world (K2)
2. Explain the concept of BCI (K2)
3. Illustrate the various signal acquisition methods and its functions (K2)
4. Determine the appropriate feature extraction methods (K3)
5. Explain various machine-learning algorithms. (K2)
6. Discuss the case studies for various applications of BCI (K2)

CO – PO, PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	-	3	-	-	-	-	3	-	-	-	-	-	2	1
CO2	3	3	-	3	-	-	-	-	3	-	-	-	-	-
CO3	3	3	3	3	3	3	-	-	-	-	-	-	2	3
CO4	3	3	-	-	3	-	-	-	-	-	-	-	2	1
CO5	3	3	-	-	3	-	-	-	-	-	-	-	2	1
CO6	3	3	3	3	3	3		3	3	3	3	3	2	-

PROFESSIONAL ELECTIVES - III

20ECEL709 SDG NO. 4	DIGITAL IMAGE PROCESSING	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To become familiar with digital image fundamentals.
- To get exposed to image enhancement techniques in Spatial and Frequency domain.
- To learn concepts of degradation function and restoration techniques.
- To study image segmentation and representation techniques.
- To become familiar with image compression and recognition methods.

UNIT I DIGITAL IMAGE FUNDAMENTALS **9**

Steps in Digital Image Processing – Components – Elements of Visual Perception – Image Sensing and Acquisition – Image Sampling and Quantization – Relationships between pixels - Color image fundamentals - RGB, HSI models, Two-dimensional mathematical preliminaries, 2D transforms - DFT, DCT.

UNIT II IMAGE ENHANCEMENT 9

Spatial Domain: Gray level transformations – Histogram processing – Basics of Spatial Filtering– Smoothing and Sharpening Spatial Filtering, Frequency Domain: Introduction to Fourier Transform– Smoothing and Sharpening frequency domain filters – Ideal, Butterworth and Gaussian filters, Homomorphic filtering, Color image enhancement.

UNIT III IMAGE RESTORATION 9

Image Restoration - degradation model, Properties, Noise models – Mean Filters – Order Statistics – Adaptive filters – Band reject Filters – Band pass Filters – Notch Filters – Optimum Notch Filtering – Inverse Filtering – Wiener filtering.

UNIT IV IMAGE SEGMENTATION 9

Edge detection, Edge linking via Hough transform – Thresholding - Region based segmentation – Region growing – Region splitting and merging – Morphological processing- erosion and dilation, Segmentation by morphological watersheds – basic concepts – Dam construction – Watershed segmentation algorithm.

UNIT V IMAGE COMPRESSION AND RECOGNITION 9

Need for data compression, Huffman, Run Length Encoding, Shift codes, Arithmetic coding, JPEG standard, MPEG. Boundary representation, Boundary description, Fourier Descriptor, Regional Descriptors – Topological feature, Texture - Patterns and Pattern classes - Recognition based on matching

TOTAL: 45 PERIODS

TEXT BOOKS:

1. Rafael C. Gonzalez, Richard E. Woods, "Digital Image Processing", Pearson, 3rd Edition , 2010, Fifth Edition. (Unit I – V)
2. Anil K. Jain, "Fundamentals of Digital Image Processing", Pearson, 2002. (Unit I –V)

REFERENCES:

1. Kenneth R. Castleman, "Digital Image Processing", Pearson, 2006.
2. Rafael C. Gonzalez, Richard E. Woods, Steven Eddins, "Digital Image Processing using MATLAB", Pearson Education, Inc., 2011.
3. D,E. Dudgeon and R. M. Mersereau, "Multidimensional Digital Signal Processing", Prentice Hall Professional Technical Reference, 1990.
4. William K. Pratt, "Digital Image Processing", John Wiley, New York,4th Edition,2007.
5. Milan Sonka, Vaclav Hlavac & Roger Boyle, "Image processing, Analysis and Machine Vision", Thomson Asia Prt. Ltd, 4th Edition, 2015.

6. Sid Ahmed M.A., "Image Processing - Theory, Algorithm and Architecture", McGraw Hill, 2009

WEB REFERENCES:

1. Introduction to sensors: http://www.shortcourses.com/sensors/
2. Digital Image Fundamentals:: http://www.ph.tn.tudelft.nl/Courses/FIP/Frames/fip.html
3. DIAL-Digital Image Analysis Laboratory http://www.ece.arizona.edu/~dial/
4. JPEG image compression standard: www.jpeg.org

ONLINE RESOURCES:

1. https://www.tutorialspoint.com/dip/image_processing_introduction.htm
2. https://sisu.ut.ee/imageprocessing/book/1

OUTCOMES:

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

1 Summarize the digital image acquisition concepts and color model fundamentals (K2).
2 Elaborate the image enhancement techniques in spatial and 2D transform domain (K3).
3 Describe image degradation models and filtering techniques (K3).
4 Discuss types of image segmentation techniques and morphological operators (K2).
5 Identify image compression techniques (K2).
6 Utilize to represent image in form of boundary and regional descriptors (K2).

CO – PO, PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	1	-	-	-	-	-	-	-	-	-	-	-	-
CO2	3	2	2	3	2	-	-	-	-	-	2	2	2	1
CO3	2	2	2	2	2	-	-	-	-	-	2	2	2	1
CO4	2	1	2	3	2	-	-	-	-	-	2	-	2	1
CO5	2	2	2	2	2	-	-	-	-	-	2	2	2	1
CO6	3	1	2	2	2	-	-	-	-	-	3	2	2	1

PROFESSIONAL ELECTIVES - III

20ECEL710 SDG NO. 4	DEEP LEARNING PRINCIPLES AND PRACTICES	L	T	P	C
		3	0	0	3

OBJECTIVES:

- Learn the Deep learning fundamentals
- Be familiar with CNN
- Be exposed to deep models
- Be familiar with RNN
- Learn to represent image/signal in form of features
- Apply deep learning techniques to applications

UNIT 1 INTRODUCTION TO DEEP LEARNING **9**

History of Deep learning, McCulloch Pitts Neuron, Perceptrons - Perceptron Learning Algorithm, Multilayer Perceptrons, Gradient Descent, Feedforward Neural Networks, Backpropagation– neural network and state-of-the art approaches to deep learning.

UNIT 2 CONVOLUTIONAL NEURAL NETWORKS **9**

Convolutional Neural Networks -LeNet, AlexNet, VGGNet, GoogLeNet, ResNet, Guided Backpropagation. Familiarization of convolutional neural network toolbox.

UNIT 3 DEEP MODELS FOR AI **9**

Deep generative architectures - Restricted Boltzmann Machines, Deep Belief Networks, Auto encoders, Bayesian approach. Familiarization of deep neural network toolbox.

UNIT 4 RECURRENT NETWORKS **9**

Introduction to RNN, Training RNs with back propagation - issues – Long short term memory networks, Backpropagation through time – vanishing gradient, RNN extensions – Deep (Bidirectional) RNNs. Familiarization of recurrent neural network toolbox.

UNIT 5 DEEP LEARNING APPLICATIONS **9**

Applications of Deep Learning–object recognition and Computer vision tasks, Natural language processing, Speech and audio processing Case Study: Named Entity Recognition – Opinion Mining using Recurrent Neural Networks – Parsing and Sentiment Analysis using Recursive Neural Networks – Sentence

Classification using Convolutional Neural Networks – Dialogue Generation with LSTMs.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. Goodfellow, I., Bengio, Y., & Courville, A. (2016). Deep learning. MIT press.
2. Bengio, Y. (2009). Learning deep architectures for AI. Foundations and trends® in Machine Learning.

