ANNA UNIVERSITY, CHENNAI

UNIVERSITY DEPARTMENTS

B.E. ELECTRONICS AND COMMUNICATION ENGINEERING

REGULATIONS – 2019

VISION

The Department of ECE shall strive continuously to create highly motivated, technologically competent engineers, be a benchmark and a trend setter in Electronics and Communication Engineering by imparting quality education with interwoven input from academic institutions, research organizations and industries, keeping in phase with rapidly changing technologies imbibing ethical values.

MISSION

- Imparting quality technical education through flexible student centric curriculum evolved continuously for students of ECE with diverse backgrounds.
- Providing good academic ambience by adopting best teaching and learning practices.
- Providing congenial ambience in inculcating critical thinking with a quest for creativity, innovation, research and development activities.
- Enhancing collaborative activities with academia, research institutions and industries by nurturing ethical entrepreneurship and leadership qualities.
- Nurturing continuous learning in the stat-of-the-art technologies and global outreach programmes resulting in competent world class engineers.

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The Programme defines Programme Educational Objectives, Programme Outcomes and Programme Specific Outcomes as follows:

1. PROGRAMME EDUCATIONAL OBJECTIVES (PEOs):

PEO1 Equip the students with sufficient theoretical, analytical and initiative skills in Basic Sciences and Engineering necessary, to assimilate, analyze, synthesis and innovate solutions to meet societal needs.

PEO2 To provide adequate research ambience enabling the students to inculcate thirst for life long learning and sustained research interest.

PEO3 To instill and practice values, leadership qualities and team spirit to promote entrepreneurship and indigenization.

After the course duration of four years, B.E. graduates of Electronics and Communication Engineering will exhibit the following outcomes:

2. PROGRAMME OUTCOMES (POs):

PO1: Ability to apply technical knowledge in mathematics, Science and Engineering leading to the realization and evaluation of complex systems, through research problems in the context of evolving societal needs

PO2: Imaginative critical thinking with an ability to think critically, analyze and solve engineering problems

PO3: Ability to design a system, component, or process to meet desired needs within realistic constraints.

PO4: Ability to, gather user needs and requirements, design, develop, integrate, and test complex systems by employing systems engineering thinking and processes, within required operational and acquisition system environments.

PO5: Personal and intellectual autonomy to independently and with an openness to reflect upon and use modern engineering tools necessary to engineering practices

PO6: Educational practices necessary to understand the impact of engineering solutions in a global, economical, environmental and societal context.

PO7: An active and committed global citizen with an awareness of contemporary issues and their Impact on economic, environmental, social, political, ethical, health and safety, manufacturability and sustainability.

PO8: An understanding of professional, ethical, legal issues and responsibilities

PO9: A creative, enterprising team player and engaged participative leader able to effect change.

PO10: A confident, resilient and adaptable individual with good communication skills

PO11: Exercise their responsibilities in the management of cost-effective systems product development by leading and participating in interdisciplinary teams

PO12: Active exploration of new ideas through lifelong learning.

3. PROGRAMME SPECIFIC OUTCOMES (PSOs):

After the completion of B.E. Electronics and Communication Engineering programme, the student will process the follow program Specific Outcomes:

PSO1 The curriculum of ECE includes mathematics and Engineering topics necessary to analyse and design complex Electronic Systems containing Hardware and Software components.

PSO2 The curriculum of ECE includes mathematics and Engineering topics necessary to analyse and design complex Communication Systems containing Hardware and Software components.

MAPPING OF PROGRAMME EDUCATIONAL OBJECTIVES WITH PROGRAMME OUTCOMES:

A broad relation between the programme educational objective and the Programme outcomes is given in the following table

PROGRAMME EDUCATIONAL OBJECTIVES	PROGRAMME OUTCOMES											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
PEO1	✓	✓	✓	✓	✓	✓	✓			✓	✓	✓
PEO2	✓	✓	✓	✓	✓	✓	✓			✓	✓	✓
PEO3					✓	✓	✓	✓	✓	✓	✓	✓

MAPPING OF COURSE OUTCOMES WITH PROGRAMME OUTCOMES:

A broad relation between the Course Outcomes and Programme Outcomes is given in the following table

COURSE OUTCOMES		PROGRAMME OUTCOMES											
SEM	**COURSE NAME**	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
I	Technical English												
	Engineering Mathematics I												
	Engineering Physics												
	Engineering Chemistry												
	Problem Solving and Python Programming	√	√ √	√	√					√	√		√
	Basic Sciences Laboratory												
	Problem Solving and Python Programming Laboratory	√	√ √	√	√					√	√		√
II	Engineering Mathematics II												
	Basics of Electrical and Measurements Engineering												
	Engineering Mechanics	√		√									√
	Circuit Theory	3	3	2	2		2					2	1
	Semiconductor Physics and Devices												
	Workshop Practices Laboratory	√	√	√	√								
	Electronic Devices and Circuit Theory Laboratory	2	2 3	3									1

SEM	COURSE NAME	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
	Linear Algebra and Numerical Methods												
III	Electronic Circuits – I	2	3	3	3		2						
	Electromagnetic Fields and Waves	3	2	2	3	2							1
	Digital System Design	3	3	3	3								
	Signals and Systems	3	2	3	2								
	Electronic Design Laboratory	2	2	3	3	3						1	1
	Electrical and Measurements Laboratory												
	Transmission Lines and Wave Guides	3	3	3	2		2					2	1
	Communication theory	3	3	3	1								
	Electronic Circuits-II	2	3	3	2	2							
IV	Digital Signal Processing	3	3	3	3	2	2						
	Linear Integrated Circuits	2	2	3	3							1	3
	Environmental Sciences												
	Audit Course I												
	Digital Signal Processing Laboratory	2	2	3	3	3	1					1	1
	Integrated Circuits Laboratory	2	3	3	3	2						1	1
	Antennas and Wave Propagation	3	3	3	2		2					2	1
	Digital Communication	3	3	3	3		2					2	2
	Microprocessors and Microcontrollers	1	2	3	3	1						2	3
	Control Systems Engineering	3	3	2	3		2						2
	Professional Elective - I												
V	Principles of Management	√					√			√	√	√	
	Audit Course II												
	Microprocessor and Microcontroller Interfacing Laboratory	1	3	3	3							3	3
	Analog and Digital Communication Laboratory	2	2	3	3	2	2						1
	Summer Internship / Summer Project (Minimum 4 Weeks)	√	√	√	√	√	√					√	√

SEM	COURSE NAME	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
VI	Digital VLSI	3	3	3	3	1	2					1	3
	Wireless Communication	2	2	2	1	2			2				1
	Communication Networks	2	3	3	2								
	Professional Elective II												
	Open Elective - I*												
	Values and Ethics												
	VLSI Laboratory	√	√	√	√	√						√	√
	Wireless Communication and Networking Laboratory	2	2	3	3	2	2						1
VII	Millimeter and Optical Wave Communication	3	3	3	2		2					2	1
	Human Relations at Work		√	√		√	√	√	√	√	√	√	√
	Professional Elective III												
	Professional Elective IV												
	Open Elective - II												
	High Frequency Communication Laboratory	2	2	3	3	2	2						1
	Project I												
VIII	Professional Elective V												
	Professional Elective VI												
	Project II												

ANNA UNIVERSITY, CHENNAI
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CHOICE BASED CREDIT SYSTEM
I - VIII SEMESTER CURRICULA AND SYLLABI

SEMESTER I

S. NO.	CODE NO.	COURSE TITLE	CATE GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
THEORY								
1.	HS5151	Technical English	HSMC	4	0	0	4	4
2.	MA5158	Engineering Mathematics I	BSC	3	1	0	4	4
3.	PH5151	Engineering Physics	BSC	3	0	0	3	3
4.	CY5151	Engineering Chemistry	BSC	3	0	0	3	3
5.	GE5153	Problem Solving and Python Programming	ESC	3	0	0	3	3
PRACTICALS								
6.	BS5161	Basic Sciences Laboratory	BSC	0	0	4	4	2
7.	GE5161	Problem Solving and Python Programming Laboratory	ESC	0	0	4	4	2
			TOTAL	**16**	**1**	**8**	**25**	**21**

SEMESTER II

S. NO.	CODE NO.	COURSE TITLE	CATE GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
THEORY								
1.	MA5252	Engineering Mathematics II	BSC	3	1	0	4	4
2.	EE5201	Basics of Electrical and Measurement Engineering	ESC	3	0	0	3	3
3.	GE5152	Engineering Mechanics	ESC	3	1	0	4	4
4.	EC5251	Circuit Theory	ESC	3	1	0	4	4
5.	PH5202	Semiconductor Physics and Devices	BSC	3	0	0	3	3
PRACTICALS								
6.	GE5162	Workshop Practices Laboratory	ESC	0	0	4	4	2
7.	EC5211	Electronic Devices and Circuit Theory Laboratory	PCC	0	0	4	4	2
			TOTAL	**15**	**3**	**8**	**26**	**22**

SEMESTER III

S. NO.	CODE NO.	COURSETITLE	CATE GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
THEORY								
1.	MA5356	Linear Algebra and Numerical Methods	BSC	3	1	0	4	4
2.	EC5301	Electronic Circuits -I	PCC	3	1	0	4	4
3.	EC5302	Electromagnetic Fields and Waves	PCC	3	0	0	3	3
4.	EC5303	Digital System Design	PCC	3	0	0	3	3
5.	EC5304	Signals and Systems	PCC	3	1	0	4	4
PRACTICALS								
6.	EC5311	Electronic Design Laboratory	PCC	0	0	4	4	2
7.	EE5313	Electrical and Measurements Laboratory	ESC	0	0	4	4	2
			TOTAL	**15**	**3**	**8**	**26**	**22**

SEMESTER IV

S. NO.	CODE NO.	COURSETITLE	CATE GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
THEORY								
1.	EC5401	Transmission lines and wave Guides	PCC	3	0	0	3	3
2.	EC5402	Communication Theory	PCC	3	0	0	3	3
3.	EC5403	Electronics Circuits - II	PCC	3	1	0	4	4
4.	EC5404	Digital Signal Processing	PCC	3	0	0	3	3
5.	EC5405	Linear Integrated Circuits	PCC	3	0	0	3	3
6.	GE5251	Environmental Sciences	BSC	3	0	0	3	3
7.		Audit Course I*	AC	3	0	0	3	0
PRACTICALS								
8.	EC5411	Digital Signal Processing Laboratory	PCC	0	0	4	4	2
9.	EC5412	Integrated Circuits Laboratory	PCC	0	0	4	4	2
			TOTAL	**21**	**1**	**8**	**30**	**23**

