SRI VENKATESWARA COLLEGE OF ENGINEERING

An Autonomous Institution,

Affiliated to Anna University, Chennai

REGULATION 2018

B.E. ELECTRONICS AND COMMUNICATION ENGINEERING

Choice Based Credit System

Curriculum and Syllabi (I – VIII Semester)

SRI VENKATESWARA COLLEGE OF ENGINEERING
(An Autonomous Institution, Affiliated to Anna University, Chennai)
SRIPERUMBUDUR TK - 602 117
REGULATION – 2018
B.E. ELECTRONICS AND COMMUNICATION ENGINEERING
Choice Based Credit System (CBCS)
CURRICULUM & SYLLABI (I - VIII Semesters)

SEMESTER I

Sl. No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C	Prerequisites	Fixed / Movable
	THEORY									
1	HS18151	Communicative English (Common to all Branches)	HS	3	3	0	0	3	-	F
2	MA18151	Engineering Mathematics I (Common to all Branches Except MR)	BS	4	3	1	0	4	-	F
3	PH18151	Engineering Physics (Common to all Branches)	BS	3	3	0	0	3	-	F
4	CY18151	Engineering Chemistry (Common to all Branches Except MR)	BS	3	3	0	0	3	-	F
5	EE18152	Basic Electrical Engineering	ES	3	3	0	0	3	-	F
6	GE18151	Engineering Drawing (Common to all Branches)	ES	5	3	0	2	4	-	F
	PRACTICAL									
7	PC18161	Physics and Chemistry Laboratory (Common to all Branches)	BS	2	0	0	2	1	-	F
8	GE18161	Engineering Practices Laboratory (Common to all Branches)	ES	3	0	0	3	1.5	-	F
		TOTAL		**26**	**18**	**1**	**7**	**22.5**		

SEMESTER II

Sl. No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C	Prerequisites	Fixed / Movable
	THEORY									
1	HS18251	Technical English (Common to all Branches)	HS	3	3	0	0	3	-	F
2	MA18251	Engineering Mathematics II (Common to all Branches Except MR)	BS	4	3	1	0	4	-	F
3	IT18101	Programming for Problem Solving (Common to all Branches)	ES	3	3	0	0	3	-	F
4	GE18251	Environmental Science and Engineering (Common to all Branches)	BS	3	3	0	0	3	-	F
5	EC18201	Electron Devices	PC	3	3	0	0	3	-	F
6	PH18252	Physics of Materials (Common to BT, EE and EC)	BS	3	3	0	0	3	-	F
	PRACTICAL									
7	IT18111	Programming for Problem Solving Laboratory (Common to all Branches Except MR)	ES	3	0	0	3	1.5	-	F
8	EC18211	Electron Devices and Electrical Machines Laboratory	ES	4	0	0	4	2	-	F
		TOTAL		**26**	**18**	**1**	**7**	**22.5**		

SEMESTER III

Sl. No.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C	Prerequisites	Fixed / Movable
THEORY										
1.	MA18351	Engineering Mathematics III (Common to BT, CH, CE, EE, EC and ME)	BS	4	3	1	0	4	-	F
2.	EC18301	Object Oriented Programming and Data Structures	ES	4	3	1	0	4	-	F
3.	EC18302	Electromagnetic Fields and Waves	PC	4	3	1	0	4	-	F
4.	EC18303	Circuit Theory	PC	3	3	0	0	3	-	F
5.	EC18304	Digital System Design	PC	3	3	0	0	3	-	F
6.	EC18305	Electronic Circuits	PC	3	3	0	0	3	-	F
PRACTICAL										
7.	EC18311	Analog and Digital Circuits Laboratory	PC	3	0	0	3	1.5	-	F
8.	EC18312	Object Oriented Programming and Data Structures Laboratory	ES	3	0	0	3	1.5	-	F
TOTAL				**27**	**18**	**3**	**6**	**24**	-	-

SEMESTER IV

Sl. No.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C	Prerequisites	Fixed / Movable
THEORY										
1.	MA18454	Probability and Random Processes	BS	4	3	1	0	4	-	F
2.	EC18401	Analog Communication Systems	PC	3	3	0	0	3	-	F
3.	EC18402	Signals and Systems	PC	3	3	0	0	3	-	F
4.	EC18403	Analog Integrated Circuits and its Applications	PC	3	3	0	0	3	-	F
5.	EC18404	Linear Control Systems	PC	3	3	0	0	3	-	F
6.	EC18405	Microprocessor and Microcontroller Based System Design	PC	3	3	0	0	3	-	F
PRACTICAL										
7.	EC18411	Analog Integrated Circuits and Simulation Laboratory	PC	3	0	0	3	1.5		F
8.	EC18412	Microprocessor and Microcontroller Based System Design Laboratory	PC	3	0	0	3	1.5		F
TOTAL				**25**	**18**	**1**	**6**	**22**	-	-

SEMESTER V

Sl. No.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C	Prerequisites	Fixed / Movable
THEORY										
1.	EC18501	Digital Communication	PC	4	3	1	0	4	EC18401	F
2.	EC18502	Principles of Digital Signal Processing	PC	4	3	1	0	4	EC18402	F
3.	EC18503	Computer Organization and Design	PC	4	3	1	0	4	EC18304, EC18405	F
4.	EC18504	Transmission Lines and Waveguides	PC	4	3	1	0	4	EC18302	F
5.	GE18551	Principles of Management (Common to EC, AE, BT, EE and ME)	HS	3	3	0	0	3	-	M
6.	*******	Professional Elective I	PE	3	3	0	0	3	-	M
PRACTICAL										
7.	EC18511	Communication Systems Laboratory	PC	4	0	0	4	2	-	F
8.	EC18512	Digital Signal Processing Laboratory	PC	4	0	0	4	2	-	F
9.	HS18561	Interview and Career Skills Laboratory (Common to all Branches except BT and EE)	EEC	3	0	0	3	2	-	F
TOTAL				**33**	**18**	**4**	**11**	**28**	**-**	**-**

SEMESTER VI

Sl. No.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C	Prerequisites	Fixed / Movable
THEORY										
1.	EC18601	VLSI Design (Common to EC and EE)	PC	3	3	0	0	3	EC18304	F
2.	EC18602	Antenna Theory and Design	PC	4	3	1	0	4	EC18302, EC18504	F
3.	EC18603	Communication Networks	PC	3	3	0	0	3	EC18501	F
4.	EC18604	Wireless Communication	PC	4	3	1	0	4	EC18501	F
5.	*******	Professional Elective II	PE	3	3	0	0	3	-	M
6.	*******	Open Elective I	OE	3	3	0	0	3	-	M
PRACTICAL										
7.	EC18611	Communication Networks Laboratory	PC	4	0	0	4	2	-	F
8.	EC18612	VLSI Design Laboratory	PC	4	0	0	4	2	-	F
TOTAL				**28**	**18**	**2**	**8**	**24**	-	-

SEMESTER VII

Sl. No.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C	Prerequisites	Fixed / Movable
THEORY										
1.	EC18701	RF and Microwave Engineering	PC	4	3	1	0	4	EC18504	F
2.	EC18702	Optical Communication and Networks	PC	4	3	1	0	4	PH18252	F
3.	EC18703	Embedded and Real Time Systems	PC	4	3	1	0	4	EC18405	F
4.	*******	Professional Elective III	PE	3	3	0	0	3	-	M
5.	*******	Open Elective II	OE	3	3	0	0	3	-	M
PRACTICAL										
6.	EC18711	Mini Project	EEC	6	0	0	6	3	-	F
7.	EC18712	Optical and Microwave Laboratory	PC	4	0	0	4	2	-	F
8.	EC18713	Embedded Systems Laboratory	PC	4	0	0	4	2	-	F
TOTAL				**32**	**15**	**3**	**14**	**25**	-	-

SEMESTER VIII

Sl. No.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C	Prerequisites	Fixed/ Movable
THEORY										
1.	*******	Professional Elective IV	PE	3	3	0	0	3	-	M
2.	*******	Professional Elective V	PE	3	3	0	0	3	-	M
PRACTICAL										
3.	EC18811	Project Work	EEC	24	0	0	24	12	-	F
TOTAL				**30**	**6**	**0**	**24**	**18**	-	-

Total Credits: 186

INTERNSHIP / TRAINING[#]

No. of Weeks	Credit
2	1

[#]Students should complete Internship/Training before 6th semester and must earn at least 1 credit.

PROFESSIONAL ELECTIVES (PE) (OFFERED IN ODD SEMESTER)

Sl. No.	COURSE CODE	COURSE TITLE
1.	EC18001	CAD for VLSI Circuits
2.	CS18051	Fundamentals of Operating Systems
3.	EC18003	High Speed Electronics
4.	EC18005	Industrial Internet of Things
5.	EC18007	Measurements and Instrumentation
6.	EC18009	Medical Electronics
7.	EC18011	CISC and RISC Architectures
8.	EC18013	Robotics and Automation
9.	EC18015	Satellite Communication
10.	EC18017	Speech Processing
11.	EC18019	Deep Learning and its applications
12.	EC18021	Wireless Technologies
13.	EC18099	Professional Readiness for Innovation, Employability and Entrepreneurship

PROFESSIONAL ELECTIVES (PE) (OFFERED IN EVEN SEMESTER)

Sl. No.	COURSE CODE	COURSE TITLE
1.	EC18002	Adhoc and Sensor Networks
2.	EC18004	Cognitive Radio Communication

3.	EC18006	Cryptography and Communication Network Security
4.	EC18008	Digital Image Processing
5.	EC18010	Digital Switching and Transmission
6.	EC18012	Electromagnetic Interference and Compatibility
7.	EC18014	Information Theory
8.	GE18051	Intellectual Property Rights (Common to all Branches Except BT)
9.	EC18016	Machine Learning
10.	EE18024	Nanoelectronics (Common to EE and EC)
11.	EC18018	Next Generation Networks – 5G
12.	EC18020	Parallel Architecture
13.	GE18054	Professional Ethics (Common to CE, CS, IT, EE, EC and MR)
14.	EC18024	Soft Computing
15.	EC18026	Statistical Theory of Signal Processing
16.	EC18028	Testing of VLSI Circuits
17.	GE18052	Total Quality Management (Common to ME, AE, CS, EC and MR)
18.	EC18030	Wireless LANs and PANs

PROFESSIONAL ELECTIVES (Can be chosen whenever offered)

Sl. No.	COURSE CODE	COURSE TITLE
1.	SE18001	Mathematics for AI & ML (Common to All Branches Except MR)
2.	SE18002	Corporate Finance (Common to All Branches Except MR)
3.	SE18003	Financial Statement Analysis (Common to All Branches Except MR)
4.	SE18004	Managerial Economics (Common to All Branches Except MR)
5.	SE18005	Market Research (Common to All Branches Except MR)
6.	SE18006	Production Management (Common to All Branches Except MR)
7.	SE18007	Project Management (Common to All Branches Except MR)
8.	SE18008	Introduction to Securities Market (Common to All Branches Except MR)
9.	SE18009	Supply Chain Management (Common to All Branches Except MR)

MANDATORY COURSE
(Course to be completed between 3rd and 6th semester)

Sl. No.	COURSE CODE	COURSE TITLE
1.	MC18001	Indian Constitution and Society (Common to all Branches Except MR)

OPEN ELECTIVES OFFERED IN ODD SEMESTER*

Sl. No.	COURSE CODE	COURSE TITLE	OFFERING DEPARTMENT
1.	OE18101	Fundamentals of Automobile Engineering	AUT
2.	OE18103	Fundamentals of Automotive Air Conditioning	AUT
3.	OE18201	Introduction to Biofuels and Bioenergy	BIO
4.	OE18203	Basics of Environmental Biotechnology	BIO
5.	OE18205	Introduction to Bioinformatics and Computational Biology	BIO
6.	OE18207	Basics of Nanobiotechnology	BIO
7.	OE18209	Introduction to Biomaterials	BIO
8.	OE18301	Waste to Energy	CHE
9.	OE18303	Industrial Safety	CHE
10.	OE18305	Composite Materials	CHE
11.	OE18307	Industrial Waste Water Treatment	CHE
12.	OE18309	Fuel Cell Technology	CHE
13.	OE18401	Basic Civil Engineering	CVE
14.	OE18403	Fundamentals of Remote Sensing and GIS	CVE
15.	OE18405	Electronic Waste Management	CVE
16.	OE18407	Basics and Principles of Green Building Design	CVE
17.	OE18409	Principles of Vastu in Interior Design	CVE
18.	OE18501	Basic Operating Systems	CSE
19.	OE18503	Basics on Cyber Security and Ethical Hacking	CSE
20.	OE18505	Introduction to Internet of Things	CSE
21.	OE18507	Multimedia and Animation Techniques	CSE
22.	OE18509	Python Programming	CSE
23.	OE18601	Electrical Machines and Applications	EEE
24.	OE18603	Control System Engineering	EEE
25.	OE18605	Micro and Smart Grid	EEE
26.	OE18607	Electric Vehicle Technology	EEE
27.	OE18609	Nanotechnology	EEE
28.	OE18701	Autotronics	ECE
29.	OE18703	Sensing Techniques	ECE
30.	OE18705	System Design using Microcontrollers	ECE
31.	OE18707	Fundamentals of Wireless Communication	ECE
32.	OE18801	IT Essentials for Engineers	INT
33.	OE18803	Internet of Everything	INT
34.	OE18805	Foundation on Mobile App Development	INT
35.	OE18901	Elements of Marine Engineering	MAR
36.	OE18903	Marine Propulsion	MAR
37.	OE18001	Basics of Mechanical Engineering	MEC
38.	OE18003	Elements of Mechanical Components	MEC
39.	OE18005	Industrial Engineering and Management	MEC

40.	OE18007	Basics of Energy Resources	MEC
41.	OH18001	Content Writing	HSS
42.	OH18003	Critical Thinking	HSS
43.	OH18005	Urban / Rural Development and Constitutional Provisions	HSS
44.	OC18001	Nanochemistry	ACH
45.	OC18003	Polymer Chemistry	ACH
46.	OM18001	Statistical Methods for Engineers	APM
47.	OM18003	Linear Programming	APM

OPEN ELECTIVES OFFERED IN EVEN SEMESTER*

Sl. No.	COURSE CODE	COURSE TITLE	OFFERING DEPARTMENT
1.	OE18102	Automotive Fault Diagnostics	AUT
2.	OE18104	Fundamentals of Automotive Pollution and Control Methods	AUT
3.	OE18106	Fundamentals of Automotive Safety and Maintenance	AUT
4.	OE18202	Introduction to Food Manufacturing	BIO
5.	OE18204	Testing of Biological Materials	BIO
6.	OE18206	Introduction to Tissue Engineering	BIO
7.	OE18208	Introduction to Cancer Biology	BIO
8.	OE18210	Basic Bio-pharmaceutical Technology	BIO
9.	OE18302	Industrial Pollution Prevention	CHE
10.	OE18304	Solid Waste Management	CHE
11.	OE18306	Plant Utilities	CHE
12.	OE18308	Green Energy	CHE
13.	OE18310	Energy Management	CHE
14.	OE18402	Integrated Solid Waste Management	CVE
15.	OE18404	Life Cycle Assessment	CVE
16.	OE18406	Air Pollution and Control Engineering	CVE
17.	OE18408	Water Pollution and its Management	CVE
18.	OE18502	Artificial Intelligence Basics	CSE
19.	OE18504	Database Systems and Applications	CSE
20.	OE18506	Internet Programming	CSE
21.	OE18508	Introduction to Cloud and Big Data Analytics	CSE
22.	OE18510	Introduction to Data Structures	CSE
23.	OE18602	Industrial Automation	EEE
24.	OE18604	MEMS and Nano Devices	EEE
25.	OE18606	Renewable Energy Systems	EEE
26.	OE18608	Indian Power Grid	EEE
27.	OE18610	Power Converters	EEE
28.	OE18702	Consumer Electronics	ECE
29.	OE18704	Introduction to Communication Systems	ECE
30.	OE18706	Robotics Systems	ECE

31.	OE18802	Embedded and Real Time Systems	INT
32.	OE18804	Ethical Hacking and IT Security	INT
33.	OE18806	User Interface Design	INT
34.	OE18808	AI for Android	INT
35.	OE18902	Introduction to Marine Diesel Engines and Machineries	MAR
36.	OE18904	Marine Vehicles	MAR
37.	OE18002	Elements of Automation	MEC
38.	OE18004	Quality concepts and tools	MEC
39.	OE18006	Refrigeration and Air conditioning Systems	MEC
40.	OE18008	Thermal Management of Electronics Devices	MEC
41.	OP18002	Sensors and Transducers	APH
42.	OP18004	Essential Properties for Selection of Materials	APH
43.	OP18006	Opto Electronics and Applications	APH
44.	OP18008	Basics of Environmental Safety	APH
45.	OH18002	Environmental Law, Policy and International Conventions	HSS
46.	OH18004	Climate Change and Vulnerability Assessment	HSS
47.	OH18006	Gender Sensitization and Social Impact	HSS
48.	OC18002	Fuel Cell Chemistry	ACH
49.	OC18004	Industrial Catalysis	ACH
50.	OM18002	Linear Algebra for Engineers	APM
51.	OM18004	Transform Techniques for Boundary Value Problems	APM

*Students can choose Open Electives offered only by other departments

VALUE-ADDED COURSES ** (Courses should be completed between 3rd and 6th semester)

Sl. No.	COURSE CODE	COURSE TITLE	No. of Hours	Credit
1.	VD18701	PCB Design using EDA tool	30	2
2.	VD18702	Signal Processing using Simulation tool	30	2
3.	VD18703	Hardware Modeling and Analysis using EDA tool	30	2
4.	VD18704	RF Circuit Design – Theory and Simulation using EM Simulation tools	30	2
5.	VD18705	Embedded Programming using PIC Microcontrollers	30	2
6.	VD18706	System Design for IoT applications	30	2
7.	VC18001	Communicative German (Common to all Branches)	30	2
8.	VC18002	Communicative Japanese (Common to all Branches)	30	2
9.	VC18003	Communicative Hindi (Common to all Branches)	30	2
10.	VC18004	Design Thinking and Prototyping Laboratory (Common to all Branches)	30	2
11.	VC18005	Basics of Entrepreneurship Development (Common to all Branches)	30	2
12.	VC18006	Advance in Entrepreneurship Development (Common to all Branches)	30	2

**Students must earn at least 2 credits.

Summary:

Subject Area	Credit as per Semester								Total Credit	Percentage
	I	II	III	IV	V	VI	VII	VIII		
Humanities and Social Sciences (HS), including Management	3	3			3				**9**	4.84%
Basic Sciences (BS) including Mathematics, Physics, Chemistry, Biology	11	10	4	4					**29**	15.59%
Professional Subjects - Core (PC), relevant to the chosen specialization/branch; (May be split into Hard (no choice) and Soft (with choice), if required)		3	14.5	18	20	18	16		**89.5**	48.11%
Engineering Sciences (ES), including Materials, Workshop, Drawing, Basics of Electrical/Electronics/Mechanical/Computer Engineering, Instrumentation	8.5	6.5	5.5						**20.5**	11.02%
Professional Subjects - Elective (PE), relevant to the chosen specialization/ branch					3	3	3	6	**15**	8.06%
Open Subjects - Elective (OE), from other technical and/or emerging subject areas						3	3		**6**	3.22%
Employability Enhancement Courses (EEC) Project Work, Seminar and/or Internship in Industrial or Elsewhere					2		3	12	**17**	9.14%
Total Credits	**22.5**	**22.5**	**24**	**22**	**28**	**24**	**25**	**18**	**186**	100%

SEMESTER I

HS18151	COMMUNICATIVE ENGLISH (Common to all Branches)	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To enable learners to interact fluently on everyday social contexts.
- To enable learners to engage in conversations in an academic/scholarly setting.
- To enable learners to overcome public speaking barriers.
- To develop learners' ability to take notes and in the process, improve their listening skills
- To develop learners' reading skill through reading text passages for comprehension and contemplation.
- To enable learners to write on topics of general interest and drafting correspondences for general purposes.

UNIT I	**9**

Listening - short video clips - conversational scenes form movies, celebrities' speeches/interviews. Speaking - several ways of introducing oneself at several situations, introducing others at several situations, inviting people for several occasions, describing people and their places. Reading - short comprehension passages - making inferences, critical analysis. Writing - completing the incomplete sentences - developing hints from the given information. Grammar - Wh-Questions and Yes or No questions - Parts of speech. Vocabulary development - prefixes - suffixes - articles - countable / uncountable nouns.

UNIT II	**9**

Listening - customer care voice files, short narratives - identifying problems and developing telephone etiquettes. Speaking - speaking over skype/whatsapp, making business calls, making self-recorded informative videos, inquiring about a concept/activity, describing a concept/activity. Reading - reading the headlines on news magazines - slogans and taglines from advertisements. Writing - free writing - writing - headlines, slogans and taglines individual inspirations. Grammar - conjunctions, idioms, phrases, quotes. Vocabulary development - guessing the meanings of words in various different contexts.

UNIT III	**9**

Listening - courtroom scenes from movies, debates and talks from news channels, notes taking. Speaking - language and tone for arguments, discussion, deliberation, contemplation, expressing opinions, reacting to different situations in an alien country. Reading - language used in instruction manuals of household appliances, cookery and other basic instructions. Writing- understanding the structure of texts - use of reference words, discourse markers-coherence, rearranging the jumbled sentences. Grammar - adjectives - degrees of comparison, framing direct and indirect questions. Vocabulary development - concise approach, single word substitution

UNIT IV	**9**

Listening - Sports commentaries, advertisements with users' criticisms; Speaking - for social causes, for promoting a concept, negotiating and bargaining; Reading - review of a product, movie, movement or a system; Writing - writing for advertisements, selling a product; Grammar - Tenses - Simple Past, Present and Future, Continuous - Past, Present and Future; Vocabulary Development - synonyms, antonyms and phrasal verbs.

UNIT V	**9**

Listening - video lectures, video demonstration of a concept; Speaking - presenting papers/concepts, delivering short speeches, discourses on health, suggesting natural home remedies, cleanliness, civic sense and responsibilities; Reading - columns and articles on home science; Writing - correspondences of requests, basic enquiry/observation and basic complaints; Grammar - modal verbs, perfect tenses - Vocabulary development - collocations.

TOTAL: 45 PERIODS

OUTCOMES: At the end of the course, learners will be able to

- Read articles and infer meanings from specific contexts from magazines and newspapers.
- Participate effectively in informal/casual conversations; introduce themselves and their friends and express opinions in English.
- Comprehend conversations and short talks delivered in English.
- Write short write-ups and personal letters and emails in English.

REFERENCES:

1. Department of English, Anna University. Mindscapes: English for Technologists and Engineers. Orient Black swan, Chennai. 2017
2. Downes, Colm, Cambridge English for Job-hunting, Cambridge University Press, New Delhi. 2008
3. Murphy, Raymond, Intermediate English Grammar with Answers, Cambridge University Press 2000
4. Thomson, A.J. Practical English Grammar 1& 2 Oxford 1986.

WEBSITES

1. http://www.usingenglish.com
2. http://www.uefap.com3
3. https://owl.english.purdue.edu/owl/
4. www.learnenglishfeelgood.com/esl-printables-worksheets.html

SOFTWARE

1. Face 2 Face Advance – Cambridge University Press, 2014
2. English Advance Vocabulary- Cambridge University Press
3. IELTS test preparation – Cambridge University Press 2017
4. Official Guide to the TOEFL Test With CD-ROM, 4th Edition
5. CAMBRIDGE Preparation for the TOEFL TEST- Cambridge University Press, 2017

MA18151	ENGINEERING MATHEMATICS I	L	T	P	C
	(Common to all Branches Except MR)	**3**	**1**	**0**	**4**

OBJECTIVES:

- To understand and apply matrix techniques for engineering applications.
- To make the student knowledgeable in statistical methods of analyzing and interpret the data for engineering problems.
- To familiarize the student with basic calculus including functions of several variables. This is needed in many branches of engineering.
- To acquaint the student with mathematical tools needed in evaluating multiple integrals and their usage.

UNIT I	**MATRICES**	**9+3**

Eigen values and Eigen vectors of a real matrix - Characteristic equation - Properties of Eigen values and Eigen vectors - Statement and Applications of Cayley-Hamilton Theorem - Diagonalization of matrices - Reduction of a quadratic form into canonical form by orthogonal transformation - Nature of quadratic forms.

UNIT II	**STATISTICAL METHODS**	**9+3**

Scatter diagram - Karl Pearson coefficient of correlation for raw data - Spermann rank correlation coefficient - lines of regression - Regression equation X on Y and Y on X- Curve fitting by Principle of least squares - Fitting a straight line $y = ax + b$ and a parabola $y = ax^2 + bx + c$.

UNIT III	**APPLICATION OF DIFFERENTIAL CALCULUS**	**9+3**

Curvature in Cartesian co-ordinates - Centre and radius of curvature - Circle of curvature - Evolutes - Envelopes.

UNIT IV	**DIFFERENTIAL CALCULUS OF SEVERAL VARIABLES**	**9+3**

Limits and Continuity - Partial derivatives - Total derivatives - Differentiation of implicit functions - Jacobians and properties - Taylor's series for functions of two variables - Maxima and Minima of functions of two variables - Lagrange's method of undetermined multipliers

UNIT V	**MULTIPLE INTEGRALS**	**9+3**

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

TOTAL: (L: 45+ T: 15): 60 PERIODS

OUTCOMES: At the end of the course, learners will be able to

- Develop the use of matrix algebra techniques which is needed for practical applications.
- Apply the skill to solve statistical problems under correlation and regression and acquire the knowledge for fitting the straight line and parabola.
- Acquire the skills to evaluate the functions of several variables.
- Express proficiency in handling the concept of improper integrals of gamma, beta and error functions.
- Acquaint the student with mathematical tools needed in evaluating multiple integrals and their usage.

TEXT BOOKS:

1. Erwin Kreyszig, Advanced Engineering Mathematics,8th Edition, John Wiley, (1999)
2. Bali N. P and Manish Goyal, "A Text book of Engineering Mathematics", Eighth Edition,

	Laxmi Publications Pvt Ltd., (2011).
3	Grewal. B.S, "Higher Engineering Mathematics", 41st Edition, Khanna Publications, Delhi, (2011).

REFERENCES:

1. S C Gupta and V K Kapoor, Fundamentals of Mathematical Statistics, S.Chand Private Ltd.,11th Edition (2005).
2. Glyn James, "Advanced Modern Engineering Mathematics", 3rd Edition, Pearson Education, (2012).
3. Peter V.O'Neil, "Advanced Engineering Mathematics", 7th Edition, Cengage learning, (2012).
4. Ramana B.V, "Higher Engineering Mathematics", Tata McGraw Hill Publishing Company New Delhi, (2008).
5. Sivarama Krishna Das P. and Rukmangadachari E., "Engineering Mathematics", Volume I, Second Edition, Pearson Publishing (2011).

.

PH18151	ENGINEERING PHYSICS	L	T	P	C
	(Common to all Branches)	**3**	**0**	**0**	**3**

OBJECTIVES:

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

UNIT I	**CRYSTAL PHYSICS**	**12**

Unit cell - Bravais Lattices - Miller indices - Distance between Inter planar distance 'd' (derivation) - discussion of various crystal structures: calculation of Atomic radius, Coordination number, effective number of lattice points and Atomic Packing Factor for the SC, BCC, FCC, HCP, Diamond Cubic (derivation) - discussion about the NaCl, Graphite structures. Crystal defects**:** Zero dimensional, one dimensional, Two dimensional and Three dimensional defects. Diffraction of X-rays by crystal planes - Bragg's spectrometer - Powder Diffraction method.

UNIT II	**THERMAL PHYSICS**	**6**

Modes of heat transfer: Newton's law of cooling - thermal conductivity - Lee's disc method (derivation and expt) - Radial heat flow - Rubber tube method - conduction through compound media (series and parallel).

UNIT III	**WAVE MECHANICS**	**9**

Quantum principles: Black body radiation - Planck Hypothesis (qualitative), Compton's effect (derivation).

Wave-particle duality - De-Broglie matter waves - Heisenberg's uncertainty principle - Wave function and its significance - Schrödinger's wave equation (time dependent and Time independent) (derivation) - Application of Schrodinger's wave equation - Particle in one dimensional box (derivation) - Degenerate and non-degenerate energy states.

UNIT IV	**ACOUSTICS AND ULTRASONICS**	**9**

Acoustics: Classification of Sound - Characteristics of Musical Sound - Quality (Timbre), Pitch, Intensity of Sound - Units of Sound - decibel - Reverberation of sound - Reverberation time - absorption of sound energy by materials - Absorption coefficient - Sabine's Formula (derivation) - Factors affecting the acoustics of buildings - Remedies.

Ultrasonics **:** Introduction to ultrasonics - Properties of ultrasonic waves - Production of Ultrasonics - Magnetostriction method, Piezo electric method - detection of ultrasonics - Ultrasonic Acoustic grating - Applications of ultrasonic waves - SONAR, NDT, Sonogram

UNIT V	**OPTOELECTRONICS AND FIBER OPTICS**	**9**

Lasers: Basic properties of Lasers - Einstein's coefficients (Derivation) - Population inversion - Types of Lasers - Molecular Gas Lasers (CO_2 Laser) - Solid state Laser (Nd: YAG Laser) - Applications of Lasers in Engineering and Medicine.

Fibre optics: Introduction - Principle and structure of optical fibers - Acceptance angle-Numerical aperture-Types of optical fibers-Optical fiber communication system (block diagram) - Advantages and its applications.

TOTAL: 45 PERIODS

OUTCOMES: Students will be able to

- Interpret the thermal properties of the materials
- Exhibit the ability to solve the problems pertaining to the behavior of sub-atomic particles using quantum mechanics.

- Learn to solve the issues related to defects in the buildings due to acoustic design
- Develop an understanding about photonics and Fiber Optic communication system
- Classify and demonstrate the fundamentals of crystals and their defects.

TEXT BOOKS:

1. Gaur R.K. and Gupta S.L, "Engineering Physics", Dhanput Publications, 2015.
2. Shatendra Sharma and Jyotsna Sharma, "Engineering Physics", Pearson, 2006.
3. Rajendran V, "Engineering Physics", Tata McGraw Hill, 2009.
4. Arumugam M, "Materials Science", Anuradha Publications, 2015.

REFERENCES:

1. David Halliday, Robert Resnick Jearl Walker, "Principles of Physics", 10th Edition, Wiley, 2015.
2. Peter Atkins and Julio De Paula, "Physical Chemistry", 10th Edition., Oxford University Press, 2014.
3. Arthur Beiser, Shobhit Mahajan and Rai Choudhury S, "Concepts of Modern Physics", 7th Edition, McGraw Hill Education, 2017.
4. Raghavan V, "Materials Science and Engineering", PHI Learning Pvt. Ltd., 2010.

CY18151	ENGINEERING CHEMISTRY	L	T	P	C
	(Common to all Branches Except MR)	3	0	0	3

OBJECTIVES:

- To make the students conversant with boiler feed water requirements, related problems and the water treatment techniques.
- To develop an understanding the principle, types and mechanism of corrosion and protective coatings.
- To acquaint the students with the basics of nanomaterials, their properties and applicants.
- To develop an understanding of the laws of photochemistry and basic spectral (UV and IR) analysis.
- To enable the students to understand the types of fuels, its calorific values and the significance flue gas analysis.

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

Sources, hard & soft water, estimation of hardness by EDTA method, boiler feed water, boiler problems, cause and preventive measures, softening of water, zeolite process & demineralization by ion exchangers, internal treatment methods, specifications for drinking water, BIS & WHO standards, treatment of water for domestic use, desalination - reverse osmosis & electrodialysis.

UNIT II	**CORROSION AND ITS CONTROL**	**9**

Corrosion: Basic concepts - mechanism of chemical, electrochemical corrosion - Pilling Bedworth rule – Types of Electrochemical corrosion - galvanic corrosion - differential aeration corrosion - pitting corrosion – stress corrosion – factors influencing corrosion. Corrosion control: Cathodic protection – sacrificial anodic method - corrosion inhibitors. Protective coatings: surface preparation For metallic coatings - electro plating (copper plating) and electroless plating (Nickel plating) - chemical conversion coatings - anodizing, phosphating & chromate coating.

UNIT III	**NANOCHEMISTRY**	**9**

Basics - distinction between molecules, nanoparticles and bulk materials; size-dependent properties. nanoparticles: nano cluster, nano rod, nanotube (CNT) and nanowire. Synthesis: precipitation, thermolysis, hydrothermal, solvothermal, electrodeposition, chemical vapour deposition, laser ablation; Properties and applications of nanomaterials.

UNIT IV	**PHOTOCHEMISTRY AND SPECTROSCOPY**	**9**

Photochemistry: Laws of photochemistry - Grotthuss - Draper law, Stark-Einstein law and Lambert Beer Law. Quantum efficiency - Photo processes - Internal Conversion, Inter-system crossing, Fluorescence, Phosphorescence and Photo-sensitization. Spectroscopy: Electromagnetic spectrum - Absorption of radiation - Electronic, Vibrational and rotational transitions. UV-visible and IR spectroscopy - principles, instrumentation (Block diagram only) and applications.

UNIT V	**FUELS AND COMBUSTION**	**9**

Fuel: Introduction - classification of fuels - calorific value - higher and lower calorific values - coal analysis of coal (proximate and ultimate) - carbonization - manufacture of metallurgical coke (Otto Hoffmann method) - petroleum- refining - manufacture of synthetic petrol (Bergius process) - knocking octane number - diesel oil - cetane number - natural gas - compressed natural gas (CNG) - liquefied petroleum gases (LPG) - producer gas - water gas. Combustion of fuels: introduction - theoretical calculation of calorific value - calculation of stoichiometry of fuel and air ratio - flue gas analysis by ORSAT Method.

TOTAL: 45 PERIODS

OUTCOMES:

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

- Estimate the hardness of water, asses the boiler feed water requirement and related problems also identification of suitable water treatment methods.
- Differentiate the mechanisms of different types of corrosion and suggest suitable corrosion control techniques to mitigate the problem of corrosion including protective coatings.
- Compare the nano and bulk materials, their synthesis and its applications in various fields.
- Interpret the photochemical reactions and spectroscopic techniques.
- Asses the types and quality of fuels, its calorific values and significance of flue gas analysis.

TEXT BOOKS:

1. Jain P.C. and Monica Jain, "Engineering Chemistry", Dhanpat Rai Publishing Company (P) Ltd., New Delhi, 2010.
2. Dara S.S, Umare S.S, "Engineering Chemistry", S. Chand & Company Ltd., New Delhi 2010
3. Sivasankar B., "Engineering Chemistry", Tata McGraw-Hill Publishing Company, Ltd., New Delhi, 2008.

REFERENCES:

1. Ozin G. A. and Arsenault A. C., "Nanochemistry: A Chemical Approach to Nanomaterials", RSC Publishing, 2005.
2. B.R. Puri, L.R. Sharma, M.S. Pathania., "Principles of Physical Chemistry" Vishal Publishing Company, 2008.

EE18152	BASIC ELECTRICAL ENGINEERING	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To introduce basics of electrical circuits
- To impart knowledge on solving circuits using theorems
- To study the working principles of electrical machines and power converters
- To introduce the components of low voltage electrical installations

UNIT I	**BASIC CIRCUITS ANALYSIS**	**9**

Ohm's Law – Kirchoff's laws – DC and AC Circuits – Resistors in series and parallel circuits – Mesh current and node voltage method of analysis for D.C and A.C. circuits – Phasor Diagram – Power, Power Factor and Energy.

UNIT II	**NETWORK REDUCTION AND NETWORK THEOREMS FOR DC AND AC CIRCUITS**	**9**

Network reduction: Voltage and current division, Source transformation – Star delta conversion. Thevenin and Norton & Theorem – Superposition Theorem – Maximum power transfer theorem –Reciprocity Theorem.

UNIT III	**DC MACHINES AND TRANSFORMER**	**9**

Introduction- ideal and practical transformer, equivalent circuit, losses in transformers, regulation and efficiency. Auto-transformer. Construction, working, torque-speed characteristic and speed control of separately excited dc motor – Applications.

UNIT IV	**AC MACHINES**	**9**

Overview of three phase circuits, Generation of rotating magnetic fields, Construction and working of a three-phase induction motor, Significance of torque-slip characteristic, Loss components and efficiency, Single-phase induction motor, Working of synchronous generators.

UNIT V	**ELECTRICAL INSTALLATIONS AND POWER CONVERTERS**	**9**

Components of LT switch gear: Switch Fuse Unit (SFU), MCB, ELCB, MCCB. Types of Wires and Cables, Earthing. Types of Batteries, Important Characteristics for Batteries. Elementary calculations for energy consumption. DC-DC buck and boost converters, duty ratio control. Introduction to voltage source inverters.

TOTAL: 45 PERIODS

OUTCOMES:

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

- Apply various circuit analysis technique to solve problems in DC and AC Circuits.
- Apply various network reduction technique and network theorem to solve problems in DC and AC Circuits.
- Illustrate the construction, working prinicple, characteristics and applications of Transformer and Seperately excited DC Motor.
- Illustrate the construction, working prinicple, characteristics and applications of Induction motor and Synchronous Generator.
- Explore the significance of the Electrical Installation and different power converter.

TEXT BOOKS:

1. D.P. Kothari and I.J. Nagrath, “Basic Electrical Engineering”, Tata McGraw Hill, 3rd edition 2010.
2. D.C. Kulshreshtha,“Basic Electrical Engineering”, Tata McGraw Hill,2009.
3. E. Hughes,“Electrical and Electronics Technology”, 10th Edition, Pearson, 2010.

REFERENCES:

1. Vincent Deltoro,“Electrical Engineering Fundamentals”, Second Edition, Prentice Hall India,1989.
2. S.K.Bhattacharya , “Basic Electrical and Electronics Engineering”, Pearson India, 2011.
3. William Hayt and Jack E. Kemmerly, “Engineering circuit analysis”, Mc Graw Hill Company, 6th edition, 2016.
4. Newnes Electrical Power Engineers handbook, II edition, Elsevier publications, 2005.

GE18151	ENGINEERING DRAWING (Common to all Branches)	L	T	P	C
		3	0	2	4

OBJECTIVES:

This course will introduce students to Engineering Drawing and build their ability to read drawings and interpret the position and form of simple geometry, culminating into understanding of simple technical assemblies.

UNIT 0	**ENGINEERING DRAWING FUNDAMENTALS (Not for Examination)**	**5**

Drawing standard: BIS, Lettering, Dimensioning, Type of lines, Conventions, Geometrical constructions: Dividing a straight line into equal parts, Bisecting a given angle, Construction of polygon - Triangle, Square, Pentagon and Hexagon using drawing tools.

UNIT I	**CURVES AND PROJECTION OF POINTS AND LINES**	**15**

Construction of Engineering Curves: Conic Sections - Ellipse, Parabola, Hyperbola using Eccentricity method, Cycloid, Involute of Circle and Pentagon.

Projection: Principal Planes, Projection of Points using Four Angles of Projection, Projection of Straight Lines - Lines parallel or inclined to one or both planes using Rotating Line Method in First Angle of Projection.

UNIT II	**PROJECTION OF PLANES AND SOLIDS**	**15**

Projection of Plane Figures - Inclined to any one Principal Plane, Projection of Solids - Simple Solids (Prisms, Pyramids, Cone and Cylinder) axis inclined to any one Principal Plane

UNIT III	**SECTION OR SOLIDS & DEVELOPMENT OF SURFACES**	**15**

Section of Solids - Sectional views of simple vertical solids cut by section plane inclined to any one Principal Plane.

Development of Surfaces - Development of lateral surfaces of truncated and frustum of simple solids.

UNIT IV	**PICTORIAL PROJECTION**	**15**

Introduction to Pictorial Projection, Isometric Projection - Principle, Isometric Planes, Isometric Scales, Isometric Projection of simple solids and their combination.

Free Hand Drawing - Orthographic Projection - Orthographic views of simple blocks from their Isometric view, Isometric view of simple blocks from their Orthographic views.