Reference Books and papers:

1. LeCun, Y., Bengio, Y., & Hinton, G. (2015). Deep learning. nature.
2. Hochreiter, S., & Schmidhuber, J. (1997). Long short-term memory. Neural computation.
3. Hinton, G. E., Sejnowski, T. J., & Ackley, D. H. (1984). Boltzmann machines: Constraint satisfaction networks that learn. Pittsburgh: Carnegie-Mellon University, Department of Computer Science.
4. Collobert, R., Weston, J., Bottou, L., Karlen, M., Kavukcuoglu, K., &Kuksa, P. (2011). Natural language processing (almost) from scratch. Journal of machine learning research.
5. Kim, Y. (2014). Convolutional neural networks for sentence classification. arXiv preprint arXiv:1408.
6. Kalchbrenner, N., Grefenstette, E., &Blunsom, P. (2014). A convolutional neural network for modeling sentences. arXiv preprint arXiv:1404.2188.
7. Larochelle, H., Bengio, Y., Louradour, J., &Lamblin, P. (2009). Exploring strategies for training deep neural networks. Journal of machine learning research,.
8. Lee, H., Grosse, R., Ranganath, R., & Ng, A. Y. (2009, June). Convolutional deep belief networks for scalable unsupervised learning of hierarchical representations. In Proceedings of the 26th annual international conference on machine learning.
9. Salakhutdinov, R., & Hinton, G. (2009, April). Deep Boltzmann machines. In Artificial intelligence and statistics.

WEB REFERENCES:

1. https://freevideolectures.com/course/4068/nptel-deep-learning
2. https://swayam.gov.in/nd1_noc19_cs54

ONLINE RESOURCES:

1. https://www.edx.org/professional-certificate/ibm-deep-learning
2. https://www.edx.org/course/deep-learning-with-tensorflow

OUTCOMES

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

1. Review the basic concepts of neural networks (K1)
2. Implement different types of Convolutional Neural Network (K3)
3. Analyze different deep models (K4)
4. Get familiar with the use of deep learning toolbox (K3)
5. Apply Recurrent Neural Network to different applications (K3)
6. Discuss the applications of deep learning in NLP and image processing (K2)

CO – PO, PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	1	3	1	1	-	-	-	-	-	1	2	1
CO2	3	3	1	3	1	1	-	-	-	-	-	1	2	1
CO3	3	2	1	3	1	1	-	-	-	-	-	1	2	1
CO4	3	3	1	3	1	1	-	-	-	-	-	1	2	1
CO5	3	2	1	3	1	1	-	-	-	-	-	1	2	1
CO6	3	2	1	3	1	1	-	-	-	-	-	1	2	1

PROFESSIONAL ELECTIVES - III

20MGEL701 SDG NO. 9 & 12	FOUNDATION SKILLS IN INTEGRATED PRODUCT DEVELOPMENT	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To understand the global trends and development methodologies of various types of products and services.
- To conceptualize, prototype and develop product management plan for a new product based on the type of the new product and development methodology integrating the hardware, software, controls, electronics and mechanical systems.
- To understand requirement engineering and know how to collect, analyze and arrive at requirements for new product development and convert them in to design specification.
- To understand system modeling for system, sub-system and their interfaces and arrive at the optimum system specification and characteristics.

- To develop documentation, test specifications and coordinate with various teams to validate and sustain up to the EoL (End of Life) support activities for engineering customer.

UNIT I FUNDAMENTALS OF PRODUCT DEVELOPMENT 9

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

UNIT II REQUIREMENTS AND SYSTEM DESIGN 9

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

UNIT III DESIGN AND TESTING 9

Conceptualization - Industrial Design and User Interface Design - Introduction to Concept generation Techniques – Challenges in Integration of Engineering Disciplines - Concept Screening & Evaluation - Detailed Design - Component Design and Verification – Mechanical, Electronics and Software

Subsystems - High Level Design/Low Level Design of S/W Program - Types of Prototypes, S/W Testing- Hardware Schematic, Component design, Layout and Hardware Testing – Prototyping - Introduction to Rapid Prototyping and Rapid Manufacturing - System Integration, Testing, Certification and Documentation

UNIT IV SUSTENANCE ENGINEERING AND END-OF-LIFE (EOL) SUPPORT9

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

UNIT V BUSINESS DYNAMICS – ENGINEERING SERVICES INDUSTRY 9

The Industry - Engineering Services Industry - Product Development in Industry versus Academia –The IPD Essentials - Introduction to Vertical Specific Product Development processes -Manufacturing/Purchase and Assembly of Systems - Integration of Mechanical, Embedded and Software

Systems – Product Development Trade-offs - Intellectual Property Rights and Confidentiality – Security and Configuration Management.

TOTAL: 45 PERIODS

TEXTBOOKS:

1. Book specially prepared by NASSCOM as per the MoU.
2. Karl T Ulrich and Stephen D Eppinger, "Product Design and Development", Tata McGraw Hill, 5th Edition, 2011.
3. John W Newstorm and Keith Davis, "Organizational Behavior", Tata McGraw Hill, 11th Edition, 2005.

REFERENCES:

1. Hiriyappa B, “Corporate Strategy – Managing the Business”, Author House, 2013.
2. Peter F Drucker, “People and Performance”, Butterworth – Heinemann [Elsevier], Oxford, 2004.
3. Vinod Kumar Garg and Venkita Krishnan N K, “Enterprise Resource Planning – Concepts”, 2nd Edition, Prentice Hall, 2003.
4. Mark S Sanders and Ernest J McCormick, "Human Factors in Engineering and Design", McGraw Hill Education, 7th Edition, 2013.

WEB REFERENCES:

1. https://www.udemy.com/course/strategic-product-management-and-leadership/
2. https://www.udemy.com/course/building-insanely-great-products/
3. https://www.coursera.org/learn/customer-insights-orientation

ONLINE RESOURCES:

1. https://pursuite-production.s3-ap-southeast-1.amazonaws.com/media/cms_page_media/162/FSIPD+OBF+-+2012+F0_1.pdf
2. https:// futureskillsnasscom. edcast. com/ pathways/ product-management-primer-pathway/cards/5603673#

OUTCOMES:

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

1 Explain the basic essentials of product development. (K2)
2 Discuss the learnings to incorporate effective design for product development. (K2)
3 Describe the various tools of innovation & product development process in the Business context. (K2)
4 Identify the various process and choose the appropriate tools for designing, development and testing. (K2)

5 Discuss disruptive models / process to manage a product development from start to finish. (K2)

CO – PO, PSO MAPPING:

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

PROFESSIONAL ELECTIVES - IV

20ECEL801 SDG NO. 4,8 9, 11,15	5G AND 6G WIRELESS COMMUNICATION SYSTEMS	L	T	P	C
		3	0	0	3

OBJECTIVES:

- Understand the Basics of 5G and Beyond Wireless communication
- Bring a basic understanding of the key technologies and enablers of 5G and beyond communication systems.
- Study 5G Radio Access Technology
- Learn massive MIMO and mmWave (mmW) communication
- Understand 6G Technology
- Learn 6G concepts

UNIT I DRIVERS FOR 5G **9**

Evolution of LTE Technology to Beyond 4G – Pillars of 5G – Standardization Activities -Use cases and Requirements – System Concept – Spectrum and Regulations: Spectrum for 4G – Spectrum Challenges in 5G – Spectrum Landscape and Requirements – Spectrum Access Modes and Sharing Scenarios

UNIT II 5G ARCHITECTURE AND MILLIMETER WAVE COMMUNICATION **9**

5G Architecture: Software Defined Networking – Network Function Virtualization – Basics about RAN Architecture –High-Level Requirements for 5G Architecture – Functional Architecture and 5G Flexibility – Physical Architecture and 5G Deployment Millimeter Wave Communication: Channel Propagation – Hardware Technologies for mmW Systems

UNIT III 5G RADIO ACCESS TECHNOLOGIES **9**

Access Design Principles for Multi-user Communications – Multi-carrier with Filtering – Non-orthogonal Schemes for Efficient Multiple Access – Radio Access for Dense Deployments – Radio Access for V2X Communication.

UNIT IV MASSIVE MULTIPLE-INPUT MULTIPLE –OUTPUT SYSTEMS **9**

MIMO in LTE – Single-user MIMO – Multi-user MIMO – Capacity of Massive MIMO – Pilot Design of Massive MIMO – Resource Allocation and Transceiver Algorithms for Massive MIMO

UNIT-V 6G OVERVIEW **9**

Introduction to 6G Key Enablers: Wireless energy harvesting, machine learning, visible light communication - IRS.