*Audit Course is optional

SEMESTER V

S. NO.	CODE NO.	COURSETITLE	CATE GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
THEORY								
1.	EC5501	Antennas and Wave Propagation	PCC	3	0	0	3	3
2.	EC5502	Digital Communication	PCC	3	0	0	3	3
3.	EC5551	Microprocessors and Microcontrollers	PCC	3	0	0	3	3
4.	EC5503	Control Systems Engineering	PCC	3	0	0	3	3
5.		Professional Elective I	PEC	3	0	0	3	3
6.	MG5451	Principles of Management	HSMC	3	0	0	3	3
7.		Audit Course II*	AC	3	0	0	0	0
PRACTICALS								
8.	EC5561	Microprocessor and Microcontroller Interfacing Laboratory	PCC	0	0	4	4	2
9.	EC5511	Analog and Digital Communication Laboratory	PCC	0	0	4	4	2
10.	EC5512	Summer Internship / Summer Project (Minimum 4 Weeks)	EEC	0	0	4	4	2
			TOTAL	**21**	**0**	**12**	**30**	**24**

*Audit Course is optional

SEMESTER VI

S. NO.	CODE NO.	COURSETITLE	CATE GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
THEORY								
1.	EC5651	Digital VLSI	PCC	3	0	0	3	3
2.	EC5601	Wireless Communication	PCC	3	0	0	3	3
3.	EC5602	Communication Networks	PCC	3	0	0	3	3
4.		Professional Elective II	PEC	3	0	0	3	3
5.		Open Elective I	OEC	3	0	0	3	3
6.	HM5354	Values and Ethics	HSMC	3	0	0	3	3
PRACTICALS								
7.	EC5611	VLSI Laboratory	PCC	0	0	4	4	2
8.	EC5612	Wireless Communication and Networking Laboratory	PCC	0	0	4	4	2
			TOTAL	**21**	**0**	**8**	**26**	**22**

SEMESTER VII

S. NO.	CODE NO.	COURSE TITLE	CATE GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
THEORY								
1.	EC5701	Millimeter And Optical Wave Communication	PCC	3	0	0	3	3
2.	HM5353	Human Relations at Work	HSMC	3	0	0	3	3
3.		Professional Elective III	PEC	3	0	0	3	3
4.		Professional Elective IV	PEC	3	0	0	3	3
5.		Open Elective II	OEC	3	0	0	3	3
PRACTICALS								
6.	EC5711	High Frequency Communication Laboratory	PCC	0	0	4	4	2
7.	EC5712	Project I	EEC	0	0	6	6	3
			TOTAL	**15**	**0**	**10**	**25**	**20**

SEMESTER VIII

S. NO.	CODE NO.	COURSETITLE	CATE GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
THEORY								
1.		Professional Elective V	PEC	3	0	0	3	3
2.		Professional Elective VI	PEC	3	0	0	3	3
PRACTICALS								
3.	EC5811	Project II	EEC	0	0	16	16	8
			TOTAL	**6**	**0**	**16**	**22**	**14**

TOTAL CREDITS: 168

HSMC COURSES

S.NO	COURSE CODE	COURSE TITLE	CATEGORY	L	T	P	CONTACT PERIODS	C
1.	HS5151	Technical English	HSMC	4	0	0	4	4
2.	MG5451	Principles of Management	HSMC	3	0	0	3	3
3.	HM5354	Values and Ethics	HSMC	3	0	0	3	3
4.	HM5353	Human Relations at Work	HSMC	3	0	0	3	3

BASIC SCIENCE COURSES

S.NO	COURSE CODE	COURSE TITLE	CATEGORY	L	T	P	CONTACT PERIODS	C
1.	MA5158	Engineering Mathematics I	BSC	3	1	0	4	4
2.	PH5151	Engineering Physics	BSC	3	0	0	3	3
3.	CY5151	Engineering Chemistry	BSC	3	0	0	3	3
4.	BS5161	Basic Sciences Laboratory	BSC	0	0	4	4	2
5.	MA5252	Engineering Mathematics II	BSC	0	0	4	4	2
6.	PH5202	Semiconductor Physics and Devices	BSC	3	0	0	3	3
7.	MA5356	Linear Algebra and Numerical Methods	BSC	3	1	0	4	4
8.	GE5251	Environmental Sciences	BSC	3	0	0	3	3

ENGINEERING SCIENCE COURSES

S.NO	COURSE CODE	COURSE TITLE	CATEGORY	L	T	P	CONTACT PERIODS	C
1.	GE5153	Problem Solving and Python Programming	ESC	3	0	0	3	3
2.	GE5152	Engineering Mechanics	ESC	3	1	0	4	4
3.	EE5201	Basics of Electrical and Measurements Engineering	ESC	3	0	0	3	3
4.	EC5251	Circuit Theory	ESC	3	1	0	4	4
5.	GE5161	Problem Solving and Python Programming Laboratory	ESC	0	0	4	4	2
6.	EE5313	Electrical and Measurements Laboratory	ESC	0	0	4	4	2
7.	GE5162	Workshop Practices Laboratory	ESC	0	0	4	4	2

PROFESSIONAL CORE COURSES

S. NO	COURSE CODE	COURSE TITLE	CATEGORY	L	T	P	CONTACT PERIODS	C
1.	EC5211	Electronic Devices and Circuit theory Laboratory	PCC	0	0	4	4	2
2.	EC5301	Electronic Circuits -I	PCC	3	1	0	4	4
3.	EC5302	Electromagnetic Fields and Waves	PCC	3	0	0	3	3
4.	EC5303	Digital System Design	PCC	3	0	0	3	3
5.	EC5304	Signals and Systems	PCC	3	1	0	4	4
6.	EC5311	Electronic Design Laboratory	PCC	0	0	4	4	2
7.	EC5401	Transmission lines and wave Guides	PCC	3	0	0	3	3
8.	EC5402	Communication Theory	PCC	3	0	0	3	3
9.	EC5403	Electronics Circuits - II	PCC	3	1	0	4	4
10.	EC5404	Digital Signal Processing	PCC	3	0	0	3	3
11.	EC5405	Linear Integrated Circuits	PCC	3	0	0	3	3
12.	EC5411	Digital Signal Processing Laboratory	PCC	0	0	4	4	2
13.	EC5412	Integrated Circuits Laboratory	PCC	0	0	4	4	2
14.	EC5501	Antenna and Wave Propagation	PCC	3	0	0	3	3
15.	EC5502	Digital Communication	PCC	3	0	0	3	3
16.	EC5503	Control Systems Engineering	PCC	3	0	0	3	3
17.	EC5511	Analog and Digital Communication Laboratory	PCC	0	0	4	4	2
18.	EC5551	Microprocessors and Microcontrollers	PCC	3	0	0	3	3
19.	EC5561	Microprocessor and Microcontroller Interfacing Laboratory	PCC	0	0	4	4	2
20.	EC5701	Millimeter And Optical Wave Communication	PCC	3	0	0	3	3
21.	EC5602	Communication Networks	PCC	3	0	0	3	3

22.	EC5611	VLSI Laboratory	PCC	0	0	4	4	2
23.	EC5711	High Frequency Communication Laboratory	PCC	0	0	4	4	2
24.	EC5651	Digital VLSI	PCC	3	0	0	3	3
25.	EC5601	Wireless Communication	PCC	3	0	0	3	3
26.	EC5612	Wireless Communication and Networking Laboratory	PCC	0	0	4	4	2

EEC COURSES

S.NO	COURSE CODE	COURSE TITLE	CATEGORY	L	T	P	CONTACT PERIODS	C
1.	EC5512	Summer Internship / Summer Project (Minimum 4 Weeks)	EEC	0	0	0	0	2
2.	EC5712	Project I	EEC	0	0	6	6	3
3.	EC5811	Project II	EEC	0	0	16	16	8

AUDIT COURSES (AC)

Registration for any of these courses is optional to students

Sl. No	Course Code	Course Title	Periods per week			Credits
			Lecture	Tutorial	Practical	
1.	AD5091	Constitution of India	3	0	0	0
2.	AD5092	Value Education	3	0	0	0
3.	AD5093	Pedagogy Studies	3	0	0	0
4.	AD5094	Stress Management by Yoga	3	0	0	0
5.	AD5095	Personality Development Through Life Enlightenment Skills	3	0	0	0
6.	AD5096	Unnat Bharat Abhiyan	3	0	0	0
7.	AD5097	Essence of Indian Knowledge Tradition	3	0	0	0
Total Credits:						**0**

LIST OF PROFESSIONAL ELECTIVES

Sl. No	COURSE CODE	COURSE TITLE	CATEGORY	L	T	P	CONTACT PERIODS	C
1.	EC5001	Adhoc and Wireless Sensor Networks	PE	3	0	0	3	3
2.	EC5002	Advanced Wireless Communication	PE	3	0	0	3	3
3.	EC5003	Cognitive Radio Networks	PE	3	0	0	3	3
4.	EC5004	Information Theory	PE	3	0	0	3	3
5.	EC5005	Optical Networks	PE	3	0	0	3	3
6.	EC5006	RF Microelectronics	PE	3	0	0	3	3
7.	EC5007	Satellite Communication	PE	3	0	0	3	3
8.	EC5008	Wireless Communication Networks	PE	3	0	0	3	3
9.	EC5072	Cryptography and Network Security	PE	3	0	0	3	3
10.	EC5009	Digital Switching and Transmission	PE	3	0	0	3	3
11.	EC5073	Electro Magnetic Interference and Compatibility	PE	3	0	0	3	3
12.	EC5010	Optoelectronics	PE	3	0	0	3	3
13.	EC5011	Advanced Digital Signal Processing	PE	3	0	0	3	3
14.	EC5012	VLSI Signal Processing	PE	3	0	0	3	3
15.	EC5080	Speech Processing	PE	3	0	0	3	3
16.	EC5076	Multimedia Compression and Networks	PE	3	0	0	3	3
17.	EC5013	Fundamentals Digital Image Processing	PE	3	0	0	3	3
18.	EC5014	CMOS Analog IC Design	PE	3	0	0	3	3
19.	EC5075	Mixed Signal IC Design	PE	3	0	0	3	3
20.	EC5015	Data Converters	PE	3	0	0	3	3
21.	EC5016	Introduction to Embedded Controllers	PE	3	0	0	3	3
22.	EC5071	Advanced Microcontrollers	PE	3	0	0	3	3
23.	EC5017	MEMS	PE	3	0	0	3	3
24.	EC5077	Real Time Embedded Systems	PE	3	0	0	3	3
25.	EC5078	Robotics	PE	3	0	0	3	3
26.	EC5018	Display Technologies	PE	3	0	0	3	3
27.	EC5019	Digital Control Engineering	PE	3	0	0	3	3
28.	EC5020	Measurements and Instrumentation	PE	3	0	0	3	3
29.	EC5074	Foundations for Nano Electronics	PE	3	0	0	3	3
30.	EC5021	Medical Electronics	PE	3	0	0	3	3
31.	EC5022	IoT Enabled Systems Design	PE	3	0	0	3	3
32.	EC5023	CAD for VLSI Circuits	PE	3	0	0	3	3
33.	EC5024	Fundamentals of Operating Systems	PE	3	0	0	3	3