UNIT V	**PERSPECTIVE PROJECTION**	**10**

Perspective Projection of full solids in simple positions with respect to projection planes by visual ray and vanishing point method.

TOTAL: 75 PERIODS

OUTCOMES:

On Completion of the course, the student will be able to

- Construct conic sections and curves and sketch the orthographic views of lines as per drawing standards.
- Obtain orthographic projections of plane surfaces and simple solids in various positions.
- Draw projections of sectioned solids and develop the lateral surfaces of simple solids.
- Draw isometric projections of simple solids and their combinations. Also perform free hand sketching of orthographic views of given objects.
- Draw perspective projections for the given objects in different positions

TEXT BOOKS:		
1.	Bhatt N.D, Panchal Pramod V.M and Ingle R, "Engineering Drawing", Charotar Publishing House, 2014.	
REFERENCES:		

1. Venugopal K and Prabhu Raja V, "Engineering Graphics", New Age International (P) Limited, 2009.
2. Shah M.B and Rana B.C, "Engineering Drawing", Pearson Education, 2009.
3. Gopalakrishna K.R, "Engineering Drawing" (Vol. I & II), Subhas Publications, 2010.
4. Natrajan K.V, "A Textbook of Engineering Graphics", Dhanalakshmi Publishers, Chennai, 2006.
5. Gowri S and Jeyapoovan T, "Engineering Graphics", Vikas Publishing House Pvt. Ltd., 2011.

PC18161	PHYSICS AND CHEMISTRY LABORATORY	L	T	P	C
	(Common to all Branches) **Physics Laboratory**	**0**	**0**	**2**	**1**

Objective

- To make the student to acquire practical skills in the determination of various physical properties of materials.

LIST OF EXPERIMENTS:

1	Determination of compressibility of the liquid - Ultrasonic interferometer.
2	Determination of thickness of the given object by Air wedge method.
3	Determination of dispersive power of a prism by Spectrometer.
4	Determination of Young's modulus of wooden scale by Non-Uniform bending.
5	Determination of wavelength, particle size and numerical aperture of fibre using Lasers.
6	Lee's Disc – Thermal conductivity of the poor conductor.
7	Torsional Pendulum – Determination of Rigidity modulus and moment of inertia.

OUTCOMES:

The student will be able to

- Analyze the physical principle involved in the various instruments, also relate the principle to new application.
- Comprehend the Experiments in the areas of optics, mechanics and thermal physics to nurture the concepts in all branches of Engineering.
- Apply the basic concepts of Physical Science to think innovatively and also improve the creative skills that are essential for engineering.

LIST OF EQUIPMENTS FOR THE BATCH OF 30 STUDENTS:

Spectrometer, Mercury Vapour lamp, Lee's disc exptl setup, Travelling microscope, ultrasonic interferometer, Sodium vapour lamp, diode laser, optical fiber kit.

	Chemistry Laboratory	

Objective

- To make the student to acquire practical skills in the determination of water quality parameters through volumetric and instrumental analysis.
- To acquaint the students with the determination of molecular weight of a polymer by viscometery.

LIST OF EXPERIMENTS:

1	Determination of total, temporary & permanent hardness of water by EDTA method.
2	Estimation of copper by EDTA.
3	Conductometric titration of a strong acid with a strong base
4	Estimation of iron content of the given solution using potentiometer.
5	Estimation of iron content of the water sample using spectrophotometer.
6	Determination of molecular weight of polymer using viscometer.
7	Determination of Alkalinity in water.

OUTCOMES

- The students will be equipped with hands - on knowledge in the quantitative chemical analysis of water quality related parameters.

TOTAL: 30 PERIODS

REFERENCES

1. Rajendran V, "Engineering Physics", Tata McGraw Hill, 2009.
2.Furniss B.S. Hannaford A.J, Smith P.W.G and Tatchel A.R., "Vogels Textbook of Practical Organic Chemistry", 8th Edition, LBS Singapore, 2014

LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS:

1. Conductivity meter – 10 Nos
2. Spectrophotometer – 10 Nos
3. Ostwald Viscometer – 10 Nos
4. Potentiometer - 10 Nos
5. Electronic Balance - 2 Nos

Common Apparatus: Pipette, Burette, conical flask, iodine flask, porcelain tile, dropper (each 30 Nos.)

GE18161	ENGINEERING PRACTICES LABORATORY	L	T	P	C
	(Common to all Branches)	0	0	3	1.5

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

	GROUP B (ELECTRICAL & ELECTRONICS)	
III	**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 and comparison of energy for resistive and LED load using single phase energy meter. 6. Measurement of resistance to earth of an electrical equipment.		
IV ELECTRONICS ENGINEERING PRACTICE		
1. Identification of circuit components A) Resistor, capacitor, diode (PN & Zener), transistors. B) Soldering practice – Circuits – Using general purpose PCB. 2.Evaluating the parameters for DC power supply and AC power supply (peak-peak, rms, average, period, frequency) using function generator and CRO. 3.Study and implementation of logic functions using NAND, NOR, and NOT gates. 4.VI Characteristics of PN Junction diode. 5.VI Characteristics of Solar photovoltaic panel. 6.Design a 5V/12V Regulated Power Supply: using FWR rectifier and IC7805/IC7812.		
COURSE OUTCOMES		
On Completion of the course the student will be able to • Fabricate carpentry components and to lay pipe connections including plumbing works. • Use welding equipments to join the structures. • Wiring of basic electrical system and measurement of electrical parameters. • Study and implementation of basic electronic components, circuits and solar photovoltaic panel. • Design a basic regulated power supply.		
REFERENCES		
1	Jeyachandran K., Natarajan S. & Balasubramanian S., "A Primer on Engineering Practices Laboratory", Anuradha Publications, 2007.	
2	Jeyapoovan T., Saravanapandian M. & Pranitha S., "Engineering Practices Lab Manual", Vikas Publishing House Pvt.Ltd, 2006.	
3	Bawa H.S., "Workshop Practice", Tata McGraw Hill Publishing Company Limited, 2007.	
4	Rajendra Prasad A. and Sarma P.M.M.S., "Workshop Practice", Sree Sai Publication, 2002.	
5	Kannaiah P. & Narayana K.L., "Manual on Workshop Practice", Scitech Publications, 1999.	
6	Mittle V.N, Arvind Mittal, "Basic Electrical Engineering", Tata McGraw Hill (India), Second Edition,2013.	
7	Sedha R.S., "A Text Book of Applied Electronics", S. Chand & Co., 2014.	
	TOTAL: 45 PERIODS	

LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS:

S. No.	Description of Equipment	Qty
	CIVIL	
1.	Assorted components for plumbing consisting of metallic pipes, plastic pipes, flexible pipes, couplings, unions, elbows, plugs and other fittings.	15 Sets.
2.	Carpentry vice (fitted to work bench)	15 Nos.
3.	Standard woodworking tools	15 Sets.
4.	Models of industrial trusses, door joints, furniture joints	5 each
5.	Power Tools: (a) Rotary Hammer (b) Demolition Hammer (c) Circular Saw (d) Planer (e) Hand Drilling Machine (f) Jigsaw	2 Nos
	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
	ELECTRICAL	
1.	Assorted electrical components for house wiring	15 Sets
2.	Electrical measuring instruments	10 Sets
3.	Study purpose items: Iron box, fan and regulator, emergency lamp	1 each
4.	Megger (250V/500V)	1 No.
5.	Power Tools: (a) Range Finder 2 Nos (b) Digital Live-wire detector	2 Nos.
6.	LED lamp 8 W & 16 W	2 Nos. each
	ELECTRONICS	
1.	Soldering guns	10 Nos.
2.	Assorted electronic components for making circuits	50 Nos.
3.	Small PCBs	10 Nos.
4.	Multimeters	10 Nos.
5.	Study purpose ICs: IC7805/IC7812	1 each
6.	Photovoltaic panel: 5 W/10 W	2 Nos.
7.	Light Source for PV panel	1 No.

SEMESTER II

HS18251	TECHNICAL ENGLISH (Common to all Branches)	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To enable learners to define and understand technical communication and scientific writing
- To expose learners to nuances of seminar presentation, group discussion, and public speaking
- To expose learners to writing for scientific purposes
- To expose learners to drafting correspondences for business purposes
- To expose learners to writing for documenting purposes
- To enable students to have a holistic understanding of job interviews and recruiting process.

UNIT I	**9**

Listening - AV files pertaining to manufacturing processes of products, scientific documentaries; **Speaking** - syllable division and word stress, intonation, sharing opinions; **Reading** - news articles related to science and technology; **Writing** - definitions, instruction, recommendation, data interpretation, resume; **Grammar** - tenses and their aspects, sentence connectors - discourse markers, sequential words, active and passive voice, subject-verb agreement

UNIT II	**9**

Listening - AV pertaining to marketing strategies, peer reading and pronunciation; **Speaking** - turn taking, sharing opinions; conducting and attending a meeting, understanding the nuances of spoken communication among internal audience and external audience; **Reading** - analytical documents, descriptive documents; **Writing** - fliers, brochures, resume - letter of application, checklists; **Grammar** - modal verbs, clauses - types and uses, conditional clauses, articles.

UNIT III	**9**

Listening - AV related to how to use components, scientific description. **Speaking** - speaking for motivation and initiation, speaking at a seminar presentation; **Reading** - scientific journals, papers; **Writing** - Technical descriptions - process description, purpose and function, PowerPoint, Google forms, user manuals; **Grammar** - phrasal verbs, prepositions, technical and scientific affixes.

UNIT IV	**9**

Listening - scientific debates, crisis management; **Speaking** - handling conflicts, speaking about the loss of benefits, progress or decline of business, identifying the connotative meanings, **Reading**- documented evidences of uses and functions of a product, review of a product, **Writing** - memos, follow-up letters, reports - proposal, project, progress reports, sales reports, reports on industrial visits, executive summary. **Grammar** - reported speech and tag questions, sentence structure - comparative, imperative, cause and effect, infinitive of result.

UNIT V	**9**

Listening - AV of Group discussions, panel discussions, face to face interviews for recruitment purposes; **Speaking**- speaking at group discussions, interviewing a personality, answering at the interviews; **Reading** - WebPages of topnotch engineering companies, **Writing** - blogging, e-mails, letter of complaint, minutes of the meeting; **Grammar** - one word substitution, collocations, better word/sentence substitution (rephrasing the content/improvising ideas).

	TOTAL: 45 PERIODS

Suggested Activities [task based] – case study, guest lectures as models, problem solving,

understanding team work.

OUTCOMES:

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

- Understand the nuances of technical communication and scientific writing
- Present papers and give seminars
- Discuss in groups and brainstorm
- Draft business correspondences and write for documenting purposes
- Face job interviews with confidence

REFERENCES:

1. Department of English, Anna University. Mindscapes: English for Technologists and Engineers. Orient Blackswan, Chennai. 2012
2. Downes, Colm, Cambridge English for Job-hunting, Cambridge University Press, New Delhi. 2008
3. Murphy, Raymond, Intermediate English Grammar with Answers, Cambridge University Press 2000
4. Thomson, A.J. Practical English Grammar 1& 2 Oxford 1986.
5. Herbert A J, The Structure of Technical English Longman, 1965

Websites

1. http://www.usingenglish.com
2. http://www.uefap.com3
3. https://owl.english.purdue.edu/owl/
4. www.learnenglishfeelgood.com/esl-printables-worksheets.html

Software

1. Face2Face Advance – Cambridge University Press,2014
2. English Advance Vocabulary- Cambridge University Press
3. IELTS test preparation – Cambridge University Press 2017
4. Official Guide to the TOEFL Test With CD-ROM, 4th Edition
5. CAMBRIDGE Preparation for the TOEFL TEST- Cambridge University Press, 2017

MA18251	ENGINEERING MATHEMATICS II (Common to all Branches Except MR)	L	T	P	C
		3	1	0	4

OBJECTIVES:

- To acquaint the student with the concepts of vector calculus needed for problems in all engineering disciplines.
- To make the student acquire sound knowledge of techniques in solving ordinary differential equations that model engineering problems.
- To develop an understanding of the standard techniques of complex variable theory so as to enable the student to apply them with confidence in application areas such as heat conduction, elasticity, fluid dynamics and flow of electric current.
- To make the student appreciate the purpose of using transforms to create a new domain in which it is easier to handle the problem that is being investigated.

UNIT I	**VECTOR CALCULUS**	**9+3**

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

UNIT II	**ORDINARY DIFFERENTIAL EQUATIONS**	**9+3**

Higher order linear differential equations with constant coefficients - Method of variation of parameters - Cauchy's and Legendre's linear equations - Simultaneous first order linear equations with constant coefficients

UNIT III	**LAPLACE TRANSFORM**	**9+3**

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

UNIT IV	**ANALYTIC FUNCTION**	**9+3**

Functions of a complex variable - Analytic functions: Necessary conditions - Cauchy-Riemann equations and sufficient conditions (excluding proofs) - Harmonic and orthogonal properties of analytic function - Harmonic conjugate - Construction of analytic functions - Conformal mapping -Translation, rotation and inversion ($w = z+c$, cz, $1/z$, z^2) - Bilinear transformation.

UNIT V	**COMPLEX INTEGRATION**	**9+3**

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

TOTAL: (L:45 + T: 15): 60 PERIODS

OUTCOMES:

On completion of the course the students will be able to

- Interpret the fundamentals of vector calculus and be fluent in the use of Stokes theorem and Gauss divergence theorem.

- Express proficiency in handling higher order differential equations.
- Determine the methods to solve differential equations using Laplace transforms and Inverse Laplace transforms.
- Explain Analytic functions and Categorize transformations.
- Solve complex integrals using Cauchy integral theorem and Cauchy's residue theorem.

TEXT BOOKS:

1	Erwin Kreyszig, Advanced engineering mathematics,8th Edition, John Wiley, 1999.
2	Bali N. P and Manish Goyal, "A Text book of Engineering Mathematics", Eighth edition, Laxmi Publications Pvt Ltd., (2011).
3	Grewal. B.S, "Higher Engineering Mathematics", 41st Edition, Khanna Publications, Delhi, (2011).

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, (2012).
3. Peter V.O'Neil, "Advanced Engineering Mathematics", 7th Edition, Cengage learning, (2012).
4. Ramana B.V, "Higher Engineering Mathematics", Tata McGraw Hill Publishing Company New Delhi, (2008).
5. Sivarama Krishna Das P. and Rukmangadachari E., "Engineering Mathematics", Volume I, Second Edition, PEARSON Publishing, 2011.

IT18101	PROGRAMMING FOR PROBLEM SOLVING	L	T	P	C
	(Common to all Branches)	**3**	**0**	**0**	**3**

OBJECTIVES:

The students should be made to:

- Learn the organization of a digital computer.
- Learn to think logically and write algorithms or draw flow charts for problems.
- Be exposed to the syntax of C.
- Be familiar with programming in C.
- Learn to use arrays, strings, functions, pointers, structures and unions in C.

UNIT I	**INTRODUCTION TO PROBLEM SOLVING**	**9**

Simple model of a Computer - Hardware - Software - Data Representation, Introduction to Computer Networks and Internet, Problem Solving Techniques - Bottom up design and top down design - applications, Introduction to Algorithms and Flow Chart.

UNIT II	**C PROGRAMMING BASICS**	**9**

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

UNIT III	**ARRAYS AND STRINGS**	**9**

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

UNIT IV	**FUNCTIONS AND USER DEFINED DATA TYPES**	**9**

Function - definition of function - Declaration of function - Pass by value - Pass by reference - Recursion - Enumerators - Structures - Unions.

UNIT V	**POINTERS AND FILES**	**9**

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

TOTAL: 45 PERIODS

OUTCOMES:

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

- Apply various problem solving techniques and represent solutions to problems in the form of algorithms and flow charts.
- Examine given problems, design solutions and write C programs using the constructs of C language.
- Apply the advanced constructs and string manipulation feature available in C programming language to solve problems.
- Demonstrate the use functions, structures and unions to create modularized applications in C language.
- Illustrate the dynamics of memory by the use of files and pointers.

TEXT BOOKS:	
1	Pradip Dey, Manas Ghosh, “Fundamentals of Computing and Programming in C”, First Edition, Oxford University Press, 2009.
2	Byron S Gottfried, “Programming with C”, Schaum’s Outlines, Third Edition, Tata McGraw-Hill, 2010.

REFERENCES:

1. Kernighan,B.W and Ritchie,D.M, “The C Programming language”, Second Edition, Pearson Education, 2015.
2. Yashavant P. Kanetkar. “Let Us C”, BPB Publications, 2011.
3. Paul J Deitel,Dr.Harvey M.Deitel,"C How to Program", Seventh Edition, Pearson Education, 2016.

GE18251	ENVIRONMENTAL SCIENCE AND ENGINEERING	L	T	P	C
	(Common to all Branches)	**3**	**0**	**0**	**3**

OBJECTIVES:

- To study the nature and facts about environment.
- To study the interrelationship between living organism and environment.
- To implement scientific, technological, economic and political solutions to environmental problems.
- To study the integrated themes and biodiversity, natural resources, pollution control and waste management.

UNIT I	**ENVIRONMENT, ECOSYSTEMS AND BIODIVERSITY**	**12**

Definition, scope and importance of environment - need for public awareness - concept of an ecosystem - structure and function of an ecosystem - energy flow in the ecosystem - ecological succession - food chains, food webs and ecological pyramids - Introduction, types, characteristic features, structure and function of the forest ecosystem, grassland ecosystem, desert ecosystem, aquatic ecosystems, Introduction to biodiversity definition: genetic, species and ecosystem diversity - biogeographical classification of India - value of biodiversity - Biodiversity at global, national and local levels - India as a mega-diversity nation - hot-spots of biodiversity - threats to biodiversity - man-wildlife conflicts - endangered and endemic species of India - conservation of biodiversity: In-situ and ex-situ conservation of biodiversity.

UNIT II	**NATURAL RESOURCES AND DISASTER MANAGEMENT**	**10**

Forest resources: Use and over-exploitation, deforestation, case studies- timber extraction, mining, dams and their effects on forests and tribal people - Water resources: Use and over - utilization of surface and ground water, floods, drought, conflicts over water, dams - benefits and problems - Mineral resources: Use and exploitation, environmental effects of extracting and using mineral resources, case studies - Food resources: World food problems, changes caused by agriculture and overgrazing, effects of modern agriculture, fertilizer - pesticide problems, water logging, salinity, case studies - Energy resources: Growing energy needs, renewable and non renewable energy sources, use of alternate energy sources. case studies - Land resources: Land as a resource - role of an individual in conservation of natural resources - Equitable use of resources for sustainable lifestyles.

UNIT III	**ENVIRONMENTAL POLLUTION AND DISASTER MANAGEMENT**	**10**

Definition - causes, effects and control measures Air pollution, Water pollution, Soil pollution, Marine pollution, Noise pollution, Thermal pollution, Nuclear hazards - solid waste management: causes, effects and control measures of municipal solid wastes, e-Waste, risk related to e-Waste - role of an individual in prevention of pollution - pollution case studies - disaster management: floods, earthquake, cyclone and landslides, land degradation, man induced landslides, soil erosion and desertification.

UNIT IV	**SOCIAL ISSUES AND THE ENVIRONMENT**	**7**

From unsustainable to sustainable development - urban problems related to energy - water conservation, rain water harvesting, watershed management - resettlement and rehabilitation of people; its problems and concerns, case studies - role of non-governmental organization- environmental ethics: Issues and possible solutions - Principles of green chemistry, climate change, global warming, acid rain, ozone layer depletion, nuclear accidents and holocaust, case studies - wasteland reclamation - consumerism and waste products - Environment protection act - Air (Prevention and Control of Pollution) act - Water (Prevention and control of Pollution) act - Wildlife

protection act - Forest conservation act - central and state pollution control boards - Public awareness.		
UNIT V	**HUMAN POPULATION AND THE ENVIRONMENT**	**6**
Population growth, variation among nations - population explosion - family welfare programme - environment and human health - human rights - value education - HIV / AIDS, Swine flu, Dengue fever - women and child welfare - role of information technology in environment and human health management - case studies		
		TOTAL: 45 PERIODS

OUTCOMES:

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

- Describe the importance of ecosystems, biodiversity and its protection.
- Implement the knowledge which requires optimum use of various natural resources for the conservation of natural resources.
- Classify the different types of pollution, their effects and control measures. Also apply the knowledge gained for disaster management.
- Describe the sustainable development, social issues, role of NGO's and various laws available in the country for environmental protection.
- Recognize the importance of women and child welfare, prevention of HIV/AIDS and usage of technology for environmental management.

TEXT BOOKS:

1	Benny Joseph, Environmental Science and Engineering', Tata McGraw-Hill, New Delhi, 2012.
2	Gilbert M.Masters, Introduction to Environmental Engineering and Science', 2nd edition, Pearson Education, 2010.

REFERENCES:

1. Dharmendra S. Sengar, Environmental law ', Prentice Hall of India PVT LTD, New Delhi, 2012.
2. Erach Bharucha, ―Textbook of Environmental Studies, Universities Press(I) PVT, LTD, Hydrabad, 2015.
3. Rajagopalan, R, Environmental Studies-From Crisis to Cure, Oxford University Press, 2011.
4. Tyler Miller. G and Scott E. Spoolman, ―Environmental Science, Cengage Learning India PVT, LTD, Delhi, 2013.

EC18201	ELECTRON DEVICES	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To gain knowledge about the construction, theory and operation of basic electronic devices.

UNIT I	**SEMICONDUCTOR DIODE**	**9**

PN junction diode, Current equations, Diffusion and drift current densities, forward and reverse bias characteristics, Switching Characteristics.

UNIT II	**BIPOLAR JUNCTION TRANSISTOR**	**9**

NPN - PNP – Junctions - 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 III	**FIELD EFFECT TRANSISTORS**	**9**

JFETs – Drain and Transfer characteristics - Current equations - Pinch off voltage and its significance – MOSFET - Characteristics - Threshold voltage - Channel length modulation, D-MOSFET, E-MOSFET- Current equation - Equivalent circuit model and its parameters, FINFET, DUAL GATE MOSFET.

UNIT IV	**SPECIAL SEMICONDUCTOR DEVICES**	**9**

Metal-Semiconductor Junction- MESFET, Schottky barrier diode - Zener diode - Varactor diode Tunnel diode- Gallium Arsenide device, LASER diode, LDR.

UNIT V	**POWER DEVICES AND DISPLAY DEVICES**	**9**

UJT, SCR, Diac, Triac, Power BJT, LED, Photo diode, Photo transistor, Opto Coupler, Solar cell, LCD, CCD.

TOTAL: 45 PERIODS

OUTCOMES:

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

- Depicted the construction, working principle and V – I (Voltage and Current) characteristics of PN Junction diode.
- Explore and analyze the construction, working principle, Input and Output characteristics of BJT (Bipolar Junction Transistor).
- Expose construction, working principle, drain and transfer characteristics of FET, MOSFET and cutting edge technology of FINFET, Dual Gate MOSFET.
- Express Incredible performance of the special semiconductor devices.
- Illustrate the construction, working prinicple, characteristics and applications of power and display device.

TEXT BOOKS:

1. Donald A Neaman, “Semiconductor Physics and Devices”, Fourth Edition, Tata Mc Graw Hill Inc., 2012.
2. Adel S. Sedre and Kenneth C. Smith, “Microelectronic Circuits: Theory and Applications”, 6th Edition, Oxford University Press, 2013
3. Robert Boylestad and Louis Nashelsky, “Electron Devices and Circuit Theory”, Pearson Prentice Hall, 11th edition, 2013.

4. Dr. Sanjay Sharma, “Basic Electronics”, First Edition, S.K. Kataria & Sons, 2012.

REFERENCES:

1. Jacob Millman & Christos C. Halkias, “Electronic Devices & Circuits”, Fourth Edition, McGraw Hill 2015.
2. Salivahanan. S, Suresh Kumar. N, Vallavaraj.A, “Electronic Devices and circuits”, Third Edition, Tata McGraw Hill, 2012.

PH18252	PHYSICS OF MATERIALS	L	T	P	C
	(Common to BT, EE and EC)	**3**	**0**	**0**	**3**

OBJECTIVES:

- Understand the physical properties of materials.
- Summarize the importance of free electrons in determining the properties of metals, semiconductors, and superconductors and understand the concept of Fermi energy.
- Describe the basic magnetic, superconducting and dielectric properties of materials.
- Ability to understand different types of modern engineering materials

UNIT I	**CONDUCTING MATERIALS**	**9**

Introduction - Classification of materials based on the electrical resistivity - Classical Free electron theory - Electrical and thermal conductivity of metal (derivation) - Wiedemann - Franz law - Lorentz number - Drawbacks of Classical Free electron theory - Quantum Free electron theory - Fermi distribution function - Effect of temperature of Fermi function - Density of energy states (derivation) - Carrier concentration in metals - Emission of electrons from metals - Thermionic emission - Photoelectric emission - Field emission.

UNIT II	**SEMICONDUCTING MATERIALS**	**9**

Introduction - Classification of materials based on band theory (metals, semiconductors and insulators) - Intrinsic and extrinsic semiconductors - Carrier concentration in intrinsic semiconductor (derivation) - Effect of temperature on Fermi level - Compound semiconductors - Variation of electrical conductivity in intrinsic semiconductors with temperature - Band gap determination of intrinsic semiconductor (derivation and Expt) - Hall effect (derivation and experiment).

UNIT III	**DIELECTRIC PROPERTIES OF MATERIALS**	**9**

Introduction to dielectric materials - Dielectric constant - Polarization of dielectric materials - Types of Polarization (Polarisability) - Equation of internal fields in solid (One- Dimensional) (Derivation) - Claussius - Mosotti Relation for elemental dielectric materials - Dielectric Breakdown - Frequency dependence of dielectric constant, Dielectric Losses - Important applications of dielectric material - Ferro and Piezo electricity (Qualitative).

UNIT IV	**MATERIALS AT LOW TEMPERATURE AND MAGNETIC PROPERTIES**	**9**

Temperature dependence of resistivity in superconducting materials - Meissner effect - Properties of superconductors - Type I and Type II superconductors - BCS theory (Qualitative) - Low Tc and High Tc (alloy) superconductors - Ceramic superconductors (oxide superconductors) - LaBaCuO, YBaCuO, BiSrCaCuO - Josephson's effect (AC and DC) - SQUIDS - CRYOTRON - MAG LEV - Applications of Superconductors.

Dia, para and Ferro magnetic material - Domain theory for Ferro magnetic materials - Phenomena of Hysteresis and its applications - Ferrites and its structures.

UNIT V	**PHYSICS AT NANO SCALE AND SMART MATERIALS**	**9**

Introduction to Nanomaterials- Basic principle of Nano science and technology, creation and use of Bucky balls, structure, properties and of Carbon nanotubes, Applications of nanotechnology in industrial pollution control.

Shape memory alloys - types of SMA - Properties of SMA - Pseudo elasticity - Shape Memory Effect - Hysteresis - Applications of SMA.

	TOTAL: 45 PERIODS

OUTCOMES:

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

- Demonstrate an understanding of various properties of materials and their internal structure.
- Comprehend the behaviour of electrons in solids.
- Develop an understanding the applications of nano materials and new engineering materials in various fields.

TEXT BOOKS:

1. Arumugam M, "Materials Science", Anuradha Publications, 2015.
2. Rajendran V, "Engineering Physics", Tata McGraw Hill, 2015.
3. Suresh R and Jayakumar V, "Materials Science", Lakshmi Publications 2003.
4. Palanisamy P.K, "Materials Science", SciTech publications, 2015.

REFERENCES:

1. Gaur R.K and Gupta S.L, "Engineering Physics", Dhanpat Publications, 2015.
2. Avadhnaulu M.N and Kshirsagar P.G, "A Textbook of Engineering Physics", S. Chand & Co., 2006.
3. Kittlel C, "Introduction to Solid State Physics", 7th Edition, Wiley Eastern Ltd, 2004.
4. Azaroff L.V. and Brophy J.J., "Electronic Processes In Materials", McGraw Hill.,1963

IT18111	PROGRAMMING FOR PROBLEM SOLVING LABORATORY	L	T	P	C
	(Common to all Branches)	0	0	3	1.5

Objective

The student should be made to:

- Be exposed to the syntax of C.
- Be familiar with programming in C.
- Learn to use arrays, strings, functions, pointers, structures and unions in C.

LIST OF EXPERIMENTS:

1	Usage of Basic Linux commands
2	C Programming using Simple statements and expressions
3	Scientific problem solving using decision making and looping
4	Simple programming for one dimensional and two dimensional arrays
5	Solving problems using Strings
6	C Programming using Pointers
7	C Programming using user defined functions (Pass by value and Pass by reference)
8	C Programming using Recursion
9	C Programming using structures and union
10	C Programming using enumerated data types
11	C Programming using macros and storage classes
12	C Programming using Files
	TOTAL:45 PERIODS

OUTCOMES:

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

- Apply various problem solving techniques and represent solutions to problems in the form of algorithms and flow charts.
- Examine given problems, design solutions and write C programs using the constructs of C language.
- Apply the advanced constructs and string manipulation feature available in C programming language to solve problems.
- Demonstrate the use functions, structures and unions to create modularized applications in C language.
- Illustrate the dynamics of memory by the use of files and pointers.

REFERENCES:

1. Pradip Dey and Manas Ghosh, "Programming in C", First Edition, Oxford University Press, 2018.
2. Byron S Gottfried, "Programming with C", Schaum's Outlines, Third Edition, Tata McGraw-Hill, 2010.

LIST OF EQUIPMENTS FOR THE BATCH OF 30 STUDENTS:

S. No.	Description of Equipment	Qty
HARDWARE:		
1.	Computer	30
SOFTWARE:		
2.	Open Source Linux OS	30
3.	C compiler	30

EC18211	ELECTRON DEVICES AND ELECTRICAL MACHINES LABORATORY	L	T	P	C
		0	0	4	2

Objective

The student should be made to:

- Be exposed to the characteristics of basic electronic devices.
- Be exposed to study the behavior of various passive and active electronic components
- Be familiar with the working of diodes, transistors and their applications.

LIST OF EXPERIMENTS:

ELECTRON DEVICES	
1	Zener diode characteristics and regulator using zener diode
2	Common Emitter input-output Characteristics.
3	Common Base input-output Characteristics.
4	FET Characteristics.
5	SCR Characteristics
6	Characteristics of UJT
7	Characteristics of Photo-diode and Photo transistor.
	ELECTRICAL MACHINES
1	Load test on single-phase transformer
2	Load test on DC shunt motor
3	Speed Control of DC shunt motor
4	Load test on three-phase Induction motor
5	Load test on single phase Induction motor
	TOTAL:60 PERIODS

Note:Plotting of drawings must be made for each exercise and attached to the records written by students.

OUTCOMES:

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

- Explore the Characterstics of Zener Diode and Bipolar Junction Transistor.
- Examine the Characterstics of FET,UJT,SCR and Photo Transistor.
- Construct and Observe the Load Test on single-phase transformer.
- Construct and Observe the Load test and speed control of DC Shunt Motor.
- Examine the Load test of Single Phase and Three Phase Induction Motor.

LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS: (ELECTRON DEVICES)

1. BC107, BC148, 2N2646, BFW10 - 25 each
2. 1N4007, Zener diodes - 25 each
3. Resistors, Capacitors, Inductors - Sufficient quantities
4. Bread Boards - 15 Nos.
5. CRO (30MHz) - 10 Nos.
6. Function Generators (3MHz) - 10 Nos.
7. Multimeter - 10 Nos
8. Dual Regulated Power Supplies (0 – 30V) - 10 Nos.

LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS: (ELECTRICAL MACHINES)

1. DC Shunt Motor with Loading Arrangement --2 (3HP,220V,14A,750RPM,0.6A(Shunt field))
2. DC Shunt Motor - kW: 5.2 / volts: 220 / Amps: 27.5/ Speed: 1500 RPM/ Field current: 0.9A

3. Single Phase Transformer; 2 KVA, 230/110-166 V --1
4. Three Phase Induction Motor with Loading Arrangement --1 (3.7KW,415v,7.5A,1430 RPM)
5. Single Phase Induction Motor with Loading Arrangement --1 (230V, 5HP, 17A)
6. DC Shunt Motor Coupled with DC Compound Generator --1
7. Tachometer –Digital/Analog --8
8. Single Phase Auto Transformer (0-270)V --2
9. Three Phase Auto Transformer (0-270)V --1
10. MC Voltmeter-(0-300/600)V-- 5
11. MC Ammeter (0-10/20)A --5
12. MC Ammeter (0-2/1)A --4
13. MI Voltmeter (0-300/600)V --5
14. MI Ammeter (0-10/20)A --6
15. MI Ammeter (0-1/2)A --4
16. UPF Wattmeter (300/600V,10/20A) --4
17. LPF Wattmeter (300/600V,10/20A) --4
18. Single Phase Resistive Loading Bank(10KW) --2
19. Three Phase Resistive Loading Bank(10KW) --2
20. SPST switch --2
21. Fuse various ranges as per the requirement
22. Wires As per the requirement
23. Rheostats (100Ω,1A;250Ω,1.5A;75Ω,16A,1000Ω,1A) Each --2

SEMESTER III

MA18351	ENGINEERING MATHEMATICS III	L	T	P	C
	(Common to BT, CH, CE, EE, EC and ME)	3	1	0	4

OBJECTIVES:

- To introduce Fourier series analysis this is central to many applications in engineering apart from its uses in solving boundary value problems.
- To understand the basic concepts of the Fourier transform techniques and its application in Engineering.
- To introduce the effective mathematical tools for the solutions of partial differential equations that model several physical processes and to develop Z transform techniques for discrete time systems.

UNIT I	**PARTIAL DIFFERENTIAL EQUATIONS**	**9 + 3**

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

UNIT II	**FOURIER SERIES**	**9 + 3**

Dirichlet's conditions – General Fourier series – Odd and even functions – Half range sine series –Half range cosine series –Parseval's identity – Harmonic analysis

UNIT III	**APPLICATIONS OF PARTIAL DIFFERENTIAL EQUATIONS**	**9 + 3**

Classification of PDE – Method of separation of variables - Solution of one dimensional wave equation – One dimensional equation of heat conduction – Steady state solution of two dimensional equation of heat conduction (excluding insulated edges).

UNIT IV	**FOURIER TRANSFORMS**	**9 + 3**

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 + 3**

Z- transforms - Elementary properties – Inverse Z - transform (using partial fraction, long division method and residue technique) – Convolution theorem - Formation of difference equations – Solution of difference equations using Z - transform.

TOTAL: (L: 45 + T: 15): 60 PERIODS

OUTCOMES:

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

- Express proficiency in handling higher order Partial differential equations.
- Acquire the skill in examining a signal in another domain rather in the original domain by handling Full and Half Range Fourier Series.
- Develop skills in classification, formulation, solution, and interpretation of PDE models.
- Develops the skill of conversion between time domain to frequency domain using the concept of Fourier Transforms.
- Apply the systematic method for finding the impulse response of LTI systems described by difference equations: partial fraction expansion.

TEXT BOOKS:

1. Erwin Kreyszig, "Advanced Engineering Mathematics", 10th Edition, Wiley India, 2011.
2. Grewal. B.S., "Higher Engineering Mathematics", 42nd Edition, Khanna Publishers, Delhi, 2012.
3. Narayanan.S., Manicavachagom Pillay.T.K and Ramanaiah.G "Advanced Mathematics for Engineering Students" Vol. II & III, S.Viswanathan Publishers Pvt. Ltd.1998.

REFERENCES:

1. Bali.N.P and Manish Goyal, "A Textbook of Engineering Mathematics", 7th Edition, Laxmi Publications Pvt Ltd, 2007.
2. Glyn James, "Advanced Modern Engineering Mathematics", 4th Edition, Pearson Education, 2011.
3. Veerarajan. T., “Transforms and Partial Differential Equation”, Tata McGraw Hill Publishing Company Limited, New Delhi, 2012
4. Ray Wylie. C and Barrett.L.C, "Advanced Engineering Mathematics" Tata McGraw Hill Education Pvt Ltd, Sixth Edition, New Delhi, 2012.
5. Peter V.O’Neil, “Advanced Engineering Mathematics”, Cengage Learning India pvt. Ltd. 7th Edition, New Delhi, 2012.

EC18301	OBJECT ORIENTED PROGRAMMING AND DATA STRUCTURES	L	T	P	C
		3	1	0	4

OBJECTIVES:

- To comprehend the fundamentals of object oriented programming, particularly in C++.
- To use object oriented programming to implement data structures.
- To introduce linear, non-linear data structures and their applications.
- Learn to implement sorting and searching algorithms.

UNIT I	**DATA ABSTRACTION & OVERLOADING**	**9 + 3**

Overview of C++ – Structures – Class Scope and Accessing Class Members – Reference Variables – Initialization – Constructors – Destructors – Member Functions and Classes – Friend Function – Dynamic Memory Allocation – Static Class Members – Proxy Classes – Overloading: Function overloading and Operator Overloading.

UNIT II	**INHERITANCE & POLYMORPHISM**	**9 + 3**

Base Classes and Derived Classes – Protected Members – Casting Class pointers and Member Functions – Overriding – Public, Protected and Private Inheritance – Constructors and Destructors in derived Classes – Implicit Derived – Composition Vs. Inheritance – Virtual functions – This Pointer – Abstract Base Classes and Concrete Classes – Virtual Destructors – Dynamic Binding

UNIT III	**LINEAR DATA STRUCTURES**	**9 + 3**

Abstract Data Types (ADTs) – List ADT – array-based implementation – linked list implementation — singly linked lists –Polynomial Manipulation - Stack ADT – Evaluating arithmetic expressions- Queue ADT – Circular Queue implementation.

UNIT IV	**NON-LINEAR DATA STRUCTURES**	**9 + 3**

Trees – Binary Trees – Binary tree representation and traversals - The Search Tree ADT - Binary Search Trees- – Application of trees – Graph and its representations – Graph Traversals – Representation of Graphs – Breadth-first search – Depth-first search- Dijkstra's shortest path algorithm.

UNIT V	**SORTING and SEARCHING**	**9 + 3**

Sorting algorithms: Insertion sort - Quick sort - Merge sort - Searching: Linear search –Binary Search

TOTAL: (L: 45 + T: 15): 60 PERIODS

OUTCOMES:

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

- Explain the concepts of Object Oriented Programming.
- Implement abstract data types for linear data structures
- Implement abstract data types for non-linear data structures.
- Apply linear data structures to solve various problems.
- Discuss the different methods of organizing large amounts of data.

TEXT BOOKS:

1. Deitel and Deitel, "C++, How To Program", Tenth Edition, Pearson Education, 2017.
2. Mark Allen Weiss, "Data Structures and Algorithm Analysis in C++", 2nd Edition, Pearson

Education, 2017.

REFERENCES:

1. BhushanTrivedi, “Programming with ANSI C++, A Step-By-Step approach”, Oxford University Press, 2012.
2. Goodrich, Michael T., Roberto Tamassia, David Mount, “Data Structures and Algorithms in C++”, Second Edition, Wiley. 2011.
3. Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest and Clifford Stein, "Introduction to Algorithms", Third Edition, MIT Press, 2009.
4. BjarneStroustrup, “The C++ Programming Language”, 4th Edition, Pearson Education, 2018.
5. Ellis Horowitz, SartajSahni and Dinesh Mehta, “Fundamentals of Data Structures in C++”, Galgotia Publications, Second Edition,2008

EC18302	ELECTROMAGNETIC FIELDS AND WAVES	L	T	P	C
		3	1	0	4

OBJECTIVES:

- To introduce students with different coordinate systems and to understand the Theorem, Laws, Principle and their related problems over Static Electric Fields.
- To learn the basic laws in Static Magnetic Field and able to find various parameters with the related problems.
- To know how the Electric Field is applied in Dielectrics with various equations and applications and to understand how the Magnetic Field works with Ferromagnetic Materials.
- To analyze how the Time is Varying in both Electric and Magnetic Fields with various derivation.
- To understand and analyze the Electromagnetic Field distribution which forms the basis for advanced subjects related to Electromagnetic Field.