TOTAL : 45 PERIODS

REFERENCE BOOKS:

1. Asif Oseiran, Jose F.Monserrat and Patrick Marsch, "5G Mobile and Wireless Communications Technology", Cambridge University Press, 2016.
2. Jonathan Rodriquez, "Fundamentals of 5G Mobile Networks", Wiley, 2015
3. Patrick Marsch, Omer Bulakci, Olav Queseth and Mauro Boldi, "5G System Design – Architectural and Functional Considerations and Long Term Research", Wiley, 2018

WEB REFERENCES:

1. https://onlinecourses.nptel.ac.in/noc22_ee56/preview
2. http://www.iitkgp.ac.in

ONLINE REFERENCES:

1. https://hcis-journal.springeropen.com/articles/10.1186/s13673-020-00258-2
2. https://www.qualcomm.com
3. www.electronics-notes.com › technology-basics
4. https://www.researchgate.net

OUTCOMES:

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

1. Explain 4G-LTE and 5G cellular communication networks and Spectrum standards (K2)
2. Describe 5G architectures and millimeter-wave communication (K2)
3. Illustrate the 5G techniques for the design of communication systems (K2).
4. Describe various modulation and multiplexing techniques for 5G (K2)
5. Discuss the machine learning algorithms for resource allocation in 5G MIMO systems(K2)
6. Explain the 6G technology (K2)

CO - PO, PSO MAPPING :

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	0	3	0	1	0	0	0	0	3	3	2	2
CO2	3	3	3	1	2	1	0	0	0	0	3	3	2	2
CO3	3	3	2	1	3	1	0	0	0	0	3	3	2	2
CO4	3	3	2	1	3	1	0	0	0	0	3	3	2	2
CO5	3	3	2	1	1	3	1	0	0	0	3	3	2	2
CO6	3	3	2	1	1	3	1	0	0	0	3	3	2	2

PROFESSIONAL ELECTIVES - IV

20ECEL802 SDG NO. 7, 9, 14	UNDERWATER WIRELESS COMMUNICATION SYSTEMS	L	T	P	C
		3	0	0	3

OBJECTIVES:

- Basics, Challenges and Issues in underwater acoustic propagation
- Different communication channels related to sea
- Architecture and the modeling of WSN scenario for underwater communication
- Applications and designing of underwater wireless models

UNIT I INTRODUCTION 8

Overview – Peculiarities of underwater acoustic communication channels relative to radio communication channels – Explorations establishing an innovative digital underwater acoustic communication signal processing system – Communication sonar equation.

UNIT II ACOUSTIC PROPERTIES AND ELEMENTS 10

Acoustic waves in water – The wave equation in various coordinate systems – radiation of a spherical source – Reciprocity – Oceanographic and physical properties – Reflection and transmission in multi-layered media – Ray acoustics and ray tracing – Normal modes – Acoustic transducers and antennas – Hydro acoustics.

UNIT III UNDERWATER ACOUSTIC COMMUNICATION CHANNELS 9

Theoretical methods of underwater acoustic fields – Sound transmission loss in the sea – Multipath effects in underwater acoustic communication channels

– Fluctuation of transmitted sound in underwater acoustic communication channels – Noise in the sea.

UNIT IV UNDERWATER WIRELESS SENSOR NETWORKS 10

Architecture – Propagation phenomena of underwater sensor network – Issues and challenges – Radio communication model for underwater WSN. Case Study: Optimal Node Placement in underwater WSN.

UNIT V DESIGN AND APPLICATIONS 8

ROV: Modeling, Design and Control – AUV: Design Essentials and Concepts – Modeling and control.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. Lufen Xu and Tianzeng Xu, "Digital Underwater Acoustic Communications", Academic Press, 2016.
2. Jens M Hovem, "Marine acoustics: The physics of sound in underwater environments", Los Altos Hills: Peninsula publishing, 2012.

REFERENCES:

1. K. M. Awan, P. A. Shah, K. Iqbal, S. Gillani, W. Ahmad, and Y. Nam, "Underwater Wireless Sensor Networks: A Review of Recent Issues and Challenges", WCMC, 2019.
2. Emad Felemban, Faisal Karim Shaikh, Umair Mujtaba Qureshi, Adil A. Sheikh, and Saad Bin Qaisar, "Underwater Sensor Network Applications: A Comprehensive Survey", IJDSN, Vol.11, 2015.
3. Carlos Uribe and Walter Grote, "Radio communication model for underwater WSN", 2009, 3rd International Conference on New Technologies, Mobility and Security, Pages (147-151).
4. Muhamad Felamban, Basem Shihada, and Kamran Jamshaid, "Optimal Node Placement in Underwater Wireless Sensor Networks", 2013, 27th International Conference on Advanced Information Networking and Applications (AINA), (pp. 492-499).
5. L. G. García-Valdovinos, T. Salgado-Jiménez, M. Bandala-Sánchez, L. Nava-Balanzar, R. Hernández - Alvarado, and J. Cruz-Ledesma, "Modelling, Design and Robust Control of a Remotely Operated Underwater Vehicle", International Journal of Advanced Robotic Systems, Vol.11(1), 2014.
6. L. A. Gonzalez, "Design, Modelling and Control of an Autonomous Underwater Vehicle", Bachelor of Engineering Honours Thesis 2004, Mobile Robotics Lab – CIIPS, The University of Western Australia.

ONLINE RESOURCES:

1. Gomes, R. M., Martins, A., Sousa, A., Sousa, J. B., Fraga, S. L., & Pereira, F. L. (2005, June), "A new ROV design: issues on low drag and mechanical symmetry in Europe Oceans", 2005 (Vol. 2, pp. 957-962). IEEE.
2. Chin, C. S., Lin, W. P., & Lin, J. Y. (2018), "Experimental validation of open-frame ROV model for virtual reality simulation and control", Journal of Marine Science and Technology, 23(2), 267-287.
3. Dongkyun Kim, JuanC. Cano, Wei Wang, Floriano De Rango, and Kun Hua, "Underwater Wireless Sensor Networks", Volume 2015, Article ID 623042, 2 pages.
4. En Cheng, Shengli Chen, and Fei Yuan, "Design and Detection of Multilinear Chirp Signals for Underwater Acoustic Sensor Networks", Volume 2015, Article ID 371579, 13 pages.
5. Chan-Ho Hwang, Ki-Man Kim, Seung-Yong Chun, and Sang-Kook Lee, "Doppler Estimation Based on Frequency Average and Remodulation for Underwater Acoustic Communication", Volume 2015, Article ID 746919, 8 pages.
6. Chang-Uk Baek and Ji-Won Jung, "High Throughput Receiver Structure for Underwater Communication", Volume 2015, Article ID 481576, 6 pages.
7. Emad Felemban, Faisal Karim Shaikh, Umair Mujtaba Qureshi, Adil A. Sheikh, and Saad Bin Qaisar, "Underwater Sensor Network Applications: A Comprehensive Survey", Volume2015,Article ID896832,14pages.
8. Wouter A. P. van Kleunen, Niels A. Moseley, Paul J. M. Havinga, and Nirvana Meratnia, "Proteus II: Design and Evaluation of an Integrated Power-Efficient Underwater Sensor Node", Volume 2015, Article ID 791046, 10 pages.

OUTCOMES:

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

1. Explain the basic properties of underwater acoustic channels and signal processing systems. (K2)
2. Discuss the acoustic properties and its respective elements with respect to wave equation and ray acoustics. (K2)
3. Describe the relationship between different communication channels in relation to the sea. (K2)
4. Characterize the environmental fluctuations in underwater communication. (K2)
5. Demonstrate the solutions for the challenges in building underwater WSN. (K3)
6. Design and model the different underwater communication scenarios. (K3)

CO - PO, PSO MAPPING :

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	1	-	-	2	3	3	2	1	1	2	2	2	1
CO2	3	2	1	2	2	2	3	2	-	3	2	3	3	3
CO3	3	-	-	2	1	2	2	1	2	3	2	2	1	2
CO4	2	3	3	3	2	3	3	1	2	3	2	2	3	3
CO5	3	-	3	1	3	1	2	2	3	1	3	3	3	3
CO6	3	2	3	1	3	2	2	2	1	1	3	3	3	3

PROFESSIONAL ELECTIVES - IV

20ECEL803 SDG NO.3,4,11,15	ELECTRONIC PACKAGING AND TESTING	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To introduce and discuss various issues related to the system packaging.
- To introduce CAD used in designing wiring boards and testing.