34.	EC5025	Introduction to Web Technology	PE	3	0	0	3	3
35.	EC5079	Soft Computing and Applications	PE	3	0	0	3	3
36.	EC5026	Parallel and Distributed Processing	PE	3	0	0	3	3
37.	GE5073	Foundation Skills In Integrated Product Development	PE	3	0	0	3	3
38.	EC5027	Artificial Intelligence and Machine Learning	PE	3	0	0	3	3

SUMMARY

B.E. ELECTRONICS AND COMMUNICATION ENGINEERING									
Sl. No.	**Subject Area**	**Credits per Semester**							**Credits Total**
		I	**II**	**III**	**IV**	**V**	**VI**	**VII**	**VIII**
1	HSMC	4	-	-	3	-	3	3	-	**13**
2	BSC	12	7	4	3	-	-	-	-	**26**
3	ESC	5	15	-	-	-	-	-	-	**20**
4	PCC	-	-	21	17	16	13	5	-	**72**
5	PEC	-	-	-	-	3	3	6	6	**18**
6	OEC	-	-	-	-	-	3	3	-	**6**
7	EEC	-	-	-	-	2	-	3	8	**13**
	Total	**21**	**22**	**25**	**20**	**21**	**22**	**20**	**14**	**168**
8	Non-Credit /(Audit course)				*	*				

HS5151 TECHNICAL ENGLISH L T P C
4 0 0 4

OBJECTIVES:

The first semester English course entitled 'Technical English' aims to,

- Familiarise first year students of engineering and technology with the fundamental aspects of technical English.
- Develop all the four language skills by giving sufficient practice in the use of the skills in real life contexts.
- Enhance the linguistic and communicative competence of first year engineering and technology students.

UNIT I INTRODUCING ONESELF 12

Listening: Listening and filling a form, listening to speeches by specialists from various branches of engineering and completing activities such as answering questions, identifying the main ideas of the listening text, style of the speaker (tone and tenor) – **Speaking**: Introducing oneself –introducing friend/ family - **Reading:** Descriptive passages (from newspapers / magazines)- **Writing**: Writing a paragraph (native place, school life)- **Grammar:** Simple present, present continuous – **Vocabulary Development**: One word substitution

UNIT II DIALOGUE WRITING 12

Listening: Listening to conversations (asking for and giving directions) –**Speaking:** making conversation using (asking for directions, making an enquiry), Role plays-dialogues- **Reading:** Reading a print interview and answering comprehension questions-**Writing**: Writing a checklist, Dialogue writing- **Grammar**: Simple past – question formation (Wh- questions, Yes or No questions, Tag questions)-**Vocabulary Development**: Stress shift, lexical items related to the theme of the given unit.

UNIT III FORMAL LETTER WRITING 12

Listening: Listening to speeches by famous people and identifying the central message of the speech – answering multiple-choice questions)-**Speaking:** Giving short talks on a given topic-**Reading:** Reading motivational essays on famous engineers and technologists (answering open-ended and closed questions)-**Writing:** Writing formal letters/ emails (Complaint letters)-**Grammar**: Future Tense forms of verbs, subject and verb agreement-**Vocabulary Development**: Collocations – Fixed expressions

UNIT IV WRITING COMPLAINT LETTERS 12

Listening: Listening to short talks (5 minutes duration and fill a table, gap-filling exercise) note taking/note making- **Speaking:** Small group discussion, giving recommendations-**Reading:** Reading problem – solution articles/essays drawn from various sources- **Writing:** Making recommendations – Writing a letter/ sending an email to the Editor- note making- **Grammar:** Modals – Phrasal verbs – cause and effect sentences- **Vocabulary Development**: Connectives, use of cohesive devices in writing, technical vocabulary.

UNIT V WRITING DEFINITIONS AND PRODUCT DESCRIPTION 12

Listening: Listening to a product description (labeling and gap filling) exercises- **Speaking:** Describing a product and comparing and contrasting it with other products- **Reading**: Reading graphical material for comparison (advertisements)-**Writing:** Writing Definitions (short and long) – compare and contrast paragraphs- **Grammar:** Adjectives – Degrees of comparison - compound nouns- **Vocabulary Development**: Use of discourse markers – suffixes (adjectival endings).

TOTAL: 60 PERIODS

COURSE OUTCOMES:

At the end of the course the students will have gained,

CO1: Exposure to basic aspects of technical English.
CO2: The confidence to communicate effectively I various academic situations.
CO3: Learnt the use of basic features of Technical English.

TEXTBOOK:

1. Revised Edition of 'English for Engineers and Technologists' Volume 1 published by Orient Black Swan Limited 2019.

ASSESSMENT PATTERN

- Assessments will assess all the four skills through both pen and paper and computer based tests.
- Assessments can be pen and paper based, quizzes.

MA5158	ENGINEERING MATHEMATI CS – I (Common to all branches of B.E. / B.Tech. Programmes in I Semester)	L	T	P	C
		3	1	0	4

OBJECTIVES:

- To develop the use of matrix algebra techniques that is needed by engineers for practical applications.
- To familiarize the students with differential calculus.
- To familiarize the student with functions of several variables. This is needed in many branches of engineering.
- To make the students understand various techniques of integration.
- To acquaint the student with mathematical tools needed in evaluating multiple integrals and their applications.

UNIT I MATRICES **12**

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

UNIT II DIFFERENTIAL CALCULUS **12**

Limit of function – One sided limit – Limit Laws – Continuity – left and right continuity – types of discontinuities – Intermediate Value Theorem – Derivatives of a function - Differentiation rules – Chain rule – Implicit differentiation – logarithmic differentiation – Maxima and minima – Mean value theorem – (Optional: Polar coordinate system – Differentiation in polar coordinates).

UNIT III FUNCTIONS OF SEVERAL VARIABLES **12**

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

UNIT IV INTEGRAL CALCULUS **12**

Definite and Indefinite integrals - Substitution rule - Techniques of Integration - Integration by parts, Trigonometric integrals, Trigonometric substitutions, Integration of rational functions by partial fraction, Integration of irrational functions - Improper integrals.

UNIT V MULTIPLE INTEGRALS **12**

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

TOTAL :60 PERIODS

COURSE OUTCOMES:

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

CO1: Use the matrix algebra methods for solving practical problems.
CO2: Apply differential calculus tools in solving various application problems.
CO3: Use differential calculus ideas on several variable functions.
CO4: Apply different methods of integration in solving practical problems.
CO5: Apply multiple integral ideas in solving areas, volumes and other practical problems.

TEXTBOOKS:

1. Grewal B.S., "Higher Engineering Mathematics", Khanna Publishers, New Delhi, 44th Edition, 2017.
2. James Stewart, "Calculus with Early Transcendental Functions", Cengage Learning, New Delhi, 6th Edition, 2013.
3. Joel Hass, Christopher Heil and Maurice D.Weir, "Thomas' Calculus", Pearson, New Delhi, 14th Edition, 2018.
4. Narayanan S. and Manicavachagom Pillai T. K., "Calculus" Volume I and II, S. Viswanathan Publishers Pvt. Ltd., Chennai, 2009.

REFERENCES:

1. Bali N., Goyal M. and Watkins C., "Advanced Engineering Mathematics", Firewall Media (An imprint of Lakshmi Publications Pvt., Ltd.,), New Delhi, 7th Edition, 2009.
2. Erwin Kreyszig, "Advanced Engineering Mathematics", John Wiley and Sons, New Delhi, 10th Edition, 2015.
3. Greenberg M.D., "Advanced Engineering Mathematics", Pearson Education,2nd Edition, 5th Reprint, Delhi, 2009.
4. Jain R.K. and Iyengar S.R.K., "Advanced Engineering Mathematics",Narosa Publications, New Delhi, 5th Edition, 2017.
5. Peter V.O'Neil, "Advanced Engineering Mathematics", Cengage Learning India Pvt., Ltd, New Delhi , 7th Edition, 2012.
6. Ramana B.V., "Higher Engineering Mathematics", Tata McGraw Hill Co. Ltd., 11th Reprint, New Delhi, 2010.

PH5151	ENGINEERING PHYSICS	L	T	P	C
	(Common to all branches of B.E / B.Tech programmes)	3	0	0	3

OBJECTIVES:

- To make the students in understanding the importance of mechanics.
- To equip the students on the knowledge of electromagnetic waves.
- To introduce the basics of oscillations, optics and lasers.
- To enable the students in understanding the importance of quantum physics.
- To elucidate the application of quantum mechanics towards the formation of energy bands in crystalline materials.

UNIT I MECHANICS **9**

Moment of inertia (M.I) - Radius of gyration - Theorems of M .I - M.I of circular disc, solid cylinder , hollow cylinder , solid sphere and hollow sphere - K.E of a rotating body – M.I of a diatomic molecule – Rotational energy state of a rigid diatomic molecule - centre of mass – conservation of linear momentum – Relation between Torque and angular momentum - Torsional pendulum.

UNIT II ELECTROMAGNETIC WAVES 9

Gauss's law – Faraday's law - Ampere's law - The Maxwell's equations - wave equation; Plane electromagnetic waves in vacuum, Conditions on the wave field - properties of electromagnetic waves: speed, amplitude, phase, orientation and waves in matter - polarization - Producing electromagnetic waves - Energy and momentum in EM waves: Intensity, waves from localized sources, momentum and radiation pressure - Cell-phone reception. Reflection and transmission of electromagnetic waves from a non-conducting medium-vacuum interface for normal incidence.

UNIT III OSCILLATIONS, OPTICS AND LASERS 9

Simple harmonic motion - resonance - waves on a string - standing waves - traveling waves - Energy transfer of a wave - sound waves - Doppler effect - reflection and refraction of light waves - total internal reflection - interference - interferometers - air wedge experiment. Theory of laser - characteristics - Spontaneous and stimulated emission - Einstein's coefficients - population inversion - Nd-YAG laser, CO_2 laser, semiconductor laser - applications.

UNIT IV BASIC QUANTUM MECHANICS 9

Photons and light waves - Electrons and matter waves - The Schrodinger equation (Time dependent and time independent forms) - meaning of wave function - Normalization - Particle in a infinite potential well - Normalization, probabilities and the correspondence principle.