UNIT I	STATIC ELECTRIC FIELD	9 + 3

Introduction to Co-ordinate System-Rectangular-Cylindrical and Spherical Co-ordinate system-Introduction to line, Surface and Volume Integrals-Definition of Curl, Divergence and Gradient-Meaning of Strokes theorem and Divergence theorem.

Coulomb's Law in Vector Form – Definition of Electric field Intensity-Principle of Superposition-Electric field due to discrete charges-Electric field due to continuous charge distribution-Electric field due to charges distributed uniformly on an infinite and finite line-Electric Field on the axis of a uniformly charged circular disc-Electric Field due to an infinite uniformly charged sheet.

Electric Scalar Potential-Relationship between potential and electric field-Potential due to infinite uniformly charged line-Potential due to electrical dipole-Electric Flux Density-Gauss Law-Proof of Gauss Law-Applications.

UNIT II	STATIC MAGNETIC FIELD	9 + 3

The Biot-Savart Law in vector form-Magnetic Field intensity due to a finite and infinite wire carrying a current I-Magnetic field intensity on the axis of a circular and rectangular loop carrying a current I – Ampere's circuital law and simple applications.

Force on a wire carrying a current I placed in a magnetic field – Torque on a loop carrying a current I – Magnetic moment-Magnetic Vector Potential.

UNIT III	ELECTRIC AND MAGNETIC FIELDS IN MATERIALS	9 + 3

Poisson's and Laplace's equation-Electric Polarization-Definition of Capacitance –Capacitance of various geometries using Laplace's equation-Electrostatic energy and energy density-Boundary conditions for electric fields-Point form of ohm's law-Continuity equation for current.

Definition of Inductance-Inductance of loops and solenoids-Definition of mutual inductance-simple examples. Energy density in magnetic fields-magnetization and permeability-Magnetic boundary conditions.

UNIT IV	TIME VARYING ELECTRIC AND MAGNETIC FIELDS	9 + 3

Faraday's law – Maxwell's Second Equation in integral form from Faraday's Law – Equation expressed in point form.

Displacement current – Ampere's circuital law in integral form – Modified form of Ampere's circuital law as Maxwell's first equation in integral form – Equation expressed in point form – Maxwell's four equations in integral form and different form.

UNIT V	**ELECTROMAGNETIC WAVES**	**9 + 3**

Poynting Vector and the flow of power – Power flow in a co-axial cable – Instantaneous Average and Complex Poynting Vector. Derivation of Wave Equation-Uniform plane waves-Maxwell's equation in Phasor form-Wave equation in Phasor form-Plane waves in free space and in a homogenous material.Wave equation for a conducting medium-Plane waves in lossy dielectric-Propagation in good conductors-Skin effect.

TOTAL: (L: 45 + T: 15): 60 PERIODS

OUTCOMES:

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

- Apply different coordinate systems and vector calculus for understanding different concepts in electromagnetic Engineering
- Evaluate the physical quantities of electromagnetic fields in different media
- Design storage devices like capacitor, inductor used in electrical system and materials required to assemble energy storage devices.
- Justify concepts of electromagnetic waves means of transporting energy in the form of radio waves, TV signals, Radar beams
- Determine the electromagnetic force exerted on charged particles, current elements, working principle of various electric and electromagnetic energy conversion devices are based on this force.

TEXT BOOKS:

1. David K Cheng, "Field and Wave Electromagnetics", Pearson Education Inc, Delhi, 2004.
2. John D Kraus and Daniel A Fleisch, "Electromagnetics with Applications", McGraw Hill Book Co,2005.
3. W H.Hayt & J A Buck: "Engineering Electromagnetics" TATA McGraw-Hill, 7th Edition 2007.

REFERENCES:

1. E.C. Jordan &K.G.Balmain "Electromagnetic Waves and Radiating Systems." Prentice Hall of India 2nd edition 2003.
2. M.N.O. Sadiku: "Elements of Engineering Electromagnetics" Oxford University Press, Fourth edition, 2007.
3. Narayana Rao. N: "Engineering Electromagnetics" 4th edition, Prentice Hall of India, New Delhi, 2006.
4. Ramo, Whinnery and Van Duzer: "Fields and Waves in Communications Electronics" John Wiley & Sons (3rd edition 2003).
5. Electromagnetics Joseph Edminister - Schaum's Outline Series, TMH

EC18303	CIRCUIT THEORY	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To analyze any linear time invariant electrical network.
- To analyze the transient response of DC circuits.
- To understand the concept of resonance and coupled circuit
- To understand the concept two port networks.
- To introduce the network topology

UNIT I	**DC CIRCUIT ANALYSIS**	**9**

Basic Components of electric Circuits, Charge, current, Voltage and Power, Voltage and Current Sources, Review of Ohms Law, Kirchhoff 's Current Law, and Kirchhoff 's voltage law, The single Node – Pair Circuit, series and Parallel Connected, voltage and current division, Nodal analysis, Mesh analysis.

UNIT II	**SINUSOIDAL STEADY STATE ANALYSIS**	**9**

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

UNIT III	**RESONANCE AND COUPLED CIRCUITS**	**9**

Series and parallel resonance – frequency response – Quality factor and Bandwidth – Coupled Circuits: Self and Mutual inductance – Coefficient of coupling – Linear Transformer – Ideal Transformer - Tuned circuits – Single tuned circuits.

UNIT IV	**TRANSIENT ANALYSIS AND TWO PORT NETWORKS**	**9**

Transient response of RL, RC and RLC Circuits using Laplace transform for DC and AC input – Characterization of two port networks in terms of Z, Y, ABCD and h parameters.

UNIT V	**NETWORK TOPOLOGY**	**9**

Introduction, Trees and Co-Tree, Twigs and Links, Incidence Matrix (A), Properties of Incidence Matrix A, Link Currents: Tie-set Matrix, Cut-set and Tree Branch Voltages, Mesh Analysis, Nodal Analysis.

TOTAL: 45 PERIODS

OUTCOMES:

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

- Determine the characteristics of electrical circuits by applying circuit laws.
- Compare the phasor diagram of R, L and C and analyze the AC circuit power.
- Infer the phenomenon of series and parallel resonance in electrical circuits and understand the effect of magnetic coupling between windings.
- Compare the characteristics of RC, RL and RLC circuits for AC and DC inputs and evaluate the two port network parameters.
- Sketch the various network topologies.

TEXT BOOKS:

1. A William Hayt, "Engineering Circuit Analysis" 8th Edition, McGraw-Hill Education

2. Sudhakar, A., Shyammohan, S. P.; “Circuits and Networks”; Tata McGraw-Hill New Delhi, 2015.

REFERENCES:

1. Kuo, Network Analysis & Synthesis, Wiley (2006),
2. Van, Valkenburg.; “Network analysis”; Prentice Hall of India, 2000.
3. Joseph A. Edminister, Mahmood Nahri, “Electric circuits”, Schaum s series, Tata McGraw-Hill, New Delhi, 2001.

EC18304	DIGITAL SYSTEM DESIGN	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 electronic circuits involved in the making of logic gates
- To introduce the concept of memories and programmable logic devices
- To illustrate the concept of synchronous and asynchronous sequential circuits

UNIT I	**MINIMIZATION TECHNIQUES AND LOGIC GATES**	**9**

Number Systems: Binary, Signed Binary, Octal, Hexadecimal, 8421 Codes, 2421 Codes, Excess-3 Codes, Binary Arithmetic, one's and two's complements arithmetic, Boolean postulates and laws – De-Morgan's Theorem - Principle of Duality - Boolean expression - Minimization of Boolean expressions — Minterm – Maxterm - Sum of Products (SOP) – Product of Sums (POS) – Karnaugh Map Minimization – Don't care conditions – Quine - McCluskey method of minimization - Logic Gates - Implementation of Logic Functions using gates, NAND–NOR implementation

UNIT II	**COMBINATIONAL CIRCUITS**	**9**

Design procedure – Half adder – Full Adder – Half subtractor – Full subtractor – Binary Parallel adder – Binary Parallel subtractor - Binary Parallel Adder/Subtractor – Carry Look Ahead adder – BCD adder – Binary Multiplier – Multiplexer/ Demultiplexer – Decoder /Encoder – BCD to 7-segment decoder – Parity checker – Parity generator - Magnitude Comparator

UNIT III	**SEQUENTIAL CIRCUITS**	**9**

Latches - Flip-flops - SR, JK, D, T, and Master-Slave FF – Characteristic table and equation - Realization of one flip flop using other flip flops – Ripple (Asynchronous) Counters, Modulo-n counters, Ring Counter, Johnson Counter, Synchronous Counters, - Shift registers, Universal Shift Register - Moore / Mealy models - Design of Synchronous Sequential Circuits, Sequence Detector

UNIT IV	**LOGIC FAMILIES AND SEMICONDUCTOR MEMORIES**	**9**

Logic families: TTL, CMOS – Comparison of Logic families - Tristate gates - Classification of memories – ROM: PROM, EPROM, EEPROM – RAM: Static and Dynamic RAM Cell –Memory decoding - Programmable Logic Devices (PLD) – Programmable Logic Array (PLA) - Programmable Array Logic (PAL) – Implementation of Combinational logic circuits using ROM, PLA, PAL

UNIT V	**ASYNCHRONOUS SEQUENTIAL CIRCUITS**	**9**

Asynchronous Sequential Circuits: Design of fundamental mode circuits – Incompletely specified State Machines – Problems encountered in Asynchronous Circuits: Cycles and Races, State Reduction, Race free assignments, Hazards, Essential Hazards - Design of Hazard free circuits – Introduction to HDL, Design of simple Combinational and Sequential circuits using Verilog Hardware Description Language.

TOTAL: 45 PERIODS

OUTCOMES:

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

- Examine different methods used for simplification of Boolean expressions

- Design various Combinational circuits using logic gates
- Investigate and design synchronous and asynchronous sequential circuits
- Design a RAM, ROM, PAL and PLA devices
- Develop and program simple HDL codes for digital circuits.

TEXT BOOKS:

1. M. Morris Mano, “Digital Design”, 4th Edition, Prentice Hall of India Pvt. Ltd., 2008 / Pearson Education (Singapore) Pvt. Ltd., New Delhi, 2003.
2. Charles H.Roth. “Fundamentals of Logic Design”, 6th Edition, Thomson Learning, 2013.

REFERENCES:

1. Donald P.Leach and Albert Paul Malvino, “Digital Principles and Applications”, 6th Edition, TMH, 2006.
2. Donald D.Givone, “Digital Principles and Design”, TMH, 2003.
3. John F.Wakerly, “Digital Design”, Fourth Edition, Pearson/PHI, 2008
4. John.M Yarbrough, “Digital Logic Applications and Design”, Thomson Learning, 2006.
5. Thomas L. Floyd, “Digital Fundamentals”, 10th Edition, Pearson Education Inc, 2011

EC18305	ELECTRONIC CIRCUITS	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To understand the operation, design and Analysis of low and high frequency amplifiers.
- To analyze feedback amplifiers.
- To analyze and design the frequency of oscillators.
- To explain the operation of power amplifiers.
- To understand the analysis of tuned circuits and its stability.

UNIT I	**BIASING AND SMALL SIGNAL ANALYSIS OF AMPLIFIERS**	**9**

DC Load line, Operating point, Various Biasing Methods for BJT-Design and Stability factors-Bias Compensation, Thermal Stability, Small signal Analysis of Common Emitter amplifiers. Cascaded stages - Cascode Amplifier.

UNIT II	**HIGH FREQUENCY ANALYSIS AND POWER AMPLIFIERS**	**9**

Miller effect, High frequency Analysis of CE Amplifier. Short Circuit Current gain, Cut off frequency –fβ, fT Determination of Bandwidth of Single Stage and Multistage Amplifiers. Large Signal Amplifiers- Class A, Class B, Class AB, Class C.

UNIT III	**FEEDBACK AMPLIFIERS**	**9**

Concept of feedback Amplifiers, General characteristics of negative feedback amplifiers, Effect of Feedback on Amplifier characteristics, Voltage series, voltage shunt, Current series and current shunt Feedback configurations.

UNIT IV	**OSCILLATORS**	**9**

Conditions for oscillations, Frequency and Amplitude Stability of Oscillators, Generalized analysis of LC Oscillators, Quartz, Hartley, Colpitt's, RC–phase shift and Wein Bridge oscillators.

UNIT V	**TUNED AMPLIFIERS:**	**9**

Small signal tuned amplifiers – Analysis of capacitor coupled single tuned amplifier – double tuned amplifier – Stagger tuned amplifiers – Stability of tuned amplifiers – Neutralization – Hazeltine neutralization method

TOTAL: 45 PERIODS

OUTCOMES:

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

- Apply the knowledge of BJT to design practical amplifier circuits.
- Analyze high frequency effect on CE amplifier and design power amplifiers.
- Design a feedback amplifier to improve amplifier performance.
- Understand the operation of oscillator circuit.
- Analyze the application of tuned amplifiers.

TEXT BOOKS:

1. David A. Bell, Solid state Pulse Circuits, PHI, 4th Edition 2007.
2. Robert L Boylestead and Louis Nashelsky, "Electronic Devices and circuit theory", Pearson, Tenth edition 2009.
3. Sedra and Smith, "Micro Electronic Circuits"; Sixth Edition, Oxford University Press, 2011.

REFERENCES:

1. Millman and Halkias. C., Integrated Electronics, TMH, 2007.
2. S.Salivahanan, N. Suresh Kumar and A. Vallava Raj, “Electronic Devices and circuits”, TMH, 2nd Edition 2008.
3. Spencer R. R. and M. S. Ghausi, Introduction to Electronic Circuit Design, Pearson, 2003,
4. Schilling and Belove, Electronic Circuits, 3rd Edition, TMH, 2002.

EC18311	ANALOG AND DIGITAL CIRCUITS LABORATORY	L	T	P	C
		0	0	3	1.5

OBJECTIVES:

Analog

- To study the characteristic of CE, CB and CC Amplifier
- To learn the fundamental principles of amplifier circuits
- To differentiate feedback amplifiers and oscillators.
- To perform SPICE simulation of Electronic Circuits

Digital

- To understand the functionality of combinational and sequential circuits
- To learn hardware implementation and functional verification of digital circuits

ANALOG CIRCUITS

1. Frequency Response of CE amplifier
2. Series and Shunt feedback amplifiers-Frequency response.
3. Single Tuned Amplifiers
4. RC Phase Shift Oscillator
5. Colpitts Oscillator
6. Class A Power amplifier
7. SPICE Simulation of Common Emitter Amplifier.

DIGITAL CIRCUITS

1. Implementation of Boolean expression using universal gates
2. Implementation of
    a. Full adder / Full subtractor using two half adder / half subtractors.
    b. Implementation of BCD adder using IC 7483
3. Implementation of Decoder and 2-bit Magnitude comparator using logic gates
4. Implementation of
    a. Multiplexer using logic gates
    b. Boolean expression using MUX
5. Truth table verification of JK, T, and D Flip Flops and Conversion of one FF to other FF
6. Implementation of BCD counter (Synchronous and Asynchronous) with seven segment display.
7. Data transfer using shift registers.

Note:Plotting of drawings must be made for each exercise and attached to the records written by students.

TOTAL: 45 PERIODS

OUTCOMES:

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

- Analyze the limitation in bandwidth of various amplifiers
- Analyze various types of feedback amplifiers.
- Design oscillators and tuned amplifiers
- Simulate feedback amplifiers, oscillators, tuned amplifier using SPICE
- Design, implement and verify the functionality any Combinational and Sequential Digital logic circuits for handling real life projects.

LIST OF EQUIPMENTS FOR A BATCH OF 30 STUDENTS:

Equipments for Analog Lab	
CRO (Min 30MHz)	15 Nos
Signal Generator /Function Generators (2 MHz)	15 Nos

Dual Regulated Power Supplies (0 – 30V)	15 Nos
Digital Multimeter	15 Nos
Digital LCR Meter	2 Nos
Standalone desktops PC	15 Nos
Transistor/FET (BJT-NPN-PNP and NMOS/PMOS)	50 Nos
SPICE Circuit Simulation Software	15
Equipments for Digital Lab	
IC Trainer Kit	15 Nos
Bread Boards	15 Nos
Multimeter	15 Nos
CRO (30MHz)	3 Nos
ICs 7400/ 7402 / 7404 / 7486 / 7408 / 7432 / 7483 / 74150 /74151 / 74147 / 7445 / 7476/7491/ 555 / 7494 / 7447 / 74180 / 7485 / 7473 / 74138 / 7411 / 7474	Each 25 Nos

EC18312	OBJECT ORIENTED PROGRAMMING AND DATA STRUCTURES LABORATORY	L	T	P	C
		0	0	3	1.5

OBJECTIVES:

- Be familiar with C++ programming language.
- Learn to implement linear and non linear data structures.
- To implement various applications using different data structures.
- Learn to implement sorting and searching algorithms.

LIST OF EXPERIMENTS:

1. Basic Programs for C++ Concepts
   i) Prime Number Generation
   ii) Leap Year Checking
   iii) Factorial with and without Recursion
   iv) Swapping of two numbers using pointers.
   v) Find length of the string without using library function.
   vi) Bank Account using structures.
   vii) Function overloading
   viii) Static data member and member Function.
   ix) Friend Functions.
   x) Area and perimeter of a circle using class.
2. Array implementation of List Abstract Data Type (ADT)
3. Linked list implementation of List ADT
4. Cursor implementation of List ADT
5. Stack ADT - Array and linked list implementations
6. The next two exercises are to be done by implementing the following source files
   i. Program source files for Stack Application 1
   ii. Array implementation of Stack ADT
   iii. Linked list implementation of Stack ADT
   iv. Program source files for Stack Application 2
   v. An appropriate header file for the Stack ADT should be included in (i) and (iv)
7. Implement any Stack Application using array implementation of Stack ADT (by implementing files (i) and (ii) given above) and then using linked list
8. Implementation of Stack ADT (by using files (i) and implementing file (iii))
9. Implement another Stack Application using array and linked list implementations of Stack ADT (by implementing files (iv) and using file (ii), and then by using files (iv) and (iii))
10. Queue ADT – Array and linked list implementations
11. Search Tree ADT - Binary Search Tree
12. Implement an interesting application as separate source files and using any of the searchable ADT files developed earlier. Replace the ADT file alone with other appropriate ADT files. Compare the performance.
13. Implementation of Linear Search and Binary Search.
14. Quick Sort

TOTAL: 45 PERIODS

OUTCOMES:

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

- Design and implement C++ programs for implementing linked lists.

- Design and implement C++ programs for implementing stacks, and queues.
- Apply good programming design methods for program development.
- Apply different data structures for solving real world problems.
- Develop sorting and searching programs.

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.

SEMESTER IV

MA18454	PROBABILITY AND RANDOM PROCESSES	L	T	P	C
		3	1	0	4

OBJECTIVES:

- To provide the required Mathematical support in real life problems and develop probabilistic models. This can be used in several areas of science and engineering.
- To acquire skills in handling situations involving more than one random variable and functions of random variables.
- To Understand and characterize phenomena which evolve with respect to time in Probabilistic manner.
- To understand the relationship within and between random processes.
- To analyze the response of random inputs to linear time invariant systems.

UNIT I	**RANDOM VARIABLES**	**9 + 3**

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

UNIT II	**TWO - DIMENSIONAL RANDOM VARIABLES**	**9 + 3**

Joint distributions – Marginal and conditional distributions – Covariance – Correlation and Linear regression – Central limit theorem- Transformation of random variables.

UNIT III	**RANDOM PROCESSES**	**9 + 3**

Classification – Stationary process – Poisson process – Gaussian process-Random telegraph process

UNIT IV	**CORRELATIONAND SPECTRAL DENSITIES**	**9 + 3**

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

UNIT V	**LINEAR SYSTEM WITH RANDOM INPUTS**	**9 + 3**

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

TOTAL: (L:45 + T:15): 60 PERIODS

OUTCOMES:

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

- Reproduce and explain the basic concepts such as probability and random variable and identify the distribution
- Acquire skills in handling situations involving more than one random variable
- Study the characterize phenomena with respect to time in probabilistic manner
- Apply the relationship within and between random processes
- Apply the response of random inputs to linear time invariant systems.

TEXT BOOKS:

1. Ibe. O.C., "Fundamentals of Applied Probability and Random Processes", Elsevier, 1st IndianReprint, 2007.
2. Peebles Jr. P.Z., “Probability Random Variables and Random Signal Principles”, Tata McGraw-Hill Publishers, Fourth Edition, New Delhi, 2002.

REFERENCES:

1. Robertazzi, "Computer Networks and Systems: Queueing Theory and performance evaluation", Springer, 3rd Edition, 2006.
2. Taha. H.A., "Operations Research", Pearson Education, Asia, 8th Edition, 2007.
3. Trivedi.K.S., "Probability and Statistics with Reliability, Queueing and Computer Science Applications", John Wiley and Sons, 2nd Edition, 2002.43
4. H.Hwei Hsu, "Schaum's Outline of Theory and Problems of Probability, Random Variables and Random Processes", Tata McGraw Hill Edition, New Delhi, 2004.
5. Yates. R.D. and Goodman. D. J., "Probability and Stochastic Processes", Wiley India Pvt. Ltd.
6. Veerarajan T., Probability, Statistics and Random processes, Tata McGraw-Hill Education Private Limited, Fifth Edition, New Delhi,2008

EC18401	ANALOG COMMUNICATION SYSTEMS	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To introduce the relevance of this course to the existing technology through demonstrations, case studies, simulations, contributions of scientist, national/international policies with a futuristic vision along with socio-economic impact and issues.
- To introduce the concepts of various modulations and their spectral characteristics.
- To introduce random processes, their characteristics and significance
- To understand the impact of noise on different modulations and communication systems
- To introduce some of the essential baseband signal processing techniques.

UNIT I	**AMPLITUDE MODULATION**	**9**

Review of Fourier and Hilbert Transforms-Amplitude Modulation – AM, DSBSC, SSBSC, VSB– Spectral analysis of modulated signals–Demodulation – Square law, envelope detectors Superheterodyne receivers

UNIT II	**ANGLE MODULATION**	**9**

Angle modulation – PM and FM – Narrow band, Wideband FM - Spectral analysis of modulated signal – FM Modulators and FM Demodulators – Discriminator, PLL

UNIT III	**RANDOM PROCESS**	**9**

Random variables, Central limit Theorem, 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 PERFORMANCE**	**9**

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

UNIT V	**BASEBAND TECHNIQUES**	**9**

Quantization – Uniform and non-uniform quantization – Quantization noise – Companding laws of speech signals – PCM, DPCM, ADPCM, DM, ADM (Block Diagram Approach) and Sub-band Coding. Multiplexing– TDM, FDM

TOTAL: 45 PERIODS

OUTCOMES:

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

- Comprehend and appreciate the significance and role of this course in the present contemporary world.
- Acquire the knowledge on different modulation techniques.
- Investigate the effect of noise and its performance in different communication systems.
- Explore and appreciate the significance of the different baseband signal processing techniques in communication systems.
- Understand the role of random process in communication systems.

TEXT BOOKS:

1. D.Roody, J.Coolen, “Electronic Communications”, 4th edition PHI 2006.

2. S.Haykin, “Communication Systems” 4th edition, John Wiley 2007.

REFERENCES:

1. B.P.Lathi, “Modern Digital and Analog Communication Systems”, 3rd Edition, Oxford University Press, 2007.
2. B.Sklar, “Digital Communications Fundamentals and Applications” 2nd Edition Pearson Education 2007.
3. Couch.L., "Modern Communication Systems", Pearson, 2001. J.G.Proakis, M.Salehi, “Fundamentals of Communication Systems”, Pearson Education 2006.
4. H P Hsu, Schaum Outline Series, “Analog and Digital Communications”, TMH 2006.

EC18402	SIGNALS AND SYSTEMS	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To understand the basic properties of signal & systems and the various methods of classification
- To learn Laplace Transform & Fourier transform and their properties
- To know Z transform & DTFT and their properties
- To understand the causality and stability of LTI-CT system.
- To study the causality and stability of LTI-DT system.

UNIT I	**CLASSIFICATION OF SIGNALS AND SYSTEMS**	**9**

Introduction: Continuous time signals (CT signals)-Discrete time signals (DT signals)-Elementary signals-Step, Ramp, Pulse, Impulse, Sinusoidal, Exponential- Basic operations on signals-Classification of CT and DT signals - Periodic & Aperiodic signals, Deterministic & Random signals, Energy & Power signals.

Introduction: Concept of system-CT systems and DT systems-Classification of systems – Static & Dynamic, Linear & Nonlinear, Time-variant & Time-invariant, Causal & Non causal, Stable & Unstable.

UNIT II	**ANALYSIS OF CONTINUOUS TIME SIGNALS**	**9**

Representation of CT aperiodic signals by Continuous Time Fourier Transform (CTFT) – Convergence of CTFT – Fourier transform for CT periodic signals - Properties of CTFT:Linearity,Symmetry,Timeshifting,Parseval'stheorem,convolution in time domain, Laplace Transforms in CT Signal Analysis –Properties of Laplace transform: Linearity, Symmetry, Time shifting, Time scaling, Initial and final value theorem, convolution in time domain -Region of Convergence for Laplace Transform - Inverse Laplace Transform-Unilateral and Bilateral Laplace Transforms

UNIT III	**LINEAR TIME INVARIANT- CONTINUOUS TIME SYSTEMS**	**9**

Differential Equation-Block diagram representation-impulse response- convolution integrals-Fourier and Laplace transforms in analysis of CT systems -relation between transfer function and differential equation-Stability and causality analysis - Frequency response of LTI systems, computation of impulse response and transfer function using Fourier and Laplace transform.

UNIT IV	**ANALYSIS OF DISCRETE TIME SIGNALS**	**9**

Baseband Sampling: Representation of CT signal by samples – Reconstruction of CT signal from samples - Effect of under sampling – Aliasing. Fourier transform of D.T signals (DTFT)-Properties of DTFT: Linearity, Periodicity, Symmetry, Time shifting, Frequency shifting, Time scaling, convolution in time domain, Z-Transform – Properties of z-transform: Linearity, symmetry, Time reversal, Time scaling, Time shifting, Differentiation in time domain, convolution – Inverse z-transform – Long division, Partial fraction and Cauchy's residue Methods – Region of Convergence-Relationship between DTFT and Z transform.

UNIT V	**LINEAR TIME INVARIANT-DISCRETE TIME SYSTEMS**	**9**

LTI-DT systems – Characterization using difference equation – convolution sum and its properties-Interconnection of LTI Systems –Analysis of LTI discrete time systems using DTFT and Z transform-Stability and Causality analysis-Computation of Impulse response and Transfer

function-Analysis of Recursive & Non-Recursive systems.

TOTAL: 45 PERIODS

OUTCOMES:

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

- Classify signals and systems based on their properties.
- Infer the spectral characteristics of continuous time signals by applying Fourier and Laplace transform.
- Use the principles of Fourier transform and Z transform to analyze the characteristics of discrete time signals
- Determine the response of continuous and discrete time LTI systems
- Illustrate the process of sampling and the effects of under and over sampling

TEXT BOOKS:

1. Alan V Oppenheim, Alan S Wilsky, and S Hamid Nawab, "Signals and Systems", PHI Learning Private Limited, New Delhi, 2010.
2. B. P. Lathi, "Principles of Linear Systems and Signals", Second Edition, Oxford, 2009.

REFERENCES:

1. John Alan Stuller, "An Introduction to Signals and Systems", Thomson, 2007
2. M.J.Roberts, "Signals & Systems Analysis using Transform Methods & MATLAB", Tata McGraw Hill, 2012.
3. R.E.Zeimer, W.H.Tranter and R.D.Fannin, "Signals & Systems - Continuous and Discrete",Pearson, 2014.

EC18403	ANALOG INTEGRATED CIRCUITS AND ITS APPLICATIONS	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To introduce the basic building blocks of linear integrated circuits
- To learn the linear and non-linear applications of operational amplifiers
- To introduce the theory and applications ofanalog multipliers and PLL
- To understand the concepts of waveform generation.
- To study various special function ICs

UNIT I	**BASICS OF OPERATIONAL AMPLIFIERS**	**9**

General operational amplifier stages -BJT Differential amplifier analysis-Concept of CMRR –methods to improve CMRR-Current mirror and Current sources, Current sources as active loads-IC 741-Ideal Operational Amplifier - DC and AC performance characteristics, slew rate, Open and Closed loop configurations of Op-amp-Inverting, Non inverting and Differential amplifiers-Voltage Follower.

UNIT II	**APPLICATIONS OF OPERATIONAL AMPLIFIERS**	**9**

Linear and Nonlinear Circuits using operational amplifiers and their analysis, Inverting and Noninverting Amplifiers, Differentiator, Integrator, Voltage to Current converter, Instrumentation amplifier, Sine wave Oscillators, Low pass and band pass filters, Comparator, Multivibrators, Schmitt trigger, Triangle wave generator, Precision rectifier, Log and Antilog amplifiers, Non-linear function generator.

UNIT III	**ANALOG TO DIGITAL AND DIGITAL TO ANALOG CONVERTERS**	**9**

High speed sample and hold circuit and IC‘s, Types of D/A converter-Weighted Resistor,R-2R Current driven DAC, Switches for DAC, A/D converter - Flash, Single slope, Dual slope, Successive approximation, Voltage to Time and Voltage to Frequency converters

UNIT IV	**ANALOG MULTIPLIER AND PLL**	**9**

Analog Multiplier using Emitter Coupled Transistor Pair - Gilbert Multiplier cell - Variable transconductance technique, analog multiplier ICs and their applications, Voltage Controlled Oscillator, Operation of the basic PLL, Closed loop analysis of PLL, Monolithic PLL IC 565, Applications of PLL-Frequency synthesizing.

UNIT V	**SPECIAL FUNCTION ICS**	**9**

555 Timer, Voltage regulators - linear and switched mode types, Switched capacitor filter, SMPS, features of TPS40200, TPS40210 buck and boost converters, Frequency to Voltage converters, Isolation Amplifiers, Video amplifiers, Fiber optics ICs and Opto couplers, Sources for Noises, Op Amp noise analysis and Low noise OP- Amps.

TOTAL: 45 PERIODS

OUTCOMES:

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

- Infer the DC and AC characteristics of operational amplifiers and its effect on output and their compensation techniques.
- Elucidate and design the linear and non-linear applications of an opamp and special application Ics.

- Classify and comprehend the working principle of data converters.
- Illustrate the function of application specific ICs such as Analog multiplier,PLL and its application in communication.
- Explain the working of multivibrators using IC 555,the special function ICs such as Voltage regulators,

TEXT BOOKS:

1. D.Roy Choudhry, Shail Jain, ―Linear Integrated Circuits‖, New Age International Pvt. Ltd., 2018, Fifth Edition.
2. Sergio Franco, ―Design with Operational Amplifiers and Analog Integrated Circuits‖, 4th Edition, Tata McGraw-Hill, 2016.

REFERENCES:

1. B.S.Sonde, ―System design using Integrated Circuits‖ , 2nd Edition, New Age Pub, 2001.
2. Robert F.Coughlin, Frederick F.Driscoll, ―Operational Amplifiers and Linear Integrated Circuits‖, Sixth Edition, PHI, 2001.
3. Gray and Meyer, ―Analysis and Design of Analog Integrated Circuits‖, Wiley International, 5th Edition,2009.
4. Michael Jacob, "Applications and Design with Analog Integrated Circuits", Prentice Hall of India, 1996.
5. Ramakant A. Gayakwad, ―OP-AMP and Linear ICs‖, 4th Edition, Prentice Hall / Pearson Education, 2015.
6. William D.Stanley, ―Operational Amplifiers with Linear Integrated Circuits‖, Pearson Education, 4th Edition, 2001.

EC18404	LINEAR CONTROL SYSTEMS	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To introduce the elements of control system and various representations.
- To provide knowledge on the time response and stability of systems
- To introduce the various frequency response plots and analyze the stability of systems.
- To introduce state variable representation of physical systems and study the effect of state feedback.
- To design various types of compensators.

UNIT I	**CONTROL SYSTEM MODELING & SYSTEM REPRESENTATION**	**9**

Basic Elements of Control System – Open loop and Closed loop systems - Differential equation -Transfer function, Modeling of Electric systems, Translational and Rotational mechanical systems – Transfer function – AC & DC Servomotor and Synchros -Block diagram reduction Techniques - Signal flow graph.

UNIT II	**TIME RESPONSE AND STABILITY ANALYSIS**	**9**

Time response analysis - First Order Systems - Impulse and Step Response analysis of Second order systems - Steady state errors- Concepts of Stability-Routh-Hurwitz Criterion-Root Locus Technique- Application of Root Locus Diagram- Relative Stability.

UNIT III	**FREQUENCY RESPONSE AND STABILITY ANALYSIS**	**9**

Frequency response – Frequency domain specifications - Correlation between frequency domain and time domain specifications – Stability analysis - Bode plot – Polar plot - Nyquist Stability criterion.

UNIT IV	**STATE VARIABLE ANALYSIS**	**9**

State space representation of Continuous Time systems – State equations – Transfer function from State Variable Representation – Solutions of the state equations - Concepts of Controllability and Observability.

UNIT V	**COMPENSATOR DESIGN**	**9**

Compensators - Effect of adding poles and zeros - Lag, lead and lag-lead compensators design using Bode plot – Design of State feedback controller - P, PI, PD and PID Controller.

TOTAL: 45 PERIODS

OUTCOMES:

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

- Represent the mathematical model of control systems.
- Determine the time domain characteristics of control systems using various techniques.
- Determine the frequency domain characteristics of control systems using various plots.
- Sketch the representation of control systems in state space and their characteristics.
- Design compensators to satisfy the desired specifications of control systems.

TEXT BOOKS:

1. Nagarath I.J. and Gopal M., “Control Systems Engineering”, New Age International Publishers, 2017

2. Norman S Nise, “Control Systems Engineering”, 7th Edition, Wiley, 2015
3. Benjamin C. Kuo, “Automatic Control systems”, Wiley, 2014

REFERENCES:

1. M. Gopal, “Control Systems, Principles and Design”, 4th Edition, Tata McGraw Hill, New Delhi, 2012.
2. S.K.Bhattacharya, “Control System Engineering”, 3rd Edition, Pearson, 2013.
3. Richard C. Dorf and Robert H. Bishop, “Modern Control Systems”, Prentice Hall, 2012.
4. K. Ogata, “Modern Control Engineering”, 5th edition, PHI, 2012.
5. NPTEL Online Courses on “Control Engineering” and “Digital Control Systems”.

EC18405	MICROPROCESSOR AND MICROCONTROLLER BASED SYSTEM DESIGN	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To study the Architecture, assembly language programming of 8085, 8086 microprocessors
- To learn the system bus structure of 8086 microprocessors.
- To learn the design aspects of peripherals and its interfacing.
- To study the architecture and assembly language programming of 8051 microcontroller
- To design and implement interfacing units with 8051 microcontroller based systems.

UNIT I	**THE 8086 MICROPROCESSOR**	**9**

Overview of 8085 Microprocessor Architecture - Introduction to 8086 Microprocessor - Architecture – Addressing modes - Instruction set and assembler directives – Assembly language programming - Stacks - Procedures – Macros – Interrupts and interrupt service routines – Byte and String Manipulation.

UNIT II	**8086 SYSTEM BUS STRUCTURE**	**9**

8086 signals – Basic configurations – System bus timing –System design using 8086 – I/O programming – Introduction to Multiprogramming – System Bus Structure – Multiprocessor configurations – Coprocessor - Closely coupled and loosely Coupled configurations

UNIT III	**PERIPHERALS AND INTERFACING**	**9**

Programmable Peripheral Interface (8255), Keyboard display controller (8279), ADC and DAC Interface, Programmable Timer Controller (8254), Programmable interrupt controller (8259), Serial Communication Interface (8251).

UNIT IV	**MICROCONTROLLER**	**9**

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

UNIT V	**MICROCONTROLLER BASED SYSTEM DESIGN**	**9**

Interfacing matrix display, (16x2) LCD, High power devices, Optical motor shaft encoder, Stepper Motor, DC Motor speed Control using PWM, RTC and EEPROM interface using I2C protocol

TOTAL: 45 PERIODS

OUTCOMES:

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

- Develop programs in 8086 microprocessor by understanding its architecture, instruction set and interrupt process.
- Sketch the system bus structure of 8086 and multiprocessor configurations.
- Design I/O and Memory interfacing units.
- Develop programs in 8051 microcontroller by understanding its architecture and instruction set.
- Design various interfacing units with 8051 microcontroller based systems.

TEXT BOOKS:

1. A.K. Ray, K.M. Bhurchandi, - Advanced Microprocessor and Peripherals, Second edition, Tata McGraw-Hill, 2010.
2. Yu-Cheng Liu, Glenn A.Gibson, ―Microcomputer Systems: The 8086 / 8088 Family - Architecture, Programming and Design‖, Second Edition, Prentice Hall of India, 2007.
3. Muhammad Ali Mazidi, Janice GillispieMazidi and Rolin D. McKinley, "The 8051 Microcontroller and Embedded Systems", Second Edition, Pearson Education 2008. Fifth impression 2011

REFERENCES:

1. Ramesh S. Gaonkar, "Microprocessor Architecture, Programming and Applications with 8085". Sixth edition, Penram International Publishing 2012.
2. Douglas V. Hall, "Microprocessor and Interfacing, Programming and Hardware". Revised second Edition 2006, eleventh reprint 2010.Tata McGraw Hill.
3. Krishna Kant, “Microprocessor and Microcontroller Architecture, programming and system design using 8085, 8086, 8051 and 8096, PHI, 2007, Seventh Reprint, 2011.
4. Kenneth J. Ayala., “The 8051 Microcontroller, 3rd Edition, Thompson Delmar Learning, 2012.
5. Barry B. Brey, “The Intel Microprocessors Architecture, Programming and Interfacing”, Pearson Education, 2007. Second impression 2010.

EC18411	ANALOG INTEGRATED CIRCUITS AND SIMULATION LABORATORY	L	T	P	C
		0	0	3	1.5

OBJECTIVES:

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

LIST OF EXPERIMENTS:

1. Design of inverting and non-inverting amplifier using Op-amp.
2. Design of integrator and differentiator using Op-amp.
3. Design of Differential amplifier using Op-amp.
4. Design of instrumentation amplifier using Op-amp.
5. Design of active low-pass, high-pass and band-pass filters using Op-amp.
6. Design of Astable and Monostable multivibrators using Op-amp.
7. Design of Schmitt Trigger using Op-amp.
8. Design of RC phase shift and Wien Bridge Oscillator Using Op-amp.
9. Applications of NE555 Timer.
10. PLL characteristics and its use as Frequency Multiplier.
11. DC power supply design using LM317 and LM723.
12. Simulation of experiments 3,4,5,6,7,8 using PSPICE.

Note: Plotting of drawings must be made for each exercise and attached to the records written by students.

TOTAL: 45 PERIODS

OUTCOMES:

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

- Develop a various linear and non linear applications using Operational Amplifier.
- Construct Astable and Monostable Multivibrator using NE555 Timer.
- Examine the Characteristics and applications of PLL.
- Design DC Power supply using LM317 and LM723.
- Simulate and Validate the results of various operational amplifier applications using PSPICE

LIST OF EQUIPMENTS FOR A BATCH OF 30 STUDENTS:	
1. CRO (Min 30MHz)	15 Nos.
2. Signal Generator /Function Generators (2 MHz)	15 Nos.
3. Dual Regulated Power Supplies (0 – 30V)	15 Nos.
4. Digital Multimeter	15 Nos.
5. IC tester	5 Nos.
6. Standalone desktops PC	15 Nos.
7. SPICE Circuit Simulation Software: (any public domain or commercial software)	15
8. Components and Accessories: Op-Amps, Resistors, Capacitors, diodes, Zener diodes, Bread Boards, Transformers, wires, Power transistors, Potentiometer, LEDs.	
9. Op-Amps uA741, LM 301, LM311, LM 324, LM317, LM723, 7805, 7812, 2N3524, 2N3525, 2N3391, AD 633, LM 555, LM 565	

EC18412	MICROPROCESSOR AND MICROCONTROLLER BASED SYSTEM DESIGN LABORATORY	L	T	P	C
		0	0	3	1.5

OBJECTIVES:

- To write Assembly Language Program for arithmetic and logical operations in 8085 and 8086.
- To write Assembly Language Program for arithmetic and logical operations in 8051.
- To understand string manipulation instruction using 8086.
- To understand various peripheral interfacing techniques using 8086.
- To be familiar with MASM

LIST OF EXERCISES USING 8085 Kits

1. Basic Arithmetic, Logical operations and move a data block without overlap.

LIST OF EXERCISES USING 8086 kits and MASM

2. Decimal Arithmetic, Code conversion, and Matrix operations.
3. String manipulations, Sorting and Searching
4. Counters and Time Delay

Peripherals and Interfacing Experiments

5. Traffic light control
6. Stepper motor control
7. Digital clock
8. Key board and Display
9. Serial interface and Parallel interface
10. A/D and D/A interface and Waveform Generation

LIST OF EXERCISES USING 8051 kits and MASM

11. Basic Arithmetic, Logical operations, Square and Cube program
12. Find 2s complement of a number
13. Conversion of unpacked BCD to ASCII

TOTAL: 45 PERIODS

OUTCOMES:

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

- Develop programs using 8086 microprocessor.
- Examine the performance of I/O devices interfacing with 8086 processor.
- Solve assembly language programming problems using MASM.
- Develop programs using 8085 microprocessor.
- Develop programs using 8051 microcontroller.