UNIT I OVERVIEW OF ELECTRONIC SYSTEMS PACKAGING 9

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

UNIT II ELECTRICAL ISSUES IN PACKAGING 9

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

UNIT III CHIP PACKAGES 9

IC Assembly - Purpose, Requirements, Technologies, Wire bonding, Tape Automated Bonding, Flip Chip, Wafer Level Packaging, reliability, wafer level burn – in and test. Single chip packaging: functions, types, materials processes, properties, characteristics, trends. Multi chip packaging: types, design,

comparison, trends. System – in - package (SIP); Passives: discrete, integrated, and embedded

UNIT IV PCB, SURFACE MOUNT TECHNOLOGY AND THERMAL CONSIDERATIONS 9

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

UNIT V TESTING 9

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

TOTAL: 45 PERIODS

TEXT BOOK:

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

REFERENCES:

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

WEB REFERENCES:

1. https://nptel.ac.in/courses/112105267/
2. https://nptel.ac.in/courses/108108031/

3. http://www.nptelvideos.in/2012/11/an-introduction-to-electronics-system.html

ONLINE RESOURCES:

1. https://www.classcentral.com/course/swayam-electronic-packaging-and-manufacturing- 13021
2. https://advancedengineering.umd.edu/electronic-packaging
3. https://www.ipcindia.org.in/fundamentals-of-electronics-systems-packaging-esp

OUTCOMES:

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

1 Explain the various packaging types used along with the associated thermal, speed, signal and integrity power issues.(K2)

2 Analyze the concepts of Electrical Issues in Packaging. (K3)

3 Design packages which can withstand higher temperature, vibrations and shock.(K3)

4 Design PCBs which minimize the EMI and operate at higher frequency.(K3)

5 Analyze the concepts of Testing and testing methods.(K3)

6 Device Test Plan and rules(K3)

CO - PO, PSO MAPPING :

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	1	2	3	3	-	-	-	-	-	-	-	-	1	2
CO2	1	2	3	3	-	-	-	-	-	-	-	-	1	2
CO3	1	2	3	3	-	-	-	-	-	-	-	-	1	2
CO4	1	2	3	3	-	-	-	-	-	-	-	-	1	2
CO5	1	2	3	3	-	-	-	-	-	-	-	-	1	2
CO6	1	2	3	3	-	-	-	-	-	-	-	-	1	2

PROFESSIONAL ELECTIVES - IV

20ECEL804 SDG NO. 4	EMBEDDED PRODUCT DEVELOPMENT	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To provide the basic concepts of product design, product features and its architecture
- To introduce the possible approaches for product development
- To understand the concepts of industrial design strategies
- To explore the stages of electronic product development
- To study about the embedded product design

UNIT I CONCEPTS OF PRODUCT DEVELOPMENT 9

Need for PD- Generic product Development Process Phases- Product Development Process Flows- Product Development organization structures- Strategic importance of Product Planning process – Product Specifications- Target Specifications-Plan and establish product specifications - integration of customer, designer, material supplier and process planner, Competitor and customer – Understanding customer and behaviour analysis. Concept Generation, Five Step Method-Basics of Concept selection- Creative thinking –creativity and problem solving- creative thinking methods- generating design concepts-systematic methods for designing –functional decomposition – physical decomposition.

UNIT II INTRODUCTION TO APPROACHES IN PRODUCT DEVELOPMENT 9

Product development management - establishing the architecture - creation - Product Architecture changes - variety – component standardization , clustering -geometric layout development - Fundamental and incidental interactions - related system level design issues - secondary systems - architecture of the chunks - creating detailed interface specifications-Portfolio Architecture competitive benchmarking- Approach for the benchmarking process-Design for manufacturing - Industrial Design-Robust Design – Prototype basics - Principles of prototyping - Planning for prototypes- Economic & Cost Analysis -Testing Methodologies- Product Branding.

UNIT III INDUSTRIAL DESIGN STRATEGIES 9

Role of Integrating CAE, CAD, CAM tools for Simulating product performance and manufacturing processes electronically- Basics on reverse engineering – Reverse engineering strategies – Finding reusable software components –

Recycling real-time embedded software based approach and its logical basics-Incorporating reverse engineering for consumer product development –case study on DeskJet Printer.

UNIT IV ELECTRONIC PRODUCT DEVELOPMENT STAGES 9

Product Development Stages-Embedded product modeling- Linear, Iterative, Prototyping, Spiral - Selection of Sensor, Voltage Supply, Power supply protection, Grounding and noise elimination methods, Thermal protection with heat management – PCB design steps – Software design and testing method – documentation.

UNIT V EMBEDDED PRODUCTS DESIGN 9

Creating general Embedded System Architecture (with Case study example: Mobile Phone / DeskJet Printer./ Robonoid as a product) –Architectural Structures- Criteria in selection of Hardware Software Components, processors, input/output interfaces & connectors, ADC System ,Memory, choosing Bus Communication Standards, Criteria in selection of Embedded OS/Device Drivers, Need for Developing with IDE, Translation & Debugging Tools & Application Software, Performance Testing, Costing, Benchmarking, Documentation.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. Anita Goyal, Karl T Ulrich, Steven D Eppinger, "Product Design and Development", McGraw –Hill International Edns.1999/ Tata McGrawEducation, ISBN-10-007-14679-9.
2. R.G. Kaduskar and V.B. Baru, " Electronic Product Design", Wiley, 2014
3. George E.Dieter, Linda C.Schmidt, "Engineering Design", McGraw-Hill International Edition,Fourth Edition, 2009, ISBN 978-007-127189-9
4. Stephen Armstrong, "Engineering and Product Development Management; The Holistic Approach", CAMBRIDGE UNIVERSITY PRESS (CUP),2014.

REFERENCES:

1. Rajkamal, "Embedded system-Architecture, Programming, Design" TMH,2011.
2. KEVIN OTTO & KRISTIN WOOD, "Product Design and Development", Fourth Edition,2009, Product Design Techniques in Reverse Engineering and New Product Development , Pearson Education (LPE),2001./ISBN 9788177588217
3. Yousef Haik, T. M. M. Shahin, "Engineering Design Process", 2nd

Edition Reprint, Cengage Learning, 2010, ISBN 0495668141

4. Clive L.Dym, Patrick Little, "Engineering Design: A Project-based Introduction", Third Edition, John Wiley & Sons, 2009, ISBN 978-0-470- 22596-7.

ONLINE RESOURCES

1. https://barrgroup.com/embedded-systems/consulting-services/product-development
2. http://logicproindia.com/index.php/products/
3. https://www.arm.com/resources/education/online-courses
4. https://openlabpro.com/design-platforms/

OUTCOMES:

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

1. Use the integration of customer requirements in product design.(K3)
2. Apply structural approach to concept generation, creativity, selection and testing.(K3)
3. Outline various aspects of design such as industrial design, design of Consumer specific product and product architecture.(K2)
4. Define various aspects of its Reverse Engineering manufacture, economic analysis.(K1)
5. Design an embedded product.(K3)
6. Apply the various tool to design and simulate the performance of the product(K3)

CO - PO, PSO MAPPING :

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	3	2	3	2	2	1	2	1	1	3	2	3
CO2	3	2	3	2	3	2	2	1	2	1	2	3	1	3
CO3	3	2	3	2	3	2	2	1	2	1	1	3	2	3
CO4	3	2	3	2	3	2	2	1	2	1	2	3	2	3
CO5	3	2	3	2	3	2	2	1	2	1	1	3	1	3
CO6	2	1	2	-	2	-	-	1	-	-	-	1	2	1

PROFESSIONAL ELECTIVES - IV

20ECEL805 SDG NO. 4, 9, 11	RF SYSTEM DESIGN AND MMIC	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To understand the conceptual understanding of RF receiver Parameters, architectures with their different issues.
- To understand the Practical RF measurement
- To know the basic techniques needed for analysis of RF systems and MIC Components
- To know the basic techniques needed for analysis of RF systems
- To understand the fundamentals of RF design and Microwave Integrated Circuits

UNIT I RF SYSTEM DESIGN 9

Frequency Planning - Blockers, Spurs and Descending, Transmitter Leakage, LO Leakage and Interference, Image, Half IF, Link Budget Analysis – Linearity, Noise, Signal-to-Noise Ratio, Receiver Gain, Propagation Effects - Path Loss, Multipath and Fading, Equalization, Diversity, Coding, Interface Planning

UNIT II REVIEW OF RECEIVER ARCHITECTURES 9

Heterodyne Receivers, Image Reject Receivers - Hartley Architecture, Weaver Architecture, Zero IF Receivers, Low IF Receivers, Issues in Direct Conversion Receivers – Noise, LO Leakage and Radiation, Phase and Amplitude Imbalance, DC Offset, Intermodulations, Architecture Comparison, and Trade-off.