UNIT V APPLIED QUANTUM MECHANICS 9

The harmonic oscillator - Barrier penetration and quantum tunneling - Tunneling microscope - Resonant diode - Finite potential wells - particle in a three dimensional box - Bloch's theorem for particles in a periodic potential, Kronig-Penney model and origin of energy bands.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

After completion of this course, the students will able to

CO1: Understand the importance of mechanics.
CO2: Express the knowledge of electromagnetic waves.
CO3: Know the basics of oscillations, optics and lasers.
CO4: Understand the importance of quantum physics.
CO5: Apply quantum mechanical principles towards the formation of energy bands in crystalline materials.

TEXT BOOKS:

1. D.Kleppner and R.Kolenkow. An Introduction to Mechanics. McGraw Hill Education, 2017.
2. D.Halliday, R.Resnick and J.Walker. Principles of Physics. John Wiley & Sons, 2015.
3. N.Garcia, A.Damask and S.Schwarz. Physics for Computer Science Students. Springer-Verlag, 2012.

REFERENCES:

1. R.Wolfson. Essential University Physics. Volume 1 & 2. Pearson, 2016.
2. D.J.Griffiths. Introduction to Electrodynamics. Pearson Education, 2015
3. K.Thyagarajan and A.Ghatak. Lasers: Fundamentals and Applications. Springer, 2012.

CY5151 **ENGINEERING CHEMISTRY** **L T P C**
(COMMON TO ALL BRANCHES) **3 0 0 3**

OBJECTIVES:

- To introduce the basic concepts of polymers, their properties and some of the important applications.
- To impart knowledge on the basic principles and preparatory methods of nanomaterials.
- To facilitate the understanding of the laws of photochemistry, photoprocesses and instrumentation & applications of spectroscopic techniques.
- To familiarize the operating principles and applications of energy conversion, its processes and storage devices.
- To inculcate sound understanding of water quality parameters and water treatment techniques.

UNIT I POLYMER CHEMISTRY **9**

Introduction: Functionality-degree of polymerization. Classification of polymers- natural and synthetic, thermoplastic and thermosetting. Types and mechanism of polymerization: addition (free radical, cationic, anionic and living); condensation and copolymerization. Properties of polymers: Tg, tacticity, molecular weight-weight average, number average and polydispersity index. Techniques of polymerization: Bulk, emulsion, solution and suspension. Structure, Properties and uses of: PE, PVC, PC, PTFE, PP, Nylon 6, Nylon 66, Bakelite, Epoxy; Conducting polymers – polyaniline and polypyrrole.

UNIT II NANOCHEMISTRY **9**

Basics-distinction between molecules, nanomaterials and bulk materials; size-dependent properties. Types –nanoparticle, nanocluster, nanorod, nanowire and nanotube. Preparation of nanomaterials: sol-gel, solvothermal, laser ablation, chemical vapour deposition, electrochemical deposition and electro spinning. Characterization - Scanning Electron Microscope and Transmission Electron Microscope - Principle and instrumentation (block diagram). Properties (optical, electrical, mechanical and magnetic) and Applications of nanomaterials - medicine, agriculture, electronics and catalysis.

UNIT III PHOTOCHEMISTRY AND SPECTROSCOPY **9**

Photochemistry: Laws of photochemistry - Grotthuss-Draper law, Stark-Einstein law and Lambert-Beer Law (derivation and problems). Photo physical processes – Jablonski diagram. Chemiluminescence, photo-sensitization and photoquenching – mechanism and examples. Spectroscopy: Electromagnetic spectrum - absorption of radiation - electronic, vibrational and rotational transitions. Width and intensities of spectral lines. Atomic absorption spectroscopy, UV-Vis and IR spectroscopy- principles, instrumentation (Block diagram) and applications.

UNIT IV ENERGY CONVERSIONS AND STORAGE **9**

Nuclear fission - controlled nuclear fission - nuclear fusion - differences between nuclear fission and fusion - nuclear chain reactions - nuclear energy - light water nuclear power plant – fast breeder reactor. Solar energy conversion - solar cells. Wind energy. Batteries - types of batteries – primary battery (dry cell), secondary battery (lead acid, nickel-cadmium and lithium-ion-battery). Fuel cells – H_2-O_2 and microbial fuel cell. Explosives – classification, examples: TNT, RDX, Dynamite; Rocket fuels and propellants – definition and uses.

UNIT V WATER TECHNOLOGY **9**

Water – sources and impurities – water quality parameters: colour, odour, pH, hardness, alkalinity, TDS, COD and BOD. Boiler feed water – requirement – troubles (scale & sludge, caustic embrittlement, boiler corrosion and priming & foaming. Internal conditioning – phosphate, calgon and carbonate treatment. External conditioning - zeolite (permutit) and ion exchange demineralization. Municipal water treatment process – primary (screening, sedimentation and coagulation), secondary (activated sludge process and trickling filter process) and tertiary (ozonolysis, UV treatment, chlorination, reverse osmosis).

TOTAL: 45 PERIODS

COURSE OUTCOMES:

CO1: To recognize and apply basic knowledge on different types of polymeric materials, their general preparation methods and applications to futuristic material fabrication needs.
CO2: To identify and apply basic concepts of nanoscience and nanotechnology in designing the synthesis of nanomaterials for engineering and technology applications.
CO3: To identify and apply suitable spectroscopic technique for material analysis and study different forms of photochemical reactions.
CO4: To recognize different forms of energy resources and apply them for suitable applications in energy sectors.
CO5: To demonstrate the knowledge of water and their quality in using at different industries.

TEXT BOOKS:

1. Jain P. C. & Monica Jain., "Engineering Chemistry", Dhanpat Rai Publishing Company (P) Ltd, New Delhi, 16th Edition, 2015.
2. Sivasankar B., "Engineering Chemistry", Tata McGraw-Hill Publishing Company Ltd, New Delhi, 2012.
3. S.S.Dara, "A text book of Engineering Chemistry", Chand Publications, 2014.

REFERENCE BOOKS:

1. Schdeva M V, "Basics of Nano Chemistry", Anmol Publications Pvt Ltd
2. B.Sivasankar, "Instrumental Methods of Analysis", Oxford University Press. 2012.
3. Friedrich Emich, "Engineering Chemistry", Scientific International Ltd.
4. V RGowariker, N V Viswanathan and Jayadev Sreedhar, "Polymer Science" New AGE International Publishers, 2009.

GE5153 PROBLEM SOLVING AND PYTHON PROGRAMMING L T P C
3 0 0 3

OBJECTIVES:

- To know the basics of algorithmic problem solving.
- To develop Python programs with conditionals and loops.
- To define Python functions and use function calls.
- To use Python data structures - lists, tuples, dictionaries.
- To do input/output with files in Python.

UNIT I INTRODUCTION TO COMPUTING AND PROBLEM SOLVING 9

Fundamentals of Computing – Computing Devices – Identification of Computational Problems – Pseudocodes and Flowcharts – Instructions – Algorithms – Building Blocks of Algorithms – Introduction to Python Programming – Python Interpreter and Interactive Mode – Variables and Identifiers – Arithmetic Operators– Values and Types – Statements.

SUGGESTED ACTIVITIES:

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

SUGGESTED EVALUATION METHODS:

- Assignments on pseudocodes and flowcharts.
- Tutorials on Python programs.

UNIT II CONDITIONALS AND FUNCTIONS 9

Operators – Boolean Values – Operator Precedence – Expression – Conditionals: If-Else Constructs – Loop Structures/Iterative Statements – While Loop – For Loop – Break Statement – Function Call and Returning Values – Parameter Passing – Local and Global Scope – Recursive Functions.

SUGGESTED ACTIVITIES:

- Simple Python program implementation using Operators, Conditionals, Iterative Constructs and Functions.
- Implementation of a simple calculator.
- Developing simple applications like calendar, phone directory, to-do lists etc.
- Flow charts for GCD, Exponent Functions, Fibonacci Series using conditionals and iterative statements.
- External learning - Recursion vs. Iteration.

SUGGESTED EVALUATION METHODS:

- Tutorials on the above activities.
- Group discussion on external learning.

UNIT III SIMPLE DATA STRUCTURES IN PYTHON 10

Introduction to Data Structures – List – Adding Items to a List – Finding and Updating an Item – Nested Lists – Cloning Lists – Looping Through a List – Sorting a List – List Concatenation – List Slices – List Methods – List Loop – Mutability – Aliasing – Tuples: Creation, Accessing, Updating, Deleting Elements in a Tuple, Tuple Assignment, Tuple as Return Value, Nested Tuples, Basic Tuple Operations – Sets.

SUGGESTED ACTIVITIES:

- Implementing python program using lists, tuples, sets for the following scenario:
  Simple sorting techniques
  Student Examination Report
  Billing Scheme during shopping.
- External learning - List vs. Tuple vs. Set – Implementing any application using all the three data structures.

SUGGESTED EVALUATION METHODS:

- Tutorials on the above activities.
- Group Discussion on external learning component.

UNIT IV STRINGS, DICTIONARIES, MODULES 10

Strings: Introduction, Indexing, Traversing, Concatenating, Appending, Multiplying, Formatting, Slicing, Comparing, Iterating – Basic Built-In String Functions – Dictionary: Creating, Accessing, Adding Items, Modifying, Deleting, Sorting, Looping, Nested Dictionaries Built-in Dictionary Function – Finding Key and Value in a Dictionary – Modules – Module Loading and Execution – Packages – Python Standard Libraries.

SUGGESTED ACTIVITIES:

- Implementing Python program by importing Time module, Math package etc.
- Creation of any package (student's choice) and importing into the application.

SUGGESTED EVALUATION METHODS:

- Tutorials on the above activities.

UNIT V FILE HANDLING AND EXCEPTION HANDLING 7

Introduction to Files – File Path – Opening and Closing Files – Reading and Writing Files – File Position – Exception: Errors and Exceptions, Exception Handling, Multiple Exceptions.

SUGGESTED ACTIVITIES:

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

SUGGESTED EVALUATION METHODS:

- Tutorials on the above activities.
- Case Studies.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

CO1: Develop algorithmic solutions to simple computational problems.
CO2: Develop and execute simple Python programs.
CO3: Write simple Python programs for solving problems.
CO4: Decompose a Python program into functions.
CO5: Represent compound data using Python lists, tuples, dictionaries etc.
CO6: Read and write data from/to files in Python programs.

TEXT BOOKS:

1. Reema Thareja, “Python Programming: Using Problem Solving Approach”, Oxford University Press, 2017.
2. Allen B. Downey, “Think Python: How to Think Like a Computer Scientist”, Second Edition, Shroff/O‘Reilly Publishers, 2016. (http://greenteapress.com/wp/thinkpython/).