LIST OF EQUIPMENTS FOR A BATCH OF 30 STUDENTS:

HARDWARE: 8086 Microprocessor development kits	15 Nos.
HARDWARE: 8051Microcontroller development kits	15 Nos.
HARDWARE: Interfacing Units	Each 3 Nos.
SOFTWARE: Intel Desktop Systems with MASM 8086 Assembler	10
SOFTWARE:8051 Cross Assembler	10

SEMESTER V

EC18501	DIGITAL COMMUNICATION	L	T	P	C
		3	1	0	4

OBJECTIVES:

- To know the principles of sampling & 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	**BASEBAND TRANSMISSION TECHNIQUES: CODING**	**9 + 3**

Information & Entropy - Discrete Memoryless Channel - Mutual Information & its properties - Channel Capacity Theorem - Hartley-Shannon Law - Source Coding Theorem - Huffman & Shannon-Fano Codes

UNIT II	**BASEBAND TRANSMISSION TECHNIQUES: FORMATTING**	**9 + 3**

Low Pass Sampling - Aliasing - Signal Reconstruction - Quantization - Types of Quantization (Uniform & Non-uniform) WAVEFORM & MODEL-BASED ENCODING PCM - TDM - Delta Modulation - Differential PCM - Adaptive Delta Modulation - Spectral Waveform Encoding - Subband Coding - Model-based Encoding

UNIT III	**BASEBAND PULSE TRANSMISSION**	**9 + 3**

Properties of Line codes- Power Spectral Density of Unipolar / Polar RZ & NRZ – Bipolar NRZ -Manchester- ISI – Nyquist criterion for distortion less transmission – Pulse shaping – Correlative coding - Mary schemes – Eye pattern – Equalization

UNIT IV	**PASSBAND DIGITAL TRANSMISSION**	**9 + 3**

Geometric Representation of signals - Generation, detection, PSD & BER of Coherent BPSK, BFSK & QPSK - Carrier Synchronization - structure of Non-coherent Receivers - Principle of QAM & DPSK - Principle of M-ary Modulation – Direct Sequence and Frequency Hop Spread Spectrum Techniques

UNIT V	**ERROR CONTROL CODING**	**9 + 3**

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

TOTAL: (L: 45 + T: 15): 60 PERIODS

OUTCOMES:

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

- Develop source coding schemes for real time applications.
- Develop PCM systems.
- Distinguish the base band transmission schemes and band pass signaling schemes for any communication system.
- Determine and manipulate the spectral characteristics of band pass signaling schemes and their noise performance of a communication system.
- Develop error control coding schemes for real time applications.

TEXT BOOKS:		
1. Simon Haykin, “Communication Systems”, 4th edition, Wiley Publications, 2013. 2. Amitabha Bhattacharya, “Digital Communication”, TMH, Ninth Reprint 2017.		
REFERENCES:		
1. B. Sklar, “Digital Communication Fundamentals and Applications”, 2nd Edition, Pearson Education, 2009 2. B.P.Lathi, “Modern Digital and Analog Communication Systems”, 3rd Edition, Oxford University Press 2007. 3. H P Hsu, “Schaum Outline Series - Analog and Digital Communications”, TMH 2006. 4. J.G Proakis, “Digital Communication”, 4th Edition, Tata Mc Graw Hill Company, 2001.		

EC18502	PRINCIPLES OF DIGITAL SIGNAL PROCESSING	L	T	P	C
		3	1	0	4

OBJECTIVES:

- To learn discrete Fourier transform and its properties
- To know the characteristics and design of FIR filter.
- To design a IIR filters to filter undesired signals.
- To understand Finite word length effects.
- To study the concept of Multirate Signal Processing and its applications.

UNIT I	**DISCRETE FOURIER TRANSFORM**	**9 + 3**

DSP advantages – .Introduction to DFT – Properties of DFT – Circular Convolution - Filtering methods based on DFT – FFT Algorithms – Decimation in time Algorithms, Decimation in frequency Algorithms.

UNIT II	**DESIGN OF FIR FILTER**	**9 + 3**

Linear phase FIR filter – Filter design (Low Pass, High Pass filters) using windowing techniques (Rectangular Window, Hamming Window, Hanning Window), Frequency sampling techniques - Realization structures of FIR Filter - Transversal, Poly-phase and Linear phase structures.

UNIT III	**DESIGN OF IIR FILTER**	**9 + 3**

Characteristics of Analog filters – Butterworth filters, Chebyshev Type I filters. Transformation of analog filters into equivalent digital filters using Impulse invariant method and Bilinear transformation method- Realization structures for IIR filters – direct, cascade, parallel forms.

UNIT IV	**FINITE WORD LENGTH EFFECTS**	**9 + 3**

Fixed point and floating point number representations – ADC – Quantization- Truncation and Rounding errors - Quantization noise – coefficient quantization error – Product quantization error – Round-off noise power - limit cycle oscillations due to product round off and overflow errors – Principle of scaling.

UNIT V	**MULTIRATE SIGNAL PROCESSING**	**9 + 3**

Introduction - Decimation, Interpolation, Sampling rate conversion by a rational factor - Multistage implementation of sampling rate conversion - Applications of Multirate signal processing.

TOTAL: (L: 45 + T: 15): 60 PERIODS

OUTCOMES:

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

- Determine the frequency spectrum of Discrete time signal using Discrete fourier transform.
- Interpret the characteristics of FIR filters and articulate the design of finite impulse response filters for filtering undesired signals
- Observe the IIR filter characteristics and manipulate IIR filters in real time applications.
- Assess the word length effect in signal processing systems.
- Manipulate multirate signal processing and observe its characteristics.

TEXT BOOKS: At the end of the course, learners will be able to

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

2007.

2. Andreas Antoniou, ―Digital Signal Processing‖, Tata Mc Graw Hill, 2006.

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 Mc Graw Hill, 2007.
3. A.V.Oppenheim, R.W. Schafer and J.R. Buck, "Discrete-Time Signal Processing", 8th Indian Reprint, Pearson, 2004.

EC18503	COMPUTER ORGANIZATION AND DESIGN	L	T	P	C
		3	1	0	4

OBJECTIVES:

- To Understand the basic structure and operation of computers.
- To gain knowledge about the various arithmetic operations that performed by ALU**.** .
- To expose the students to the concept of Pipelining.
- To introduce the students to the major ideas and concepts in parallel processing.
- To describe hierarchical memory systems including cache memories and virtual memory..

UNIT I	**OVERVIEW AND INSTRUCTIONS**	**9 + 3**

Eight ideas in Computer Architecture – Components – Technology – Performance – Power wall – Uniprocessors to multiprocessors; Instructions – operations and operands – Representing instructions – Logical operations – Control operations – Addressing and addressing modes.

UNIT II	**ARITHMETIC OPERATIONS**	**9 + 3**

ALU - Addition and subtraction – Multiplication – Division – Floating Point operations –Subword parallelism.

UNIT III	**PROCESSOR AND CONTROL UNIT**	**9 + 3**

Basic MIPS implementation – Building datapath – Control Implementation scheme – Pipelining – Pipelined datapath and control – Handling Data hazards & Control hazards – Exceptions.

UNIT IV	**PARALLEL PROCESSORS**	**9 + 3**

Instruction-level-parallelism – Parallel processing challenges – Flynn's classification – Hardware Multithreading – Multicore processors

UNIT V	**MEMORY AND I/O SYSTEMS**	**9 + 3**

Memory hierarchy - Memory technologies – Cache basics – Measuring and improving cache performance - Virtual memory, TLBs - Input/output system, Programmed I/O, DMA and interrupts, I/O processors.

TOTAL: (L: 45 + T: 15): 60 PERIODS

OUTCOMES:

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

- Compute the performance of various computer architecture and to interpret the instruction set of MIPS processor.
- Design and construct various arithmetic circuits for an Arithmetic and Logic units of computing systems
- Assessing various pipelining techniques to implement it for better datapath construction for Control units of computing systems
- Categorize various paralleling process techniques and its challenges and also to distinguish various multithreading techniques
- Organize the different Memory technologies and I/O systems to be preferred for computer architectural design

TEXT BOOKS:

1. David A. Patterson and John L. Hennessey, "Computer organization and design", MIPS Edition Morgan kauffman, Fifth Edition, 2014.
2. William Stallings: Computer Organization & Architecture, 9th Edition, Pearson, 2015.

REFERENCES:

1. Govindarajalu, “Computer Architecture and Organization, Design Principles and Applications", Tata McGraw Hill, Second Edition,2017
2. John P. Hayes, “Computer Architecture and Organization”, Third Edition, Tata McGraw Hill, 2012.

EC18504	TRANSMISSION LINES AND WAVEGUIDES	L	T	P	C
		3	1	0	4

OBJECTIVES:

- To give insight about Passive filters.
- To introduce the various types of transmission lines and to discuss the losses associated.
- To give thorough understanding about high frequency line, power and impedance measurements.
- To impart technical knowledge in impedance matching using smith chart.
- To impart knowledge on waveguide and cavity resonators.

UNIT I	**FILTERS**	**9 + 3**

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

UNIT II	**TRANSMISSION LINE THEORY**	**9 + 3**

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

UNIT III	**HIGH FREQUENCY TRANSMISSION LINES**	**9 + 3**

Transmission line equations at radio frequencies - Line constants of Zero dissipation-voltage and current on the dissipationless line, Standing Waves, Nodes, Standing Wave Ratio - Input impedance of the dissipation-less line - Open and short-circuited lines - -Reflection losses.

UNIT IV	**IMPEDANCE MATCHING IN HIGH FREQUENCY LINES**	**9 + 3**

Impedance matching: $\lambda/8$, $\lambda/2$ lines, Quarter wave transformer- Basics of Tapered lines - Impedance matching by stubs - Single stub and double stub matching - Smith chart-Solutions of problems using Smith chart -Single and double stub matching using Smith chart.

UNIT V	**WAVE GUIDES AND CAVITY RESONATORS**	**9 + 3**

Introduction to TM, TE and TEM waves, TM and TE waves between parallel plates, TM and TE waves in Rectangular wave guides, Impossibility of TEM waves in Rectangular Waveguides, Bessel's differential equation and Bessel function, TM and TE waves in Circular wave guides, Rectangular and circular cavity Resonators.

TOTAL: (L: 45 + T: 15): 60 PERIODS

OUTCOMES:

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

- Interpret the filter fundamentals and familiarize with types and techniques of passive filters.
- Explain line theory and classify transmission lines. Assess distortionless transmissions on lines.
- Express transmission lines at high frequency and assess the performance.
- Assess performance of lines implementing impedance matching techniques using Smith chart.
- Explain waveguides and Cavity Resonators and categorise them.

TEXT BOOKS:

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

REFERENCES:

1. G.S.N Raju "Electromagnetic Field Theory and Transmission Lines Pearson Education, 2005.
2. R. K. Shevgaonkar, " Electromagnetic Waves, Tata Mc Graw Hill Publications, 2006
3. Umesh Sinha, "Transmission Lines and Networks: Networks, Filters and Transmission lines" Satya Prakashan, Publication, 2010.

GE18551	PRINCIPLES OF MANAGEMENT (Common to EC, AE, BT, EE and ME)	L	T	P	C
		3	0	0	3

OBJECTIVES:

To enable the students to study the evolution of management, functions and principles of management and to learn the application of management principles in an organization.

UNIT I	INTRODUCTION TO MANAGEMENT AND ORGANIZATIONS	9

Definition of Management –Nature of Management-Management as Science or Art-Management and Administration-Evolution of Management-Contribution of Taylor and Fayol– types of managers - managerial roles and skills - Organization Culture – Dimensions, strong and weak culture –External Environment -specific and general environment – Understanding the global environment.

UNIT II	PLANNING	9

Nature and purpose of planning – Steps Involved in planning process – Types of plans – management by objectives – Strategic management process– types of corporate strategies - Planning Tools and Techniques-Forecasting – Benchmarking - Decision making steps and process

UNIT III	ORGANISING	9

Nature and purpose – Formal and informal organization — Line and staff authority – delegation of authority – departmentalization by different strategies - centralization and decentralization –span of control- Human Resource Management – External factors - HR Planning - Recruitment and Decruitment - selection – selection tools – Orientation – Employee training - Employee Performance Management – Appraisal methods - Compensation and benefits.

UNIT IV	DIRECTING	9

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

UNIT V	CONTROLLING	9

Types of control systems: Market, Bureaucratic, Clan- Importance of control - process of controlling – Types of control: Feed forward, Concurrent, Feedback -Qualities of effective control system – Factors affecting control – controlling for organizational performance – control techniques -budget - Program evaluation and review technique – Information technology in controlling: opportunities and challenges.

TOTAL: (L: 45): 45 PERIODS

OUTCOMES:

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

- Apply managerial approaches and practice managerial roles as demanded by the current environment of the organization.
- Develop planning process and apply strategies, planning tools and techniques to attain organizational objectives.
- Organize activities in the organization and execute human resource management tasks.
- Apply the motivational and leadership techniques and utilize communication methods in the organization.
- Apply control techniques to monitor the progress of activities and to take corrective measures accordingly.

TEXT BOOKS:

1. Stephen P. Robbins, Mary Coulter and Agna Fernandez, “Management”, 14th Edition, Prentice Hall (India) Pvt. Ltd., 2019.
2. Stephen A. Robbins, David A. Decenzo, Sanghamitra, Bhattacharyya, Madhushree Nanda Agarwal “Fundamentals of Management” 6th Edition, Pearson Education, 2011.

REFERENCES:

1. Harold Koontz & Heinz Weihrich “Essentials of management” 10th edition, Tata Mc Graw Hill, 2015.
2. JAF Stoner, Freeman R.E and Daniel R Gilbert “Management”, 6th Edition, Pearson Education, 2004.
3. Heinz Weihrich, Mark V Cannice, and Harold Koontz “Management: A Global, Innovative and Entrepreneurial Perspective”, 15th Edition, McGrawHill, 2019.

WEB RESOURCES

1. https://nptel.ac.in/courses/110105069/
2. https://nptel.ac.in/courses/122108038/
3. https://nptel.ac.in/courses/110/102/110102016/

EC18511	COMMUNICATION SYSTEMS LABORATORY	L	T	P	C
		0	0	4	2

OBJECTIVES:

- To visualize the effects of sampling, multiplexing and digital pulse modulation techniques.
- To implement AM & FM modulation and demodulation.
- To implement FSK, PSK and M-ary schemes.
- To implement Equalization algorithms and Error control coding schemes.
- To simulate communication link and CDMA link.

LIST OF EXERCISES USING MATLAB & DIGITAL AND ANALOG DEVICES

1. Signal Sampling and reconstruction
2. Time Division Multiplexing
3. AM Modulator and Demodulator
4. FM Modulator and Demodulator
5. Pulse Code Modulation and Demodulation
6. Delta Modulation and Demodulation
7. Observation (simulation) of signal constellations of BPSK, QPSK and QAM
8. Line coding schemes
9. FSK, PSK, DPSK and M-ary schemes (Simulation)
10. Error control coding schemes - Linear Block Codes (Simulation)
11. Communication link simulation
12. Equalization – Zero Forcing & LMS algorithms(simulation)
13. CDMA- DSSS and FHSS (simulation)

Note: Plotting of drawings must be made for each exercise and attached to the records written by students.

TOTAL: 60 PERIODS

OUTCOMES:

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

- Construct and validate the results of AM, FM modulator and Demodulator, Time Division Multiplexing (TDM), Signal Sampling and Reconstruction, Pulse Code Modulation (PCM), Delta Modulation and Demodulation
- Construct and Observe the results of Base Band Signaling techniques.
- Simulation and Forecasting of Signal Constellations, Digital Modulation Schemes, Equalization using Zero forcing and LMS algorithm in MATLAB.
- Simulate and Verify the results of error detection and correction coding technique in MATLAB.
- Simulate and Validate the results of AM Communication link(system) using MATLAB.

LIST OF EQUIPMENTS FOR A BATCH OF 30 STUDENTS:

Description of Equipment	Quantity
Kits for Signal Sampling, TDM, AM, FM, PCM, DM and Line Coding Schemes	2 Nos. each
MATLAB / SCILAB or equivalent software package for simulation experiments	10 Licenses
PCs	10 Nos.

EC18512	DIGITAL SIGNAL PROCESSING LABORATORY	L	T	P	C
		0	0	4	2

OBJECTIVES:

- To implement DFT and FFT
- To implement Linear and Circular Convolution
- To design a FIR filter using windowing method.
- To design a IIR filter using Impulse Invariant technique and Bilinear Transformation method.
- To study the architecture of DSP processor

LIST OF EXERCISES USING MATLAB / EQUIVALENT SOFTWARE PACKAGE

1. Generation of standard signals, periodic and Aperiodic signal
2. DFT and IDFT
3. FFT algorithms - Decimation in Time / Decimation in Frequency.
4. Linear and Circular Convolution in time domain and in frequency domain (using DFT)
5. Spectrum Analysis using DFT
6. IIR filter design
7. FIR filter design
8. Decimation and Interpolation

DSP PROCESSOR BASED IMPLEMENTATION

1. Study of architecture of Digital Signal Processor
2. MAC operation using various addressing modes
3. Linear through Circular Convolution in time domain
4. Waveform generation
5. FIR Implementation

TOTAL: 60 PERIODS

OUTCOMES:

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

- Generate Elementary signals
- Design the applications of FFT in signal processing
- Design digital filters.
- Examine the DSP processor based implementation of DSP systems
- Formulate filtering applications of DSP

LIST OF EQUIPMENTS FOR A BATCH OF 30 STUDENTS:

	Quantity
PCs with Fixed / Floating point DSP Processors (Kit / Add-on Cards)	15
MATLAB with Simulink and Signal Processing Tool Box or Equivalent Software in desktop systems	15 Licenses

HS18561	INTERVIEW AND CAREER SKILLS LABORATORY (Common to all Branches except BT and EE)	L	T	P	C
		0	0	3	2

OBJECTIVES:

- To enable learners to build confidence and enhance their language proficiency.
- To expose learners to the use of professional English.
- To equip them with employability skills.
- To expose learners to build entrepreneurship skills

UNIT I	**LISTENING AND SPEAKING SKILLS**	**12**

Conversation Skills – Types - Small Talk, Face-to-Face and Telephonic, Formal and Informal Conversations – Skills in presenting ideas and collating information during Conference Calls (one –to-one and technical group / team) – Academic and Workplace Situations – Conversing with Faculty/Visiting Faculty/Guests/Officials/Employers and Employees – Group Discussion – Etiquette and Dos and Don'ts, Turn-taking –Presentation Skills – Seminars and Projects using Digital Tools; Mock Interview – Etiquette and Dos and Don'ts – Audio-Visual interface for enhancement of Listening and Speaking Skills

UNIT II	**READING / SPEEDREADING,CRITICAL THINKING AND WRITING SKILLS**	**12**

Reading Comprehension – General and Scientific Texts/Articles/Case Studies from different or relevant fields of study for analysis and critical thinking; Employability Skills – Writing Job Applications – Cover Letter accompanying Résumé – Types of Business Letters and Email Writing and Etiquette; Writing Reports – Statement of Purpose – Writing Articles for Publication Style and Format – Creating Blogs or Company Profiles – Speed Reading of Voluminous Reports / Documents and Exacting Necessary Information and Abstract Preparation including Dissemination

UNIT III	**ENGLISH FOR PROFESSIONAL EXAMINATIONS**	**12**

Sentences, Paragraphs and Reading Comprehension – Vocabulary Building – General and Technical Terms – Contextual Meaning – Spelling – Subject-Specific Words – Usage and User-Specific Terminology

UNIT IV	**ENTREPRENEURSHIP SKILLS**	**9**

Introduction to Entrepreneurship; Developing Leadership Qualities and Team Work; Goal Setting and Real-Life Scenarios; Fundamentals of Entrepreneurial Skills – Marketing Strategies - Microcosmic and Macrocosmic Levels of Product Sales and Survey – Sector / Industry Appraisal and Appreciation (Review and Understanding State of the Nation / Economy / Environment / Sector Reports Published) - Interaction & Understanding Role of Multi-Lateral Financial / Institutional / Industrial Agencies such as World Bank, ADB, UNDP, CII etc.

TOTAL: (L: 45): 45 PERIODS

TEACHING METHODS

1. To be totally learner-centric with minimum teacher intervention as the course revolves around practice.
2. Suitable audio/video samples from Podcast/YouTube to be used for illustrative purposes.
3. Portfolio approach for writing to be followed. Learners are to be encouraged to blog, tweet, text and email employing appropriate language.

4. GD/Interview/Role Play/Debate could be conducted off the laboratory (in a regular classroom) but learners are to be exposed to telephonic interview and video conferencing.
5. Learners are to be assigned to read/write/listen/view materials outside the classroom as well for gaining proficiency and better participation in the class.
6. Learners to form team(s), select a module of external Industrial / Institutional interaction and prepare a short thesis/project proposal.

OUTCOMES:

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

- Take international examination such as IELTS and TOEFL
- Make presentations and Participate in Group Discussions.
- Successfully answer questions in interviews

REFERENCES:

1. Business English Certificate Materials, Cambridge University Press.
2. Graded Examinations in Spoken English and Spoken English for Work downloadable materials from Trinity College, London.
3. International English Language Testing System Practice Tests, Cambridge University Press.
4. Interactive Multimedia Programs on Managing Time and Stress.
5. Personality Development (CD-ROM), Times Multimedia, Mumbai.

WEB SOURCES:

1. http://www.slideshare.net/rohitjsh/presentation-on-group- discussion
2. http://www.washington.edu/doit/TeamN/present_tips.ht ml
3. http://www.oxforddictionaries.com/words/writing-job- applications
4. http://www.kent.ac.uk/careers/cv/coveringletters.htm
5. http://www.mindtools.com/pages/article/newCDV_34.html

SEMESTER VI

EC18601	VLSI DESIGN (Common to EC and EE)	L	T	P	C
		3	0	0	3

OBJECTIVES:

To study the

- Fabrication processes of MOS circuits, design rules for layouts and the limitations in scaling
- Realization of MOS circuits for various combinational logic blocks and analyze the performance tradeoffs with respect to the area, power and delay
- Various arithmetic building blocks and their timing constraints
- Various synchronous and asynchronous sequential designs and analyze the timing constraints
- Various architectural choices available for FPGA.

UNIT I	**MOS TRANSISTOR PRINCIPLE**	**9**

NMOS, PMOS -Enhancement and depletion MOSFET; MOS transistor-Ideal I-V characteristics; Fabrication Process - MOSFET, CMOS- n-well, p-well, Twin tub, SOI; Scaling principles and fundamental limits; CMOS inverter characteristics; Stick diagram; Layout diagrams; Design rules; Layer Representation

UNIT II	**COMBINATIONAL LOGIC CIRCUITS**	**9**

Static CMOS Design: Examples of Combinational Logic Design; Complementary CMOS concept and properties; Ratioed Logic -DCVSL logic gate; Pass Transistor Logic - Concept, Complementary PTL and Differential PTL; CMOS transmission gate; Elmores constant; **Dynamic CMOS design:** Dynamic Logic - Basic Principles; Issues in Dynamic Design; Cascading Dynamic Gates

UNIT III	**SEQUENTIAL LOGIC CIRCUITS**	**9**

Timing Metrics for Sequential Circuits; Static Latches and Registers; Bi-stability Principle; Multiplexer Based Latches; Master-Slave based Edge Triggered Register; Non-ideal clock signals; Dynamic Latches and Registers; Transmission-Gate Edge-triggered Registers; C2MOS Register; Dual-Edge Registers; True Single-Phase Clocked Register (TSPCR) Timing issues; Pipelines; Clock Strategies; Synchronous and Asynchronous design- Low power design principles

UNIT IV	**DESIGNING ARITHMETIC BUILDING BLOCKS**	**9**

Data path circuits; Architectures for Ripple Carry Adders; Carry Look Ahead Adders; Carry Select Adder; Carry Bypass Adder; High speed adders - Brunt Kung adder, Kogge Stone; Multipliers - Wallace Tree multiplier, Booth Multiplier; Barrel shifters; Speed and Area Trade-off for all above Arithmetic Building Blocks

UNIT V	**IMPLEMENTATION STRATEGIES**	**9**

Full custom and Semi-custom design; Standard cell design and cell libraries; FPGA building block architecture - FPGA interconnect routing procedures; Design for Testability: Ad Hoc Testing, Scan Design, BIST

TOTAL: (L: 45): 45 PERIODS

OUTCOMES:

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

- Sketch the CMOS logic circuit using Stick Diagrams and Layout Diagrams.
- Identify the MOS circuits for various combinational logic blocks and analyze performance parameters.
- Develop Sequential logic blocks and perform timing analysis.
- Detect suitable MOS logic style for designing arithmetic logic blocks.
- Compute FPGA and perform testing.

TEXT BOOKS:

1. Jan Rabaey, AnanthaChandrakasan, B.Nikolic, "Digital Integrated Circuits: A Design Perspective", Second Edition, Prentice Hall of India, 2003.
2. M.J. Smith, "Application Specific Integrated Circuits", Addisson Wesley, 1997.

REFERENCES:

1. N.Weste, K.Eshraghian, "Principles of CMOS VLSI Design", Second Edition, Addision Wesley 1993.
2. R.Jacob Baker, Harry W.LI., David E.Boyee, "CMOS Circuit Design, Layout and Simulation", Prentice Hall of India 2005.
3. A.Pucknell, Kamran Eshraghian, "BASIC VLSI Design", Third Edition, Prentice Hall of India, 2007.

EC18602	ANTENNA THEORY AND DESIGN	L	T	P	C
		3	1	0	4

OBJECTIVES:

- To give an insight of Radiation Phenomena in antennas.
- To give thorough understanding of the radiation characteristics of different types of aperture antenna.
- To understand and analyse the recent special antennas.
- To understand radiation in microstrip antennas and design/ analyse patch structures.
- To compare, analyse and understand the different types of propagation mechanisms at different frequencies.

UNIT I	**ANTENNA FUNDAMENTALS AND ARRAYS**	**9 + 3**

Radiation Mechanism, Types of Antenna, Antenna terms and parameters- Gain, Directivity, Effective aperture, Radiation Resistance, Band width, Beam width, Input Impedance. Polarization, Efficiency, Friis transmission equation, Reciprocity principle, Radiation from Half wave dipole, Folded dipole, N element linear array, Pattern multiplication, Broadside and End fire array, Binomial array

UNIT II	**APERTURE AND SLOT ANTENNAS**	**9 + 3**

Huygens' principle, Field equivalence principle, Radiation from rectangular apertures, Horn antenna, Babinets principle, Slot and complementary dipole, Reflector antenna-Aperture blockage, Feeding methods -Radiation mechanisms of above antennas and Application.

UNIT III	**MICROSTRIP ANTENNAS**	**9 + 3**

Radiation mechanisms of patch antennas, Types, Excitation techniques, Design of microstrip antennas, Radiation analysis using cavity model, Computer aided design of microstrip antennas.

UNIT IV	**SPECIAL ANTENNAS**	**9 + 3**

Spiral antenna, Helical antenna, Log periodic, Yagi antenna-Design, Modern antennas-Reconfigurable antenna, Reflect array antenna, Electronic band gap (EBG) antennas, MIMO Antenna, Antennas for 5G applications**.**

UNIT V	**ANTENNA MEASUREMENTS AND PROPAGATION**	**9 + 3**

Antenna Measurements- Measurement of Gain, Radiation pattern, Polarization.
Modes of propagation, Structure of atmosphere, Ground wave propagation, Tropospheric propagation, Duct propagation, Sky wave propagation – Virtual height, critical frequency, Maximum usable frequency – Skip distance, Fading, Multi hop propagation.

TOTAL: (L: 45 + T: 15): 60 PERIODS

OUTCOMES:

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

- Illustrate the insights of antennas and arrays
- Determine the radiation characteristics of different types of aperture and slot antenna.
- Design microstrip antennas and its analysis
- Show the recent special antennas and its analysis
- Identify the different types of propagation mechanisms at different frequencies.

TEXT BOOKS:

1. John D Kraus,"Antennas for all Applications", 3rd Edition, Mc Graw Hill, 2005.
2. Constantine.A.Balanis "Antenna Theory Analysis and Design", Wiley Student Edition, 2006.
3. Edward C.Jordan and Keith G.Balmain" Electromagnetic Waves and Radiating Systems" Prentice Hall of India, 2006.

REFERENCES:

1. R.E.Collin,"Antennas and Radiowave Propagation", Mc Graw Hill 1985.
2. Rajeswari Chatterjee, "Antenna Theory and Practice" Revised Second Edition New Age International Publishers, 2006.
3. S. Drabowitch, "Modern Antennas" Second Edition, Springer Publications, 2007.
4. Robert S.Elliott "Antenna Theory and Design" Wiley Student Edition, 2006.
5. H.Sizun "Radio Wave Propagation for Telecommunication Applications", First Indian Reprint,Springer Publications, 2007.

EC18603	COMMUNICATION NETWORKS	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To understand the concepts of network architecture and transmission medium
- To Perform and understand methods for error detection and correction of data.
- To be exposed to various addressing schemes and routing protocols.
- To learn the flow control and congestion control algorithms
- To be familiar with real time applications of networks

UNIT I	**FUNDAMENTALS OF NETWORKING**	**9**

Overview of Data Communication Networks – Network Topology – Types of Networks – LAN – WAN - Building a Network - Layering and protocols - OSI Model – Overview of Data and Signals.

UNIT II	**DATA LINK LAYER**	**9**

Introduction to Data Link Layer – Link Layer Addressing - Error Detection and Correction -Media access control - Ethernet - Wireless LANs – Bluetooth - Zigbee – Switching.

UNIT III	**ROUTING**	**9**

Basic Internetworking - Routing – Unicast Routing – Algorithms - Protocols – Multicast Routing - Protocols – IPv4 & IPv6 Addressing - Transition from IPv4 to IPv6.

UNIT IV	**TRANSPORT LAYER**	**9**

Introduction to Transport layer – Protocols - UDP - TCP - Connection management - Flow control - Retransmission – Timer Management - TCP Congestion control - Congestion avoidance – QoS.

UNIT V	**APPLICATION LAYER**	**9**

Traditional Applications - Electronic Mail – WWW & HTTP – DNS – Need for Cryptography & Network Security.

TOTAL: (L: 45): 45 PERIODS

OUTCOMES:

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

- Adopt the required functionality at each layer for given application
- Recognize and Correct the error in the frame
- Exercise the knowledge of addressing scheme and various routing protocols in data communication to select optimal path.
- Determine the flow of information from one node to another node in the network
- Develop real time applications of networks

TEXT BOOKS:

1. Behrouz A. Forouzan, “Data Communications and Networking”, Fifth Edition, McGrawHill, 2013.
2. Andrew S. Tanenbaum, David J. Wetherall , "Computer Networks" 5th Edition, Kindle Edition.

REFERENCES:

1. James F. Kurose, Keith W. Ross, “Computer Networking - A Top-Down Approach Featuring the Internet”, Fifth Edition, Pearson Education, 2009.
2. Nader. F. Mir, “Computer and Communication Networks”, Pearson Prentice Hall Publishers, 2010.

3. Ying-Dar Lin, Ren-Hung Hwang, Fred Baker, “Computer Networks: An Open-Source Approach”, Mc Graw Hill Publisher, 2011.
4. Larry L. Peterson, Bruce S. Davie, “Computer Networks: A Systems Approach”, Fifth Edition, Morgan Kaufmann Publishers, 2011.

EC18604	WIRELESS COMMUNICATION	L	T	P	C
		3	1	0	4

OBJECTIVES: The student should be made to

- Know the characteristic of wireless channel
- Learn the various cellular architectures
- Understand the concepts behind various digital signaling schemes for fading channels
- Be familiar with various multipath mitigation techniques
- Gain knowledge of few cellular standards

UNIT I	**WIRELESS CHANNELS**	**9 + 3**

Spectrum, 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 + 3**

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 + 3**

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 + 3**

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	**STANDARDS**	**9 + 3**

GSM standardization - architecture and function partitioning - GSM radio aspects - security aspects protocol model - call flow sequences - evolution to 2.5G mobile radio networks. IS-95 service and radio aspects, key features of IS-95 CDMA systems – 3G WCDMA - UMTS, LTE physical layer - UMTS network architecture - CDMA 2000 physical layer – 4G WiMax – Introduction to 5G Wireless Technology.

TOTAL: (L: 45 + T: 15): 60 PERIODS

OUTCOMES:

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

- Characterize wireless channels, assignment, and capacity improvement.
- Design and implement various signaling schemes for fading schemes.
- Compare multipath mitigation techniques and examine their performance.
- summarize the principles and applications of wireless systems and standards.
- Interpret the Multiuser Systems, CDMA, WCDMA network planning, and OFDM Concepts.

TEXT BOOKS:		
1. Rappaport,T.S., “Wireless communications”, Second Edition, Pearson Education, 2010. 2. Haykin & Moher, "Modern Wireless Communications" Pearson 2011 (Indian Edition).		
REFERENCES:		
1. Andreas.F. Molisch, “Wireless Communications”, John Wiley – India, 2006. 2. Andreas Goldsmith, “Wireless Communication Cambridge University Press, Aug-2005. 3. D. Tse and P. Viswanath, "Fundamentals of Wireless Communications," Cambridge University Press, 2005.		

EC18611	COMMUNICATION NETWORKS LABORATORY	L	T	P	C
		0	0	4	2

OBJECTIVES:

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

LIST OF EXERCISES USING Ns & LSIM NETWORK SIMULATOR

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. Study of Socket Programming and Client – Server model
6. Write a socket Program for Echo/Ping/Talk commands
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 any one symmetric and asymmetric encryption and decryption algorithm
13. Study of DHCP protocol
14. Study of Switching and Routing.

TOTAL: 60 PERIODS

OUTCOMES:

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

- Communicate between two desktops
- Write program using sockets
- Implement and compare the various routing algorithms
- Use Simulation tools like NSIM, LSIM and NS
- Implement different protocols

LIST OF EQUIPMENTS FOR A BATCH OF 30 STUDENTS:

	Quantity
Software C / C++ / Java, Network simulator like NS2/ NS3 / Glomosim/OPNET	30
PCs	30

EC18612	VLSI DESIGN LABORATORY	L	T	P	C
		0	0	4	2

OBJECTIVES:

- To learn Hardware Descriptive Language
- 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 EXERCISES

1. HDL based design entry and simulation of Combinational circuits
   (a) 4-bit Ripple Carry Adder
   (b) Carry Look ahead adder
   (c) Multiplexer and Demultiplexer
   (d) Decoder and Priority Encoder
   (e) Code Converters
2. HDL based design entry and simulation of Sequential circuits
   (a) Shift register (SISO, SIPO, PIPO)
   (b) Synchronous and asynchronous Counter design
   (c) Mealy and Moore model
3. HDL based design entry, simulation and implementation of Multiplier and ALU. Perform Synthesis, P&R, post P&R simulation and static timing analysis. Identification of critical path
4. Simulation of Static/Dynamic logic using EDA tool.
5. Design and simulation of a MOS differential amplifier.
6. Layout generation, parasitic extraction and post-simulation of Inverter
7. Area, Delay and Power estimation of Adder using EDA tool.

TOTAL: 60 PERIODS

OUTCOMES:

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

- Prepare HDL code for basic as well as advanced digital integrated circuits.
- Use and Import the logic modules into FPGA Boards.
- Design,Synthesize, Place and Route the digital ICs.
- Design,Simulate and Extract the layouts of IC Blocks using EDA tools.
- Compute Area,Delay and Power of digital circuits using EDA tools.

LIST OF EQUIPMENTS FOR A BATCH OF 30 STUDENTS:

	Quantity
1. Xilinx software, Xilinx or Altera FPGA	10 Nos.
2. Cadence/Tanner or equivalent software package	10 Licenses
3. PCs	10 Nos.

SEMESTER VII

EC18701	RF AND MICROWAVE ENGINEERING	L	T	P	C
		3	1	0	4

OBJECTIVES:

- To inculcate understanding of the basics required for circuit representation of RF networks.
- To deal with the issues in the design of microwave amplifier.
- To instill knowledge on the properties of various microwave components.
- To deal with the microwave generation and microwave measurement techniques
- To understand the measurement of microwave signals and analyze the parameters

UNIT I	**TWO PORT NETWORK THEORY**	**9 + 3**

High Frequency parameters, Formulation of S parameters, Properties of S parameters, Reciprocal and lossless Network, Transmission matrix, RF behavior of Resistors, Capacitors and Inductors. Applications of RF and Microwaves.

UNIT II	**RF AMPLIFIERS AND MATCHING NETWORKS**	**9 + 3**

Characteristics of Amplifiers, Amplifier power relations, Stability considerations, Stabilization Methods, Noise Figure, Constant VSWR, Broadband, High power and Multistage Amplifiers, Impedance matching using discrete components, Two component matching Networks, Frequency response and quality factor.

UNIT III	**PASSIVE AND ACTIVE MICROWAVE DEVICES**	**9 + 3**

Terminations, Attenuators, Phase shifters, Directional couplers, Hybrid Junctions, Power dividers, Circulator, Isolator, Impedance matching devices: Tuning screw, Stub and quarter wave transformers. Crystal and Schottkey diode detector and mixers, PIN diode switch, Gunn diode oscillator, IMPATT diode oscillator and amplifier, Varactor diode, YIG Devices.

UNIT IV	**MICROWAVE GENERATION**	**9 + 3**

Introduction to klystron, Theory and application of two cavity Klystron Amplifier, Reflex Klystron oscillator, Traveling wave tube amplifier, and Magnetron oscillator using Cylindrical, Linear, Coaxial, Voltage tunable Magnetrons, Backward wave Crossed field amplifier and oscillator.

UNIT V	**MEASUREMENTS**	**9 + 3**

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

TOTAL: (L: 45 + T: 15): 60 PERIODS

OUTCOMES:

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

- Explain the active and passive components at microwave frequencies.
- Analyze the multi port networks and transistor amplifiers at RF frequencies.
- Analyze microwave devices for various applications.
- Evaluate the microwave sources and their applications.
- Measure and analyze the microwave signal parameters

TEXT BOOKS:

1. Reinhold Ludwig and Gene Bogdanov, “RF Circuit Design: Theory and Applications”, Pearson Education Inc., 2011.
2. Samuel Y Liao, “Microwave Devices and Circuits” Prentice Hall of India 2012.
3. Annapurna Das and Sisir K Das, “Microwave Engineering”, Tata Mc Graw Hill Publishing Company Ltd, New Delhi, 2005.

REFERENCES:

1. Robert E Colin, “Foundations for Microwave Engineering”, John Wiley & Sons Inc, 2005.
2. David M. Pozar, “Microwave Engineering”, Wiley India (P) Ltd, New Delhi, 2008.
3. Mathew M Radmanesh, “RF and Microwave Electronics”, Prentice Hall, 2000.