UNIT III SILICON-BASED RECEIVER DESIGN 9

Receiver Architecture and Design - System Description and Calculations, Basics of OFDM, System Architectures, System Calculations, Circuit Design - SiGe BiCMOS Process Technology, LNA, Mixer, Frequency Divider, Receiver Design Steps- Design and Integration of Building Blocks, DC Conditions, Scattering Parameters, Small-Signal Performance, Transient Performance, Noise Performance, Linearity Performance, Parasitic Effects, Process Variation, 50-Ω and Non50-Ω Receivers, Layout Considerations

UNIT IV RECEIVER FRONT-END MEASUREMENTS 9

DC Test, Functionality Test, SParameter Test, Conversion Gain Test, Linearity Test, Noise Figure Test, I/Q Imbalance, DC Offset, Measurement Results, and Discussions - Close Examination of Noise Figure and I/Q Imbalance, Comments on I/Q Imbalance

UNIT V MIC COMPONENTS 9

Introduction to MICs, Fabrication Technology, Advantages and applications, MIC components- Microstrip components, Coplanar circuits: Transistors, switches, active filters. Coplanar microwave amplifiers.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. Joy Laskar, Babak Matinpour, Sudipto Chakraborty, "Modern Receiver Front- Ends Systems, Circuits, and Integration", Wiley- Interscience, 2004.
2. T. Lee,"Design of CMOS RF Integrated Circuits", Cambridge, 2004.

REFERENCES:

1. Igor Minin, "Microwave and millimeter wave technologies modern UWB antennas and equipment", In-Tech publication, 2010.

WEB REFERENCES:

1 https://ocw.mit.edu/courses/electrical-engineering-and-computerscience/6-772-compound-semiconductor-devices-spring-2003/lecture notes/Lecture10v2.pdf

ONLINE RESOURCES:

1 https://swayam.gov.in/nd1_noc20_ee25/

OUTCOMES:

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

1 Discuss the basic concepts of RF and MIC. (K1)
2 Understand the various components of RF systems. (K1)
3 Discuss the operation of RF circuits (K1)
4 Analyze the performance of RF Circuits (K2)
5 Understand the operation of Microwave components. (K1)
6 Discuss various MIC components (K1)

CO - PO, PSO MAPPING :

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	2	3	3	2	3	2	-	2	3	3	3	3
CO2	3	2	3	2	3	2	3	1	-	1	2	2	3	2
CO3	3	3	3	3	3	2	2	2	-	2	2	2	3	2
CO4	3	3	3	3	3	2	2	2	-	2	2	2	3	2
CO5	3	2	3	2	3	2	3	3	2	2	2	2	3	3
CO6	3	3	3	2	3	2	3	2	2	3	2	2	3	3

PROFESSIONAL ELECTIVES - IV

20ECEL806 SDG NO. 9	PHOTONIC NETWORKS	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To understand the importance of the back bone infrastructure for our present and future communication needs
- To familiarize the student with the architectures and the protocol stack in use
- To understand the differences in the design of data plane and the control plane and the routing, switching and the resource allocation methods
- To understand the network management and protection methods in vogue
- To expose the student to the advances in networking and switching domains and the future trends

UNIT I OPTICAL SYSTEM COMPONENTS 9

Light Propagation in optical fibers – Loss & bandwidth, System limitations, Nonlinear effects; Solitons Optical Network Components–Couplers, Isolators & Circulators, Multiplexers & Filters, Optical Amplifiers, Switches, Wavelength Converters.

UNIT II OPTICAL NETWORK ARCHITECTURES 9

Introduction to Optical Networks; SONET/SDH, Metropolitan - Area Networks, Layered Architecture; Broadcast and Select Networks – Topologies for Broadcast Networks, Media - Access Control Protocols, Wavelength Routing Architecture.

UNIT III WAVELENGTH ROUTING NETWORKS 9

The optical layer, Optical Network Nodes, Routing and wavelength assignment, Traffic Grooming in Optical Networks, Architectural variations-Linear Light wave networks, Logically Routed Networks.

UNIT IV PACKET SWITCHING AND ACCESS NETWORKS 9

Photonic Packet Switching – OTDM, Multiplexing and Demultiplexing, Synchronization, Broadcast OTDM networks, Switch-based networks, Contention Resolution Access Networks – Network Architecture overview, Optical Access Network Architectures and OTDM networks.

UNIT V NETWORK DESIGN AND MANAGEMENT 9

Transmission System Engineering–System model, Power penalty-transmitter, receiver, Optical amplifiers, crosstalk, dispersion, Wavelength stabilization, Overall design considerations, Control and Management–Network management functions, Configuration management, Performance management, Fault management, Optical safety, Service interface.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. Rajiv Ramaswami and Kumar N. Sivarajan, "Optical Networks: A Practical and Perspective", Harcourt Asia Pte Ltd., Second Edition, 2004.
2. C.Siva Ram Moorthy and Mohan Gurusamy, "WDM Optical Networks:st Concept, Design and Algorithms", Prentice Hall of India, First Edition, 2002

REFERENCES:

1. P.E. Green, Jr., "Fiber Optic Networks", Prentice Hall,NJ, 1993.
2. Biswanath Mukherjee, "Optical WDM Networks", Springer Series, 2006.

WEB REFERENCES:

1. https://www.fujitsu.com/global/about/resources/publications/fstj/archives/vol35-1.html
2. https://www.adva.com/en/innovation/photonic-networking

ONLINE RESOURCES:

1. https://moodle.telt.unsw.edu.au/login/index.php

OUTCOMES:

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

1 Use the back bone infrastructure for our present and future communication needs. (K2)
2 Analyze network management and protection methods in vogue. (K2)
3 Analyze the architectures and the protocol stack. (K2)
4 Analyze the design of data plane and control plane. (K2)
5 Understand the protection methods in vogue . (K2)
6 Compare the differences in the design of data plane, control plane, routing, switching, resource allocation methods, (K2)

CO- PO, PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	2	3	3	2	3	2	-	2	3	3	3	3
CO2	3	2	3	2	3	2	3	1	-	1	2	2	3	2
CO3	3	3	3	3	3	2	2	2	-	2	2	2	3	2
CO4	3	3	3	3	3	2	2	2	-	2	2	2	3	2
CO5	3	2	3	2	3	2	3	3	2	2	2	2	3	3
CO6	3	2	3	2	3	2	3	2	2	3	2	2	3	3

PROFESSIONAL ELECTIVES - IV

20ECEL807 SDG NO. 9	TELEHEALTH TECHNOLOGY	L	T	P	C
		3	0	0	3

OBJECTIVES:

- Learn the key principles for telemedicine and health
- Understand telemedical technology.
- Know telemedical standards, mobile telemedicine and its applications.

UNIT I FUNDAMENTALS OF TELEMEDICINE 9

History of telemedicine, definition of telemedicine, tele-health, tele-care, scope, Telemedicine Systems, benefits & limitations of telemedicine. Ethical and legal aspects of Telemedicine - Confidentiality, Social and legal issues, Safety and regulatory issues, Advances in Telemedicine.

UNIT II TYPE OF INFORMATION & COMMUNICATION INFRASTRUCTURE FOR TELEMEDICINE 9

Audio, video, still images, text and data, fax-type of communications and network: PSTN, POTS, ANT, ISDN, internet, air/ wireless communications, GSM satellite, microwave, Mobile health and ubiquitous healthcare.