REFERENCES:

1. Guido van Rossum, Fred L. Drake Jr., “An Introduction to Python – Revised and Updated for Python 3.2”, Network Theory Ltd., 2011.
2. John V Guttag, “Introduction to Computation and Programming Using Python”, Revised and Expanded Edition, MIT Press , 2013
3. Charles Dierbach, “Introduction to Computer Science using Python”, Wiley India Edition, 2016.
4. Timothy A. Budd, “Exploring Python”, Mc-Graw Hill Education (India) Private Ltd., 2015.
5. Kenneth A. Lambert, “Fundamentals of Python: First Programs”, Cengage Learning, 2012.

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

BS5161	BASIC SCIENCES LABORATORY	L	T	P	C
	(Common to all branches of B.E. / B.Tech Programmes)	0	0	4	2

PHYSICS LABORATORY: (Any Seven Experiments)

OBJECTIVES:

- To inculcate experimental skills to test basic understanding of physics of materials including properties of matter, thermal and optical properties.
- To induce the students to familiarize with experimental determination of velocity of ultrasonic waves and band gap determination.

1. Torsional pendulum - Determination of rigidity modulus of wire and moment of inertia of disc
2. Non-uniform bending - Determination of young's modulus
3. Uniform bending – Determination of young's modulus
4. Lee's disc Determination of thermal conductivity of a bad conductor
5. Potentiometer-Determination of thermo e.m.f of a thermocouple
6. Laser- Determination of the wave length of the laser using grating
7. Air wedge - Determination of thickness of a thin sheet/wire
8. a) Optical fibre -Determination of Numerical Aperture and acceptance angle
   b) Compact disc- Determination of width of the groove using laser.
9. Acoustic grating- Determination of velocity of ultrasonic waves in liquids.
10. Ultrasonic interferometer – determination of the velocity of sound and compressibility of liquids
11. Post office box -Determination of Band gap of a semiconductor.
12. Spectrometer- Determination of wavelength using gating.
13. Photoelectric effect
14. Michelson Interferometer.
15. Estimation of laser parameters.
16. Melde's string experiment

TOTAL: 30 PERIODS

COURSE OUTCOMES:

Upon completion of the course, the students will be able

CO1: To determine various moduli of elasticity and also various thermal and optical properties of materials.

CO2: To determine the velocity of ultrasonic waves, band gap determination and viscosity of liquids.

CHEMISTRY LABORATORY: (Minimum of 8 experiments to be conducted)

OBJECTIVES:

- To inculcate experimental skills to test basic understanding of water quality parameters, such as, acidity, alkalinity, hardness, DO, chloride and copper.
- To induce the students to familiarize with electroanalytical techniques such as, pH metry, potentiometry and conductometry in the determination of impurities in aqueous solutions.
- To demonstrate the analysis of metals and polymers by spectroscopy and viscometry methods.

LIST OF EXPERIMENTS:

1. Estimation of HCl using Na2CO3 as primary standard and Determination of alkalinity in water sample.
2. Determination of total, temporary & permanent hardness of water by EDTA method.
3. Determination of DO content of water sample by Winkler‟s method.
4. Determination of chloride content of water sample by argentometric method.
5. Estimation of copper content of the given solution by Iodometry.
6. Determination of strength of given hydrochloric acid using pH meter.
7. Determination of strength of acids in a mixture of acids using conductivity meter.
8. Estimation of iron content of the given solution using potentiometer.
9. Estimation of iron content of the water sample using spectrophotometer (1, 10-

Phenanthroline / thiocyanate method).
10. Estimation of sodium and potassium present in water using flame photometer.
11. Determination of molecular weight of polyvinylalcohol using Ostwald viscometer.
12. Pseudo first order kinetics-ester hydrolysis.
13. Corrosion experiment-weight loss method.
14. Phase change in a solid.

TOTAL: 30 PERIODS

OUTCOMES:

CO3: To analyse the quality of water samples with respect to their acidity, alkalinity, hardness and DO.
CO4: To determine the amount of metal ions through volumetric and spectroscopic techniques
CO5: To determine the molecular weight of polymers by viscometric method.
CO6: To quantitatively analyse the impurities in solution by electroanalytical techniques
CO7: To design and analyse the kinetics of reactions and corrosion of metals

TEXTBOOKS:

1. Laboratory Manual- Department of Chemistry, CEGC, Anna University, 2014.
2. Vogel's Textbook of Quantitative Chemical Analysis, 8th Edition, 2014.

GE5161 PROBLEM SOLVING AND PYTHON PROGRAMMING LABORATORY L T P C
0 0 4 2

OBJECTIVES:

- To understand the problem solving approaches.
- To learn the basic programming constructs in Python.
- To articulate where computing strategies support in providing Python-based solutions to real world problems.
- To use Python data structures - lists, tuples, dictionaries.
- To do input/output with files in Python.

EXPERIMENTS:

1. Identification and solving of simple real life or scientific or technical problems, and developing flow charts for the same.
2. Python programming using simple statements and expressions.
3. Scientific problems using Conditionals and Iterative loops.
4. Implementing real-time/technical applications using Lists, Tuples.
5. Implementing real-time/technical applications using Sets, Dictionaries.
6. Implementing programs using Functions.
7. Implementing programs using Strings.
8. Implementing programs using written modules and Python Standard Libraries.
9. Implementing real-time/technical applications using File handling.
10. Implementing real-time/technical applications using Exception handling.
11. Exploring Pygame tool.
12. Developing a game activity using Pygame like bouncing ball, car race etc.

TOTAL: 60 PERIODS

OUTCOMES:

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

CO1: Develop algorithmic solutions to simple computational problems
CO2: Develop and execute simple Python programs.
CO3: Structure simple Python programs for solving problems.
CO4: Decompose a Python program into functions.
CO5: Represent compound data using Python data structures.
CO6: Apply Python features in developing software applications.

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

MA5252 ENGINEERING MATHEMATICS – II L T P C
(Common to all branches of B.E. / B.Tech. Programmes in II Semester) 3 1 0 4

OBJECTIVES:

- To acquaint the students with the concepts of vector calculus which naturally arises in many engineering problems.
- To develop an understanding of the standard techniques of complex variable theory in particular analytic function and its mapping property.
- To familiarize the students with complex integration techniques and contour integration techniques which can be used in real integrals.
- To acquaint the students with Differential Equations which are significantly used in Engineering problems.
- To make the students 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 12

Gradient and directional derivative – Divergence and Curl – Irrotational and Solenoidal vector fields – Line integral over a plane curve – Surface integral - Area of a curved surface - Volume integral - Green's theorem, Stoke's theorem and Gauss divergence theorem – Verification and application in evaluating line, surface and volume integrals.

UNIT II ANALYTIC FUNCTION 12

Analytic functions – Necessary and sufficient conditions for analyticity - Properties – Harmonic conjugates – Construction of analytic function - Conformal mapping – Mapping by functions - Bilinear transformation $w = c + z,\ az,\ 1/z,\ z^2$.

UNIT III COMPLEX INTEGRATION 12

Line integral - Cauchy's integral theorem – Cauchy's integral formula – Taylor's and Laurent's series – Singularities – Residues – Residue theorem – Application of residue theorem for evaluation of real integrals – Use of circular contour and semicircular contour with no pole on real axis.

UNIT IV DIFFERENTIAL EQUATIONS 12

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

UNIT V LAPLACE TRANSFORMS 12

Existence conditions – Transforms of elementary functions – Transform of unit step function and unit impulse function – Basic properties – Shifting theorems – Transforms of derivatives and integrals – Initial and Final Value Theorems – Inverse Transforms – Convolution Theorem – Transform of periodic functions – Application to solution of linear ordinary differential equations with constant coefficients.

TOTAL : 60 PERIODS

COURSE OUTCOMES:

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

CO1: Calculate grad, div and curl and use Gauss, Stokes and Greens theorems to simplify calculations of integrals.
CO2: Construct analytic functions and use their conformal mapping property in application problems.
CO3: Evaluate real and complex integrals using the Cauchy's integral formula and residue theorem.
CO4: Apply various methods of solving differential equation which arise in many application problems.
CO5: Apply Laplace transform methods for solving linear differential equations.

TEXT BOOKS:

1. Erwin Kreyszig, "Advanced Engineering Mathematics", John Wiley and Sons, 10th Edition, New Delhi, 2015.
2. Grewal B.S., "Higher Engineering Mathematics", Khanna Publishers, 44th Edition, New Delhi, 2017.

REFERENCES:

1. Bali N., Goyal M. and Watkins C., "Advanced Engineering Mathematics", Firewall Media (An imprint of Lakshmi Publications Pvt., Ltd.,), 7th Edition, New Delhi, 2009.
2. Glyn James, "Advanced Modern Engineering Mathematics", Pearson Education, 4th Edition, New Delhi, 2011.
3. Jain R.K. and Iyengar S.R.K., "Advanced Engineering Mathematics", Narosa Publications, 5th Edition, New Delhi, 2017.
4. Peter V.O'Neil, "Advanced Engineering Mathematics", Cengage Learning India Pvt., Ltd, 7th Edition, New Delhi, 2012.
5. Ramana B.V., "Higher Engineering Mathematics", Tata McGraw Hill Co. Ltd., 11th Reprint, New Delhi, 2010.

EE5201 BASICS OF ELECTRICAL AND MEASUREMENTS ENGINEERING L T P C
3 0 0 3

OBJECTIVES:

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

UNIT I ELECTRIC CIRCUITS 9

Ohms Law – Kirchhoff's Law-Mesh analysis – Superposition and Thevenin's theorem - Introduction to AC circuits – waveforms, RMS and average value – Power and power factor, Three phase balanced circuits-Three phase Power measurement.

UNIT II ELECTRICAL MACHINES 9

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

UNIT III SPECIAL ELECTRICAL COMPONENTS 9

Synchronous machine – Brushless DC Motor - Stepper motor – Switched reluctance motor, Electromechanical Relays.

UNIT IV ELECTRICAL MEASUREMENTS 9

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

UNIT V MECHANICAL MEASUREMENTS 9

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

TOTAL: 45 PERIODS

COURSE OUTCOMES

CO1: Upon Completion of this subject, the students will gain knowledge on different types of electrical circuits, electrical machines and basics of measurements and instrumentation.

TEXT BOOKS:

1. Del Toro 'Electrical Engineering Fundamentals' Pearson Education, New Delhi, 2007.
2. Alan S. Moris, Principles of Measurements and Instruments, Prentice-Hall of India Pvt. Ltd., New Delhi, 1999.
3. Smarjit Ghosh 'Fundamentals of Electrical and Electronics Engineering, 2nd Edition 2007

REFERENCES:

1. Rajendra Prasad 'Fundamentals of Electrical engineering' Prentice Hall of India, 2006.
2. Sanjeev Sharma 'Basics of Electrical Engineering' S.K International Publishers, New Delhi 2007.
3. John Bird, Electrical Circuits theory and Technology, Elsevier, First India Edition, 2006.
4. Doebelin, E.O., Measurements Systems – Application and Design', McGrawHill Publishing Co, 1990.