EC18702	OPTICAL COMMUNICATION AND NETWORKS	L	T	P	C
		3	1	0	4

OBJECTIVES:

- To study about the various optical fiber modes, configuration and transmission characteristics of optical fibers
- To gain the knowledge about various types signal degradation that occurs in optical fibers
- To learn about the various optical sources, detectors and transmission techniques
- To explore various idea about optical fiber measurements and various coupling techniques
- To Enrich the idea of optical fiber networks algorithm such as SONET/SDH and optical CDMA.

UNIT I	INTRODUCTION TO OPTICAL FIBERS	9 + 3

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

UNIT II	SIGNAL DEGRADATION IN OPTICAL FIBERS	9 + 3

Attenuation – Attenuation units - Absorption losses, Scattering losses, Bending Losses, Core and Cladding losses, Signal Distortion in Optical Wave guides-Information Capacity determination -Group Delay, Material Dispersion, Wave guide Dispersion, Signal distortion in SM fibers-Intermodal dispersion, Pulse Broadening in GI fibers.

UNIT III	FIBER OPTICAL SOURCES AND COUPLING	9 + 3

Direct and indirect Band gaps - LED structures - Light source materials - Quantum efficiency and LED power, Modulation of a LED, lasers Diodes - Modes and Threshold condition - Rate equations -External Quantum efficiency - Resonant frequencies -Laser Diodes, Temperature effects, Introduction to Quantum laser, Fiber amplifiers - Power Launching and coupling, Lensing schemes, Fiber -to- Fiber joints, Fiber splicing - Signal to Noise ratio, Detector response time.

UNIT IV	FIBER OPTIC RECEIVER AND MEASUREMENTS	9 + 3

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

UNIT V	OPTICAL NETWORKS AND SYSTEM TRANSMISSION	9 + 3

Basic Networks – SONET / SDH – Broadcast – and –select WDM Networks –Wavelength Routed Networks – Non-linear effects on Network performance –-Link Power budget -Rise time budget, Noise Effects on System Performance-Operational Principles of WDM Performance of WDM + EDFA system – Soliton – Optical CDMA – Ultra High Capacity Networks.

TOTAL: (L: 45 + T: 15): 60 PERIODS

OUTCOMES:

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

- Recognize and classify the structures of Optical fiber and its types
- Investigate the various signal degradation factors associated with optical fiber
- Evaluate the various optical sources and optical detectors and their use in the optical communication systems
- Examine the digital transmission and its associated parameters on system performance with the optical fiber measurements and various coupling techniques
- Enrich one's own knowledge on design of optical fiber networks such as SONET/SDH and optical CDMA systems.

TEXT BOOKS:

1. P Chakrabarti, "Optical Fiber Communication‖, McGraw Hill Education (India) Private

Limited, 2016
2. Gred Keiser,"Optical Fiber Communication‖, McGraw Hill Education (India) Private Limited. Fifth Edition, Reprint 2013.
3. John M. Senior, “Optical Fiber Communications: Principles and Practice”, Third Edition, Pearson Education, 2010.

REFERENCES:

1. Ramaswami, Sivarajan and Sasaki “Optical Networks”, Morgan Kaufmann, 2009.
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.

EC18703	EMBEDDED AND REAL TIME SYSTEMS	L	T	P	C
		3	1	0	4

OBJECTIVES:

- To learn the architecture and programming of ARM processor.
- To be familiar with the embedded computing platform design and analysis.
- To be exposed to the basic concepts and overview of real time Operating system and the processes involved.
- To learn the system design techniques and networks for embedded systems to industrial applications.
- To learn the applications of embedded systems in various domains.

UNIT I	INTRODUCTION TO EMBEDDED COMPUTING AND ARM PROCESSORS	9 + 3

Introduction to embedded computing: Characteristics of embedded computing applications, Challenges in embedded system design, Embedded system Design process. ARM cortex M4 Processor Instruction set-Programming – GPIO configuration, UART, Interfacing of ADC and DAC.

UNIT II	EMBEDDED COMPUTING PLATFORM DESIGN	9 + 3

The CPU Bus–Memory devices and I/O devices–Models of programs– Assembly, linking and loading – compilation techniques– Program level performance analysis – Software performance optimization – Program level energy and power analysis and optimization – Analysis and optimization of program size– Program validation and testing.

UNIT III	PROCESSES AND OPERATING SYSTEMS	9 + 3

Introduction – Kernel, Threads –Multiple tasks and multiple processes – Multirate systems– Preemptive real–time operating systems– Priority based scheduling– Interprocess communication mechanisms. Introduction to OS- GPOS versus RTOS- Classification of RTOS- Example Real time operating systems– POSIX/Windows CE. Evaluating operating system performance

UNIT IV	SYSTEM DESIGN TECHNIQUES AND NETWORKS	9 + 3

Design methodologies– Design flows – Requirement Analysis – Specifications – Quality Assurance techniques– Distributed embedded systems – Networks for embedded systems: I^2C, Ethernet, Field bus– Overview on Internet of Things.

UNIT V	APPLICATIONS OF EMBEDDED SYSTEMS	9 + 3

GPS Navigation system – Engine control unit – Pacemaker– Defibrillator – Smart Vending Machine –Smart Home Security System – Challenges and trends in embedded systems in industrial applications.

TOTAL: (L: 45 + T: 15): 60 PERIODS

OUTCOMES:

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

- Develop programs in ARM processor using ARM architecture and Instruction set.
- Interrelate the various attributes that contribute to the analysis of Program Performance in Embedded Systems.
- Compare the scheduling algorithms and Operating Systems.
- Categorize the design methodologies and Networks for embedded systems.

- Design real-time consumer/industrial applications using embedded-system concepts.

TEXT BOOKS:

1. Marilyn Wolf, "Computers as Components - Principles of Embedded Computing System Design", Fourth Edition "Morgan Kaufmann Publisher (An imprint from Elsevier), 2016.
2. Alexander G. Dean, "Embedded Systems Fundamentals with Arm Cortex-M based Microcontrollers: A Practical Approach", ARM Education media, Paperback – 1 March 2017.

REFERENCES:

1. Jonathan W.Valvano, "Embedded Microcomputer Systems Real Time Interfacing", Third Edition Cengage Learning, 2012.
2. David. E. Simon, "An Embedded Software Primer", 1st Edition, Fifth Impression, AddisonWesley Professional, 2007.
3. C.M. Krishna, Kang G. Shin, "Real-Time Systems", Tata McGraw-Hill Education, 2010.
4. K.V.K.K.Prasad, "Embedded Real-Time Systems: Concepts, Design & Programming", DreamTech Press, 2005.
5. Sriram V Iyer, Pankaj Gupta, "Embedded Real Time Systems Programming", Tata McGrawHill, 2017.
6. ARM Cortex M4 Cookbook by Dr.Markfisher, PACKT publications.
7. Discovering the STM32 Micro controller, Geoffrey Brown, Indiana University press, 2016.

EC18711	MINI PROJECT	L	T	P	C
		0	0	6	3

OBJECTIVES:

- To define, formulate and analyze a real-world problem in the field of ECE.
- To solve the problems independently or as part of a team.
- To acquire knowledge in terms of the innovation & product design development process of the project work.
- To Work independently as well as in teams.
- To manage the project from start to finish.

PROJECT WORK MODALITIES

Students can take up small real world problems in the field of electronics and communication engineering as mini project. Each student or as a team should conceive, design develop and realize an electronic product. The basic elements of product design - the function ergonomics and aesthetics - should be considered while conceiving and designing the product. It can be related to solution to an engineering problem, verification and analysis of experimental data available, by conducting suitable experiments on various engineering subjects, characterization, studying a software tool for the solution of an engineering problem etc. The realization of the product should include design and fabrication of PCB. The student should submit a soft bound report at the end of the semester. The product should be demonstrated at the time of examination.

TOTAL: 90 PERIODS

OUTCOMES:

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

- Identify problems and perform survey on the existing methods
- Develop a novel idea and analyze the various implementation issues
- Implement the design and develop a prototype
- Demonstrate the working module.
- Prepare a presentation and a report and explain the project work

EC18712	OPTICAL AND MICROWAVE LABORATORY	L	T	P	C
		0	0	4	2

OBJECTIVES:

- To understand the working principle of optical sources, detector, fibers and microwave components
- To develop understanding of simple optical communication link.
- To learn about the characteristics and measurements in optical fiber
- To know about the behavior of microwave components.
- To practice microwave measurement procedures

LIST OF EXPERIMENT – OPTICAL

1. DC Characteristics of LED and PIN Photo diode
2. Mode Characteristics of Fibers
3. Measurement of connector loss, bending losses and Attenuation loss in Fibers
4. Link analysis in Fibers-Analog and Digital Link
5. Numerical Aperture determination for Fibers

LIST OF EXPERIMENT – MICROWAVE

1. Reflex klystron or Gunn diode characteristics
2. Measurement of VSWR, frequency, wavelength.
3. Directional Coupler Characteristics.
4. Radiation Pattern of Horn Antenna.
5. S-parameter Measurement of the Isolator and Circulator
6. S-parameter Measurement of E plane Tee, H Plane Tee and Magic Tee
7. Attenuation and Power Measurement

TOTAL: 60 PERIODS

Note: Plotting of drawings must be made for each exercise and attached to the records written by students.

OUTCOMES:

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

- evaluate microwave signal aspects and parameters.
- evaluate the performance of optical link and its parameters.
- evaluate the properties of microwave components.
- measure and analyze the mode characteristics of fiber optics.
- measure and analyze the radiation pattern of horn antenna.

LIST OF EQUIPMENTS FOR A BATCH OF 30 STUDENTS:

Description of Equipment	Quantity
Trainer kit for carrying out LED and PIN diode characteristics, Digital multi meter, optical power meter.	2 Nos.
Trainer kit for determining the mode characteristics, losses in optical fiber	2 Nos.
Trainer kit for analyzing Analog and Digital link performance, 2 Mbps PRBS Data source,10 MHz signal generator	2 Nos.
Optical Kit for measuring Numerical aperture and Attenuation of fiber	2 Nos.
MM/SM Glass and plastic fiber patch chordswith ST/SC/E2000 connectors	2 set
LEDs with ST / SC / E2000 receptacles – 650 /850 nm	2 set
PiN PDs with ST / SC / E2000 receptacles –650 / 850 nm	2 set
Microwave test Bench at X band to determine Directional coupler characteristics	2 Nos.
Microwave test Bench at X band and Antenna turn table to measure Radiation pattern of Horn antenna, 2 Horn antennas	2 Nos.
Microwave test Bench at X band to determine VSWR, VSWR meter	2 Nos.
Microwave test Bench at X band, to determine S parameters of Isolator,	2 Nos.

Circulator, E Plane Tee, H plane Tee,Magic Tee.	
Gunn source based Microwave test Bench at X band	3 Nos
Microwave power meter	2 Nos
30 MHz Digital / Analog Oscilloscope	15 Nos
3 MHz Function Generator	5 Nos

EC18713	EMBEDDED SYSTEMS LABORATORY	L	T	P	C
		0	0	4	2

OBJECTIVES:

- To learn the working of ARM processor
- To write programs to interface the I/Os with processor
- To write programs to interface the various peripherals with processor
- To learn the Raspberry-Pi initial setup and web interface
- To write programs for IoT based application on Raspberry-Pi

LIST OF EXERCISES USING µKeil / IAR WORK BENCH /ARM C COMPILER

1. Study of ARM evaluation system.
2. Interfacing ADC and DAC.
3. Interfacing LED and PWM.
4. Interfacing real time clock and serial port.
5. Interfacing keyboard and LCD.
6. Interfacing of servo motor and DC motor.
7. Interfacing stepper motor and temperature sensor.
8. Implementing zigbee protocol with ARM.

LIST OF EXERCISES USING RASPBERRY PI 3

1. Study of Raspberry-Pi and OS installation
2. Simple web interface for Raspberry-Pi to control the connected LEDs remotely through the interface.
3. Implementation of client and server application on Raspberry-Pi.

TOTAL: 60 PERIODS

OUTCOMES:

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

- Illustrate the ARM evaluation system based on ARM cortex M4 using STM320 series processor through any open source IDE
- Design to program the I/O ports of ARM processor by flashing LED's, Interfacing ADC and implementing PWM
- Interface the Keyboard, DAC, LCD module, stepper motor with the ARM processor .
- Articulate the embedded C concepts to program the ARM processor to interface with Zigbee modules, DC motor. Also to perform Realtime clock generation using the inbuilt features
- Develop python codes for Raspberry-Pi to flash LED and to implement Client-Server communication.

LIST OF EQUIPMENTS FOR A BATCH OF 30 STUDENTS:

Description of Equipment	Quantity
HARDWARE: Embedded Trainer kits with ARM Boards	10 Nos.
SOFTWARE: uKeil / IAR WORK BENCH, Raspbian OS, Python 3 compiler	10 Nos.
Embedded Trainer kits suitable for wireless communication	10 Nos.
Raspberry pi 3 board with essential components	10 Nos.
Stepper motor, Servo motor and DC motor	Each 5 Nos.

SEMESTER VIII

EC18811	PROJECT WORK	L	T	P	C
		0	0	24	12

OBJECTIVES:

- To solve engineering problems relevant to the society.
- To offer students an opportunity to integrate the knowledge gained in various subjects of the degree course.
- To demonstrate their competence in practical courses.
- To apply communication skills, both oral and written, to communicate results, concepts and ideas.

PROJECT WORK MODALITIES

The object of Project Work is to enable the student to take up investigative study in the broad field of Electronics & Communication Engineering, either fully theoretical/practical or involving both theoretical and practical work to be assigned by the Department on an individual basis or two/three students in a group, under the guidance of a Supervisor from the Department alone or jointly with a Supervisor drawn from R&D laboratory/Industry. This is expected to provide agood initiation and training for the student(s) in R&D work and technical leadership. The assignment to normally include:

1. In depth survey and study of published literature on the assigned topic;
2. Review and finalization of the Approach to the Problem relating to the assigned topic
3. Preparing an Action Plan for conducting the investigation, including team work
4. Working out a preliminary Approach to the Problem relating to the assigned topic and Conducting preliminary Analysis/Modelling/Simulation/Experiment/Design/Feasibility
5. Detailed Analysis/Modelling/Simulation/Design/Problem Solving/Experiment as needed;
6. Final development of product/process, testing, results, conclusions and future directions;
7. Preparing a paper for Conference presentation/Publication in Journals, if possible;
8. Preparing a Dissertation in the standard format for being evaluated by the Department
9. Final Seminar Presentation before a Departmental Committee.

TOTAL: 360 PERIODS

OUTCOMES:

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

- Identify challenging practical problems, solutions to cope up with present scenario in the field of Electronics and Communication Engineering.
- Distinguish various methodologies and technologies for solving the problem with team.
- Use technical knowledge and project management skills for solving the problem.
- Develop specific hardware and/or software for the project.
- Conclude concepts, results and analysis in written and oral form.

PROFESSIONAL ELECTIVES

EC18001	CAD FOR VLSI CIRCUITS	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To be exposed to VLSI Design Methodologies.
- To familiar with VLSI design automation tools.
- To be exposed to floor planning and routing.
- To be exposed to various modeling and simulation.
- To be exposed to high level synthesis.

UNIT I	**INTRODUCTION TO VLSI DESIGN FLOW**	**9**

Introduction to VLSI Design methodologies, Basics of VLSI design automation tools, Algorithmic
Graph Theory and Computational Complexity, Tractable and Intractable problems.

UNIT II	**LAYOUT, PLACEMENT AND PARTITIONING**	**9**

Layout Compaction, Design rules, Problem formulation, Algorithms for constraint graph compaction, Placement and partitioning, Circuit representation, Placement algorithms, Partitioning

UNIT III	**FLOOR PLANNING AND ROUTING**	**9**

Floor planning concepts, Shape functions and floorplan sizing, Types of local routing problems, Area routing, Channel routing.

UNIT IV	**SIMULATION AND LOGIC SYNTHESIS**	**9**

Simulation, Gate-level modeling and simulation, Switch-level modeling and simulation, Combinational Logic Synthesis, Two Level Logic Synthesis.

UNIT V	**HIGH LEVEL SYNTHESIS**	**9**

Hardware models for high level synthesis, internal representation, allocation, assignment and scheduling, High level transformations.

TOTAL: (L: 45): 45 PERIODS

OUTCOMES:

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

- Determine the VLSI design methodologies for tractable and Intractable problems
- Design compact layouts and develop algorithms for circuit placement and partitioning
- Identify routing problems and develop floor planning and routing
- Simulate and synthesize logical functions.
- Develop hardware models for high level synthesis.

TEXT BOOK:

1. S.H. Gerez, "Algorithms for VLSI Design Automation", John Wiley & Sons, 2006.
2. N.A. Sherwani, "Algorithms for VLSI Physical Design Automation", Kluwer Academic Publishers, 2002.

REFERENCES:

1. Stephen M. Trimberger,"An Introduction to CAD for VLSI" Springer, 2013.
2. Sadiq M. Sait, Habib Youssef, "VLSI Physical Design automation: Theory and Practice",World Scientific 1999.
3. Steven M. Rubin,"Computer Aids For VLSI Design", R. L. Ranch Press, 2009

CS18051	FUNDAMENTALS OF OPERATING SYSTEMS	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To understand the basic concepts and functions of operating systems.
- To understand Process and to analyze Scheduling algorithms.
- To understand the concept of Deadlocks.
- To analyze various memory management schemes.
- To understand I/O management and File systems.

UNIT I	INTRODUCTION TO OPERATING SYSTEMS	9

Computer System Organization - Computer System Architecture – Evolution of Operating System - Operating System Structures - Services and Operations - System Calls - System Programs - System Structure – Virtual Machines.

UNIT II	PROCESS SCHEDULING	9

Processes: Process concept – Process scheduling – Operations on processes – Cooperating processes – Interprocess communication, CPU Scheduling: Scheduling criteria – Scheduling algorithms– Multiple-processor scheduling – Real time scheduling – Algorithm Evaluation.

UNIT III	PROCESS SYNCHRONIZATION AND DEADLOCK	9

Process Synchronization: The critical-section problem – Synchronization hardware – Semaphores – Classic problems of synchronization – Deadlock: System model – Deadlock characterization – Methods for handling deadlocks – Deadlock prevention – Deadlock avoidance – Deadlock detection – Recovery from deadlock

UNIT IV	STORAGE STRUCTURE	9

Memory Management: Background – Swapping – Contiguous memory allocation – Paging –Segmentation – Segmentation with paging. Virtual Memory: Background – Demand paging, Page replacement - Allocation – Thrashing

UNIT V	FILE SYSTEMS & MASS STORAGE STRUCTURE	9

File System Storage - File Concepts - Access Methods – File Sharing and Protection - File System Structure - File System Implementation - Directory Structure - Allocation Methods - Mass Storage Structure - Disk Scheduling and Management - RAID Structure.

TOTAL (L:45): 45 PERIODS

OUTCOMES:

On the completion of the course the students will be able to

- familiarize the students to apply the functionality of operating systems.
- make the students knowledgeable to design various Scheduling algorithms.
- acquaint the students able to apply the principles of concurrency and to design deadlock prevention, detection and avoidance algorithms.
- make the students able to Compare and contrast various memory management schemes
- Implement a prototype file systems and I/O systems.

TEXT BOOKS

1. Abhraham Silberschatz, Peter B Galvin, and Gerg Gagne, “Operating System Concepts”, 10th Edition, Wiley India Pvt Ltd, 2018

REFERENCES:

1. Andrew S. Tanenbaum, “Modern Operating Systems”, fourth Edition, Pearson Education/PHI, 2015

EC18003	HIGH SPEED ELECTRONICS	L	T	P	C
		3	0	0	3

OBJECTIVES:

To impart knowledge on the following Topics

- Various semiconductor properties and characteristics
- Characteristics and small signal analysis of Homojunction Devices
- Characteristics of various MOS Devices
- Characteristics and small signal analysis of various Hetrojunction Devices
- Fabrication techniques.

UNIT I	**SEMICONDUCTOR MATERIALS CHARACTERISTICS**	**9**

Review of Crystal Structure: Crystal structure of important semiconductors (Si, GaAs, InP) -electrons in periodic lattices - energy band diagram - carrier concentration and carrier transport phenomenon - electrical - optical - thermal and high field properties of semiconductors.

UNIT II	**HOMOJUNCTION DEVICES**	**9**

Homojunction Devices (BJT and FET): Structure - band diagram - operation - I–V and C–V characteristics (analytical expressions) - small signal switching models.

UNIT III	**MOS DEVICE**	**9**

MOS Diode: Structure - band diagram - operation - C–V characteristics - effects of oxide charges - avalanche injection - high field effects and breakdown; Heterojunction Based MOSFET: Band diagram - structure - operation - I–V and C–V characteristics (analytical expressions) - MOSFET breakdown and punch through – subthreshold current – scaling down; Alternate High k-dielectric Materials: HF–MOSFETs - SOI MOSFET - buried channel MOSFET - charge coupled devices.

UNIT IV	**ADVANCED DEVICES**	**9**

HBT and HEMT Devices: AlGaAs/ GaAs, InP and SiGe based HBT and HEMT structure -band diagram - operation - I–V and C–V characteristics (analytical expressions) – small signal switching models - benefits of heterojunction transistor for high speed applications, **Silicon Carbide power Devices, SiC Diode.**

UNIT V	**FABRICATION AND CHARACTERIZATION TECHNIQUES**	**9**

Crystal Growth and Wafer Preparation: Epitaxy - diffusion - ion implantation - dielectric film deposition and oxidization techniques - masking and lithography techniques (optical, e-beam and other advanced lithography techniques) - metallization - bipolar and MOS integration techniques - interface passivation techniques; Characterization Techniques: Four probe and hall effect measurement - I–V and C–V for dopant profile characterization and DLTS.

TOTAL: (L: 45): 45 PERIODS

OUTCOMES:

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

- analyze the crystal structure of different types of Semiconductor materials and its characteristics.
- understanding the basic structure, band diagram and principle of operation of different homo junction devices (BJT & FET)

- understanding the basic structure, band diagram and principle of operation of different MOS devices.
- analyze the Characteristics and small signal analysis of various Hetrojunction Devices
- understand and compare the different types of fabrication and characterization techniques.

TEXT BOOKS:

1. Nandita Das Gupta and Amitava Das Gupta, "Semiconductor Devices: Modeling and Technology", Prentice Hall of India, 2004.
2. M. S. Tyagi, "Introduction to Semiconductor Materials and Devices", John Wiley and Sons, 2008.

REFERENCES:

1. S. M. Sze, "Physics of Semiconductor Devices", 3rd edition, John Wiley and Sons, 2007
2. J. Singh, "Semiconductor Devices: Basic Principles", John Wiley and Sons, 2007.

EC18005	INDUSTRIAL INTERNET OF THINGS	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To introduce how IoT has become a game changer in the new economy where the customers are looking for integrated value.
- To get insights over architecture and protocols of IIoT
- To know the various sensors and interfacing used in IIoT.
- To bring the IoT perspective in thinking and building solutions.
- To introduce the tools and techniques that enable IoT solution and Security aspects.

UNIT I	**INTRODUCTION**	**9**

Introduction to IOT, What is IIOT? 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	**ARCHITECTURE AND PROTOCOLS**	**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; Need for protocols, Wi-Fi, Zigbee, Bacnet, IIOT protocols –COAP, MQTT, 6lowpan.

UNIT III	**SENSORS 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	**CLOUD, SECURITY AND GOVERNANCE**	**9**

IIOT cloud platforms: Overview of cots cloud platforms, predix, thingworks, azure. Data analytics, cloud services, Business models: Saas, Paas, Iaas; Introduction to web security, Conventional web technology and relationship with IIOT, Vulnerabilities of IoT, IoT security tomography and layered attacker model, Identity establishment, Access control, Message integrity; Management aspects of cyber security.

UNIT V	**IOT ANALYTICS AND APPLICATIONS**	**9**

IOT Analytics : Role of Analytics in IOT, Data visualization Techniques, Statistical Methods; IOT Applications : Smart Metering, e-Health Body Area Networks, City Automation, Automotive Applications, Plant Automation, Real life examples of IIOT in Manufacturing Sector.

TOTAL: (L: 45): 45 PERIODS

OUTCOMES:

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

- Distinguish between IOT and Industrial IOT and interrelate the role of key components in various applications.
- Categorize the reference architectures and protocols for IOT & IIOT.

- Identify the different sensors and actuators that are used in IIOT.
- Interrelate the Commercially available IIOT Cloud Platforms and detect vulnerabilities with respect to security in IOT.
- Distinguish between various Data analytics models and visualization tools and relate to real life examples of IIOT.

TEXT BOOKS:

1. Daniel Minoli, "Building the Internet of Things with IPv6 and MIPv6: The Evolving World of M2M Communications" ,1st Edition, Wiley Publications, 2013
2. Dieter Uckelmann , Mark Harrison, Florian Michahelles, "Architecting the Internet of Things", Springer-Verlag Berlin Heidelberg 2011 Industry 4.0: The Industrial Internet of Things
3. Alasdair Gilchrist, "Industry 4.0: The Industrial Internet of Things, "First edition, Apress

REFERENCES:

1. Hakima Chaouchi,"The Internet of Things Connecting Objects to the Web "Willy Publications.
2. Olivier Hersent, David Boswarthick, Omar Elloumi, The Internet of Things: Key Applications and Protocols, 2nd Edition,Wiley Publications
3. Internet of Things - From Research and Innovation to Market Deployment; by Ovidiu Vermesan & Peter Friess; 2014, River Publishers Series
4. How Protocol Conversion Addresses IIoT Challenges:White Paper By RedLion.
5. Alasdair Gilchrist," Industry 4.0: The Industrial Internet of Things",First edition,Kindle edition

EC18007	MEASUREMENTS AND INSTRUMENTATION	L	T	P	C
		3	0	0	3

OBJECTIVES:

To impart knowledge on the following topics

- Basics of Measurements
- Fundamentals of Analog Instruments
- Fundamentals of Digital Instruments
- Various Physical Quantity Measurements using Sensors
- Recent development in Sensors

UNIT I	**BASICS OF MESUREMENTS**	**9**

Metrics and Tolerances of various Electrical parameters (V, I, f, Power), Static characteristics-Errors in measurements -Dynamic characteristics, Calibrations and Standards.

UNIT II	**ANALOG INSTRUMENTS**	**9**

Introduction to analog measuring instruments-Construction, principle and applications of - Moving Coil instrument- Moving Iron instrument - Rectifier type instrument - Dynamometer type instrument - Induction type instrument, Selection of a measuring instrument for a specific application, Statistical analysis of error data (Simple Problems) - Error correction methods, Measurements of power using CT & PT.

UNIT III	**DIGITIAL INSTRUMENTS**	**9**

Digital Voltmeter -Digital Multi meter - Digital Watt meter - Digital Frequency Meter - Digital Storage Oscilloscope - LCR meter - Energy meter - Power factor meter - Harmonic Analyzer - Spectrum analyzer – concepts of Smart Meters - Automatic Meter Reading (AMR) – Net metering. Statistical analysis of error data - Error correction methods.

UNIT IV	**APPLICATION OF SENSORS FOR PHYSICAL QUANTITY MESUREMENTS**	**9**

Pressure Measurement: Principles of pressure – Standards - Types of Sensors – Diaphragm - Bourdon Tube – Pirani Gauge – principle, operations & applications; Temperature Measurement: Temperature standards - Types of Sensors – Bimetallic strip – Resistance Temperature Detectors (RTD) – Thermistors – Thermocouples - Magnetic Field Measurement: Oscillating search coil – three orthogonal search coils – principles and applications; Current & Voltage Measurement: Hall effect sensor - Rogowski coil

UNIT V	**INTRODUCTION TO RECENT DEVELOPMENTS IN SENSORS**	**9**

Introduction – SMART Sensors, MEMS, Nano Sensors.

TOTAL: (L: 45): 45 PERIODS

OUTCOMES:

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

- Understanding the principle of measurement of electrical parameters, Error in measurement and calibration.
- Understand the working principle of operation of analog measuring instruments.
- Understand the working principle of operation of digital measuring instruments.
- understand the principle of measurement of different physical quantities using Sensors
- Introduction to recent developments in sensors.

TEXT BOOKS:

1. A.K. Sawhney, A Course in Electrical and Electronic Measurements and Instrumentation, Dhanpat Rai & Co, 2010.
2. E.O. Doebelin, Measurement Systems – Application and Design, Tata McGraw Hill publishing company, 2003.

REFERENCES:

1. Electronic Instrumentation, "Kalsi H.S", Tata McGraw-Hill 2003
2. Electrical Measurements and Measuring Instruments, "E.W. Golding and F.E. Widdis" Wheeler's student edition, 2009.
3. A Course in Electronics and Electrical Measurements and Instrumentation "J.B. Gupta", S.K. Kataria & Sons 2001.
4. Modern electronic Instrumentation and Measurement techniques, "Albert D.Helifrick, William D. Cooper", PHI, 1992.
5. Robert.B.Northrop, Introduction to instrumentation and measurements, Allied Publishers, 2002.
6. Patranabis,D, Principles of Industrial Instrumentation, 3rd Edition, Tata McGraw Hill Publishing Company Ltd., New Delhi, 2010.
7. Alan S. Morris, Principles of Measurement and Instrumentation, Prentice-Hall of India Pvt. Ltd., New Delhi, 2003.

EC18009	MEDICAL ELECTRONICS	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To gain knowledge about the origin of bio potentials and the methods of recording bio potentials.
- To understand various non- electrical parameters and the methods of recording those parameters.
- To study about the various implantable and non-implantable assist devices
- To understand the physiological effects of HF radiation and its application
- To gain knowledge about the recent technological development in diagnosis and therapy.

UNIT I	ELECTRO-PHYSIOLOGY AND BIO-POTENTIAL RECORDING	9

The origin of Bio-potentials; bio-potential electrodes; biological amplifiers-Instrumentation amplifier, Isolation amplifier, 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, PO_2, PCO_2, colorimeter, Auto analyzer, Blood flow meter-Electromagnetic and Ultrasonic blood flow meter, cardiac output - Fick's method, Indicator dilution and Dye dilution method, respiratory measurement, Blood pressure, temperature, pulse, Blood Cell Counters, Angiography

UNIT III	ASSIST DEVICES	9

Cardiac pacemakers, Artificial heart valves, DC Defibrillator, Dialyser, Heart-Lung Machine, Introduction to Hearing Aid, Dental implants, prosthetic and orthotic devices

UNIT IV	PHYSIOTHERAPY AND DIATHERMY EQUIPMENT	9

Physiological effects of HF radiation, Depth of Penetration-Diathermies-Shortwave, ultrasonic and microwave type and their applications, Surgical Diathermy, Physiological effects of current, Leakage current, Micro and macro electric shock, GFI units, Earthing Scheme, Electrical safety Analyzer.

UNIT V	RECENT TRENDS IN MEDICAL INSTRUMENTATION	9

Thermograph, Endoscopy unit, Laser in medicine, cryogenic application, Introduction to Telemetry principles, frequency selection, biotelemetry, Radiopill, Introduction to Medical Imaging techniques, Principles of MRI-MRI instrumentation, Patient Monitoring System

TOTAL: (L: 45): 45 PERIODS

OUTCOMES:

Upon completion of the course, students will be able to

- Illustrate and explain various bio-potential measuring instruments
- Distinguish and categorize bio chemical and Non electrical parameter measurements
- Identify and differentiate various assist devices
- Illustrate and explain the operation of therapeutic and telemetric devices.
- Identify and explain the operation of advanced diagnostic devices.

TEXT BOOKS:

1. Leslie Cromwell, "Biomedical Instrumentation and Measurement", Prentice Hall of India, New Delhi, 2007.
2. John G.Webster, "Medical Instrumentation Application and Design", 3rd Edition, Wiley India Edition, 2007

REFERENCES:

1. Khandpur, R.S., “Handbook of Biomedical Instrumentation”, TATA Mc Graw-Hill, New Delhi, 2003.
2. Joseph J.Carr and John M.Brown, “Introduction to Biomedical Equipment Technology”, John Wiley and Sons, New York, 2004.
3. Steve Webb, “The Physics of Medical Imaging”, Taylor & Francis, New York.1988.
4. D.N.Chesney and M.O.Chesney, “Radio Graphic Imaging”, CBS Publications, New Delhi, 1987.
5. Peggy, W., Roger D.Ferimarch, “MRI for Technologists”, Mc Graw Hill, New York, 1995

EC18011	CISC AND RISC ARCHITECTURES	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To expose the students to the fundamentals of CISC microprocessor architecture.
- To enable the students to understand RISC architectures.
- To enable the students to understand ARM application development
- To introduce the advanced features in microprocessors and microcontrollers.
- To enable the students to understand various microcontroller architectures.

UNIT I	**HIGH PERFORMANCE CISC ARCHITECTURE – PENTIUM**	**9**

CPU Architecture- Bus Operations – Pipelining – Branch prediction – Operating Modes – Segmentation and Paging – Multitasking – Exception and Interrupts – Instruction set – addressing modes – Programming the Pentium processor.

UNIT II	**HIGH PERFORMANCE RISC ARCHITECTURE – ARM**	**9**

ARM processor - ARM architecture and cores- ARM programmer's model- ARM organization- 3 stage pipeline- 5 stage pipeline- ARM instruction set- Assembly language programming.

UNIT III	**ARM APPLICATION DEVELOPMENT**	**9**

Introduction to Firmware and Boot loader – Embedded Operating systems -Integrated Development Environment- STDIO Libraries – Peripheral Interface – Application of ARM Processor - Caches- Memory protection Units – Memory Management units.

UNIT IV	**FEATURES OF MODERN MICROCONTROLLERS**	**9**

Introduction to modern microcontrollers – General microcontroller architecture - Processor Core – Memory interfaces– Communication interfaces (SPI, I^2C, USB and CAN) – ADC - PWM – Watchdog timers – Interrupts.

UNIT V	**PIC MICROCONTROLLER**	**9**

CPU Architecture – Instruction set – interrupts- Timers- I^2C Interfacing –UART- A/D Converter –PWM.

TOTAL: (L:45): 45 PERIODS

OUTCOMES:

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

- Interpret CISC architecture and program it.
- Interpret RISC architecture and program it.
- Design applications using Integrated Development Environment
- Exploit the features of the modern microcontrollers for communication interfaces.
- Exploit the features of the PIC Microcontroller for various applications.

TEXT BOOKS:

1. James L. Antonakos , " The Pentium Microprocessor", Pearson Education, 1997.
2. Andrew N.Sloss, Dominic Symes and Chris Wright "ARM System Developer's Guide: Designing and Optimizing System Software", First edition, Morgan Kaufmann Publishers, 2004.
3. John .B.Peatman , "Design with PIC Microcontroller", Prentice Hall, 1997.

REFERENCES:

1. Daniel Tabak , “Advanced Microprocessors”, Mc Graw Hill. Inc., 1995
2. Steve Furber , “ARM System –On –Chip architecture”, Addision Wesley, 2000.
3. James L.Antonakos, “An Introduction to the Intel family of Microprocessors”, Pearson Education, 1999.
4. Barry. B. Breg,” The Intel Microprocessors “, PHI, 2008.

EC18013	ROBOTICS AND AUTOMATION	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To acquire basic knowledge on robotics and associated automation principles along with the existing industrial applications.
- To explore on various types of sensors, robot actuators, end effectors concerned with manipulators.
- To study about robot motion analysis and control.
- To acquire knowledge on vision system for robot and basic robotic programming.
- To explore on robotics automation and applications in industry.

UNIT I	BASICS OF ROBOTICS AND AUTOMATION SYSTEMS	9

Robotics: Definition, Origin, Different types, Various generations –Degrees of freedom; Anatomy of a robot – Classification of robots – Cartesian, Cylindrical, Spherical, Articulated, SCARA; Precision of robot movements – Accuracy, Resolution, Repeatability.

Automation: Basic elements of an automated system – Level of automation; Computer process control – Control requirements, Forms of computer process control.

Material handling applications through industrial robotics (Brief overview at introduction level): Material transfers – Machine loading and unloading.

UNIT II	SENSORS AND MANIPULATOR	9

Sensors: Sensor characteristics, Types of sensors – Tactile sensors, Touch sensors; Position sensors – Potentiometer, Encoder, LVDT, Resolvers; Proximity sensors – Magnetic, Optical, Ultrasonic, Inductive, Capacitive, Eddy current; Speed sensors – Velocity/motion sensors; Force/Pressure and torque sensors.

Actuators: Mechanical Actuation System – Cams, Gear trains, Ratchet and Pawl, Belt and chain drives, Bearings; Electrical Actuation System– Electrical systems, Solid State Switches, Solenoids, D.C. motors, A.C motors, Stepper motors; Hydraulic and Pneumatic Actuation System – Introduction to Hydraulic and Pneumatic Systems, Directional Control valves, Flow control valves;

End effectors: Grippers and Tools – Types and mechanisms, Design considerations in gripper selection;

UNIT III	ROBOT MOTION ANALYSIS AND CONTROL	9

Overview on controller and its types – PI, PD, PID; Manipulator kinematics – Position representation and orientation – Forward, Reverse and Homogeneous transformation – Kinematic equations – Solving Inverse kinematic equations; Overview on Manipulator path control – Slew, Joint interpolated and Straight line motion; Differential motions – Jacobian; Robot dynamics – Static analysis – Robot arm dynamics – Newton-Euler method – Euler-Lagrangian formulation; Force control – Tasks, Strategies.

UNIT IV	ROBOTIC VISION AND ROBOT PROGRAMMING	9

Architecture and components of robotic vision systems; Image acquisition and representation; Image histograms, Spatial operations, Segmentation, Feature extractions-Region, Line, Point and other features, Object descriptors; Stereo vision-point clouds; Object Recognition; Image based visual servoing (IBVS), Introduction to advanced visual servoing- IBVS, Applications – Arm-type robot, Mobile robot and Aerial robot.

Robot programming – Robot languages; Artificial intelligence (AI) – Goals – AI search Techniques for problem solving, Introduction to Machine learning.

UNIT V	ROBOTIC AUTOMATION IN INDUSTRY	9
Flexible Manufacturing Systems – Components, Planning and implementation issues, Benefits and applications; Automated Storage Retrieval Systems (ASRS) – types, components and operating features; Automated processing/machining – Transfer lines; Automatic assembly – System configuration, parts delivery, applications; Automatic inspection – types, procedure, accuracy; Overview – Internet of Robotic Things – Cloud robotics.		
	TOTAL: (L: 45): 45 PERIODS	

OUTCOMES:

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

- Categorize robots and automation based on various aspects
- Identify appropriate sensors, robot actuators, end effectors for certain applications
- Solve the basic manipulator kinematics, robot dynamics and sketch the manipulator path control
- Design appropriate vision system for certain robotic applications and compute the required robot controls using basic robotic programming.
- Use the acquired knowledge on robotics for certain automation in industry

TEXT BOOKS:

1. Mikell P. Groover, Mitchell Weiss, Roger N. Nagel and Nicholas G. Odrey, “Industrial Robotics”, Tata Mc Graw Hill, 2010.
2. Peter Corke, “Robotics, Vision and control-Fundamental algorithms in MATLAB”, Springer International publishing AG, 2017.
3. Mittal R K, Nagrath I J, “Robotics and control”, Tata McGraw Hill, 2010.

REFERENCES:

1. Fu. K. S., Gonzalez. R. C. & Lee C.S.G., “Robotics control, sensing, vision and intelligence”, McGraw Hill Book co, 1987.
2. Saeed B. Niku, “An Introduction to Robotics: Analysis, systems and applications”, Pearson Education, 2009.
3. Richard D Klafter, and Michael Negin, “Robotics Engineering”, Prentice Hall, 2009.
4. John.J. Craig, “Introduction to Robotics: Mechanics and control”, Pearson Education, 2009.
5. Mikell P. Groover, “Automation, Production systems and Computer Integrated Manufacturing”, Prentice Hall India Pvt. Ltd., 2011.
6. J. Wan, S. Tang, H. Yan, D. Li, S. Wang, A. Vasilakos, "Cloud robotics: Current status and open issues", IEEE Access, vol. 4, pp. 2797-2807, Jun. 2016. (DOI: 10.1109/ACCESS.2016.2574979)
7. P.P. Ray, "Internet of robotic things: concept technologies and challenges", IEEE Access, vol. 4, pp. 9489-9500, 2016. (DOI: 10.1109/ACCESS.2017.2647747)

EC18015	SATELLITE COMMUNICATION	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To give an insight of communication using satellites.
- To give thorough understanding of the space segment and ground segment that makes the satellite system
- To understand and analyse the uplink and downlink behavior and work out link budget.
- To understand access techniques of satellites through FDMA, TDMA and CDMA and compare the characteristics and performance.
- To familiarize the different arena in which satellite systems are applied and study the applications.