UNIT III TELEMEDICAL STANDARDS 9

Data Security and Standards: Encryption, Cryptography, Mechanisms of encryption, phases of Encryption. Protocols: TCP/IP, ISO-OSI, Standards to follow DICOM, HL7, H. 320 series Video Conferencing, Security and confidentiality of medical records, Cyber laws related to telemedicine.

UNIT IV PICTURE ARCHIVING AND COMMUNICATION SYSTEM 9

Introduction to radiology information system and ACS, DICOM, PACS strategic plan and needs assessment, technical Issues, PACS architecture.

UNIT V APPLICATION OF TELEMEDICINE 9

Telemedicine access to health care services – health education and self care. • Introduction to robotics surgery, telesurgery. Telecardiology, Teleoncology, Telemedicine in neurosciences, Electronic Documentation, e-health services security and interoperability. .Business aspects - Project planning and costing, Usage of telemedicine.

TOTAL:L+T=45PERIODS

TEXT BOOKS:

1. Norris A C, "Essentials of Telemedicine and Telecare", John Wiley, New York, 2002.
2. H K Huang, "PACS and Imaging Informatics: Basic Principles and Applications" Wiley, New Jersey, 2010

REFERENCES:

1. Olga Ferrer Roca, Marcelo Sosa Iudicissa, "Handbook of Telemedicine", IOS Press, Netherland, 2002.
2. Khandpur R S, "Handbook of Biomedical Instrumentation", Tata McGraw Hill, New Delhi, 2003.
3. Keith J Dreyer, Amit Mehta, James H Thrall, "Pacs: A Guide to the Digital Revolution", Springer, New York, 2002.
4. Khandpur R S, "TELEMEDICINE – Technology and Applications", PHI Learning Pvt Ltd., New Delhi, 2017.

WEB REFERENCES :

1. https://www.youtube.com/watch?v=8C0qB4w_fk8

2. https://www.physio-pedia.com/Fundamentals_of_Telehealth_Technology#:~:text= Telehealth%20is%20the%20delivery%20of,one%20particular%20type%20of%20technology.

OUTCOMES:

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

1. To learn objectives of Telehealth, Tele care and Organs of telemedicine. (K2)
2. Describe the Principles of Multimedia - Text, Audio, Video, data, Data communications and networks, PSTN, POTS, ANT, ISDN, Internet, Air/ wireless communications.(K2)
3. Discuss the ethical and legal issues involved in telemedicine (K2)
4. Explain the Standards and Protocols to be followed in Telemedicine : TCP/IP, ISO-OSI, DICOM, HL7, H. 320 series (Video phone based ISBN). (K2)
5. Illustrate the function of Picture archiving and communications system (K2)
6. Discuss the various applications in Telemedicine. (K2)

CO – PO, PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	2	-	-	3	-	-	3	-	-	2	3	2
CO2	-	2	-	-	2	3	-	3	2	-	-	-	3	1
CO3	-	-	-	3	-	-	3	-	-	3	3	2	1	3
CO4	-	2	-	-	2	3	3	-	2	-	-	-	2	1
CO5	-	3	3	-	-	3	3	3	-	3	-	-	2	-
CO6	3	-	-	-	2	2	-	-	-	2	3	-	2	1

PROFESSIONAL ELECTIVES - IV

20ECEL808 SDG NO. 9	MEDICAL INFORMATICS	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To teach ICT applications in medicine with an introduction to health informatics.
- To understand the theories and practices adopted in Hospital Information Systems in the light of medical standards, medical data formats and recent trends in Hospital Information Systems.

UNIT I MEDICAL INFORMATICS 9

Introduction - Medical Informatics – Bioinformatics – Health Informatics - Structure of Medical Informatics – Functional capabilities of Hospital Information System - On-line services and off – line services - History taken by computer, Dialogue with the computer.

UNIT II MEDICAL STANDARDS 9

Evolution of Medical Standards – IEEE 11073 - HL7 – DICOM – IRMA - LOINC – HIPPA – Electronics Patient Records – Healthcare Standard Organizations – JCAHO (Join Commission on Accreditation of Healthcare Organization) - JCIA (Joint Commission International Accreditation) - Evidence Based Medicine - Bioethics.

UNIT III MEDICAL DATA ACQUISITION AND STORAGE 9

Plug-in Data Acquisition and Control Boards – Data Acquisition using Serial Interface - Medical Data formats – Signal, Image and Video Formats – Medical Databases - Automation in clinical laboratories - Intelligent Laboratory Information System - PACS , Data mining.

UNIT IV HEALTH INFORMATICS 9

Bioinformatics Databases, Bio-information technologies, Semantic web and Bioinformatics, Genome projects, Clinical informatics, Nursing informatics, Public health informatics -Education and Training.

UNIT V RECENT TRENDS IN MEDICAL INFORMATICS 9

Medical Expert Systems, Virtual reality applications in medicine, Virtual Environment - Surgical simulation - Radiation therapy and planning – Telemedicine – virtual Hospitals - Smart Medical Homes – Personalized e-health services – Biometrics - GRID and Cloud Computing in Medicine.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. R.D.Lele, "Computers in Medicine: Progress in Medical Informatics'', Tata McGraw Hill Publishing computers Ltd, New Delhi, 2005.
2. Mohan Bansal, "Medical informatics", Tata McGraw Hill Publishing computers Ltd, New Delhi, 2003.

REFERENCES:

1. N.Mathivanan, "PC-Based Instrumentation'', Prentice Hall of India Pvt Ltd – New Delhi, 2007.
2. Yi – Ping Phoebe Chen, "Bioinformatics Technologies'', Springer International Edition, New Delhi, 2007.

3. Orpita Bosu, Bioinformatics – Databases, Tools and Algorithms, Oxford University Press, 2007.
4. Lukas K Baehler, Bioinformatics – Basics, Applications in Biological Sciences and Medicine, Taylor & Francis, London, 2005.
5. John P Woodward, Biometrics – The Ultimate Reference, Dreamtech Publishers, New Delhi, 2003.

WEB REFERENCES:

1. https://www.youtube.com/watch?v=-otUihKQy5Q
2. https://www.youtube.com/watch?v=pzS--PaGC9o
3. https://www.youtube.com/watch?v=MB_yyDerwGs
4. https://www.youtube.com/watch?v=mmeGQOmzb3M
5. https://www.youtube.com/watch?v=vlGKot_zIDg

ONLINE RESOURCES:

1. https://www.mtu.edu/health-informatics/what-is/
2. https://onlinedegrees.sandiego.edu/what-is-medical-informatics/
3. https://www.ncbi.nlm.nih.gov/books/NBK216088/
4. https://nptel.ac.in/courses/102/106/102106065/
5. https://www.google.com/aclk?sa=l&ai=DChcSEwjIxdzb7M7w AhVYBWAKHZWwCokYABAAGgJ0bQ&ae=2&sig=AOD64_13IJxJvajTum Dberm4hAUoetuaOg&q&adurl&ved=2ahUKEwjphtXb7M7wAhXhyDgG HTn5CqQQ0Qx6BAgEEAE

OUTCOMES:

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

1 Summarize health informatics and different ICT applications in medicine. (K2)
2 Demonstrate Hospital Information Systems. (K3)
3 Analyze, appreciate and adopt medical standards. (K2)
4 Illustrate medical data acquisition system and its storage. (K3)
5 Apply virtual reality tools in medical informatics. (K3)
6 Examine the notion of various information systems and their requirements.(K3)

CO – PO, PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	-	-	2	-	-	-	-	-	-	3	-	-
CO2	-	-	3	3	3	2	-	-	1	-	3	3	-	2
CO3	-	-	-	-	3	3	-	3	-	3	-	3	-	1
CO4	3	1	2	-	3	1	-	-	-	-	-	3	-	-
CO5	-	-	-	3	3	3	3	3	-	-	-	3	-	1
CO6	-	-	3	3	3	-	-	-	-	-	3	3	-	1

PROFESSIONAL ELECTIVES - IV

20ECEL809 SDG NO. 9	ROBOTICS AND AUTOMATION	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To understand the basic concepts associated with the design, functioning, applications and social aspects of robots
- To study about the electrical drive systems and sensors used in robotics for various applications
- To learn about analyzing robot kinematics, dynamics through different methodologies and study various design aspects of robot arm manipulator and end-effector
- To learn about various motion planning techniques and the associated control architecture
- To understand the implications of AI and other trending concepts of robotics

UNIT I INTRODUCTION TO ROBOTICS 9

Introduction -- brief history, definition, anatomy, types, classification, specification and need based applications; role and need of robots for the immediate problems of the society, future of mankind and automation-ethical issues; industrial scenario local and global, case studies on mobile robot research platform and industrial serial arm manipulator

UNIT II BUILDING BLOCKS OF A ROBOT 9

Types of electric motors - DC, Servo, Stepper; specification, drives for motors - speed & direction control and circuitry, Selection criterion for actuators, direct

drives, non-traditional actuators; Sensors for localization, navigation, obstacle avoidance and path planning in known and unknown environments – optical, inertial, thermal, chemical, biosensor, other common sensors; Case study on choice of sensors and actuators for maze solving robot and self driving cars.