GE5152 ENGINEERING MECHANICS L T P C
3 1 0 4

OBJECTIVES:

The main learning objective of this course is to prepare the students for:

- Applying the various methods to determine the resultant forces and its equilibrium acting on a particle in 2D and 3D.
- Applying the concept of reaction forces (non-concurrent coplanar and noncoplanar forces) and moment of various support systems with rigid bodies in 2D and 3D in equilibrium. Reducing the force, moment, and couple to an equivalent force - couple system acting on rigid bodies in 2D and 3D.
- Applying the concepts of locating centroids/center of gravity of various sections / volumes and to find out area moments of inertia for the sections and mass moment of inertia of solids.
- Applying the concepts of frictional forces at the contact surfaces of various engineering systems.
- Applying the various methods of evaluating kinetic and kinematic parameters of the rigid bodies subjected to concurrent coplanar forces.

UNIT I STATICS OF PARTICLES (9+3)

Fundamental Concepts and Principles, Systems of Units, Method of Problem Solutions, Statics of Particles -Forces in a Plane, Resultant of Forces, Resolution of a Force into Components, Rectangular Components of a Force, Unit Vectors. Equilibrium of a Particle- Newton's First Law of Motion, Space and Free-Body Diagrams, Forces in Space, Equilibrium of a Particle in Space.

UNIT II EQUILIBRIUM OF RIGID BODIES (9+3)

Principle of Transmissibility, Equivalent Forces, Vector Product of Two Vectors, Moment of a Force about a Point, Varignon's Theorem, Rectangular Components of the Moment of a Force, Scalar Product of Two Vectors, Mixed Triple Product of Three Vectors, Moment of a Force about an Axis, Couple - Moment of a Couple, Equivalent Couples, Addition of Couples, Resolution of a Given Force into a Force -Couple system, Further Reduction of a System of Forces, Equilibrium in Two and Three Dimensions - Reactions at Supports and Connections.

UNIT III DISTRIBUTED FORCES (9+3)

Centroids of lines and areas – symmetrical and unsymmetrical shapes, Determination of Centroids by Integration , Theorems of Pappus - Guldinus, Distributed Loads on Beams, Centre of Gravity of a Three-Dimensional Body, Centroid of a Volume, Composite Bodies , Determination of Centroids of Volumes by Integration.

Moments of Inertia of Areas and Mass - Determination of the Moment of Inertia of an Area by Integration , Polar Moment of Inertia , Radius of Gyration of an Area , Parallel-Axis Theorem , Moments of Inertia of Composite Areas, Moments of Inertia of a Mass - Moments of Inertia of Thin Plates , Determination of the Moment of Inertia of a Three-Dimensional Body by Integration.

UNIT IV FRICTION (9+3)

The Laws of Dry Friction. Coefficients of Friction, Angles of Friction, Wedges, Wheel Friction. Rolling Resistance, Ladder friction.

UNITV DYNAMICS OF PARTICLES (9+3)

Kinematics - Rectilinear Motion and Curvilinear Motion of Particles. Kinetics- Newton's Second Law of Motion -Equations of Motions, Dynamic Equilibrium, Energy and Momentum Methods - Work of a Force , Kinetic Energy of a Particle, Principle of Work and Energy, Principle of Impulse and Momentum, Impact, Method of Virtual Work - Work of a Force, Potential Energy, Potential Energy and Equilibrium.

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

COURSE OUTCOMES:

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

CO1: Apply the various methods to determine the resultant forces and its equilibrium acting on a particle in 2D and 3D.

CO2: Apply the concept of reaction forces (non-concurrent coplanar and noncoplanar forces) and moment of various support systems with rigid bodies in 2D and 3D in equilibrium. Reducing the force, moment, and couple to an equivalent force - couple system acting on rigid bodies in 2D and 3D.

CO3: Apply the concepts of locating centroids / center of gravity of various sections / volumes and to find out area moments of inertia for the sections and mass moment of inertia of solids.

CO4: Apply the concepts of frictional forces at the contact surfaces of various engineering systems.

CO5: Apply the various methods of evaluating kinetic and kinematic parameters of the rigid bodies subjected to concurrent coplanar forces.

TEXT BOOKS:

1. Beer Ferdinand P, Russel Johnston Jr., David F Mazurek, Philip J Cornwell, Sanjeev Sanghi, Vector Mechanics for Engineers: Statics and Dynamics, McGraw Higher Education., 11thEdition, 2017.
2. Vela Murali, "Engineering Mechanics-Statics and Dynamics", Oxford University Press, 2018.

REFERENCES:

1. Boresi P and Schmidt J, Engineering Mechanics: Statics and Dynamics, Cengage learning, 1st Edition, 2008.
2. Hibbeller, R.C., Engineering Mechanics: Statics, and Engineering Mechanics: Dynamics, Prentice Hall, 13th Edition, 2013.
3. Irving H. Shames, Krishna Mohana Rao G, Engineering Mechanics – Statics and Dynamics, Pearson Education Asia Pvt. Ltd., 4th Edition, 2005.

4. Meriam J L and Kraige L G, Engineering Mechanics: Statics and Engineering Mechanics: Dynamics, Wiley student edition, 7th Edition, 2013.
5. Timoshenko S, Young D H, Rao J V and Sukumar Pati, Engineering Mechanics, McGraw Hill Higher Education, 5th Edition, 2013.

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	0.9	0.6	0.6	0.3								0.6	0.9	0.3	0.3
2	0.9	0.6	0.6	0.3								0.6	0.9	0.3	0.3
3	0.9	0.6	0.9	0.3								0.6	0.9	0.3	0.6
4	0.9	0.6	0.9	0.3								0.6	0.9	0.3	0.6
5	0.9	0.6	0.9	0.3								0.6	0.9	0.3	0.6

EC5251 CIRCUIT THEORY L T P C
3 1 0 4

OBJECTIVES:

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

UNIT I DC CIRCUIT ANALYSIS 9+3

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

UNIT II NETWORK THEOREM AND DUALITY 9+3

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

UNIT III SINUSOIDAL STEADY STATE ANALYSIS 9+3

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

UNIT IV TRANSIENTS AND RESONANCE IN RLC CIRCUITS 9+3

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

UNIT V COUPLED CIRCUITS AND TOPOLOGY 9+3

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

TOTAL : 60 PERIODS

COURSE OUTCOMES

CO1: Ability to comprehend and design ac/dc circuits.

CO2 : Develop and understand ac/dc circuits.

CO3 : To be Capable of evaluating ac/dc circuits.

CO4 : To be able develop the capacity to analyze electrical circuits.

CO5 : To inherit the ability to apply circuit theorems in real time.

TEXT BOOKS:

1. Hayt JackKemmerly, Steven Durbin, "Engineering Circuit Analysis",Mc Graw Hill education, 9th Edition, 2018.
2. Robert.L. Boylestead, "Introductory Circuit Analysis", Pearson Education India, 12th Edition, 2014.

REFERENCES:

1. Charles K. Alexander & Mathew N.O.Sadiku, "Fundamentals of Electric Circuits", Mc Graw- Hill, 2nd Edition, 2003.
2. D.R.Cunningham, J.A. Stuller, "Basic Circuit Analysis", Jaico Publishing House, 2005.
3. David Bell, "Fundamentals of Electric Circuits", Oxford University press, 7thEdition, 2009.
4. Charles.K.Alexander, Mathew N.O.Sadiku," Fundamentals of Electric Circuits", McGraw Hill, 5th Edition, 2012.
5. John O Mallay, Schaum's Outlines "Basic Circuit Analysis", The Mc Graw Hill companies, 2nd Edition, 2011.

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

PH5202 SEMICONDUCTOR PHYSICS AND DEVICES L T P C
3 0 0 3

OBJECTIVES:

- To make the students to understand the concepts of electronic states and band structure formation.
- To equip the students on the knowledge of carrier concentration and doping in semiconductors.
- To introduce the basics of electrical transport of charge carriers.
- To enable the students in understanding the importance of optical properties of materials.
- To elucidate the physics of semiconductor devices and quantum structures.

UNIT I ELECTRONIC STATES 9

Crystal structures –reciprocal lattice – Brillouin zone and band representation. Dynamics of electrons in periodic potential: Kronig-Penny and nearly free electron models – band structure calculations – band structures of real semiconductors. Band gaps in semiconductors: Holes and effective mass concept – properties of conduction and valence bands.

UNIT II CARRIERS AND DOPING 9

Fermi distribution and energy – Density of states – valence and conduction band density of states – intrinsic concentration – intrinsic Fermi level – n and p type doping – density of carriers in extrinsic semiconductors and their temperature dependence – extrinsic semiconductor Fermi energy level – degenerate and non-degenerate semiconductors – band-gap engineering –electrons and holes in quantum wells and superlattices.

UNIT III ELECTRICAL TRANSPORT 9

Scattering in semiconductors – Velocity-electric field relations: Low field response; mobility and high field transport. Very high field transport: Breakdown phenomena – avalanche breakdown - Zener tunneling. Carrier transport by diffusion – transport by drift and diffusion: Einstein's relation. Charge injection and quasi-Fermi levels.

UNIT IV OPTICAL TRANSPORT 9

Electron –hole pair generation and recombination: band to band and intra band transitions, free – carrier and phonon transitions. Excitons: Origin, electronic levels and properties. Radiative recombination (Shockely – Read- Hall and Auguer) processes. Carrier transport: continuity equations. Optical constants: Kramers – Kronigrelations – Electron-phonon interaction – Semiconductor laser.

UNIT V DEVICES 9

Processing of semiconductor devices: crystal growth, doping, deposition of dielectric films, lithography and metallization – p-n semiconductor junctions – homo and hetero junctions. MOS diode and MOSFET. Semiconductor quantum structures, density of states and excitons. Semiconductor photonic structures: 1D, 2D and 3D photonic crystals. Active and passive optoelectronic devices:photo processes.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

After completion of this course, the students will able to

CO1: Know basics of electronic states and energy band structure formation
CO2: Know the importance of carrier concentration and doping in semiconductors
CO3: Understand physics of transport of charge carriers.
CO4: Know the importance of optical properties of materials.
CO5: Understand the physics of devices and importance of quantum structures.

TEXT BOOKS:

1. R.F.Pierret, "Semiconductor Device Fundamentals", Pearson, 2006.
2. D.Neamen and D.Biswa, "Semiconductor physics and devices", McGraw Hill Education, 2017.

REFERENCES:

1. N.Garcia, A. Damask and S.Schwarz "Physics for Computer Science Students", Springer-Verlag, 2012.
2. Umesh Mishra and Jasprit Singh, "Semiconductor Device Physics and Design", Springer, 2008.
3. Nandita Dasgupta and Amitava Dasgupta, "Semiconductor Devices: Modelling and Technology", PHI Learning Pvt. Ltd., 2004.