UNIT I	**SATELLITE ORBITS**	**9**

Kepler's Laws, Newton's law, orbital parameters, orbital perturbations, geo stationary vs Geo-synchronous orbits – Look Angle Determination- Limits of visibility –Eclipse-Sub satellite point –Sun transit outage-Launching Procedures - launch vehicles.

UNIT II	**SPACE SEGMENT AND EARTH SEGMENT**	**9**

Spacecraft subsystems- Structure, Primary power, Attitude and Orbit control, Thermal control and Propulsion, communication Payload and supporting subsystems, Telemetry, Tracking and command, Antenna, System reliability and design lifetime.
Earth segment - Introduction – Receive – Only home TV systems – Outdoor unit – Indoor unit for analog (FM) TV – Master antenna TV system – Community antenna TV system – Transmit – Receive earth stations – Problems.

UNIT III	**SATELLITE LINK DESIGN**	**9**

Free-space transmission –Transmission losses–Noise– Carrier to- Noise ratio – Satellite uplink and downlink Analysis and Design, Link power budget equation, E/N calculation, Effects of rain – Fade margin – Combined uplink and downlink C/N ratio – Performance impairments.

UNIT IV	**SATELLITE ACCESS**	**9**

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

UNIT V	**SATELLITE APPLICATIONS**	**9**

INTELSAT Series, INSAT, VSAT, Mobile satellite services: GSM, GPS, INMARSAT, LEO, MEO, Satellite Navigational System. Direct Broadcast satellites (DBS)- Direct to home Broadcast (DTH), Digital audio broadcast (DAB)- Worldspace services, Business TV(BTV), GRAMSAT, Specialized services – E –mail, Video conferencing, Internet.

TOTAL: (L: 45): 45 PERIODS

OUTCOMES:

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

- Explain the various terms and parameters of satellites and develop equations of orbit to locate satellite in space.
- Categorise and recognise the significance of various satellite subsystems and ground segment.

- Identify the various aspects involved in satellite communication link and measure link budget.
- Classify and grade the varied multiple access techniques.
- Develop various satellite based applications.

TEXT BOOKS:

1. Dennis Roddy, “Satellite Communication”, 4th Edition, Mc Graw Hill International, 2006.
2. Timothy Pratt, Charles Bostian and Jeremy Allnutt, “Satellite Communications”, Wiley India, 3rd Edition, 2019

REFERENCES:

1. Wilbur L.Pritchard, Hendri G. Suyderhoud, Robert A. Nelson, “Satellite Communication Systems Engineering”, Prentice Hall/Pearson, 2007.
2. N.Agarwal, “Design of Geosynchronous Space Craft”, Prentice Hall, 1986.
3. Bruce R. Elbert, “The Satellite Communication Applications”, Hand Book, Artech House Bostan London, 1997.
4. Tri T. Ha, “Digital Satellite Communication”, II nd edition, 1990.
5. Emanuel Fthenakis, “Manual of Satellite Communications”, Mc Graw Hill Book Co., 1984.
6. M.Richharia, “Satellite Communication Systems-Design Principles”, Macmillan 2003.

EC18017	SPEECH PROCESSING	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To understand speech production and speech related parameters
- To be familiar with various pattern comparison techniques
- To understand various speech modelling methods
- To gain knowledge about various speech recognition techniques
- To analyze issues in speech synthesis and evaluation

UNIT I	**BASIC CONCEPTS**	**9**

Speech Fundamentals: Articulatory Phonetics –Production and Classification of Speech Sounds; Acoustic Phonetics –Acoustics of speech production; nature of speech signal, models of speech production- purpose of speech processing, Digital processing of speech signals, Significance -Short-Time Fourier Transform, MDCT, Filter-Bank and LPC Methods

UNIT II	**SPEECH ANALYSIS**	**9**

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

UNIT III	**SPEECH MODELING**	**9**

Modeling techniques for developing speech systems: Vector quantization, Hidden Markov models, Optimal State Sequence – Viterbi Search, Baum-Welch Parameter Re-estimation, Gaussian mixture models, Support vector machines and Neural networks

UNIT IV	**SPEECH RECOGNITION**	**9**

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

UNIT V	**SPEECH SYNTHESIS**	**9**

Issues in speech synthesis, Text-to-Speech Synthesis: Concatenative and waveform synthesis methods, sub-word units for TTS, intelligibility and naturalness –role of prosody, Applications and present status, Development of speech synthesis system. Evaluation methodologies for speech synthesis systems

TOTAL: (L:45): 45 PERIODS

OUTCOMES:

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

- Explain the fundamentals of speech
- Extract and compare different speech parameters
- Identify an appropriate statistical speech model for a given application
- Design a speech recognition system.
- Categorize different speech synthesis techniques and develop a speech synthesis system.

TEXT BOOKS:

1. Lawrence Rabiner and Biing-Hwang Juang, “Fundamentals of Speech Recognition”, Pearson Education India, 2008.
2. Daniel Jurafsky and James H Martin, “Speech and Language Processing – An Introduction to Natural Language Processing, Computational Linguistics, and Speech Recognition”, Pearson Education, 2009.

REFERENCES:

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

EC18019	DEEP LEARNING AND ITS APPLICATIONS	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To understand the basic ideas and principles of Neural Networks
- To understand the basic concepts of Convolutional Neural Networks
- To understand the basic concepts of recurrent and recursive nets
- To understand and implement Deep Learning Architectures
- To understand the use of Deep Learning Applications

UNIT I	**INTRODUCTION TO DEEP LEARNING**	**9**

Feed Forward Neural Networks – Gradient Descent – Back Propagation Algorithm – Vanishing Gradient problem – Mitigation – RelU Heuristics for Avoiding Bad Local Minima – Heuristics for Faster Training – Nestors Accelerated Gradient Descent – Regularization – Dropout.

UNIT II	**CONVOLUTIONAL NEURAL NETWORKS**	**9**

CNN Architectures – Convolution – Pooling Layers – Transfer Learning – Image Classification using Transfer Learning-Popular CNN Architectures: ResNet, AlexNet – Applications

UNIT III	**RECURRENT AND RECURSIVE NETS**	**9**

Recurrent Neural Networks, Bidirectional RNNs, Encoder-decoder sequence to sequence architectures - BPTT for training RNN, Long Short-Term Memory Networks.

UNIT IV	**DEEP LEARNING ARCHITECTURES**	**9**

Learning Algorithms: Capacity - Overfitting - Underfitting - Bayesian Classification - Activation Functions: RELU, LRELU, ERELU, Unsupervised Training of Neural Networks, Restricted and Deep Boltzmann Machines, Auto Encoders

UNIT V	**APPLICATIONS OF DEEP LEARNING**	**9**

Image Processing Application: Image Segmentation – Object Detection – Automatic Image Captioning, Models for Computer Vision – Case Study: FACE Recognition - Parsing and Sentiment Analysis using Recursive Neural Networks.

TOTAL: (L: 45): 45 PERIODS

OUTCOMES:

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

- Understand the role of Deep learning in Machine Learning Applications.
- To design and implement Convolutional Neural Networks.
- Critically Analyze Different Deep Learning Models in Image Related Projects.
- Understand basic concept of Deep Learning Architectures.
- To know about applications of Deep Learning in Image Processing and Computer Vision model

TEXT BOOKS:

1. Ian Goodfellow, Yoshua Bengio, and Aaron Courville, “Deep Learning”, First Edition,

MIT Press, 2016.
2. Nikhil Buduma and Nicholas Lacascio, “Fundamentals of Deep Learning”, First Edition, O.Reilly, 2017.
3. Francois Chollet, “Deep Learning with Python”, Manning Publications, 2018

REFERENCES:

1. Josh Patterson, Adam Gibson "Deep Learning: A Practitioner's Approach", O'Reilly Media, 2017
2. Laura Graesser, Wah Loon Keng "Foundations of Deep Reinforcement Learning: Theory and Practice in Python" Addison-Wesley Professional -2020
3. Jon Krohn, Grant Beyleveld, Aglaé Bassens "Deep Learning Illustrated: A Visual, Interactive Guide to Artificial Intelligence", 1st edition Addison-Wesley Professional 2019
4. Phil Kim, “Matlab Deep Learning: With Machine Learning, Neural Networks and Artificial Intelligence”, Apress , 2017.
5. Ragav Venkatesan, Baoxin Li, “Convolutional Neural Networks in Visual Computing”, CRC Press, 2018.
6. Navin Kumar Manaswi, “Deep Learning with Applications Using Python”, Apress, 2018. 6. Joshua F. Wiley, “R Deep Learning Essentials”, Packt Publications, 2016.

EC18021	WIRELESS TECHNOLOGIES	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To understand the fundamentals of WLAN, Bluetooth and high rate Wireless Personal Area Networks (WPAN)
- To analyze the network layer protocols for wireless internet
- To understand the evolution of cellular technologies from 2G to 3G, architecture, protocol stack of 3G networks and concept of cognitive radio
- To analyze the architecture, protocol stack, security aspects of 4G Long Term Evolution standard
- To understand fundamentals of next generation networks like Software Defined Networks and Delay Tolerant Networks

UNIT I	**WIRELESS LAN**	**9**

Introduction, fundamentals of WLAN –technical issues, network architecture, IEEE 802.11-physical layer, Mac layer mechanism, CSMA/CA, RTS/CTS, Polling, Bluetooth- User scenarios, Architecture, Radio layer, Baseband layer, Link manager protocol, L2CAP, Security, SDP, IEEE 802.15.3.

UNIT II	**WIRELESS INTERNET**	**9**

Introduction –wireless internet, address mobility, inefficiency of transport layer and Application layer protocol, mobile IP – simultaneous binding, route optimization, mobile IP variations, handoffs, IPv6 advancements, IP for wireless domain, security in mobile IP, TCP in wireless domain – TCP over wireless, TCPs -traditional, snoop, indirect, mobile, transaction- oriented, impact of mobility.

UNIT III	**3G NETWORKS**	**9**

Evolution from GSM, 3G Services and Applications - UMTS network structure - Core network - UMTS Radio access - HSPA – HSUPA- HSDPA- CDMA 1X - EVDO Rev -0, Rev-A, Rev-B, Rev-C Architecture- Protocol stack, Cognitive Radio network, Spectrum Sensing.

UNIT IV	**4G - LTE**	**9**

Overview of LTE Networks - Need for LTE- From LTE to LTE-Advanced SAE:- LTE Architecture, Radio Protocol stack , Interfaces, Concept of HetNET, Quality of Service and Bandwidth Reservation - QoS metrics, Signaling for Bandwidth Requests and Grants, Bandwidth Allocation and Traffic Handling, Mobility Management, Security Protocols.

UNIT V	**INNOVATIVE NETWORKS**	**9**

Software Defined Networks – Evolution of switches and control planes – Centralized and distributed data and control planes – OpenFlow and SDN Controllers – Network Function Virtualization – Needs of the Data Centres – SDN solutions for data centres - Delay Tolerant Networks – Overlay architecture – Bundle Protocol – Opportunistic routing and Epidemic routing

TOTAL: (L: 45): 45 PERIODS

OUTCOMES:

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

- Classify the wireless LAN technologies

- Categorize IP and TCP protocols in wireless domain
- Compare 2G,3G and 3.5 G technologies in mobile cellular networks
- Interrelate advanced wireless networking technologies, their features and services in 4G networks
- Analyze the architecture and protocols for next generation networks like SDN and DTN.

TEXT BOOKS:

1. Jochen Schiller, ―Mobile Communication‖, Pearson education, 2nd edition 2005.
2. Vijay. K. Garg, ―Wireless Communication and Networking‖, Morgan Kaufmann Publishers, 2007.

REFERENCES:

1.Abd-Elhamid M. Taha and Hossam S. Hassanein and Najah Abu Ali, ―LTE, LTEAdvanced and Wimax towards IMT-advanced networks‖ John Wiley &Sons , 2012.
2. HarriHolma and Antti Toskala, ―HSDPA/HSUPA for UMTS‖, John Wiley & Sons, 2006.
3. JuhaKorhonen, ―Introduction to 3G Mobile Communication‖, Artech House, 2003.
4. Larry J. Greenstein, Andrea J. Goldsmith, ―Principles of Cognitive Radio‖, Cambridge University press, 2013.
5.Paul Goransson, Chuck Black, ―Software Defined Networks: A Comprehensive Approach‖, Morgan Kauffman, 2014

EC18002	ADHOC AND SENSOR NETWORKS	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To introduce the concept of Adhoc networks
- To get insights of MAC protocols for Adhoc networks
- To introduce the energy management techniques for adhoc networks
- To provide overview of the wireless sensor networks
- To introduce the protocols and QoS services of wireless sensor networks

UNIT I	**ADHOC WIRELESS NETWORKS**	**9**

Introduction- Cellular and Adhoc Wireless Networks, Applications of Adhoc Wireless Networks; Issues in Adhoc Wireless Networks- Medium Access schems, routing, multicasting, transport layer protocols, pricing scheme, QoS provisioning, self organisation, security, Addressing and service discovery, energy management, scalability, deployment consideartions; Adhoc wireless Internet

UNIT II	**MAC PROTOCOLS FOR ADHOC WIRELESS NETWORKS**	**9**

Issues in designing a MAC protocol for Adhoc Wireless networks, design goals of a MAC protocol for Adhoc wireless networks,; Contention based protocols- MACAW, floor acquisition multiple access protocols; Contention based protocols with reservation mechanisms- Distributed packet reservation multiple access protocol, collision avoidance time allocation protocol; Contention based MAC protocols with scheduling mechanisms- distributed wireless ordering protocol; MAC protocols using directional antennas- Directional busy tone based MAC protocol, directional MAC protocols for Adhoc wireless networks

UNIT III	**ENERGY MANAGEMENT IN ADHOC WIRELESS NETWORKS**	**9**

Need for energy management in adhoc wireless networks; classification of energy management schemes- Battery management schemes- device dependent schemes, data link layer and network layer solutions; transmission power management schemes- data link layer, network layer solutions; System power management schemes

UNIT IV	**WIRELESS SENSOR NETWORKS**	**9**

Introduction, Applications of sensor networks, comparison with adhoc wireless networks, issues and challenges in designing a sensor network; sensor network architecture- layered architecture, clustered architecture, Data dissemination- flooding, gossiping, rumor routing, sequential assignment routing, directed diffusion; data gathering- direct transmission, power efficient gathering for sensor information systems, binary scheme, chain based three level scheme

UNIT V	**MAC PROTOCOLS AND QUALITY OF A SENSOR NETWORKS**	**9**

MAC protocols - self organising MAC for sensor networks, eavesdrop and register, Hybrid TDMA/FDMA, CSMA- based MAC Protocols; Location Discovery- Indoor localisation, sensor network localisation; quality of a sensor network- coverage, exposure; evolving standards; other issues- energy efficient design, synchronisation, transport layer issues and security

OUTCOMES:

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

- Differentiate the cellular networks and adhoc networks.

- Identify the various protocols in adhoc networks
- Design a adhoc system with energy management schemes
- Differentiate the adhoc and sensor networks.
- Learn various MAC protocols and Quality of sensor networks.

TEXT BOOKS:

1. C.Siva Ram Murthy and B.S. Manoj, “Adhoc Wireless Sensor Networks”, Pearson Publications, 2017.
2. Carlos De Morais Cordeiro, Dharma Prakash Agrawal “Ad Hoc & Sensor Networks: Theory and Applications”, World Scientific Publishing Company, 2006.

REFERENCES:

1. Waltenegus Dargie , Christian Poellabauer, “Fundamentals Of Wireless Sensor Networks Theory And Practice”, By John Wiley & Sons Publications, 2011.
2. Sabrie Soloman, “Sensors Handbook" by McGraw Hill publication. 2009.
3. Feng Zhao, Leonidas Guibas, “Wireless Sensor Networks”, Elsevier Publications, 2004.

EC18004	COGNITIVE RADIO COMMUNICATION	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To enable the students to understand the need, characteristics and benefits and applications of Software Defined Radio and Cognitive Radio technologies.
- To expose the students to gain knowledge on the various methods of Spectrum Sensing Identification function of Cognitive Radio and the associated Trade – offs.
- To make the students to learn about the Cooperative Communication techniques
- To provide insights of Theoretical Limits of Information in Cognitive radio Networks.
- To enable the students to identify the need and suitability of Cognitive radio technology for Public Safety Applications.

UNIT I	**COGNITIVE RADIO TECHNOLOGY**	**9**

Introduction - Software-Defined Radio, Cognitive Radio – Evolution of Cognitive Radio, Spectrum Measurements and Usage- Applications for Spectrum Occupancy Data

UNIT II	**SPECTRUM SENSING AND IDENTIFICATION**	**9**

Primary Signal Detection: Energy Detector, Cyclostationary Feature Detector, Matched Filter, Cooperative Sensing, Definition and Implications of Spectrum Opportunity, Spectrum Opportunity Detection, Fundamental Trade-offs: Performance versus Constraint, MAC Layer Performance - Measures, Global Interference Model, Local Interference Model, Fundamental Trade-offs: Sensing Accuracy versus Sensing Overhead.

UNIT III	**USER COOPERATIVE COMMUNICATION**	**9**

User Cooperation and Cognitive Systems, Relay Channels: General Three-Node Relay Channel, Wireless Relay Channel, User Cooperation in Wireless Networks: Two-User Cooperative Network, Cooperative Wireless Network, Multihop Relay Channel

UNIT IV	**INFORMATION THEORETICAL LIMITS ON CR NETWORKS**	**9**

Types of Cognitive Behaviour, Interference - Avoiding Behaviour: Spectrum Interweave, Interference Controlled Behaviour: Spectrum Underlay, Underlay in Small Networks: Achievable Rates, Underlay in Large Networks: Scaling Laws, Interference-Mitigating Behaviour: Spectrum Overlay, Opportunistic Interference Cancellation, Asymmetrically Cooperating Cognitive Radio Channels.

UNIT V	**PUBLIC SAFETY AND COGNITIVE RADIO**	**9**

Introduction- Requirements, Commercial Wireless Communication Networks, Economic Value of the Spectrum, Benefits of Cognitive Radio; Standards for Public Safety Communication- TETRA, C2000; Applications of Cognitive Radio- The Firework Disaster in The Netherlands – A Case Study, Bandwidth Requirements, Spectrum Organization, Propagation Conditions, White Space Assessment, System Spectral Efficiency, Antijamming

TOTAL: (L: 45): 45 PERIODS

OUTCOMES:

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

- To identify the application of cognitive radio technology to the different wireless communication standards.
- To identify suitable spectrum sensing technique for a given wireless communication scenario to improve the performance.

- To apply user cooperative communication techniques to improve the performance of cognitive radio networks.
- To apply proper interference avoiding & controlling techniques to improve the performance of cognitive radio networks.
- To Identify the requirements of public safety applications and apply cognitive radio technology to meet out the same.

TEXT BOOKS:

1. Alexander M. Wyglinski, Maziarnekovee, Y. Thomas Hu, "Cognitive Radio Communication and Networks", Elsevier, 2010.
2. Joseph Mitola III," Software Radio Architecture: Object-Oriented Approaches to Wireless System Engineering", John Wiley & Sons Ltd. 2000.

REFERENCES:

1. Thomas W.Rondeau, Charles W. Bostain, "Artificial Intelligence in Wireless communication", ARTECH HOUSE .2009.
2. Bruce A. Fette, "Cognitive Radio Technology", Elsevier, 2009.

EC18006	CRYPTOGRAPHY AND COMMUNICATION NETWORK SECURITY	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To understand OSI security architecture and classical encryption techniques.
- To understand various block cipher and stream cipher models.
- To acquire fundamental knowledge on the concept of authentication functions.
- To describe the principles of public key cryptosystems, hash functions and digital signature.
- To understand the network and system level security.

UNIT I	**SYMMETRIC CIPHERS**	**9**

OSI Security Architecture-Classical Encryption techniques-Cipher Principles-Data Encryption Standard-Block Cipher Design Principles and Modes of Operation-Evaluation criteria for AES-AES Cipher-Triple DES-Placement of Encryption Function-Traffic Confidentiality

UNIT II	**PUBLIC KEY CRYPTOGRAPHY**	**9**

Introduction to Number Theory-Key Management - Diffie-Hellman key Exchange-Elliptic Curve Arithmetic and Cryptography - Public Key Cryptography and RSA.

UNIT III	**AUTHENTICATION AND HASH FUNCTION**	**9**

Authentication requirements - Authentication functions-Message Authentication Codes-Hash Functions-Security of Hash Functions and MACs-Secure Hash Algorithm–HMAC-Digital Signatures-Authentication Protocols-Digital Signature Standard.

UNIT IV	**NETWORK SECURITY**	**9**

Authentication Applications: Kerberos-X.509 Authentication Service-Electronic Mail Security-PGP-S/MIME-IP Security-Web Security.

UNIT V	**SYSTEM SECURITY**	**9**

Intrusion detection - password management - Viruses and related Threats - Virus Counter measures - Firewall Design Principles – Trusted Systems.

TOTAL: (L: 45): 45 PERIODS

OUTCOMES:

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

- Comparison of classical encryption techniques.
- Compare and implement symmetric and asymmetric key algorithms for real time applications.
- Realize the authentication and hash function concepts.
- Figure out network security issues and identify suitable solution.
- Figure out system level security issues and identify suitable solution.

TEXT BOOKS:

1. William Stallings, “Cryptography and Network Security”, Principles and Practice, 4th edition, PHI, 2005.
2. Behrouz A. Forouzan, “Cryptography and Network Security”, 2nd edition Tata Mc Graw Hill, 2010.

REFERENCES:

1. Charlie Kaufman and Radia Perlman, Mike Speciner, “Network Security, Second Edition, Private Communication in Public World”, PHI 2002.
2. Bruce Schneier and Neils Ferguson, “Practical Cryptography”, First Edition, Wiley Dreamtech India Pvt Ltd, 2003.

EC18008	DIGITAL IMAGE PROCESSING	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To get exposed to different image enhancement techniques and color image analysis .
- To learn about image transformation and image restoration.
- To learn about image segmentation.
- To get exposed to different classification techniques.
- To study various applications of image processing.

UNIT I	**INTRODUCTION TO IMAGE PROCESSING AND IMAGE TRANSFORMS**	**9**

Introduction-Introduction-Origins, Fundamental steps, Components, Fundamentals-Elements of Visual Perception, Image Sensing & Acquisition, Sampling and Quantization, Relationship between Pixels. Transforms: Discrete Fourier Transform, Discrete sine transform, Discrete cosine transform, Walsh, Hadamard transform.

UNIT II	**IMAGE ENHANCEMENT AND COLOR IMAGE PROCESSING**	**9**

Spatial Domain Enhancement: Gray level transformations – Histogram processing –, Basics of Spatial Filtering–Smoothing and Sharpening Spatial Filtering, Mean Filters – Order Statistic filters Frequency Domain Enhancement: Smoothing and Sharpening frequency domain filters – Ideal, Butterworth and Gaussian filters, Homomorphic filters
Color Image processing: Color: Models- RGB and HSI models, Conversion of RGB to HSI and vice versa.

UNIT III	**IMAGE RESTORATION AND SEGMENTATION**	**9**

Image Restoration: Noise models, Image degradation and restoration model, Noise filters-Inverse filtering, Wiener filtering. Image Segmentation: Detection of Discontinuities–Edge detection and Thresholding – Active contours- image segmentation using Snakes, Region based segmentation; Morphological processing- erosion and dilation.

UNIT IV	**IMAGE CLASSIFICATION**	**9**

Pattern classification: Statistical classifier-Neural Networks and Deep learning: Multilayer Feed forward Neural Networks, Deep Convolutional Neural Networks.

UNIT V	**IMAGE COMPRESSION AND APPLICATIONS OF IMAGE PROCESSING**	**9**

Image Compression: Fundamentals – Image Compression models – Error Free Compression – Variable Length Coding-Huffman and Arithmetic coding – Lossy Compression – Lossy Predictive Coding – JPEG Compression Standards.Applications of Image processing: Face Recognition, Finger print Recognition, In-Vehicle Vision systems.

TOTAL: (L: 45): 45 PERIODS

OUTCOMES:

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

- Examine the different image enhancement techniques.
- Identify and Interrelate the various image compression techniques.
- Assess various image transformation techniques and Image analysis.

- Determine the image segmentation and classification techniques for various applications.
- Infer the various image processing techniques employed for real time applications

TEXT BOOKS:

1. Rafael C.Gonzalez & Richard E.Woods – Digital Image Processing – Pearson Education-4/e – Reprint 2018
2. Rafael C. Gonzalez, Richard E. Woods, Steven L. Eddins, "Digital Image Processing Using MATLAB", Third Edition Tata Mc Graw Hill Pvt. Ltd., 2020.
3. Anil Jain K. "Fundamentals of Digital Image Processing", PHI Learning Pvt. Ltd. Third edition, 2015.

REFERENCES:

1. Willliam K Pratt, "Digital Image Processing", John Willey, Fourth edition,2015.
2. Malay K. Pakhira, "Digital Image Processing and Pattern Recognition", First Edition, PHI Learning Pvt. Ltd., 2011.
3. E. R. Davies, "Computer & Machine Vision", Fifth Edition, Academic Press, 2017.
4. S.Sridhar, "Digital Image Processing", Oxford University Press, second edition, 2016.

EC18010	DIGITAL SWITCHING AND TRANSMISSION	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To introduce fundamental concepts in Communication networks
- To introduce different types of signaling in digital telephony
- To introduce various transmission schemes for telephony and broadband
- To introduce principles and evolution of Switching systems
- To introduce modeling and analysis techniques for data transmission

UNIT I	**INTRODUCTION**	**9**

Overview of existing Voice, Data and Multimedia Networks and Services; Review of Basic Communication principles; Synchronous and Asynchronous transmission, Line Codes

UNIT II	**TRUNK TRANSMISSION**	**9**

Multiplexing & Framing - types and standards; Trunk signaling; Optical Transmission-line codes and Muxing: SONET/SDH; ATM; Microwave and Satellite Systems

UNIT III	**LOCAL LOOP TRANSMISSION**	**9**

The Analog Local Loop; ISDN local loop; DSL and ADSL; Wireless Local Loop; Fiber in the loop; Mobile and Satellite Phone local loop

UNIT IV	**SWITCHING**	**9**

Evolution; Space switching, Time switching and Combination Switching; Blocking and Delay characteristics; Message, Packet and ATM switching; Advances in switching techniques – shared memory fast packet switches, shared medium fast packet switches and space division fast packet switches, Photonic switching - Optical TDM, WDM.

UNIT V	**TELE TRAFFIC ENGINEERING**	**9**

Telecom Network Modeling; Arrival Process; Network Blocking performance; Delay Networks-Queuing system analysis and delay performance

TOTAL: (L: 45): 45 PERIODS

OUTCOMES:

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

- Basic principles behind voice, data and multimedia communication.
- Understand the different type of signaling in Trunk transmission.
- Understand and compare Local loop transmission schemes.
- Analyze different Switching techniques for data transmission.
- Model and analyze the performance of telecom network.

TEXT BOOKS:

1. J. Bellamy, "Digital Telephony", John Wiley, 3rd Edition, 2003
2. JE Flood, "Telecommunications Switching, Traffic and Networks", Pearson, 2005

REFERENCES:

1. R.A.Thompson, "Telephone switching Systems", Artech House Publishers, 2000.
2. W. Stalling, "Data and Computer Communications", Prentice Hall, 1993.
3. T.N.Saadawi, M.H.Ammar, A.E.Hakeem, "Fundamentals of Telecommunication Networks", Wiley Interscience, 1994.
4. W.D. Reeve, "Subscriber Loop Signalling and Transmission Hand book", IEEE Press

(Telecomm Handbook Series), 1995.
5. Tarmo Anttalaien, "Introduction to Telecommunication Network Engineering", 2nd edition, Artech House, 2003.
6. T. Viswanathan, "Telecommunication Switching Systems", Prentice-Hall, 1992.

EC18012	ELECTROMAGNETIC INTERFERENCE AND COMPATIBILITY	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To introduce the concepts of electromagnetic interference and electromagnetic Compatibility
- To understand various modes of electromagnetic interference coupling principles.
- To study the electromagnetic interference control techniques.
- To get comprehensive insight of the current EMC standards and regulations.
- To infer on electromagnetic interference measurements and Instruments.

UNIT I	**BASIC THEORY**	**9**

Introduction to EMI and EMC, Intra and inter system EMI, Elements of Interference, Sources and Victims of EMI, Conducted and Radiated EMI emission and susceptibility, Case Histories, Radiation hazards to humans, Various issues of EMC, EMC Testing categories EMC Engineering Application.

UNIT II	**COUPLING MECHANISM**	**9**

Electromagnetic field sources and Coupling paths, Coupling via the supply network, Common mode coupling, Differential mode coupling, Impedance coupling, Inductive and Capacitive coupling, Radioactive coupling, Ground loop coupling, Cable related emissions and coupling, Transient sources, Automotive transients.

UNIT III	**EMI MITIGATION TECHNIQUES**	**9**

Working principle of Shielding and Murphy‟s Law, LF Magnetic shielding, Apertures and shielding effectiveness, Choice of Materials for H, E, and free space fields, Gasketting and sealing, PCB Level shielding, Principle of Grounding, Isolated grounds, Grounding strategies for Large systems, Grounding for mixed signal systems, Filter types and operation, Surge protection devices, Transient Protection.

UNIT IV	**STANDARD AND REGULATION**	**9**

Need for Standards, Generic/General Standards for Residential and Industrial environment, Basic Standards, Product Standards, National and International EMI Standardizing Organizations; IEC, ANSI, FCC, AS/NZS, CISPR, BSI, CENELEC, ACEC. Electro Magnetic Emission and susceptibility standards and specifications, MIL461E Standards.

UNIT V	**EMI TEST METHODS AND INSTRUMENTATION**	**9**

Fundamental considerations, EMI Shielding effectiveness tests, Open field test, TEM cell for immunity test, Shielded chamber, Shielded anechoic chamber, EMI test receivers, Spectrum analyzer, EMI test wave simulators, EMI coupling networks, Line impedance stabilization networks, Feed through capacitors, Antennas, Current probes, MIL -STD test methods, Civilian STD test methods

TOTAL: (L: 45): 45 PERIODS

OUTCOMES:

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

- Gain knowledge to understand the concept of EMI / EMC related to product design & development.

- Analyze different EM coupling principles and its impact on performance of electronic system.
- Know how to mitigate electromagnetic interference using the concepts of susceptibility and immunity
- Have broad knowledge of various current leading edge industry standards across the globe.
- Measure emission and immunity level from different systems to couple with the prescribed EMC standards.

TEXT BOOKS:

1. V Prasad Kodali, "Engineering Electromagnetic Compatibility", IEEE Press, Newyork, 2001.
2. Bemhard Keiser, "Principles of Electromagnetic Compatibility", 3rd Ed, Artech house, Norwood, 1986.
3. Clayton Paul, "Introduction to Electromagnetic Compatibility", Wiley Interscience, 2006.

REFERENCES:

1. Daryl Gerke and William Kimmel, "EDN‟s Designer‟s Guide to Electromagnetic Compatibility", Elsevier Science & Technology Books, 2002.
2. Dr Kenneth L Kaiser, "The Electromagnetic Compatibility Handbook", CRC Press 2005.
3. Electromagnetic Compatibility by Norman Violette, Published by Springer, 2013.
4. Electromagnetic Interference and Compatibility: Electrical noise and EMI specifications Volume 1 of A Handbook Series on Electromagnetic Interference and Compatibility, Donald R. J. White Publisher-Don white consultants Original from the University of Michigan Digitized 6 Dec 2007.
5. Henry W. Ott, "Electromagnetic Compatibility Engineering", John Wiley & Sons Inc, Newyork, 2009.
6. W Scott Bennett, "Control and Measurement of Unintentional Electromagnetic Radiation", John Wiley & Sons Inc., (Wiley Inter science Series) 1997.

EC18014	INFORMATION THEORY	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To understand the principles of Information theory.
- To study the different data compression techniques.
- To learn the channel classification and capacity.
- To gain knowledge on differential entropy and Gaussian channel capacity.
- To understand the characterization of Rate Distortion and Gaussian channel.

UNIT I	**ENTROPY AND MUTUAL INFORMATION**	**9**

Entropy, Joint, Conditional and Relative Entropies, Mutual Information, Chain Rules for Entopy, Jensen's Inequality and Its Consequences, Log Sum Inequality and Its Applications, Data-Processing Inequality and Fano's Inequality.

UNIT II	**DATA COMPRESSION**	**9**

Examples of Codes, Kraft Inequality, Optimal Codes Bounds on the Optimal Code Length, Kraft Inequality for Uniquely Decodable Codes, Huffman Codes, Optimality of Huffman Codes, Shannon–Fano–Elias Coding, Competitive Optimality of the Shannon Code.

UNIT III	**CHANNEL CAPACITY**	**9**

Noiseless Binary Channel, Noisy Channel with Non overlapping Outputs, Binary Symmetric Channel, Binary Erasure Channel, Symmetric Channels, Properties of Channel Capacity, Definitions, Jointly Typical Sequences, Channel Coding Theorem, Zero-Error Codes, Fano's Inequality and the Converse to the Coding Theorem, Equality in the Converse to the Channel Coding Theorem, Hamming Codes.

UNIT IV	**DIFFERENTIAL ENTROPY AND GAUSSIAN CHANNEL**	**9**

Definitions, Relation of Differential Entropy to Discrete Entropy, Joint and Conditional Differential Entropy, Properties of Differential Entropy, Relative Entropy and Mutual Information, Gaussian Channel: Definitions and Capacity, Parallel Gaussian Channel

UNIT V	**RATE DISTORTION THEORY**	**9**

Quantization, Definitions, Calculation of the Rate Distortion Function - Binary Source and Gaussian Source, Converse to the Rate Distortion Theorem, Achievability of the Rate Distortion Function, Strongly Typical Sequences and Rate Distortion, Characterization of the Rate Distortion Function, Computation of Channel Capacity and the Rate Distortion Function.

TOTAL: (L: 45): 45 PERIODS

OUTCOMES:

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

- Identify various fundamental limits over information transmission.
- Apply information theory in source coding.
- Differentiate the various types of channels and determine their capacity
- Distinguish various differential and discrete entropies.
- Apply characterization of rate distortion to the computation of channel capacity.

TEXT BOOKS:

1. T. Cover and J. Thomas, "Elements of Information Theory", Second Edition. Wiley-Interscience, 2006.
2. Simon Haykin, "Communication Systems", 4th edition, Wiley Publications, 2013.

REFERENCES:

1. Das, S.K.Mullick and P.K.Chatterjee, "Principles of Digital Communication", Wiley Eastern Limited, 1986.
2. K.Sam Shanmugam, "Digital and Analog Communication Systems", John Wiley and Sons, 1985.
3. A.J.Viterbi and J.K.Omura, "Principles of Digital Communication and Coding", McGraw Hill, 1979.

GE18051	INTELLECTUAL PROPERTY RIGHTS (Common to all Branches Except BT)	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To understand the process and need for protecting technology innovations through Intellectual Property Rights

UNIT I	**TECHNOLOGICAL INNOVATIONS**	**10**

The process of technological innovation - factors contributing to successful technological innovation - the need for creativity and innovation - problem solving and creativity through brain storming - different techniques - Selection criteria - screening ideas for new products - evaluation techniques. Protection of IP as a factor in R&D and few case studies.

UNIT II	**INTRODUCTION TO IPR & RELATED AGREEMENTS AND TREATIES**	**8**

Types of IP: Patents, Trademarks, Copyright & Related Rights, Industrial Design, Traditional Knowledge, Geographical Indications. History of GATT & TRIPS Agreement; Madrid Agreement; Hague Agreement; WIPO Treaties; Budapest Treaty; PCT; Indian Patent Act 1970 & recent amendments.

UNIT III	**BASICS OF PATENTS AND CONCEPT OF PRIOR ART**	**10**

Introduction to Patents; Types of patent applications: Ordinary, PCT, Conventional, Divisional and Patent of Addition; Specifications: Provisional and complete; Forms and fees Invention in context of "prior art"; Patent databases; Searching International Databases; Country-wise patent searches, USPTO, EPO, PATENTScope (WIPO), IPO, etc.)

UNIT IV	**PATENT FILING PROCEDURES**	**9**

National & PCT filing procedure; Time frame and cost; Status of the patent applications filed; Precautions while patenting – disclosure/non-disclosure; Financial assistance for patenting - introduction to existing schemes Patent licensing and agreement Patent infringement- meaning, scope, litigation, case studies

UNIT V	**PATENT RIGTS AND NEW DEVELOPMENTS IN IPR**	**8**

Scope of Patent Rights. Licensing and transfer of technology. Patent information and databases. Geographical Indications. New Developments in IPR: Administration of Patent System.

TOTAL: (L: 45): 45 PERIODS

OUTCOMES:

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

- Interpret the process of problem solving through technological innovations.
- Infer the appropriate IPR elements for protecting intellectual property.
- Illustrate the concept of prior art search and performing it.
- Summarize the procedure for filing patent.
- Outline the scope of patent rights for licensing and transfer of technology.

TEXT BOOKS:

1. Ramappa, T. “Intellectual Property Rights Under WTO”, S. Chand, 2008
2. BAREACT, Indian Patent Act 1970 Acts & Rules, Universal Law Publishing Co. Pvt. Ltd., 2007
3. Adair, J. “Effective Innovation”, 1st Ed., Macmillan Publishing, 2003

REFERENCES:

1. Robert P. Merges, Peter S. Menell and Mark A. Lemley, “Intellectual Property in New Technological Age”, Aspen Publishers, 2016.
2. Kankanala C., Genetic Patent Law & Strategy, 1st Edition, Manupatra Information Solution Pvt. Ltd., 2007
3. Nystrom, H. Creativity and Innovation, 2nd Ed., John Wiley & Sons, 1996.

EC18016	MACHINE LEARNING	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To introduce students to theoretical concepts and practical issues associated with pattern recognition
- To learn about supervised and unsupervised pattern classifiers.
- To familiarize about parametric and non parametric approaches.
- To explore the role of linear discriminant and ANN in pattern recognition.
- To understand the application of graphical models for pattern classifier.

UNIT I INTRODUCTION TO PATTERN RECOGNITION **9**

Pattern Recognition (PR) – Overview – Relationship with other areas – Applications – Classification – Description – Patterns and Features – Training and Learning – PR approaches
Statistical PR –Introduction – Gaussian distribution - Bayes decision theory and Classifiers - Normal density and discriminant functions - Decision surfaces - Risks and errors

UNIT II SUPERVISED LEARNING - PARAMETRIC& NON PARAMETRIC APPROACHES **9**

Supervised learning - Parametric estimation– Maximum Likelihood estimation – Bayesian parameter estimation.
Nonparametric estimation – Parzen Window – K Nearest Neighbour method.