UNIT III KINEMATICS, DYNAMICS AND DESIGN OF ROBOTS & END EFFECTORS 9

Robot kinematics - Geometric approach for 2R, 3R manipulators, homogeneous transformation using D-H representation, kinematics of WMR, Lagrangian formulation for 2R robot dynamics; Mechanical design aspects of a 2R manipulator, WMR; End-effector - common types and design case study.

UNIT IV NAVIGATION, PATH PLANNING AND CONTROL ARCHITECTURE 9

Mapping & Navigation – SLAM, Path planning for serial manipulators; types of control architectures - Cartesian control, Force control and hybrid position/force control, Behaviour based control, application of Neural network, fuzzy logic, optimization algorithms for navigation problems, programming methodologies of a robot

UNIT V AI AND OTHER RESEARCH TRENDS IN ROBOTICS 9

Application of Machine learning - AI, Expert systems; Tele-robotics and Virtual Reality, Micro & Nanorobots, Unmanned vehicles, Cognitive robotics, Evolutionary robotics, Humanoids

TOTAL:45 PERIODS

TEXT BOOKS:

1. Saeed. B. Niku, Introduction to Robotics, Analysis, system, Applications, Pearson educations, 2002
2. Roland Siegwart, Illah Reza Nourbakhsh, Introduction to Autonomous Mobile Robots, MIT Press, 2011

REFERENCES:

1. Richard David Klafter, Thomas A. Chmielewski, Michael Negin, Robotic engineering: an integrated approach, Prentice Hall, 1989
2. Craig, J. J., Introduction to Robotics: Mechanics and Control, Second Edition, Addison-Wesley, 1989.
3. K.S. Fu, R.C. Gonzalez and C.S.G. Lee, Robotics: Control, Sensing, Vision and Intelligence, McGraw-Hill, 1987.
4. Wesley E Snyder R, Industrial Robots, Computer Interfacing and Control, Prentice Hall International Edition, 1988.
5. Robin Murphy, Introduction to AI Robotics, MIT Press, 2000

6. Ronald C. Arkin, Behavior-based Robotics, MIT Press, 1998
7. N. P. Padhy, Artificial Intelligence and Intelligent Systems, Oxford University Press, 2005
8. Stefano Nolfi, Dario Floreano, Evolutionary Robotics – The Biology, Intelligence and Technology of Self–Organizing Machines (Intelligent Robotics and Autonomous Agents series), MIT Press, 2004.

VIDEO LINKS

1 https://nptel.ac.in/courses/107/106/107106090/
2 https://www.youtube.com/watch?v=xrwz9IxpMJg
3 https://nptel.ac.in/courses/112/107/112107289/
4 https://www.youtube.com/watch?v=NwjbZyLTPjE

OUTCOMES

Upon completion of the course, student should be able to

1. Explain the concepts of industrial robots in terms of classification, specifications and coordinate systems, along with the need and application of robots & automation (K2)
2. Examine different sensors and actuators for applications like maze solving and self driving cars. (K2)
3. Design a 2R robot & an end-effector and solve the kinematics and dynamics of motion for robots. (K3)
4. Explain navigation and path planning techniques along with the control architectures adopted for robot motion planning. (K2)
5. Describe the impact and progress in AI and other research trends in the field of robotics. (K2)
6. Select the robot manipulators, end effectors and its programming languages for the specified applications. (K2)

CO – PO, PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	2	1	1	1	1	2	-	-	-	2	2	1
CO2	3	2	1	2	1	1	1	1	-	-	-	2	2	1
CO3	3	3	2	2	1	2	1	1	-	-	-	2	2	2
CO4	3	3	3	3	1	1	1	1	-	-	-	2	2	2
CO5	3	2	1	2	2	2	2	2	-	-	-	2	2	2
CO6	3	2	1	2	2	2	2	2	-	-	-	2	2	2

PROFESSIONAL ELECTIVES - IV

20ECEL810 SDG NO. 9	MEDICAL IMAGING SYSTEMS	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To study the production of x-rays and its application to different medical Imaging techniques.
- To study the different types of Radio diagnostic techniques.
- To study the special imaging techniques used for visualizing the cross sections of the body
- To study the imaging of soft tissues using ultrasound technique

UNIT I PRINCIPLES OF RADIOGRAPHIC EQUIPMENT 9

X-Ray tubes, cooling systems, removal of scatters, Fluoroscopy- construction of image Intensifier tubes, angiographic setup, mammography, digital radiology, DSA.

UNIT II COMPUTED TOMOGRAPHY 9

Need for sectional images, Principles of sectional scanning, CT detectors, Methods of reconstruction, Iterative, Back projection, convolution and Back-Projection. Artifacts, Principle of 3D imaging

UNIT III RADIO ISOTOPIC IMAGING 9

Alpha, Beta and Gamma radiation, Radiation detectors, Radio isotopic imaging equipments, Radio nuclides for imaging, Gamma ray camera, scanners, Positron Emission tomography, SPECT,PET/CT.

UNIT IV ULTRASONIC SYSTEMS 9

Wave propagation and interaction in Biological tissues, Acoustic radiation fields, continuous and pulsed excitation, Transducers and imaging systems, Scanning methods, Imaging Modes, Principles and theory of image generation.

UNIT V MAGNETIC RESONANCE IMAGING 9

NMR, Principles of MRI, Relaxation processes and their measurements, Pulse sequencing and MR image acquisition, MRI Instrumentation, Functional MRI.

TOTAL:L=45PERIODS

TEXT BOOKS:

1. Medical Imaging Signals and Systems, Second edition Jerry L. Prince Jonathan Links, Pearson Education Publications, ISBN-13: 9780133583151, 2014.

2. Victor I.Mikla and Victor V. Mikla, "Medical Imaging Technology", Elsevier Publications.

REFERENCES:

1. D.N.Chesney and M.O.Chesney Radio graphic imaging, CBS Publications, New Delhi, 1987.
2. Steve Webb, The Physics of Medical Imaging, Taylor & Francis, New York.1988.
3. Peggy, W., Roger D.Ferimarch, MRI for Technologists, Mc Graw Hill, New York, 1995.
4. Donald W.McRobbice, Elizabeth A.Moore, Martin J.Grave and Martin R.Prince MRI from picture to proton ,Cambridge University press, New York 2006.
5. Jerry L.Prince and Jnathan M.Links," Medical Imaging Signals and Systems"- Pearson Education Inc. 2006

WEB REFERENCES:

1. https://www.youtube.com/watch?v=PcirQo25FWU
2. https://www.youtube.com/watch?v=9gNCCnEEv5w

ONLINE RESOURCES:

1. https://onlinecourses.nptel.ac.in/noc21_bt50/preview
2. https://onlinecourses.nptel.ac.in/noc20_ee40/preview

OUTCOMES:

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

1 Outline the principles of Medical Imaging. (K2)
2 Explain about the production of x-rays and its application to different medical Imaging techniques.(K2)
3 Interpret the special imaging techniques for visualizing the cross sections of the body using Computed Tomography(K2)
4 Analyse the Radio isotopic images and practice the Radio isotopic imaging systems(K2)
5 Apply the principles in the imaging of soft tissues using ultrasound technique(K2)
6 Demonstrate professionalism in the principles of Magnetic Resonance Imaging(K2)