GE5162 WORKSHOP PRACTICES LABORATORY L T P C
(Common to all Branches of B.E. / B.Tech. Programmes) 0 0 4 2

OBJECTIVES:

The main learning objective of this course is to provide hands on training to the students in:

1. Drawing pipe line plan; laying and connecting various pipe fittings used in common household plumbing work; Sawing; planning; making joints in wood materials used in common household wood work.
2. Wiring various electrical joints in common household electrical wire work.
3. Welding various joints in steel plates using arc welding work; Machining various simple processes like turning, drilling, tapping in parts; Assembling simple mechanical assembly of common household equipments; Making a tray out of metal sheet using sheet metal work.
4. Soldering and testing simple electronic circuits; Assembling and testing simple electronic components on PCB.

GROUP – A (CIVIL & ELECTRICAL)

PART I CIVIL ENGINEERING PRACTICES 15

PLUMBING WORK:

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

WOOD WORK:

a) Sawing,
b) Planning and
c) Making joints like T-Joint, Mortise joint and Tenon joint and Dovetail joint.

Wood Work Study:

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

PART II ELECTRICAL ENGINEERING PRACTICES 15

WIRING WORK:

a) Wiring Switches, Fuse, Indicator and Lamp etc. such as in basic household,
b) Wiring Stair case light.
c) Wiring tube – light.
d) Preparing wiring diagrams for a given situation.

Wiring Study:

a) Studying an Iron-Box wiring.
b) Studying a Fan Regulator wiring.
c) Studying an Emergency Lamp wiring.

GROUP – B (MECHANICAL AND ELECTRONICS)

PART III MECHANICAL ENGINEERING PRACTICES 15

WELDING WORK:

a) Welding of Butt Joints, Lap Joints, and Tee Joints using arc welding.
b) Practicing gas welding.

BASIC MACHINING WORK:

a) (simple)Turning.
b) (simple)Drilling.
c) (simple)Tapping.

ASSEMBLY WORK:

a) Assembling a centrifugal pump.
b) Assembling a household mixer.
c) Assembling an air conditioner.

SHEET METAL WORK:

a) Making of a square tray

FOUNDRY WORK:

a) Demonstrating basic foundry operations.

PART IV ELECTRONIC ENGINEERING PRACTICES 15

SOLDERING WORK:

a) Soldering simple electronic circuits and checking continuity.

ELECTRONIC ASSEMBLY AND TESTING WORK:

a) Assembling and testing electronic components on a small PCB.

ELECTRONIC EQUIPMENT STUDY:

a) Studying a FM radio.
b) Studying an electronic telephone.

TOTAL (P: 60) = 60 PERIODS

COURSE OUTCOMES:

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

CO1: Draw pipe line plan; lay and connect various pipe fittings used in common household plumbing work; Saw; plan; make joints in wood materials used in common household wood work.
CO2: Wire various electrical joints in common household electrical wire work.
CO3: Weld various joints in steel plates using arc welding work; Machine various simple processes like turning, drilling, tapping in parts; Assemble simple mechanical assembly of common household equipments; Make a tray out of metal sheet using sheet metal work.
CO4: Solder and test simple electronic circuits; Assemble and test simple electronic components on PCB.

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	0.6	0.3											0.3	0.3	
2		0.6	0.6											0.6	
3		0.6	0.3										0.6	0.6	
4		0.6	0.6	0.3										0.6	

EC5211 ELECTRONIC DEVICES AND CIRCUITS THEORY LABORATORY L T P C
0 0 4 2

OBJECTIVES /OUTCOMES

1. Characteristics of PN Junction Diode
2. Zener diode Characteristics & Regulator using Zener diode
3. Common Emitter input-output Characteristics
4. Common Base input-output Characteristics
5. FET Characteristics
6. SCR Characteristics
7. Clipper and Clamper & FWR

8. Verifications Of Thevinin& Norton theorem
9. Verifications Of KVL & KCL
10. Verifications Of Super Position Theorem
11. verifications of maximum power transfer & reciprocity theorem
12. Determination Of Resonance Frequency of Series & Parallel RLC Circuits
13. Transient analysis of RL and RC circuits

TOTAL: 60 PERIODS

LABORATORY REQUIREMENTS

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

COURSE OUTCOMES:

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

CO1:Design RL and RC circuits
CO2:Verify Thevenin & Norton theorem KVL & KCL, and Super Position Theorems
CO3:Draw the characteristics of series and parallel resonance circuits.
CO4:Discuss the characteristics of basic electronic devices.
CO5:Describe the characteristics of Amplifiers

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

MA5356 LINEAR ALGEBRA AND NUMERICAL METHODS L T P C
3 1 0 4

OBJECTIVES:

The basic concepts and tools of the subject covered are:

- Vector spaces and subspaces; linear independence and span of a set of vectors, basis and dimension; the standard bases for common vector spaces;
- Linear maps between vector spaces, their matrix representations, null-space and Range spaces, the Rank- Nullity Theorem;
- Inner product spaces: Cauchy-Schwarz inequality, orthonormal bases, the Gramm-Schmidt procedure, orthogonal complement of a subspace, orthogonal projection;
- Eigenvalues and eigenvectors, diagonalizability of a real symmetric matrix, canonical forms;
- Mathematical foundations of numerical techniques for solving linear systems, eigenvalue problems and generalized inverses.

UNIT I VECTOR SPACES 12

Vector spaces – Subspaces – Linear combinations - Linear Span – Linear dependence - Linear independence – Bases and Dimensions

UNIT II LINEAR TRANSFORMATIONS 12

Linear Transformation – Null space, Range space - dimension theorem - Matrix and representation of Linear Transformation – Eigenvalues Eigenvectors of linear transformation – Diagonalization of linear transformation – Application of diagonalization in linear system of differential equations.

UNIT III INNER PRODUCT SPACES 12

Inner Products and norms - Inner Product Spaces - Orthogonal vectors – Gram Schmidt orthogonalization process – Orthogonal complement – Least square Approximations

UNIT IV NUMERICAL SOLUTION OF LINEAR SYSTEM OF EQUATIONS 12

Solution of linear system of equations – Direct methods: Gauss elimination method – Pivoting, Gauss Jordan method, LU decomposition method and Cholesky decomposition method - Iterative methods: Gauss-Jacobi Method, Gauss-Seidel Method and SOR Method

UNIT V NUMERICAL SOLUTION OF EIGENVALUE PROBLEMS AND GENERALISED INVERSES 12

Eigen value Problems: Power method – Jacobi's rotation method – Conjugate gradient method – QR decomposition - Singular value decomposition method.

TOTAL: 60 PERIODS

COURSE OUTCOMES:

CO1: The students can able to solve system of linear equations, to use matrix operations and vector spaces using algebraic methods.

CO2: Demonstrate understanding of common numerical methods and how they are used to obtain approximate solutions.

CO3: Apply numerical methods to obtain approximate solutions to mathematical problems.

CO4: Derive numerical methods for various mathematical operations and tasks, such as interpolation, differentiation, integration, the solution of linear and nonlinear equations, and the solution of differential equations.

CO5: Analyze and evaluate the accuracy of common numerical methods.

TEXT BOOKS:

1. Faires, J.D. and Burden, R., "Numerical Methods", Brooks/Cole (Thomson Publications), New Delhi, 4th Edition, 2012.
2. Friedberg, S.H., Insel, A.J. and Spence, E., "Linear Algebra", Pearson Education, New Delhi, 5th Edition, 2008.
3. Williams, G, "Linear Algebra with Applications", Jones & Bartlett Learning, First Indian Edition, New Delhi, 2019.

REFERENCES:

1. Bernard Kolman, David R. Hill, "Introductory Linear Algebra", Pearson Education, First Reprint, New Delhi, 2010.
2. Gerald, C.F, and Wheatley, P.O., "Applied Numerical Analysis", Pearson Education, 7th Edition, New Delhi, 2004.
3. Kumaresan, S., "Linear Algebra – A geometric approach", Prentice – Hall of India, Reprint, New Delhi, 2010.
4. Richard Branson, "Matrix Operations", Schaum's outline series, McGraw Hill, New York, 1989.
5. Strang, G., "Linear Algebra and its Applications", Cengage Learning, New Delhi, 2005.

EC5301 ELECTRONIC CIRCUITS – I L T P C
3 1 0 4

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 learn about biasing of BJT and MOSFET circuits
- To design amplifiers
- To study the effect of source and load
- To design amplifiers with active loads
- To study high frequency response of amplifiers

UNIT I BIASING OF DISCRETE BJT AND MOSFET 9+3

DC Load line, operating point, Various biasing methods for BJT-Design-Stability-Bias compensation, Thermal stability, DC bias analysis of MOSFET circuits.

UNIT II BJT AMPLIFIERS 9+3

Small signal Analysis of Common Emitter-AC Loadline, Voltage swing limitations, Common collector and common base amplifiers – Differential amplifiers- CMRR- Darlington Amplifier- Bootstrap technique - Multi stage amplifiers - Cascode Amplifier.

UNIT III MOSFET AMPLIFIERS 9+3

Small signal Analysis of amplifiers, Common source amplifier, Voltage swing limitations, Small signal analysis of Source follower and Common Gate amplifiers, Cascode amplifiers, Differential amplifiers, BiMOSCascode amplifier.

UNIT IV FREQUENCY ANALYSIS OF BJT AND MOSFET AMPLIFIERS 9+3

Low frequency analysis, Miller effect, High frequency analysis of CE, MOSFET CS amplifier and single stage amplifiers, Short circuit current gain, cut off frequency – fα fβ, Unity Gain Bandwidth

UNIT V IC MOSFET AMPLIFIERS 9+3

IC biasing Current steering circuits for IC amplifiers- current mirrors, - current sources- PMOS and NMOS current sources, Cascode current source, Widlar current source. Amplifier with resistive load,active load - Depletion load, current source load, Differential amplifiers with active load

TOTAL: 60 PERIODS

COURSE OUTCOMES:

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

CO1: Choose appropriate biasing circuit for BJT and MOSFET amplifiers.
CO2: Design and analyze amplifiers.
CO3: Determine the effect of source and load.
CO4: Design amplifiers with active loads meant for ICs.
CO5: Exposed to high frequency response of BJT and MOSFET amplifiers.
CO6: Design biasing circuits for IC amplifiers.

TEXT BOOKS:

1. Donald .A. Neamen, "Electronic Circuit Analysis and Design", 3rd Edition, Tata McGraw Hill, 2010.
2. Adel .S. Sedra, Kenneth C. Smith, "Micro Electronic Circuits", 7th Edition, Oxford University Press, 2014.