UNIT III UNSUPERVISED LEARNING METHODS **9**

Component Analysis and Dimension Reduction: Concept of feature extraction and dimensionality, Curse of dimensionality, Dimension reduction methods - Fisher discriminant analysis, Principal Component Analysis - Hidden Markov Models (HMM) basic concepts
Clustering - Criterion for clustering - Clustering Algorithms: K-Means - Expectation Maximization, Classifier Ensembles - Bagging - Boosting - Adaboost

UNIT IV LINEAR DISCRIMINANTS & ANN **9**

Linear Discriminant based algorithm: Perceptron - Support Vector Machines - Multilayer perceptrons - Back Propagation algorithm - Artificial Neural networks

UNIT V GRAPHICAL MODELS **9**

Introductory ideas and relations- Bayesian Networks - Sequential Models: State-Space Models - Hidden Markov Models - Dynamic Bayesian Networks

TOTAL: (L: 45): 45 PERIODS

OUTCOMES:

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

- Distinguish between supervised and unsupervised classifiers
- Categorize the data and identify the patterns.
- Illustrate methods for automatic training of classification systems
- Examine classification problems probabilistically and estimate classifier performance
- Use the principles of Bayesian parameter estimation and apply them in relatively simple probabilistic models

TEXT BOOKS:

1. Bishop, C. M. “Pattern Recognition and Machine Learning” Springer 2007.

2. Duda, R.O., Hart, P.E., and Stork, D.G. “Pattern Classification” Wiley-Interscience , 2nd Edition 2001.

REFERENCES:

1. Robert J.Schalkoff, Pattern Recognition Statistical, Structural and Neural Approaches, John Wiley & Sons Inc., New York, 1992.
2. Marsland, S. “Machine Learning: An Algorithmic Perspective” CRC Press. 2009 (Also uses Python.)
3. S.Theodoridis and K. Koutroumbas, “Pattern Recognition”, 4/e, Academic Press, 2009
4. Russell, S. and Norvig, N. “Artificial Intelligence: A Modern Approach” Prentice Hall Series in Artificial Intelligence. 2003.
5. Morton Nadier and Eric Smith P., “Pattern Recognition Engineering”, John Wiley & Sons, New York, 1993.

EE18024	NANOELECTRONICS (Common to EE and EC)	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To provide a good understanding of the nano electronics and its advancement
- To provide a good understanding of the carrier transport in MOS
- To develop MOS devices using the concepts mentioned above.
- To develop models and characterize MOS devices

UNIT I	**INTRODUCTION TO NANOELECTRONICS**	**9**

Moore's Law –Node technology, Basic CMOS Process flow- MOS Scaling theory, Issues in scaling MOS transistors: Short channel effects, Description of a typical 65 nm CMOS technology. Gate oxide thickness scaling trend, SiO2 vs High-k gate dielectrics

UNIT II	**ELECTRON TRANSPORT**	**9**

Electron transport in semiconductors and nanostructures- Time and length scales of the electrons in solids- Statistics of the electrons in solids and nanostructures- Density of states of electrons in nanostructures- Electron transport in nanostructures-Electrons in traditional low-dimensional structures- Electrons in quantum wells- Electrons in quantum wires- Electrons in quantum dots

UNIT III	**MOS CAPACITOR**	**9**

C-V characteristics; Effect of metal work function, oxide and interface trapped charges. Threshold voltage. Tunnelling current.

UNIT IV	**MOSFET**	**9**

Threshold based models of static I-V characteristics: Channel length modulation, field dependent mobility, short channel and narrow width effects; Subthreshold current. Quantum mechanical effects Capacitances, concept of non-reciprocal capacitances.

UNIT V	**MOSFET MODELING**	**9**

Dynamic behaviour under small and large signals. Surface potential and charge based models. Model parameters and their extraction. SOI MOSFETs, Double Gate MOSFETs and FinFETs.

TOTAL: (L: 45): 45 PERIODS

OUTCOMES:

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

- Understand the fundamentals of nanoelectronics.
- Understand the transport phenomenon at the nanoscale.
- Understand the functionality of MOS capacitors.
- Analyze the Characteristics of MOSFET.
- Model and characterize various MOS devices.

TEXT BOOKS:

1. N. DasGupta and A. DasGupta, "Semiconductor Devices Modelling and Technology, PHI Learning Pvt.Ltd."
2. Lessons from Nanoelectronics A New Perspective on Transport, Supriyo Datta, World Scientific Publishing Co. Pte. Ltd., 2012

REFERENCES:

1. Streetman and Banerjee, “Solid State Electronic Devices”, Prentice-Hall
2. Paolo Antognetti, Giuseppe Massobrio, Semiconductor Device Modeling with Spice

EC18018	NEXT GENERATION NETWORKS – 5G	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To introduce the next generation networks and their need
- To provide overview of 5G networks
- To know the architecture of 5G mobile networks
- To provide insights on 5G broadband architecture
- To know the security issues related to 5G networks

UNIT I	**DRIVERS FOR 5G**	**9**

Introduction- Evolution of LTE Technology to Beyond 4G, 5G Roadmap, 10 Pillars of 5G, 5G in Europe, 5G in North America, 5G in Asia, 5G Architecture

UNIT II	**THE 5G INTERNET**	**9**

Introduction, Internet of Things and Context-Awareness; Networking Reconfiguration and Virtualisation Support; Mobility; Quality of Service Control, Emerging Approach for Resource Over-Provisioning

UNIT III	**SMALL CELLS FOR 5G MOBILE NETWORKS**	**9**

Introduction; What are Small Cells?; Capacity Limits and Achievable Gains with Densification; Mobile Data Demand; Demand vs Capacity; Small-Cell Challenges

UNIT IV	**UNIFIED 5G BROADCAST - BROADCAST ARCHITECTURE**	**9**

Introduction, Background; Challenges; Candidate Network Architectures for a BC-BB Convergent Solution- Cellular Broadcasting in the TV Spectrum, Hybrid Network Approach – Using DVB-T2 FEFs for LTE Transmission, Next Generation Common Broadcasting System; BC-BB Architecture Options, Large-Scale Simulation and Assessment of BC-BB Convergent Options

UNIT V	**EVOLUTION OF SON AND SECURITY FOR 5G NETWORKS**	**9**

Introduction; SON in UMTS and LTE; The Need for SON in 5G, New SON Architecture for 5G; Security Issues and Challenges in 5G Communications Systems- User Equipment, Access Networks, Mobile Operator's Core Network, External IP Networks

TOTAL: (L: 45): 45 PERIODS

OUTCOMES:

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

- Know the driving force for 5G networks
- Differentiate the internet used in 5G and the previous generations
- Construct small cell architecture for 5G mobile networks
- Design an architecture for 5G networks
- Analyse the self organisation networks and security issues related to 5G networks

TEXT BOOKS:

1. Jonathan Rodriguez, "Fundamentals of 5G Mobile Networks", Wiley 2015
2. Jyh-Cheng Chen and Tao Zhang, "IP-Based Next-GenerationWireless Networks Systems, Architectures, and Protocols," John Wiley & Sons, Publication, 2006

REFERENCES:

1. Zhang, Yin, Chen, Min, “Cloud Based 5G Wireless Networks”, Springer, 2016
2. http://ieeexplore.ieee.org/document/7414384/
3. http://ieeexplore.ieee.org/document/7794586/

EC18020	PARALLEL ARCHITECTURE	L	T	P	C
		3	0	0	3

OBJECTIVES:

- Understand the micro-architectural design of processors.
- Learn about the various techniques used to obtain performance improvement and power savings in current processors.
- Understand the memory performance and peripheral devices.
- Expose the different types of multicore architectures.
- Expose the RISC - V architecture.

UNIT I	**INSTRUCTION LEVEL PARALLELISM**	**9**

ILP – Concepts and challenges – Hardware and software approaches – Dynamic scheduling – Speculation – Branch prediction – Multiple Instruction issue – Limitations of ILP.

UNIT II	**DATA LEVEL PARALLELISM AND THREAD LEVEL PARALLELISM**	**9**

Vector Architecture – Loop level parallelism- Symmetric and distributed shared memory architectures –Synchronization – Models of memory consistency - Multithreading

UNIT III	**MEMORY AND I/O**	**9**

Cache performance – Reducing cache miss penalty and miss rate – Reducing hit time – Main memory and performance – Memory technology. Types of storage devices – Buses – RAID – Reliability, availability and dependability – I/O performance measures.

UNIT IV	**MULTI-CORE ARCHITECTURES**	**9**

SMT and CMP architectures – Design issues – Case studies – Intel Multi-core architecture - heterogenous multi-core processors – Case study: IBM Cell Processor.

UNIT V	**RISC - V ARCHITECTURE**	**9**

RISC-V instruction set architecture - Addressing modes - Parallelism and Instructions: Synchronization - Local and Global Optimizations - Case study: The Intel Core i7 920.

TOTAL: (L: 45): 45 PERIODS

OUTCOMES:

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

- Use the hardware and software approaches to achieve Instruction Level Parallelism.
- Understand architectures and memory models to achieve Data Level Parallelism and Thread Level Parallelism.
- Determine cache performance and measure I/O performance.
- Analyze the various multicore architectures.
- Analyze RISC-V architecture.

TEXT BOOKS:

1. John L. Hennessey and David A. Patterson, “Computer architecture – A quantitative approach”, Morgan Kaufmann / Elsevier Publishers, Fifth Edition, 2012.
2. David A. Patterson and John L. Hennessy “Computer Organization and Design - The Hardware/Software Interface: RISC-V Edition “ , MK Publishers, Elsevier.

REFERENCES:

1. David E. Culler, Jaswinder Pal Singh, "Parallel computing architecture: A hardware/software approach", Morgan Kaufmann /Elsevier Publishers, 1999.
2. Kai Hwang and Faye Briggs, "Computer Architecture and Parallel Processing", McGraw-Hill International Edition, 2000.
3. Kai Hwang and Zhi.Wei Xu, "Scalable Parallel Computing", Tata McGraw-Hill, New Delhi, 2003.
4. Sima D, Fountain T and Kacsuk P, "Advanced Computer Architectures: A Design Space Approach", Addison Wesley, 2000.

GE18054	PROFESSIONAL ETHICS (Common to CE, CS, IT, EE, EC and MR)	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To enable the students to create an awareness on Engineering Ethics and Human Values, to instill Moral and Social Values and Loyalty and to appreciate the rights of others.

UNIT I	**HUMAN VALUES**	**10**

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

UNIT II	**ENGINEERING ETHICS**	**9**

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

UNIT III	**ENGINEERING AS SOCIAL EXPERIMENTATION**	**9**

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

UNIT IV	**SAFETY, RESPONSIBILITIES AND RIGHTS**	**9**

Safety and Risk – Assessment of Safety and Risk – Risk Benefit Analysis and Reducing Risk - Respect for Authority – Collective Bargaining – Confidentiality – Conflicts of Interest – Occupational Crime – Professional Rights – Employee Rights – Intellectual Property Rights (IPR) – Discrimination.

UNIT V	**GLOBAL ISSUES**	**8**

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

TOTAL: 45 PERIODS

OUTCOMES:

On completing this course, the students will be able to

- Summarize the importance of core values that shape the ethical behaviour of a professional.
- Apply ethical theories in controversial issues while playing the role of engineering Professionals.
- Solve moral and ethical problems through exploration and assessment by established experiments and relate the code of ethics to social experimentation.
- Enumerate the importance of safety, responsibilities and rights of an engineer at work place.

• Explain the ethical attributes of engineers in various roles and in different domains of engineering in the global context.	
TEXT BOOKS:	
1.	Mike W. Martin and Roland Schinzinger, “Ethics in Engineering”, Tata McGraw Hill, New Delhi, 2015.
2.	Govindarajan M, Natarajan S, Senthil Kumar V. S, “Engineering Ethics”, Prentice Hall of India, New Delhi, 2004.
REFERENCES:	
1.	Charles B. Fleddermann, “Engineering Ethics”, Pearson Prentice Hall, New Jersey, 2012.
2.	Charles E. Harris, Michael S. Pritchard and Michael J. Rabins, “Engineering Ethics – Concepts and Cases”, Cengage Learning, 2012
3.	John R Boatright, “Ethics and the Conduct of Business”, Pearson Education, New Delhi, 2017
4.	Edmund G Seebauer and Robert L Barry, “Fundamentals of Ethics for Scientists and Engineers”, Oxford University Press, Oxford, 2008.
5.	Laura P. Hartman and Joe Desjardins, “Business Ethics: Decision Making for Personal Integrity and Social Responsibility” Mc Graw Hill education, India Pvt. Ltd., New Delhi, 2013.
6.	World Community Service Centre, ‘Value Education’, Vethathiri publications, Erode, 2011.
Web sources:	
1.	www.onlineethics.org
2.	www.nspe.org
3.	www.globalethics.org
4.	www.ethics.org

EC18024	SOFT COMPUTING	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To be familiar with basic and constituents of soft computing
- To learn basic concepts and advancements in artificial neural networks architectures
- To be exposed to fuzzy logic systems
- To be exposed to genetic algorithm for optimization problems
- To be exposed to hybrid soft computing systems and applications

UNIT I	**INTRODUCTION TO SOFT COMPUTING CONSTITUENTS**	**9**

Introduction to Soft Computing – Requirement, Usefulness and Applications–Hard computing versus Soft computing. Introduction to Artificial Neural Network – ANN Characteristics – Learning methods – Taxonomy – Basic models –McCulloch–Pitts neuron – Linear separability – Perceptron networks – Adaptive linear neuron, Multiple adaptive linear neuron. Introduction to Fuzzy logic – Crisp/classical sets – Fuzzy sets. Introduction to Genetic algorithm – Biological background – Brief overview on traditional optimization and search techniques – Genetic algorithm – Need – Basic concepts – Issues – Benefits.

UNIT II	**ARTIFICIAL NEURAL NETWORKS**	**9**

Supervised learning networks – Backpropagation Network – Architecture, Learning algorithm – Radial Basis Function Network. Unsupervised learning networks – Kohonen self organizing feature maps, Learning Vector Quantization, ART1 network – Architecture, Algorithm. Deep Learning – Convolutional Neural Network – Introduction – Architecture overview – Possible layers – Convolutional networks architectures – LeNet, AlexNet, GoogLeNet, VGGNet (Brief comparison only).

UNIT III	**FUZZY LOGIC**	**9**

Membership functions – Features, Fuzzification, Methods of membership value assignments – Defuzzification – Lambda cuts, Methods – Extension principle – Fuzzy relations – Fuzzy rule base and approximate reasoning – Formation of rules – Decomposition of rules, Aggregation of fuzzy rules, Fuzzy reasoning – Fuzzy inference systems – Mamdani, Sugeno, TSukamoto models – Fuzzy decision making – Overview of fuzzy expert system.

UNIT IV	**GENETIC ALGORITHM**	**9**

Genetic algorithm and search space – Simple genetic algorithm modeling – Operators – Crossover, Inversion/reordering and deletion, Mutation – Generational cycle – Convergence condition – Multilevel optimization – Example Problem: Maximizing a function – Advances in GA – Genetic Programming versus Genetic Algorithm.

UNIT V	**HYBRID SOFT COMPUTING TECHNIQUES AND APPLICATIONS**	**9**

Hybrid Soft Computing Techniques – Overview on hybrid systems – Neuro-Fuzzy hybrids, Neuro-Genetic hybrids, Fuzzy-Genetic hybrids – Genetic algorithm in Fuzzy logic controller design – Fuzzy logic controlled GA based optimization – Adaptive Neuro-Fuzzy Inference Systems. Applications – Soft computing-based fusion of multispectral images with SAR images, optimization of traveling salesman problem using genetic algorithm approach, Fuzzy logic based air conditioner controller. Comparison of ANN, Fuzzy logic and GA.

TOTAL: (L: 45): 45 PERIODS

OUTCOMES:

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

- Select appropriate soft computing constituents for certain applications.
- Use suitable artificial neural networks for simple applications.
- Use fuzzy logic concepts for specific applications.
- Use genetic algorithm for optimization.
- Extend knowledge on hybrid soft computing systems.

TEXT BOOKS:

1. J.S.R.Jang, C.T. Sun and E.Mizutani, “Neuro-Fuzzy and Soft Computing: A Computational Approach to Learning and Machine Intelligence”, Pearson Education, 2015.
2. S.Rajasekaran and G.A.Vijayalakshmi Pai, "Neural Networks, Fuzzy Logic and Genetic Algorithm: Synthesis & Applications", Prentice-Hall of India Pvt. Ltd., 2017.

REFERENCES:

1. David E. Goldberg, “Genetic Algorithm in Search Optimization and Machine Learning” Pearson Education India, 2013.
2. S.N.Sivanandam, S.N.Deepa, “Introduction to Genetic Algorithms”, Springer, 2008.
3. Simon Haykin, “Neural Networks Comprehensive Foundation” Second Edition, Pearson Education, 2005.
4. S.N.Sivanandam, S.Sumathi and S.N.Deepa “Introduction to Fuzzy Logic using MATLAB”, Springer, 2007.
5. https://ieeexplore.ieee.org/
6. http://www.iitp.ac.in/~shad.pcs15/data/NN-DL.pdf.

EC18026	STATISTICAL THEORY OF SIGNAL PROCESSING	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To bring out the concepts related to stationary and non-stationary random signals
- To emphasize the importance of true estimation of power spectral density
- To introduce the design of linear optimum filtering and linear prediction
- To introduce the design of adaptive systems for filtering and their applications
- To introduce the concept of wavelet transforms in the context of image processing

UNIT I	DISCRETE-TIME RANDOM SIGNALS	9

Discrete random process – Ensemble averages, Stationary and ergodic processes, Autocorrelation and Autocovariance properties and matrices, White noise, Wiener Khintchine relation, Power Spectral Density, Spectral Factorization, Innovations Representation and Process, Filtering random processes, ARMA, AR and MA processes.

UNIT II	SPECTRUM ESTIMATION	9

Bias and Consistency, Periodogram, Modified periodogram, Blackman-Tukey method, Welch method, Parametric methods of spectral estimation, Levinson-Durbin recursion

UNIT III	OPTIMUM DIGITAL FILTERS	9

Digital wiener filter-Forward and Backward linear prediction, FIR Wiener filter- Filtering and linear prediction, IIR Wiener filters- Filtering, Smoothing, Prediction and Deconvolution-Discrete Kalman filter.

UNIT IV	ADAPTIVE FILTERS	9

Principles of adaptive filter – FIR adaptive filter – Newton‟s Steepest descent algorithm – LMS algorithm – Adaptive noise cancellation, Adaptive equalizer, Adaptive echo cancellers. - RLS Algorithm

UNIT V	MULTIRATE FIR FILTER DESIGN	9

Design of FIR filters for sampling rate conversion –Multistage design of decimator and interpolator –Filter bank implementation –Two channel filter banks-QMF filter banks-Discrete wavelet transform-Application of wavelet transform, Cepstrum and Homomorphic filtering.

TOTAL: (L: 45): 45 PERIODS

OUTCOMES: At the end of the course, learners will be able to

- Explain parametric methods for power spectrum estimation
- Apply parametric and Non parametric methods for Spectral estimation
- Design optimum digital filtering, smoothing and Prediction system
- Explain adaptive filtering techniques using LMS and RLS algorithm and the applications of adaptive filtering.
- Design multi rate FIR filter and explain the application of wavelet transforms

TEXT BOOKS:

1. Monson H, Hayes, “Statistical Digital Signal Processing and Modeling”, John Wiley and Sons Inc., New York, Indian Reprint, 2007.
2. John G.Proakis, Dimitris G. Manolakis, “Digital Signal Processing”, Pearson, Fourth 2007.
3. Dwight F. Mix, “Random Signal Processing”, Prentice Hall, 1995.

REFERENCES:

1. Sophocles J. Orfanidis, “Optimum Signal Processing, An Introduction”, Mc Graw Hill, 1990

EC18028	TESTING OF VLSI CIRCUITS	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To know the various types of faults.
- To study about fault detection and fault dominance.
- To learn the design of testable combinational circuits and sequential circuits.
- To know the concepts of DFT and BIST.
- To understand the fault diagnosis methods.

UNIT I	**TESTING AND FAULT MODELLING**	**9**

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

UNIT II	**TEST GENERATION**	**9**

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

UNIT III	**DESIGN FOR TESTABILITY**	**9**

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

UNIT IV	**SELF – TEST AND TEST ALGORITHMS**	**9**

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

UNIT V	**FAULT DIAGNOSIS**	**9**

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

TOTAL: (L:45): 45 PERIODS

OUTCOMES:

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

- Model faults and delay in digital circuits.
- Generate tests for combinational and sequential circuits.
- Develop design for testability (DFT) approaches.
- Develop self test methods and test algorithms for memories.
- Develop fault diagnosis for combinational circuits and system level circuits.

TEXT BOOKS:

1. M.Abramovici, M.A.Breuer and A.D. Friedman, “Digital systems and Testable Design”, Jaico Publishing House, 2002.
2. P.K. Lala, “Digital Circuit Testing and Testability”, Academic Press, 2002.

REFERENCES:

1. M.L.Bushnell and V.D.Agrawal, “Essentials of Electronic Testing for Digital, Memory and Mixed-Signal VLSI Circuits”, Kluwer Academic Publishers, 2002.
2. A.L.Crouch, “Design Test for Digital IC’s and Embedded Core Systems”, Prentice Hall International, 2002.

GE18052	TOTAL QUALITY MANAGEMENT	L	T	P	C
	(COMMON TO ME, AE, CS, EC and MR)	3	0	0	3

OBJECTIVES:

- To facilitate the understanding of Quality Management principles and processes.
- To learn TQM & process monitoring techniques
- To know about various quality management system implemented in industries

UNIT I	INTRODUCTION	8

Fundamentals of TQM – Historical developments – important philosophies- (Deming, Juran, Crossby, Ishikawa) and their impact of quality – Quality planning, Quality statement – Quality policy.

UNIT II	TQM PRINCIPLES	9

Customer focus - Customer satisfaction – customer perception of quality, customer complaints, Employee involvement – Empowerment and Team work- Recognition and Reward – Performance appraisal - Supplier Quality Management – Supplier Rating – Supplier rating by Analytical Hierarchical Process (AHP)

UNIT III	PROCESS MONITORING	9

Seven tools of quality, New Seven management tools, Statistical fundamentals – Normal curve charts for variables and attributes, TPM – Concepts, Process Capability analysis, PDSA cycle, 5S, Kaizen.

UNIT IV	TQM TECHNIQUES	10

Quality Functions Deployment (QFD) – house of Quality, QFD process and benefits, Benchmarking process, Taguchi Quality Loss function, FMEA – concept, Industrial case studies on DFMEA and PFMEA – Six Sigma –concepts- Methodologies

UNIT V	QUALITY MANAGEMENT SYSTEMS	9

Need for ISO – ISO 9001: 2015 – Elements, Implementation, Documentation and Auditing, QS 9000 / TS 16949 - ISO14000 and OSHAS 18000 – Concept requirements and benefits – Case studies.

TOTAL : 45 PERIODS

OUTCOMES:

- Students will be able to describe the evolution and concepts of quality and Quality Management.
- Students will be able to Practice the Principles of TQM in work environment.
- With industrial examples, student will be able to illustrate the process monitoring tools.
- Students will apply the quality techniques of TQM in industries.
- With appropriate case studies, students will deploy the need of Quality Management systems in industries.

TEXT BOOKS:

1. Dale H. Besterfiled, et at., "Total quality Management", Third Edition, Pearson Education Asia, Indian Reprint, 2006.
2. Poornima M. Charantimath, Total Quality Management, Pearson education, 3rd edition, 2017.

REFERENCES :

1. James R. Evans and William M. Lindsay, "The Management and Control of Quality", 8th Edition, First Indian Edition, Cengage Learning, 2012.
2. Janakiraman. B and Gopal .R.K., "Total Quality Management - Text and Cases", Prentice Hall (India) Pvt. Ltd., 2006.
3. Shridhara Bhat, “TQM Text and Cases”, Himalaya Publishing House, 2002.
4. Suganthi.L and Anand Samuel, "Total Quality Management", Prentice Hall (India) Pvt. Ltd.,

2006.

WEB RESOURCES:

1. https://nptel.ac.in/courses/110/104/110104080/
2. https://nptel.ac.in/courses/110/104/110104085/

EC18030	WIRELESS LANs AND PANs	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To understand the concepts of Wireless Local Area Networks and MAC protocols
- To learn the architecture and topologies of Wireless Personal Area Networks
- To analyze the co-existence between wired and wireless networks,WLAN and WPAN
- To understand the architecture of Wireless PAN standards such as IEEE 802.15.3 and IEEE 802.15.4
- To analyze the industrial applications of low rate WPAN and future trends in WLAN & WPAN

UNIT I	**WIRELESS LOCAL AREA NETWORKS (WLANs)**	**9**

Wireless LAN standards, architectures, modulation schemes, MAC layer, media access protocols, MAC layer Management, hidden nodes, collision avoidance, Data and voice transmission over Wireless LANs, WLAN Technologies: Infrared technology, UHF narrowband technology, Spread Spectrum technology

UNIT II	**WIRELESS PERSONAL AREA NETWORKS (WPANs)**	**9**

Wireless PAN specifications, Network topologies, Architecture, the physical layer, MAC sub layer, Media Access protocol, channel access Management, association, disassociation, synchronization, GTS allocation and Management.

UNIT III	**HETEROGENEOUS WIRELESS NETWORKS**	**9**

Co-existence of wired and wireless networks, collocated, co-existed wireless networks, impact of WIFI traffic on WPANs, Wireless co-existence between WLANs and WPANs, interference mitigation, performance analysis of high density wireless networks.

UNIT IV	**THE IEEE 802.15 WORKING GROUP FOR WPANs**	**9**

The IEEE 802.15.3, The IEEE 802.15.4, ZigBee Technology, ZigBee components and network topologies, The IEEE 802.15.4 LR-WPAN Device architecture: Physical Layer, Data Link Layer, The Network Layer, Applications; IEEE 802.15.3a Ultra wideband.

UNIT V	C**ASE STUDY OF** WLANs **AND** WPANs	**9**

IEEE 802.15.4 LR-WPAN for Industrial Applications, Future trends in WLANs and WPANs.

TOTAL: (L:45): 45 PERIODS

OUTCOMES:

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

- Analyze the basic protocols and technologies in WLAN
- Explain the architecture and topologies of Wireless PAN
- Interrelate the co-existence of wired and wireless networks
- Categorize the IEEE 802.15.3 and IEEE 802.15.4 standards
- Identify the future trends in WLANs, WPANs and industrial applications of low rate

WPANs.		

TEXT BOOKS:

1. Carlos de Morais Cordeiro and Dharma Prakash Agrawal, “Ad Hoc and Sensor Networks”, World Scientific, 2011.
2. Vijay K.Garg, “Wireless Communications and Networking”, Morgan Kaufmann Publishers, 2009.

REFERENCES:

1. Kaveh Pahlavan, Prashant Krishnamurthy, “Wireless Networks”, PHI, 2002.
2. Marks Ciampor, Jeorge Olenewa, “Wireless Communication”, Cengage Learning, 2007.

OPEN ELECTIVES

OE18701	AUTOTRONICS	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To learn the application of electronics in automotive industry.
- To understand the different control systems in automotives and their control.
- To identify, formulate and solve real time Engineering problems.
- To learn digitization of the conventional control systems in automotives.
- To understand the fundamentals of different instrumentation systems in automotives.

UNIT I	**FUNDAMENTALS OF AUTOMOTIVE ELECTRONICS**	**9**

Electronic Engine Management System – Components – Open and Closed Loop Control Strategies – PID Control – Look Up Tables – Introduction – Modern Control Strategies Like Fuzzy Logic and Adaptive Control – Controlled Parameters – SI and CI Engines.

UNIT II	**SENSORS AND ACTUATORS**	**9**

Introduction – Basic Sensor Arrangement – Types Of Sensors – Hall Effect Sensor – Hot Wire Anemometer – Thermistor – Piezo-Electric Sensor – Piezo-Resistive Sensors – Oxygen Concentration Sensor – Lambda Sensor – Crankshaft Angular Position Sensor – Cam Position Sensor – Mass Air Flow (MAF) Rate – Manifold Absolute Pressure (MAP) – Throttle Plate Angular Position – Engine Oil Pressure Sensor – Vehicle Speed Sensor – Stepper Motors – Relays – Detonation Sensor – Emission Sensors.

UNIT III	**SPARK IGNITION ENGINE MANAGEMENT**	**9**

Feedback Carburetor System – Throttle Body Injection – Multi Point Fuel Injection System – Injection System Controls –Advantage of Electronic Ignition Systems – Three Way Catalytic Converter – Conversion Efficiency Versus Lambda – Group and Sequential Injection Techniques – Fuel System Components – Advantages of Electronic Ignition Systems –Solid State Ignition Systems – Principle Of Operation – Types – Contact Less Electronic Ignition System – Electronic Spark Timing Control.

UNIT IV	**COMPRESSION IGNITION ENGINE MANAGEMENT**	**9**

Fuel Injection System – Parameters Affecting Combustion – Noise and Emissions in CI Engines – Pilot, Main, Advanced – Post Injection and Retarded Post Injection – Electronically Controlled Unit Injection System – Layout of the Common Rail Fuel Injection System – Fuel Injector – Fuel Pump – Rail Pressure Limiter – Flow Limiter – Working Principle – EGR Valve Control in Electronically Controlled Systems.

UNIT V	**DIGITAL ENGINE CONTROL SYSTEM**	**9**

Open Loop and Closed Loop Control System – Engine Cooling and Warm Up Control – Idle Speed Control – Acceleration and Full Load Enrichment – Deceleration Fuel Cut-off – Fuel Control Maps – Open Loop Control of Fuel Injection – Closed Loop Lambda Control – Exhaust Emission Control – On Board Diagnostics: Diagnostics – Future Automotive Electronic Systems – Electronic Dash Board Instruments – Onboard Diagnosis System.

TOTAL: (L: 45): 45 PERIODS

OUTCOMES:

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

- Understand the different control systems in automotives and their control.
- Understand the different types of sensors and actuators
- Principle of operation of Spark ignition management system
- Principle of operation of compression ignition management system
- Understand the fundamentals of different instrumentation systems in automotives.

TEXT BOOKS:

1. Arthur Primrose Young, Leonard Griffiths, "Automobile Electrical and Electronic Equipment: Theory and Practice for Students, Designers, Automobile Electricians and Motorists", London Butterworths, Ninth Edition,1986.
2. William Ribbens, "Understanding Automotive Electronics: An Engineering Perspective", Butterworth-Heinemann, Seventh Edition, 2013.

REFERENCES:

1. Allan Bonnick, "Automotive Computer Controlled Systems" Taylor & Francis, Fifth Edition, 2001.
2. Tom Denton, "Automobile Electrical and Electronics Systems", Butterworth- Heinemann, Fourth Edition, 2004.
3. Robert Bosch GmbH, "Diesel-Engine Management", John Wiley & Sons, Fourth Edition, 2006.
4. Robert Bosch GmbH and Horst Bauer, "Gasoline-Engine Management", Bentley Publishers, Second Edition, 2006.
5. Robert. N, Brady, "Automotive Computers and Digital Instrumentation", Prentice Hall, First Edition, 1988.
6. Hillier V.A.W, "Fundamentals of Automotive Electronics", Nelson Thornes Limited, Sixth Edition, 2012.

OE18703	SENSING TECHNIQUES	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To understand the underlying principles and performance characteristics of important sensors.
- To understand the use of optical components and interface electronics.
- To understand the concept of different types of motion sensors.
- To understand the various light and radiation sensors.
- To understand the essential theory of temperature and chemical sensors.

UNIT I	**PRINCIPLES OF SENSING**	**9**

Data Acquisition – sensor characteristics – electric charges, fields, potentials – capacitance magnetism – inductance – resistance – piezoelectric – pyroelectric – Hall effect – thermoelectri effects – sound waves – heat transfer – light – dynamic models of sensors.

UNIT II	**OPTICAL COMPONENTS AND INTERFACE ELECTRONICS**	**9**

Radiometry – Photometry – mirrors – lenses – fibre optics – concentrators – Interface circuits –amplifiers – light-to-voltage – excitation circuits – ADC – Digitization – Capacitance-to-voltage –bridge circuits – data transmission – noise in sensors and circuits – calibration – low power sensors.

UNIT III	**MOTION RELATED SENSORS**	**9**

Occupancy and motion detectors: ultrasonic – microwave – capacitive detectors – triboelectric –Optoelectronic motion sensors – optical presence sensor – Pressure Gradient sensors Velocity and acceleration sensors: Accelerometer characteristics – capacitive accelerometers –Piezoelectric accelerometers – piezoresistive accelerometers – thermal accelerometers –Gyroscopes – piezoelectric cables – gravitational sensors.

UNIT IV	**LIGHT AND RADIATION DETECTORS**	**9**

Light Detectors: Photo diodes – photo transistor – photo resistor – cooled detectors – CCD and CMOS image sensors – thermal detectors – optical design – gas flame detectors Radiation Detectors: scintillating detectors – ionization detectors – cloud and bubble chambers

UNIT V	**TEMPERATURE AND CHEMICAL SENSORS**	**9**

Temperature Sensors: coupling with objects – temperature reference points – thermo resistive sensors – thermoelectric contact sensors – semiconductor sensors – acoustic sensors –piezoelectric sensors-Chemical sensors: characteristics – classes of chemical sensors – biochemical sensors – multisensory arrays – electronic noses and tongues.

TOTAL: (L: 45): 45 PERIODS

OUTCOMES:

Upon the completion of this course, learners will be able

- To identify various fundamentals of sensing principles.
- To apply design concepts to interface sensors with various electronic components.
- Design and applications of various photo sensors.
- Apply the gesture sensing techniques to design sensors.
- Differentiate various temperature and chemical sensors based on its applications.

TEXT BOOKS:		
1. Pallas-Areny Ramon, John G. Webster. Sensors and signal conditioning. New York: Wiley, 2001. 2. Jacob Fraden, "Handbook of Modern Sensors: Physics, Designs, and Applications", Fourth Edition, Springer, 2010.		
REFERENCES:		
1. De Silva, Clarence W. Sensors and actuators: Engineering system instrumentation. CRC Press, 2015. 2. Ripka, Pavel, Alois Tipek, eds. Modern sensors handbook. John Wiley & Sons, 2013. 3. Khazan, Alexander D. Transducers and their elements: design and application. Prentice Hall, 1994.		

OE18705	SYSTEM DESIGN USING MICROCONTROLLERS	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To expose the students to the fundamentals of microcontroller-based system design
- To study the Architecture, addressing modes & instruction set of PIC Microcontroller and develop skills in writing simple programs.
- To understand the concepts of Interrupts, timer and Serial ports
- To introduce commonly used peripheral interfacing ICs.
- To study and understand the typical applications of micro-controllers

UNIT I	**INTRODUCTION TO PIC MICROCONTROLLER**	**9**

Overview of PIC microcontroller-Architecture – Program Memory considerations – Register File Structure - Instruction Set - Addressing modes – Assembly language Programming-Simple operations

UNIT II	**PIC PROGRAMMING IN C**	**9**

Data types and time delays in C - I/O programming -Logical Operations-Data Serialization -Program ROM allocation -Data RAM allocation

UNIT III	**PORTS, INTERRUPTS AND TIMER**	**9**

Programming I/O ports, Serial port Programming - Timers -Timer and Counter Programming, PIC micro controller Interrupts- External Interrupts and Interrupt Programming

UNIT IV	**PERIPHERALS AND INTERFACING**	**9**

Serial Communication – USART, SPI, I2C, ADC, DAC and Sensor Interfacing, Using Flash and EEPROM memories for data storage- CCP Modules

UNIT V	**SYSTEM DESIGN – CASE STUDY**	**9**

Interfacing LCD Display – Keypad Interfacing - Generation of Gate signals for converters and Inverters - Motor Control – Controlling DC/ AC appliances – Measurement of frequency - Stand alone Data Acquisition System.

TOTAL: (L: 45): 45 PERIODS

OUTCOMES:

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

- Interpret the PIC architecture and its assembly language programming
- Articulate the embedded C concepts to apply it for PIC microcontroller based applications.
- Determine the feasibility of employing the PIC microcontroller's I/O ports, Timers & Interrupts in real time applications.
- Identify the best commonly used interfaces of PIC microcontroller such as USART, SPI, I2C etc and to develop applications based on DAC, ADC, CCP and EEPROM of PIC
- Examine the available case studies based onPIC microcontroller to design a embedded system.

TEXT BOOKS:

1. Muhammad Ali Mazidi, Rolin D. Mckinlay, Danny Causey ‘PIC Microcontroller and Embedded Systems using Assembly and C for PIC18’, Pearson Education 2008
2. Peatman,J.B., “Design with PIC Micro Controllers”PearsonEducation,3rd Edition, 2004.

REFERENCES:

1. Tim Wilmshurst, “Designing Embedded Systems with PIC Microcontrollers – Principles and Applications”, Newnes Publication, 2007
2. John Iovine, ‘PIC Microcontroller Project Book’, McGraw Hill 2000
3. Julio Sanchez Maria P. Canton, “Microcontroller Programming: The microchip PIC”, CRC Press, Taylor & Francis Group, 2007.

OE18707	FUNDAMENTALS OF WIRELESS COMMUNICATION	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To introduce various generation of wireless systems.
- To acquaint fundamentals of cellular systems design.
- To familiarize with various multiple access schemes used in wireless communication.
- To provide knowledge with the latest 3G/4G networks and beyond.

UNIT I	WIRELESS COMMUNICATION SYSTEMS	9

Generation of wireless communication systems: 1G, 2G, 2.5G, 3G, 3.5G, 4G. Examples of wireless systems: Cordless, Paging Systems. Cellular Telephone System, Comparison of wireless systems, Personal Communication Systems, Call establishment in cellular systems.

UNIT II	FUNDAMENTALS OF CELLULAR COMMUNICATION	9

Frequency reuse, Handoff, Channel Assignment, Interference and system capacity, improving coverage and capacity in cellular systems: cell splitting, sectoring, repeaters for range extensions, microcell zone concept.

UNIT III	MULTIPLE ACCESS TECHNIQUES	9

Access methods: TDMA, FDMA, CDMA, CSMA, Packet Radio Services, Pure ALOHA, Slotted ALOHA, Capacity of CDMA and SDMA Systems, Basics of OFDM.

UNIT IV	WIRELESS NETWORKS	9

Wireless personal area network: Bluetooth - protocol stack, security, network connection establishment, error correction and network topology; wireless sensor network: usage and model: Zigbee technology; IEEE 802.15.3a - Ultra Wideband; Wireless Local area networks: WLAN Equipment, topologies and Technologies; IEEE 802.11 WLAN -architecture, security and power management; IEEE 802.16 -WiMAX

UNIT V	LATEST TRENDS IN WIRELESS NETWORKS	9

Introduction – 4G vision – 4G features and challenges - Applications of 4G – 4G Technologies: Multicarrier Modulation, Smart antenna techniques, Software defined radio, Cognitive radio, 5G Key Technologies

TOTAL: (L:45 + T:0): 45 PERIODS

OUTCOMES:

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

- Distinguish and understand the major cellular communication standards (1G/2G/3G/4G/5G/6G systems) and wireless communications networks.
- Gain insights cellular architecture.
- Design and implement various access mechanisms.
- Design and implement wireless network environment for any application using latest wireless protocols and standards.
- Distinguish the features of 4G, 5G techniques and 6G Enablers.

TEXT BOOKS:

1. Rappaport. T.S., “Wireless communications”, Pearson Education, 7th impression, 2012.
2. Vijay Garg, ―Wireless Communications and networking, First Edition, Elsevier 2007.

REFERENCES:

1. Jochen Schiller, “Mobile communications”, PHI/Pearson Education, 2nd Edition (2003).
2. Simon Haykin & Michael Moher, “Modern wireless Communication”, Pearson Education, 2007.
3. Andreas. F.Molisch, Wireless Communication”, John Wiley, 2006.
4. T. S. Rappaport, R. W. Heath Jr., R. C. Daniels, and J. M. Murdock,, Millimeter Wave Wireless Communication., Pearson Education, 2015.
5. M. Vaezi, Z. Ding, and H. V. Poor,, Multiple Access techniques for 5G Wireless Networks and Beyond., Springer Nature, Switzerland, 2019.

OE18702	CONSUMER ELECTRONICS	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To understand the working principles of various consumer electronic devices and its fundamentals.
- To sketch and describe operating principles of different types of microphones,display systems.
- To learn various technology involved in Smart home.
- To describe working of Washing machine, Digital Camera system, Microwave ovens and Home enablement systems with their block diagram.
- To acquaint with various devices related to telecommunication system.