CO – PO, PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	1	2	3	3	3	1	3	2	2	1	3	2	1
CO2	3	1	2	3	3	3	1	3	2	2	1	3	2	1
CO3	3	3	2	3	3	3	1	3	2	2	1	3	2	1
CO4	3	3	2	3	3	3	1	3	2	2	1	3	2	1
CO5	3	1	2	3	3	3	1	3	2	2	1	3	2	1
CO6	3	3	2	3	3	3	1	3	2	2	1	3	2	1

PROFESSIONAL ELECTIVES - IV

20MGEL801 SDG NO. 3,4,5,8,10, 13,14,15,16	PROFESSIONAL ETHICS AND VALUES	L	T	P	C
		3	0	0	3

OBJECTIVES:

- An understanding of their duties and responsibilities as professionals through gaining knowledge of the philosophies of ethics, professional practice, and world culture.
- Basic knowledge to make informed ethical decisions when confronted with problems in the working environment.
- Improved awareness of potential ethical issues within an engineering context.
- Team skills through working in teams on assignments and in-class assignments.
- Subjective analytical skills through investigation and evaluation of ethical problems in engineering settings using accepted tests for moral problem solving.
- An understanding of how societal morals vary with culture and its influence on ethical thought and action.
- Improved communications skills with regard to ethical and professional issues in engineering.
- Know some of the classic cases as well as contemporary issues in engineering ethics.

UNIT I HUMAN VALUES

Morals, Values, and Ethics – Integrity –Trustworthiness – Work Ethics – Service-Learning – Civic Virtue – Respect for others – Living Peacefully – Caring – Sharing – Honesty –Courage – Value Time – Co-operation – Commitment – Empathy – Self-confidence – Spirituality- Character.

UNIT II PRINCIPLES FOR HARMONY

Truthfulness – Customs and Traditions -Value Education – Human Dignity – Human Rights – Fundamental Duties – Aspirations and Harmony (I, We & Nature) – Gender Bias – Emotional Intelligence – Salovey – Mayer Model – Emotional Competencies – Conscientiousness.

UNIT III ENGINEERING ETHICS AND SOCIAL EXPERIMENTATION

History of Ethics – Need of Engineering Ethics – Senses of Engineering Ethics- Profession and Professionalism ––Self Interest – Moral Autonomy – Utilitarianism – Virtue Theory – Uses of Ethical Theories – Deontology- Types of Inquiry –Kohlberg's Theory – Gilligan's Argument – Heinz's Dilemma – Comparison with Standard Experiments –– Learning from the Past – Engineers as Managers – Consultants and Leaders – Balanced Outlook on Law – Role of Codes – Codes and Experimental Nature of Engineering.

UNIT IV ENGINEERS' RESPONSIBILITIES TOWARDS SAFETY AND RISK

The concept of Safety – Safety and Risk – Types of Risks – Voluntary v/sInvoluntary Risk – Consequences – Risk Assessment –Accountability – Liability – Reversible Effects – Threshold Levels of Risk – Delayed v/sImmediate Risk – Safety and the Engineer – Designing for Safety – Risk-Benefit Analysis-Accidents.

UNIT V ENGINEERS' DUTIES AND RIGHTS

Concept of Duty – Professional Duties – Collegiality – Techniques for Achieving Collegiality – Senses of Loyalty – Consensus and Controversy – Professional and Individual Rights – Confidential and Proprietary Information – Conflict of Interest-Ethical egoism – Collective Bargaining – Confidentiality – Gifts and Bribes – Problem solving-Occupational Crimes- Industrial Espionage- Price Fixing-Whistle Blowing.

UNIT VI GLOBAL ISSUES

Globalization and MNCs –Cross Culture Issues – Business Ethics – Media Ethics – Environmental Ethics – Endangering Lives – Bio Ethics – Computer Ethics – War Ethics – Research Ethics -Intellectual Property Rights.

TEXT BOOKS:

1. Engineering Ethics & Human Values by M.Govindarajan, S.Natarajan and V.S.SenthilKumar-PHI Learning Pvt. Ltd – 2009

REFERENCE BOOKS:

1. Ethical Choices in Business Response Books, Sekhar, R.C: 1997, New Delhi,Sage Publications.
2. The Ethical Organisation, Kitson, Alan and Campebell, Robert: 1996. Great Britain Macmillan Press Ltd.
3. Engineering Ethics, Pinkus, Rosa Lyun B., Larry J Shulman, Norman Phummon, Harvey Wolfe:1997, New York, Cambridge Uty., Press
4. Professional Ethics by R. Subramaniam – Oxford Publications, New Delhi.
5. Ethics in Engineering by Mike W. Martin and Roland Schinzinger – Tata McGraw-Hill – 2003.
6. Professional Ethics and Morals by Prof.A.R.Aryasri, Dharanikota Suyodhana – Maruthi Publications.
7. Engineering Ethics by Harris, Pritchard, and Rabins, Cengage Learning, New Delhi.
8. Human Values & Professional Ethics by S. B. Gogate, Vikas Publishing House Pvt. Ltd., Noida.
9. Professional Ethics and Human Values by A. Alavudeen, R.Kalil Rahman and M. Jayakumaran – University Science Press.
10. Professional Ethics and Human Values by Prof.D.R.Kiran-Tata McGraw-Hill – 2013
11. Human Values And Professional Ethics by Jayshree Suresh and B. S. Raghavan, S.Chand Publications

WEB RESOURCES

1 Ethos Education provides a concise guide on developing a code of ethics for primary and secondary schools.

2 The Ethics Resource Center has a toolkit available for use. When used for commercial purposes, a nominal license fee is required.

3 Creating A Code Of Ethics for Your Organization, with many suggested books, by Chris MacDonald

4 The Deloitte Center for Corporate Governance offers a variety of resources for those who are active in governance, including a variety of resources and a set of suggested guidelines for writing a code of ethics or a code of conduct.

MOOC REFERENCES:

1 https://www.udemy.com/course/worlplace-ethics-and-attitude/
2 https://www.udemy.com/course/business-ethics-how-to-create-an-ethical-organization/
3 https://nptel.ac.in/courses/110/105/110105097/Ethics in Engineering Practice
4 https://nptel.ac.in/courses/109/104/109104068/Human Values
5 https://www.coursera.org/learn/ethics-technology-engineering
6 https://www.classcentral.com/course/ethics-technology-engineering-10485

OUTCOMES:

Upon completion of the corse, the students will be able to

1 Classify between ethical and non-ethical situations. (K2)
2 Discuss and practice moral judgment in conditions of dilemma. (K2)
3 Explain and relate the code of ethics to social experimentation and real world scenarios. (K2)
4 Describe risk and safety measures in various engineering fields. (K2)
5 Explain the impact of engineering solutions in a global/societal / professional context. (K2)

CO – PO, PSO MAPPING:

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

Imagine the Future and

Make it happen!

Together let's build a better world where there is NO POVERTY and ZERO HUNGER.

We have GOOD HEALTH AND WELL BEING QUALITY EDUCATION and full GENDER EQUALITY everywhere.

There is CLEAN WATER AND SANITATION for everyone. AFFORDABLE AND CLEAN ENERGY

which will help to create DECENT WORK AND ECONOMIC GROWTH. Our prosperity shall be fuelled

by investments in INDUSTRY, INNOVATION AND INFRASTRUCTURE that will help us to

REDUCE INEQUALITIES by all means. We will live in SUSTAINABLE CITIES AND COMMUNITIES.

RESPONSIBLE CONSUMPTION AND PRODUCTION will help in healing our planet.

CLIMATE ACTION will reduce global warming and we will have abundant,

flourishing LIFE BELOW WATER, rich and diverse LIFE ON LAND.

We will enjoy PEACE AND JUSTICE through STRONG INSTITUTIONS

and will build long term PARTNERSHIPS FOR THE GOALS.

For the goals to be reached, everyone needs to do their part: governments, the private sector, civil society and **People like you.**

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