UNIT I	**CONSUMER ELECTRONICS FUNDAMENTALS**	**9**

History of Electronic Devices- Vacuum Tubes, Transistors, Integrated Circuits- Moorse Law, Semiconductor Devices, Diodes, Rectifiers, Transistors, Logic Gates, Combinational Circuits, ADC, DAC and Microprocessors, Microcontrollers in consumer electronics, Energy management, Intelligent Building Perspective.

UNIT II	**ENTERTAINMENT ELECTRONICS**	**9**

Audio systems: Construction and working principle of : Microphone, Loud speaker, AM and FM receiver, stereo, 2.1 home theatre, 5.1 home theatre . Display systems: CRT, LCD, LED and Graphics displays Video Players : DVD and Blue RAY. Recording Systems: Digital Cameras and Camcorders.

UNIT III	**SMART HOME**	**9**

Technology involved in Smart home, Home Virtual Assistants- Alexa and Google Home. Home Security Systems - Intruder Detection, Automated blinds, Motion Sensors, Thermal Sensors and Image Sensors, PIR, IR and Water Level Sensors.

UNIT IV	**HOME APPLIANCES**	**9**

Home Enablement Systems: RFID Home, Lighting control, Automatic Cleaning Robots, Washing Machines, Kitchen Electronics- Microwave, Dishwasher, Induction Stoves, Smart Refrigerators, Smart alarms, Smart floor, Smart locks.

UNIT V	**COMMUNICATION SYSTEMS**	**9**

Cordless Telephones, Fax Machines, PDAs- Tablets, Smart Phones and Smart Watches. Introduction to Smart OS- Android and iOS. Video Conferencing Systems- Web/IP Camera, Video security, Internet Enabled Systems, Wi-Fi, IoT, Li-Fi, GPS and Tracking Systems.

TOTAL: (L:45): 45 PERIODS

OUTCOMES:

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

- Interpret the fundamentals of Electronic Devices.
- Infer technical specification of electronics Audio system, display and recording systems.
- Identify and explain working of technology involved in Smart home.
- Demonstrate various functions of Home appliances like Washing machine, Microwave oven etc.,
- Examine the basic functions of various telecommunication systems

TEXT BOOKS:		
1. Thomas L Floyd "Electronic Devices" 10th Edition Pearson Education Asia 2018. 2. Philp Hoff "Consumer Electronics for Engineers" - Cambridge University Press.1998. 3. Jordan Frith, " Smartphones as Locative Media ", Wiley. 2014. 4. Dennis C Brewer, " Home Automation", Que Publishing 2013. 5. Thomas M. Coughlin, "Digital Storage in Consumer Electronics", Elsevier and Newness 2012.		
REFERENCES:		
1. M.L.Bushnell and V.D.Agrawal, “Essentials of Electronic Testing for Digital, Memory and Mixed-Signal VLSI Circuits”, Kluwer Academic Publishers, 2002. 2. A.L.Crouch, “Design Test for Digital IC’s and Embedded Core Systems”, Prentice Hall International, 2002.		

OE18704	INTRODUCTION TO COMMUNICATION SYSTEMS	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To understand analog communication techniques
- To understand digital communication techniques.
- To learn pulse communication techniques.
- To be familiarized with satellite/wireless communication.
- To understand latest applications of different communication systems.

UNIT I	**ANALOG COMMUNICATION**	**9**

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

UNIT II	**PULSE COMMUNICATION**	**9**

Introduction to Pulse Communication- Pulse Amplitude Modulation (PAM) – Pulse Time Modulation (PTM) – Pulse code Modulation (PCM) – Comparison of various Pulse Communication System (PAM – PTM – PCM).

UNIT III	**DIGITAL COMMUNICATION**	**9**

Introduction to Digital Communication Amplitude Shift Keying (ASK) – Frequency Shift Keying (FSK)–Phase Shift Keying (PSK) – BPSK – QPSK – Quadrature Amplitude Modulation (QAM) – Comparison of various Digital Communication System (ASK – FSK – PSK – QAM).

UNIT IV	**SATELLITE COMMUNICATION**	**9**

Frequency allocation for satellite; Types of orbits-GEO, LEO, MEO; Kepler‘s law; Orbital elements; Satellite launching procedures – launch vehicles and propulsion; Space Segment-Transponder sub-system, TT&C sub-system, Satellite Applications-INTELSAT, INMARSAT.

UNIT V	**WIRELESS COMMUNICATION**	**9**

Cellular concept - Frequency reuse - Channel assignment strategies - Hand off strategies -Improving coverage and capacity in cellular system; Multiple access techniques for wireless communication – FDMA, TDMA, CDMA; Overview and Comparison of various cellular network standards/technologies-2G, 2.5G, 3G, 3.5G, 4G, 5G (in terms of Bandwidth, Modulation techniques, Frequency band, Data rate, Applications), WLAN and Wi-Fi

TOTAL: (L: 45): 45 PERIODS

OUTCOMES:

At the end of the course, learners will be able

- Identify various analog communication techniques. based on its application.
- Identify various digital communication techniques. based on its application.
- Identify the usage of pulse communication techniques
- Utilize the concepts of satellite communication,
- Interpret wireless communication and cellular network standards through latest applications.

TEXT BOOKS:

1. Simon Haykin," Communication systems" 4th Edition, John Wiley 2014.
2. Dennis Roddy, "Satellite Communication", 4th Edition, Mc Graw Hill International, 2006.
3. Theodore S. Rappaport ―wireless communications - principles and practice‖, PEARSON,

Second edition.

REFERENCES:

1. J.G.Proakis, M,Salehi,: Fundamentals of Communication Systems", Pearson Education 2006.
2. B.P.Lathi, "Modern Digital and Analog communication Systems:,3rd Edition, Oxford University Press,2007
3. Simon Haykin," Digital Communications" John Wiley & Sons, 2010
4. T. Pratt and C.W. Boastian, "Satellite Communication", 2nd edition, John Wiley & Sons, 2002.
5. Jochen Schiller, "Mobile Communication", Pearson Education, 2012

OE18706	ROBOTICS SYSTEMS	L	T	P	C
		3	0	0	3

OBJECTIVES:

The student should be exposed to:

- Robotics, automation and control technologies
- Various types of robotic sensors
- Robotic vision and machine learning
- Actuators and robot programming
- Various applications of robotics and its system in industry

UNIT I	**OVERVIEW ON ROBOTICS AND AUTOMATION**	**9**

Robotics: Definition, Origin, Different types, Various generations, Degrees of freedom; Anatomy of a robot , Classification of robots – Cartesian, Cylindrical, Spherical, Articulated, SCARA; Precision of robot movements – Accuracy, Resolution, Repeatability.

Automation: Basic elements of an automated system – Level of automation; Overview on controller and its types – PI,PD,PID.

UNIT II	**SENSORS FOR ROBOTIC APPLICATIONS**	**9**

Sensor characteristics, Types of sensors – Tactile sensors, Touch sensors; Position sensors – Potentiometer, Encoder, LVDT, Resolvers; Proximity sensors–Magnetic, Optical, Ultrasonic, Inductive, Capacitive, Eddy current; Speed sensors– Velocity/motion sensors; Force/Pressure and torque sensors.

UNIT III	**ROBOTIC VISION SYSTEM**	**9**

Robotic Vision systems – Image processing and analysis, Segmentation, Feature extraction, Object Recognition; Overview on Artificial Intelligence/Machine Learning for robotic vision.

UNIT IV	**ACTUATORS AND ROBOT PROGRAMMING**	**9**

Actuators – Electric – Hydraulic – Pneumatic; End effectors – Grippers and Tools – Types, Design considerations in gripper selection; Robot programming, Introduction to robot languages.

UNIT V	**ROBOTIC SYSTEMS IN INDUSTRY**	**9**

Industrial applications – Material transfers, Machine loading and unloading, Automatic assembly, Automatic inspection, Flexible Manufacturing Systems; Introduction to Micro robotics and Nano robotics.

TOTAL: (L: 45) : 45 PERIODS

OUTCOMES:

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

- Classify robotics system, automation and control technologies.
- Select appropriate sensors for certain applications
- Sketch various stages involved in computer vision for robotics
- Select required actuators, end effectors, robot programming languages for any given applications.
- Illustrate recent industrial robotics and their applications.

TEXT BOOKS:

1. Mikell P. Groover, Mitchell Weiss, Roger N. Nagel and Nicholas G. Odrey, “Industrial Robotics”, Tata Mc Graw Hill, 2010.

2. Mittal R K, Nagrath I J, “Robotics and control”, Tata McGraw Hill, 2010.

REFERENCES:

1. Saeed B. Niku, “An Introduction to Robotics: Analysis, systems and applications”, Pearson Education, 2009.
2. Fu. K. S., Gonzalez. R. C. & Lee C.S.G., “Robotics control, sensing, vision and intelligence”, McGraw Hill Book co, 1987.
3. Mikell P. Groover, “Automation, Production systems and Computer Integrated Manufacturing”, Prentice Hall India Pvt. Ltd., 2011.
4. Richard D Klafter, and Michael Negin, “Robotics Engineering”, Prentice Hall, 2009.

MANDATORY COURSE

MC18001	INDIAN CONSTITUTION AND SOCIETY	L	T	P	C
	(Common to all Branches Except MR)	**3**	**0**	**0**	**0**

OBJECTIVES:

- To know about Indian constitution and fundamental rights.
- To know about central and state government functionalities in India.
- To know about Judicial system and Election commission of India.

UNIT I	**INTRODUCTION**	**11**

Historical Background – Philosophical foundations of the Indian Constitution – Preamble – Schedules – Amendments.

UNIT II	**FUNDAMENTAL RIGHTS AND FUNDAMENTAL DUTIES OF THE CITIZEN**	**8**

Union and Territories – Citizenship - Fundamental Rights – Directive Principles of State Policy – Fundamental Duties – Directive Principles of state policy.

UNIT III	**STRUCTURE AND FUNCTION OF CENTRAL GOVERNMENT**	**8**

Union Government – Structures of the Union Government and Functions – Powers of President, Vice President, Prime Minister – Cabinet ministers – Parliament.

UNIT IV	**STRUCTURE AND FUNCTION OF STATE GOVERNMENT**	**8**

State Government – Structure and Functions – Powers of Governor, Chief Minister, Cabinet ministers – State Legislature.

UNIT V	**STRUCTURE OF JUDICIAL SYSTEM AND MAJOR FUNCTIONARIES**	**10**

Supreme Court of India - Judicial System in States – High Courts and other Subordinate Courts – Judicial Review – Case studies. Election Commission of India and its functions.

TOTAL: (L: 45): 45 PERIODS

OUTCOMES: At the end of the course, learners will be able to

CO	CO statement	weightage
CO – 1	Enhance human values, create awareness about law enactment and importance of Constitution	10 %
CO – 2	To Understand the Fundamental Rights and Fundamental Duties of the Indian Citizen to instill morality, social values, honesty, dignity of life and their social Responsibilities.	30%
CO – 3	To Understand the powers and functions of Central Government.	20%
CO – 4	To Understand the powers and functions of State Government.	20%
CO – 5	To Understand the powers and functions of Judicial systems and Election commission of India.	20%

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. Maciver and Page, “Society: An Introduction Analysis “, Mac Milan India Ltd., New Delhi.
4. K.L.Sharma, (1997) “Social Stratification in India: Issues and Themes”, Jawaharlal Nehru University, 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, Jalaendhar.
3. R.N. Sharma, “Indian Social Problems “, Media Promoters and Publishers Pvt. Ltd.

VALUE ADDED COURSES

VD18701	PCB DESIGN USING EDA TOOL	L	T	P	C
		1	0	2	2

OBJECTIVES:

- To introduce the basic electronics components.
- To learn the design rules for PCB circuits.
- To understand the need for PCB Design and steps involved in PCB Design process.
- To familiarize Schematic and layout design flow using Electronic Design Automation (EDA) Tools.

UNIT I	**Introduction to Printed Circuit Board**	**6**

Fundamental of Electronic Components - Basic Electronic Circuits - Basics of Printed Circuit Board Design: Layout Planning, general rules and parameters.

UNIT II	**Design rules for PCB**	**6**

Design rules for Digital circuit PCBs - Analog circuit PCBs - high frequency applications - Power electronic applications.

UNIT III	**PCB Technology Trends**	**6**

Multilayer PCBs - Multiwire PCB - Flexible PCBs - Surface mount PCBs - Reflow soldering.

UNIT IV	**Description of PCB Design and EDA tools**	**6**

Introduction to PCB Design using EDA tool – Flowchart – PCB layers – Study of Interconnecting and Packaging Electronics Circuits (IPC) standards.

UNIT V	**Practical Training on PCB Design**	**6**

Schematic and Layout Design: Full-wave Rectifier, Regulator circuit using 7805, Inverting Amplifier or Summing Amplifier using op-amp, Astable or Monostable multivibrator using IC555, Full-Adder using half-adders.

TOTAL: 30 PERIODS

OUTCOMES:

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

- Understand the steps involved in schematic, layout and assembly process of PCB design
- Classify the design rules of Digital and analog circuit PCBs
- Appreciate the necessity and evolution of PCB, types and classes of PCB.
- Describe the PCB design and EDA tool.
- Design (schematic and layout) PCB for analog circuits, digital circuits and mixed circuits.

TEXT BOOK:

1. R.S. Khandpur, Printed Circuit Board –Design, Fabrication, Assembly & Testing, TMH, 3rd Edition, 2017.
2. Walter C. Bosshart, Printed circuit Board – Design & Technology, TMH. Reprint 2008.

REFERENCES:

1. Clyde F. Coombs, Jr., Printed Circuits Handbook, Sixth Edition, McGraw-Hill Education, 2016
2. Kraig Mitzner Bob Doe Alexander Akulin Anton Suponin Dirk Müller, Complete PCB Design Using OrCAD Capture and PCB Editor, 2nd Edition 2009.

Web Resource:
https://www.udemy.com/course/crash-course-electronics-and-pcb-design/

VD18702	SIGNAL PROCESSING USING SIMULATION TOOL	L	T	P	C
		1	0	2	2

OBJECTIVES:

- To provide background and fundamentals of MATLAB tool for the analysis and processing of signals.
- To enumerate the basic concepts of image and speech processing techniques and filter operations using MATLAB.
- To study the applications of signal processing.
- To introduce different packages, libraries and basic functions of Python.
- To provide an insight into various machine learning algorithms using Python.

UNIT I	**Introduction to MATLAB**	**6**

Introduction to MATLAB-Use of MATLAB-Key features of MATLAB-Basic commands-Assigning variables-Operations with variables-Arrays and vectors-Arithmetic operations-Matrix operations-Writing user defined functions-Built in Functions-Function calling-Return Value- GUI using MATLAB,

UNIT II	**Signal Processing using MATLAB**	**6**

Introduction to Image Processing: Importing and Visualizing & displaying images-Extracting a region of interest-Image enhancement, Image Segmentation, Image Registration.
Introduction to audio and speech processing: Speech production model-Extraction of temporal and spectral features from audio signal- Implementation of different types of filters.
Design of a simple NN using MATLAB. Neural Networks and its applications,

UNIT III	**Applications of Signal Processing using MATLAB**	**6**

Applications of Image Processing: Object Detection and Tracking, Real-World Applications
Audio signal processing: Speech recognition, Isolated word recognition -Dimensionality reduction using Deep learning models
Wireless System Design with MATLAB - Transmission Over 5G MIMO channel model, Symmetric Cryptography-Implementation of encryption and decryption algorithms using MATLAB
Biometric authentication and its applications- Multimodal biometric authentication, Palm print recognition system, Forensic and commercial applications.
Thinkspeak IOT platform with MATLAB analytics, humudity, dewpoint calculation and traffic signal monitoring using thingspeak.

UNIT IV	**Introduction to Python**	**6**

Brief Introduction-Functions and variables in Python-Importing packages-Numpy, Pandas- Lists, tuples, and dictionaries- Design with functions- The concept of data types, variables, assignments-arithmetic operators and expressions- Visualization plots

UNIT V	**Machine learning algorithms using Python**	**6**

Computer vision using Python-Different types of classifiers –Building a simple classification model –Neural network architectures-Speech recognition algorithms-Audio signal Classification
-Introduction to CNN-Application of CNN for image classification using keras.

TOTAL: 30 PERIODS

OUTCOMES:

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

- Understand the fundamentals of MATLAB tool for analysis and processing of signals
- Simulate the basic operations of signal processing using MATLAB
- Implement various signal processing applications.
- Understand the basics of Python.
- Utilize MATLAB tool for analysis and processing of signals.

REFERENCES:

1. Digital Signal Processing using MATLAB, 3rd Edition, Vinay K Ingle, John G Proakis
2. Python Crash Course, 2nd Edition: A Hands-On, Project-Based Introduction to Programming, Kindle Edition by Eric Matthes
3. MATLAB: An Introduction With Applications, 5th Edition by Amos Gilat, John Wiley
4. Learn Python the Hard Way: A Very Simple Introduction to the Terrifyingly Beautiful World of Computers and Code (Zed Shaw's Hard Way Series) Paperback – 10 October 2013 by Zed Shaw

VD18703	HARDWARE MODELLING AND ANALYSIS USING EDA TOOL	L	T	P	C
		1	0	2	2

OBJECTIVES:

- To introduce the Verilog Hardware Description Language
- To learn various Issues in Digital Circuit Modeling using Verilog
- To learn functional verification of the Hardware Model by writing test benches
- To analyze the area, power and delay of the hardware model using EDA tool

UNIT I	**Hierarchical Modeling Concepts**	**6**

Overview of Digital Design with Verilog HDL, Evolution of Computer Aided Digital Design, Emergence of HDLs, Typical Design Flow, Importance of HDLs, Popularity of Verilog HDL, Trends in HDLs, Design Methodologies - Example: 4-bit Ripple Carry Counter, Modules, Instances, Components of a Simulation, Design Block, Stimulus Block, Example- Ripple Carry Counter, Basic Concepts, Lexical Conventions, Data Types, System Tasks and Compiler Directives

UNIT II	**Components of Verilog Module and Gate-Level Modeling**	**6**

Modules and Ports, Modules- Components of Verilog Module, Example: S-R Latch, Ports- List of ports – Port Declaration - Port Connection Rules- Connecting Ports to External Signals, Gate-Level Modeling - Gate Types- AND/OR Gates, BUF/NOT Gates, Array of instances, Examples: Gate-level multiplexer, 4- bit ripple carry full adder, Gate Delays- Rise, Fall, and Turn-off Delays, Min/Typ/Max Values, Delay Example;

UNIT III	**Dataflow and Behavioral Modeling**	**6**

Dataflow Modeling - Continuous Assignments, Delays, Expressions, Operators, and Operands, Operator Types, Examples: 4-to-1 Multiplexer, 4-bit Full Adder, Ripple Counter; Behavioral Modeling, Structured Procedures, Procedural Assignments, Conditional Statements, Multiway Branching, Loops, Sequential and Parallel Blocks, Examples: 4-to-1 Multiplexer, 4-bit Counter, Traffic Signal Controller –FSM design;

UNIT IV	**Switch-Level Modeling and User-Defined Primitives**	**6**

Switch-Level Modeling, Switch-Modeling Elements- MOS switches, CMOS switches, Bi-directional switches, Power and Ground, Resistive Switches, Delay Specification on Switches, Examples: CMOS Nor Gate, 2-to-1 Multiplexer, CMOS Inverter, Hands-on with FPGA; User-Defined Primitives - UDP basics, Combinational UDPs, Sequential UDPs, UDP Table Shorthand Symbols

UNIT V	**Hands-on with CADENCE software Tool**	**6**

Design, Functional verification and Synthesis of ALU or any given subsystems using CADENCE tool and analyzing the same for Area, Power and Delay

TOTAL: 30 PERIODS

OUTCOMES: At the end of the course, learners will be able to

- Determine hierarchical hardware modeling techniques suitable for a digital designs
- Develop Gate Level Modeling for digital designs
- Develop Dataflow Modeling and Behavioral Modeling for digital designs
- Develop Switch-Level Modeling and User-Defined Primitives for digital designs
- Use CADENCE software tool for Hardware Modeling, Functional verification, Simulation,

Synthesize and Analyse - Area, Power and Delay
TEXT BOOK:
1. Samir Palnitkar “Verilog HDL: A Guide to Digital Design and Synthesis”, Second Edition. 2. Zainalabedin Navabi “Verilog Digital System Design”.
REFERENCES: 1. Simon Monk “Programming FPGAs: Getting Started with Verilog”. 2. Jayaram Bhasker “A Verilog HDL primer”.
Web Resource: https://www.udemy.com/course/system-design-using-verilog/

VD18704	RF CIRCUIT DESIGN – THEORY AND SIMULATION USING EM SIMULATION TOOLS	L	T	P	C
		1	0	2	2

OBJECTIVES:

- To get insights about RF circuit design.
- To investigate the design of Microwave Circuits.
- To be familiar with the most popular antenna design.
- To design special antenna using simulation tool.
- To introduce the design and its simulation of Microstrip Antenna

UNIT I	Overview of RF circuits	6

Introduction of the course, including an overview of applications and trends. Passive microwave circuits, covering transmission-line based circuits including impedance matching.

UNIT II	Design and Simulation of Microwave Components	6

Design and simulation of Microwave amplifiers, oscillators, filters, couplers and dividers.

UNIT III	Antenna Theory and Simulation	6

Introduction of antennas concepts. Antenna characteristics (radiation pattern, directivity, gain, impedance, bandwidth, and polarization). Wire Antennas theory and simulation. Linear array theory and simulation.

UNIT IV	Design and Simulation of Special Antennas	6

Visualization of dipole, loop, parabolic reflector, Yagi-Uda and horn antennas using simulation tool.

UNIT V	Implementation of Microstrip Patch Antennas	6

Microstrips patch antenna fundamental and design. Design and simulation of microstrip patch antenna and array using simulation tool. Implementation of specific microstrip antenna.

TOTAL: 30 PERIODS

OUTCOMES: At the end of the course, learners will be able to

- Understand the fundamentals of RF circuits.
- Utilize commercial simulation software to design and analyze the RF and Microwave circuits.
- Articulate the principles of electromagnetic energy radiation in free space by antennas.
- Design and simulate the special antennas.
- Implement the microstrip patch antennas for specific applications.

TEXT BOOK:

1. Reinhold Ludwig and Gene Bogdanov, “RF Circuit Design: Theory and Applications”, Pearson Education Inc., 2011.
2. Constantine.A.Balanis “Antenna Theory Analysis and Design”, 4th Edition Wiley Student Edition, 2016.
3. Ramesh Garg, Prakash Bhartia, Inder J. Bahl, A. Ittipiboon, "Microstrip Antenna Design Handbook, 2001, Artech House.

REFERENCES:

1. David M. Pozar, “Microwave Engineering”, 4th Edition, Wiley India (P) Ltd, New Delhi, 2013.
2. John D.Kraus,” Antennas for all Applications”, 5th Edition, Mc Graw Hill, 2017.

VD18705	EMBEDDED PROGRAMMING USING PIC MICROCONTROLLERS	L	T	P	C
		1	0	2	2

OBJECTIVES :

- To design and manufacture embedded system products of the future for better employability.
- To visualize the requirement of an embedded system and then to design it efficiently.
- To introduce various interfacing techniques for popular input devices including sensors, output devices and communication protocols.

UNIT I	Fundamentals on Microcontrollers	6

Introduction to microcontrollers, Salient Features of Modern Microcontrollers, Modular approach to embedded system design, Importance of the controllers in real world, Use of microcontrollers in industry for vehicle manufacturing.

UNIT II	CPU Architecture of PIC Microcontroller	6

Architecture of PIC Microcontroller, Memory Organization, General purpose Registers (GPR's), Interrupt Sources in microcontrollers, I/O Ports, A/D, Serial Communication, Timers /Counters, Reset Functions.

UNIT III	Hand's on session using PIC Microcontroller	6

PIC based Digital Alarm Clock,4X4 matrix keypad interfacing with PIC, Heart beat monitoring using PIC and pulse sensor, PIC to PIC communication using RF module, Interfacing DHT11 with PIC16F877A for Temperature and Humidity Measurement, IoT based web-controlled home automation using PIC microcontroller.

UNIT IV	Introduction to MSP 430	6

MSP 430 Architectures, MSP clock system and reset, Interrupts in MSP 430, Timer and Counters, A/D, D/A, Serial Communication Protocols.

UNIT V	Hand's on session using MSP 430	6

Interfacing LCD with MSP 430, Interfacing stepper motor with MSP 430, Motion detector using MSP430 and PIR sensor, Interfacing HC05 bluetooth module with MSP 430, Vehicle tracking and accident alert system using MSP 430 and GPS module, Line follower ROBOT using MSP430 launch pad.

TOTAL : 30 PERIODS

OUTCOMES:

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

- Use the features of Microcontrollers in real world applications
- Interpret the PIC architecture
- Program PIC microcontroller with interfaces for various applications
- Interpret the MSP-430 architecture
- Program MSP-430 microcontroller with interfaces for various applications

TEXT BOOKS:

1. Pic Microcontroller And Embedded Systems: Using Assembly and C for Pic Muhammed Ali Mazidi, Rolind D.Mckinlay, Danny Causey18 ISBN:9788131716755.

REFERENCES:

1. Designing Embedded Hardware, John Catsoulis, 2nd edition. Shroff Publishers and Distributors. ISBN-10: 9788184042597.
2. Embedded System Design: A Unified Hardware / Software Introduction. Tony Givargis and Frank Vahid. Wiley. ISBN-10: 812650837X
3. MSP430 Microcontroller Basics. John H. Davies. Elsevier. ISBN-10: 9789380501857. Programming Embedded Systems in C and C++. Micheal Barr. Shroff Publishers and Distributors. ISBN-10: 817366076X.

Web Resource: https://onlinecourses.nptel.ac.in/noc20_ee98/course

VD18706	SYSTEM DESIGN FOR IOT APPLICATIONS	L	T	P	C
		1	0	2	2

OBJECTIVES:

- To design embedded system products of the future.
- To visualize the requirement of an embedded system and to design it efficiently.
- To introduce various interfacing techniques for popular input devices including sensors, output devices and communication protocols.

UNIT I	INTRODUCTION TO IOT	6

IOT - IOT services - IOT Architecture -Communication Technologies used in IoT-IoT Standardization organization -Terminologies similar to IoT

UNIT II	NETWORKING TECHNOLOGIES FOR IOT	6

Wired vs Wireless-Wireless Network Classification-Cellular Networks-WiFi-Zigbee-Bluetooth-RFID-NFC

UNIT III	INTRODUCTION TO ARDUINO	6

Arduino - Flavors of Arduino - Arduino Add on -Rear Eye - A wearable additional Eye - Motion following motorized Camera Base.

UNIT IV	PERIPHERAL CONTROL	6

Interfacing touch screen - ADC, DAC and, Motor - DC Motor Control using PWM Relay and Stepper Motor interfacing.

Lab: Interfacing of sensors with SBC.

UNIT V	PREPARING IOT PROJECTS	6

Raspberry Pi - Hardware Components - Raspberry Pi for Project Development: Raspberry Pi platform – GPIO – Establishment and setting of Raspberry Pi software – LAMP Installation - Home temperature monitoring system – Webcam and Raspberry Pi camera project - Voice Based Self Assisting Robot Using Firebird V.

TOTAL : 30 PERIODS

OUTCOMES:

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

- Acquire knowledge about features of modern microcontrollers.
- Understand the concept of CPU architectures of microcontrollers Arduino and Raspberry PI Identifying the Customer and Business model.
- Acquire knowledge on interfacing microcontrollers Arduino and Raspberry PI for Real time applications.
- Design and integrate projects using Raspberry Pi with Temperature Sensor, Webcam

TEXT BOOKS:

1. Arduino-For-Beginners.pdf (makerspaces.com)
2. Donald Norris ―The Internet of Things: Do-It-Yourself at Home Projects for Arduino, Raspberry Pi and Beagle Bone Black‖, 1st Edition, McGraw Hill, 2015
3. final_report.pdf (iitb.ac.in)

REFERENCES:

1. Arduino Course for Absolute Beginners eBook Info - Programming Electronics Academy

Web Resource:

https://www.udemy.com/course/arduino-for-beginners-complete-course

VC18005	Basics of Entrepreneurship Development	L	T	P	C
		1	0	2	2

OBJECTIVES:		
• To provide Knowledge on Self-discovery and Problem identification. • To provide Skill set on Identifying customer segment and Practice on Business Model. • To understand the Market, Sales and support.		
UNIT I	**Self-Discovery & Problem Identification**	6
Orientation of Entrepreneurship – Case Study – activity – Effectuation – Principles of Effectuation – Identifying Entrepreneur skill. Problem Identification – Design thinking – look for solution – activity – Brain storming.		
UNIT II	**Customer & Business Model**	6
Identifying customer segment, understanding the market – Product selection –activity – value proposition canvas. Identify the Problem, Solution and Risk identification – Activity – Business model.		
UNIT III	**Validation and Resources**	6
Build a Minimum Viable Product (MVP) – validation and launching of MVP –activity – MVP Interview. Cost – Revenue – Pricing – Profitability – Sources of finance – activity – Bootstrap Finance – Leadership – Identifying Co-founders and Hiring a Team – activity –Pitching about a venture		
UNIT IV	**Market and sales**	6
Positioning and branding – network and channels – sales planning – activity – selling skill.		
UNIT V	**Support**	6
Project Management – Project tracking – Basics of Business regulations – Activity – capstone project.		
		TOTAL: 30 PERIODS

OUTCOMES

CO1: Acquire knowledge and Practice on Self Discovery and Problem identification.
CO2: Understand the concept of Identifying the Customer and Business model.
CO3: Acquire knowledge on various Resource and Practice on validation.
CO4: Acquire knowledge on marketing and sales.
CO5: Practice on Project management.

TEXT BOOKS:

1. S.S.Khanka, "Entrepreneurial Development" S.Chand & Co. Ltd., Ram Nagar, New Delhi, 2013.
2. Donald F Kuratko, " Entreprenuership – Theory, Process and Practice", 9th edition, Cengage Learning 2014

REFERENCES :

1. Hisrich R D, Peters M P, "Entrepreneurship" 8th Edition, Tata McGraw-Hill, 2013.
2. Mathew J Manimala, "Entrepreneurship Theory at Cross Roads: paradigms and Praxis", 2nd Edition Dream Tech, 2005.

Web Resource:
https://learnwise.wfglobal.org/#/IN/en/courses

Checklist :-

1.	The basic fundamentals have been covered in the syllabus	Yes / ~~NO~~
2.	The unit wise hours are distributed according to the contents	Yes / ~~NO~~
3.	Whether the credit allotted for this subject is sufficient	Yes / ~~No~~
4.	Whether two to three recent edition textbooks are available for the subject	Yes / ~~NO~~
5.	Whether this subject requires any prerequisites	Yes / ~~No~~
6.	Whether the recent trends are mentioned in this subject	Yes / ~~NO~~
7.	Whether the prerequisites for this subject is correctly mentioned	Yes /~~NO~~
8.	Atleast five to six reference books are mentioned in the syllabus	Yes/ ~~NO~~
9.	Web content / URL address for the recent topics are given in the references	~~Yes~~ / NO
10..	Internal Faculty Members involved in preparing the syllabus	List the name, Designation, address and signature
1. Dr.S.Ilaiyavel, Associate Professor, Dept. of Mechanical Engineering & Manager, SVCE-EPIC. 2. Mr.V.Senthil Velan, Assistant Professor, Dept. of Mechanical Engineering & Project Officer, SVCE-EPIC. 3. Dr.Amutha Charu Sheela, Assistant Professor, Dept. of HSS, SVCE. All the faculty member have been trained by EDII-TN and NEN for conducting the courses (Foundation course and advanced courses).		
11.	External faculty Expert Members involved in preparing the syllabus.	List the name, Designation, address and signature
12..	Industry expert members involved in the preparing the syllabus.	List the name, Designation, address and signature
Supported by Entrepreneurship Development and Innovation Institute (EDII-TN), Govt. of Tamil Nadu and National Entrepreneurship Network (NEN), a division of Wadhwani Foundation (WF).		
13.	Whether the syllabus meets the requirements of competitive examinations (GATE / IES)	Yes / ~~NO~~
14.	References used for framing the syllabus	List down

<table>
<tr><td colspan="3">1. Rajeev Roy, “Entrepreneurship” 2nd edition, Oxford University Press, 2011.

2. EDII “Faulty and External Experts – A Hand Book for New Entrepreneurs Publishers: Entrepreneurship Development”, Institute of India, Ahmadabad, 1986.
1.</td></tr>
<tr><td>15</td><td>Who reviewed the syllabus</td><td>List the name, Designation, address and signature</td></tr>
<tr><td colspan="3">1. Dr.S.Ilaiyavel, Associate Professor, Dept. of Mechanical Engineering & Manager, SVCE-EPIC.</td></tr>
<tr><td>16</td><td>Syllabus Approved by</td><td>List the name, Designation, address and signature</td></tr>
<tr><td colspan="3"></td></tr>
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VC18006	Advance in Entrepreneurship Development	L	T	P	C
		1	0	2	2

OBJECTIVES :

- To provide Knowledge on Business model, Business plan and new business model/prototype.
- To provide Skill set on increasing revenue and funding.
- To understand the Team building, Measurement of progress and legal matters.

UNIT I	Business Model & Product service	6

Introduction to the concept of pivoting –Business Model-Types of Business Model-Business Model Evaluation-Refining Business Model-Analyzing Business Model-Adding New customer to Business model.
Problem in new product development-New business model/Prototype

UNIT II	Business Planning	6

Business Plan-Sales plan- People plan- Finance plan-understanding finance planning-Forecasting template.
Creating procurement plan-Negotiation role play-Activity.

UNIT III	Increasing Revenue and Funding	6

Understanding of primary revenue source-Customer life cycle-Exploring secondary revenue source-Funding option.
Exploring funding option-Pitch deck.

UNIT IV	Building a team and Brandings	6

Introduction to building a team-pitching to attract team-Setting a team for success-standardize key process-Branding-Definition of values-Positioning statement-Identification of right channel-Digital marketing.
Brand name and logo activity.

UNIT V	Measurement of Progress and legal Matters	6

Metrics for customer retention and satisfaction-Metrics dash board-legal and compliance requirement-Identify mentor and advisors.
Project.

TOTAL: 30 PERIODS

OUTCOMES

CO1: Acquire knowledge and Practice on Business model and Business planning.
CO2: Understand the concept of increasing the revenue and funding.
CO3: Acquire knowledge on building a team and branding.
CO4: Acquire knowledge on Measurement of progress and legal matters.
CO5: Practice on Project management.

TEXT BOOKS:

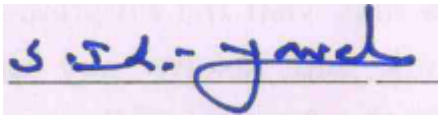
1. S.S.Khanka, “Entrepreneurial Development” S.Chand & Co. Ltd., Ram Nagar, New Delhi, 2013.
2. Donald F Kuratko, “Entreprenuership – Theory, Process and Practice”, 9th edition, Cengage Learning 2014

REFERENCES:

1. Hisrich R D, Peters M P, “Entrepreneurship” 8th Edition, Tata McGraw-Hill, 2013.
2. Mathew J Manimala, “Entrepreneurship Theory at Cross Roads: paradigms and Praxis”, 2nd Edition Dream Tech, 2005.

Web Resource:

https://lms.learnwise.wfglobal.org/IN/en/home



Dr.S.Ilaiyavel

Signature of the EDC Coordinator

XXXX **PROFESSIONAL READINESS FOR INNOVATION, EMPLOYABILITY AND ENTREPRENEURSHIP**

L	T	P	C
0	0	6	3

OBJECTIVES:

- To empower students with overall Professional and Technical skills required to solve a real world problem.
- To mentor the students to approach a solution through various stages of Ideation, Research, Design Thinking, workflows, architecture and building a prototype in keeping with the end-user and client needs.
- To provide experiential learning to enhance the Entrepreneurship and employability skills of the students.

This course is a four months immersive program to keep up with the industry demand and to have critical thinking, team based project experience and timely delivery of modules in a project that solves world problems using emerging technologies.

To prepare the students with digital skills for the future, the Experiential Project Based Learning is introduced to give them hands-on experience using digital technologies on open-source platforms with an end-to-end journey to solve a problem. By the end of this course, the student understands the approach to solve a problem with team collaboration with mentoring from Industry and faculties. **This is an EEC category course offered as an elective, under the type, "Experiential Project Based Learning".**

Highlights of this course:

- Students undergo training on emerging technologies
- Students develop solutions for real-world use cases
- Students work with mentors to learn and use industry best practices
- Students access and use Self-Learning courses on various technologies, approaches and methodologies.
- Collaborate in teams with other students working on the same topic
- Have a dedicated mentor to guide

OUTCOMES:

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

- Upskill in emerging technologies and apply to real industry-level use cases
- Understand agile development process
- Develop career readiness competencies, Team Skills / Leadership qualities
- Develop Time management, Project management skills and Communication Skills
- Use Critical Thinking for Innovative Problem Solving
- Develop entrepreneurship skills to independently work on products

The course will involve 40-50 hours of technical training, and 40-50 hours of project development. The activities involved in the project along with duration are given in Table 1.

TABLE 1: ACTIVITIES

Activity Name	Activity Description	Time (weeks)
Choosing a Project	Selecting a project from the list of projects categorized various technologies & business domains	2
Team Formation	Students shall form a team of 4 Members before enrolling to a project. Team members shall distribute the project activities among themselves.	1
Hands on Training	Students will be provided with hands-on training on selected technology in which they are going to develop the project.	2
Project Development	Project shall be developed in agile mode. The status of the project shall be updated to the mentors via appropriate platform	6
Code submission, Project Doc and Demo	Project deliverables must include the working code, project document and demonstration video. All the project deliverables are to be uploaded to cloud based repository such as GitHub.	3
Mentor Review and Approval	Mentor will be reviewing the project deliverables as per the milestone schedule and the feedback will be provided to the team.	1
Evaluation and scoring	Evaluators will be assigned to the team to evaluate the project deliverables, and the scoring will be provided based on the evaluation metrics	1
TOTAL		16 WEEKS

Essentially, it involves 15 weeks of learning and doing, and one week for evaluation. The evaluation will be carried out to assess technical and soft skills as given in Table 2.

TABLE 2: EVALUATION SCHEMA

PROFESSIONAL READINESS FOR INNOVATION, EMPLOYABILITY AND ENTREPRENEURSHIP			
Technical Skills		Soft Skills	
Criteria	Weightage	Criteria	Weightage
Project Design using Design Thinking	10	Teamwork	5
Innovation & Problem Solving	10	Time Management	10
Requirements Analysis using Critical Thinking	10	Attendance and Punctuality	5
Project Planning using Agile Methodologies	5	Project Documentation	5
Technology Stack (APIs, tools, Platforms)	5	Project Demonstration	5
Coding & Solutioning	15		
User Acceptance Testing	5		
Performance of Product / Application	5		
Technical Training & Assignments	5		
Total	70	Total	30
Total Weightage			100
Passing Requirement			50
Continuous Assessment Only			

AMENDMENT IN RESPECTIVE REGULATIONS:

1. Course is offered in the
   - $6^{th}/7^{th}$ semesters of UG programmes
2. This is an EEC category course offered as an elective under the type, "Experiential Project Based Learning".
3. **Evaluation of Experiential Project Based Learning:**
   - **Project Review & Scoring:** Evaluator accesses the project deliverables, reviews the work done by the team and assigns the score for defined metrics.
   - **Project Status Review:** Mentor reviews the deliverables submitted by student teams and shares his/her comments. Mentor ensures the timely completion of project.
   - The evaluation shall be carried out as per the metrics given in Table 2.
4. If a student takes a break and rejoins the programme at a later point in time in a semester other than the prescribed semesters identified for the course, he/she is permitted to opt for a professional elective in lieu of this course.

Course Assessment scheme: Assessed through **Continuous assessment mode**

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Passing Criteria:

The passing requirement for the courses of the type 'Experiential Project Based Learning' falling under the category of EEC is 50% of the continuous assessment marks only.

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