REFERENCES:

1. David A. Bell, "Electronic Devices and Circuits", Oxford Higher Education press, 5th Edition, 2010.
2. BehzadRazavi, "Design of Analog CMOS Integrated Circuits", Tata Mc Graw Hill, 2007.
3. Paul Gray, Hurst, Lewis, Meyer, "Analysis and Design of Analog Integrated Circuits", John Willey & Sons, 4th Edition, 2005.
4. Millman .J. and Halkias C.C, "Integrated Electronics", McGraw Hill, 2001.
5. D.Schilling and C.Belove, "Electronic Circuits", McGraw Hill, 3rd Edition, 1989.

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

EC5302 ELECTROMAGNETIC FIELDS AND WAVES L T P C
3 0 0 3

OBJECTIVES:

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

UNIT I INTRODUCTION 9

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

UNIT II STATIC ELECTRIC FIELD 9

Electric field, Coulomb's law, Gauss's law and applications, Electric potential, Conductors in static electric field, Dielectrics in static electric field, Electric flux density and dielectric constant, Boundary conditions, Capacitance, Parallel, cylindrical and spherical capacitors, Electrostatic energy, Poisson's and Laplace's equations, Uniqueness of electrostatic solutions.

UNIT III STATIC MAGNETIC FIELD 9

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

UNIT IV TIME VARYING FIELDS AND MAXWELL EQUATIONS 9

Faraday's law, Displacement current and Maxwell-Ampere law, Maxwell's equations, Potential functions, Electromagnetic boundary conditions, Wave equations and solutions, Time-harmonic fields

UNIT V PLANE EM WAVES IN ISOTROPIC MEDIA 9

Plane waves in lossless media, Plane waves in lossy media (low-loss dielectrics and good conductors), Group velocity, Electromagnetic power flow and Poynting vector, Normal incidence at a plane conducting boundary, Normal incidence at a plane dielectric boundary

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

CO1: Understand basic laws and theorems applied in Electromagnetic waves and propagation analysis

CO2: Analyse static and dynamic electric and magnetic field and associated laws

CO3: Understand the EM wave propagation in a medium and through boundaries

CO4: Understand Maxwells equations and apply to solve electromagnetic problem

CO5: Explore the application of electromagnetic principles in system used in day today life

TEXT BOOKS:

1. D.K. Cheng, "Field and Wave Electro Magnetics", Pearson (India), 2nd Edition, 1989.
2. W.H. Hayt and J.A. Buck, "Engineering electro magnetics", McGraw-Hill (India), 7th Edition, 2006.

REFERENCES:

1. Mathew.N.O.Sadiku, “Elements of Electromagnetics”, Oxford University Press, 6th Edition, 2015.
2. Kraus, Fleisch, “Electromagnetics with Applications”, McGraw-Hill, 5th Edition, 2010.

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

EC5303 DIGITAL SYSTEM DESIGN 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 Boolean algebra and its applications in digital systems
- To introduce the design of various combinational digital circuits using logic gates
- To bring out the analysis and design procedures for synchronous and asynchronous Sequential circuits
- To introduce the electronic circuits involved in the making of logic gates
- To introduce semiconductor memories and related technology

UNIT I BASIC CONCEPTS AND COMBINATIONAL CIRCUITS 9

Number Systems – Decimal, Binary, Octal, Hexadecimal, 1‘s and 2‘s complements, Codes – Binary, BCD, 84-2-1, 2421, Excess 3, Biquinary, Gray, Alphanumeric codes, Boolean theorems, Logic gates, Universal gates, Sum of products and product of sums, Minterms and Maxterms, Karnaugh map and Tabulation methods.

UNIT II MSI CIRCUITS 9

Problem formulation and design of combinational circuits - Code-Converters, Half and Full Adders, Binary Parallel Adder – Carry lookahead Adder, BCD Adder, Magnitude Comparator, Decoder, Encoder, Priority Encoder, Mux/Demux, Case study: Digital trans-receiver / 8 bit Arithmetic and logic unit

UNIT III SYNCRONOUS SEQUENTIAL CIRCUITS 9

Flip flops – SR, JK, T, D, Master/Slave FF, Triggering of FF, Analysis and design of clocked sequential circuits – Design - Moore/Mealy models, state minimization, state assignment, circuit implementation - Counters, Ripple Counters, Ring Counters, Shift registers, Universal Shift Register. Model Development: Designing of rolling display/real time clock

UNIT IV ASYNHRONOUS SEQUENTIAL CIRCUITS 9

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

UNIT V LOGIC FAMILIES AND PROGRAMMABLE LOGIC DEVICES 9

Logic families- TTL, MOS, CMOS, BiCMOS - Comparison of Logic families - Implementation of combinational logic/sequential logic design using standard ICs, ROM, PLA and PAL

TOTAL: 45 PERIODS

COURSE OUTCOMES:

CO1: Use Boolean algebra and simplification procedures relevant to digital logic.
CO2: Design various combinational digital circuits using logic gates.
C03: Ability to analyse and design synchronous sequential circuits.
C04: Ability to analyse and design asynchronous sequential circuits. .
C05: Ability to build logic gates and use programmable devices

TEXT BOOKS:

1. M. Morris Mano and Michael D. Ciletti, 'Digital Design', Pearson, 5th Edition, 2013.
2. Charles H. Roth, Jr, 'Fundamentals of Logic Design', Jaico Books, 4th Edition, 2002.

REFERENCES:

1. William I. Fletcher, "An Engineering Approach to Digital Design", Prentice- Hall of India, 1980.
2. Floyd T.L., "Digital Fundamentals", Charles E. Merril publishing company,1982.
3. John. F. Wakerly, "Digital Design Principles and Practices", Pearson Education, 4th Edition,2007.

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

EC5304 **SIGNALS AND SYSTEMS** **L T P C**
3 1 0 4

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 visualization and mathematical representation of continuous-time and discrete-time signals
- To teach the applications of Laplace and Fourier transforms in the analysis of continuous-time signals
- To teach the applications of Z- and Fourier transforms in the analysis of discrete – time signals

UNIT I CLASSIFICATION OF SIGNALS AND SYSTEMS 6+6

Continuous time signals (CT signals)- Discrete time signals (DT signals) – Step, Ramp, Pulse, Impulse, Exponential - classification of CT and DT signals – periodic and aperiodic signals, random signals, Energy & Power signals - CT systems and DT systems, Classification of systems.

UNIT II ANALYSIS OF CONTINUOUS TIME SIGNALS 6+6

Fourier series analysis- Spectrum of Continuous Time (CT) signals- Fourier and Laplace transforms in Signal Analysis.

UNIT III LINEAR TIME INVARIANT –CONTINUOUS TIME SYSTEMS 6+6

Differential Equation-Block diagram representation-impulse response, convolution integrals-Fourier and Laplace transforms in Analysis.

UNIT IV ANALYSIS OF DISCRETE TIME SIGNALS 6+6

Baseband Sampling of CT signals- Aliasing, Reconstruction of CT signal from DT signal DTFT and properties, Z-transform & properties.

UNIT V LINEAR TIME INVARIANT –DISCRETE TIME SYSTEMS 6+6

Difference Equations-Block diagram representation-Impulse response-Convolution sum-DTFT and Z Transform analysis of Recursive & Non-Recursive systems.

TOTAL: 30L + 30T: 60 PERIODS

COURSE OUTCOMES:

CO1: Ability to classify signals and systems based on various characteristics and decomposition for easier analysis.

C02: Ability to determine analyze frequency components of signals and frequency response of the systems.

C03: Ability to determine and analyze the causality and stability LTI systems from their impulse responses.

C04: Ability to convert the CT signals into DT signals and analyze, the effect of sampling and frequency content of DT signals.

C05: Ability to analyze LTI systems and realize with various structures

TEXT BOOKS:

1. Allan V.Oppenheim, S.Wilsky and S.H.Nawab, "Signals and Systems", Pearson, Indian Reprint, 2007.
2. B. P. Lathi, "Principles of Linear Systems and Signals", Oxford, 2nd Edition, 2009.

REFERENCES:

1. H P Hsu, "Signals and Systems", Schaum‘s Outlines, Tata McGraw Hill, 2006.
2. S. Haykin and B. Van Veen, "Signals and Systems", 2nd Edition, Wiley, 2003.
3. P.Ramakrishna Rao, "Signals and Systems", Tata Mc Graw Hill Publications, 2nd Edition, 2008.
4. Edward W. Kamen, Bonnie S. Heck, "Fundamentals of Signals and Systems, Using the Web and MATLAB”, Pearson, Indian Reprint, 3rd Edition, 2007.

5. John Alan Stuller, "An Introduction to Signals and Systems", Thomson, 2007.
6. M.J.Roberts, "Signals & Systems, Analysis, using Transform methods & MATLAB", TataMcGraw Hill (India), 2007.

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

EC5311 ELECTRONIC DESIGN LABORATORY L T P C
0 0 4 2

OBJECTIVES:

- To learn hardware implementation and testing of analog and digital circuits
- To design amplifier circuits to meet desired specifications
- To understand the functionality of combinational and sequential circuits
- To simulate basic combinational and sequential circuits using Hardware Description Language HDL

1. Implementation of Boolean expression using universal gates, BCD adder and 2-bit Magnitude comparator
2. Implementation of Boolean expression using MUX and truth table verification of RS, JK, T, and D Flip Flops
3. BCD counter and counters with seven segment display
4. Data transfer using shift registers
5. Realization of Digital circuits using HDL – Combinational circuits
6. Realization of Digital circuits using HDL – Sequential circuits
7. Frequency Response of CE, CB amplifiers and its Spice simulation
8. Design of CC Amplifier for a specific output impedance and its Spice Simulation
9. Spice simulation of CS, CG, and CD configuration of MOSFET amplifiers with various active load configurations.
10. Design of Differential Amplifiers and its CMRR measurement
    a. Frequency response of cascode amplifier
    b. Frequency response of cascade amplifier

TOTAL: 60 PERIODS

COURSE OUTCOMES:

At the end of the course student will be able to

CO1:Design basic amplifier topologies and analyze its impedance characteristics.
CO2:Design multistage amplifiers.
CO3:Realize combinational and sequential digital circuits.
CO4:Simulate MOSFET Circuits using SPICE.
CO5:Simulate digital circuit functionality using HDL.

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

EE5313 ELECTRICAL AND MEASUREMENTS LABORATORY L T P C
0 0 4 2

OBJECTIVES:

- To train the students in performing various tests on electrical machines.
- To impart knowledge on basics of Instrumentation

LIST OF EXPERIMENTS

1. Load test on separately excited DC shunt generator
2. Load test on DC shunt motor
3. Load test on Single phase Transformer
4. Load test on three phase Induction motor
5. Regulation of three Phase Alternator
6. Bridge Networks – AC and DC Bridges
7. Instrumentation Amplifier
8. Time constant of RC circuit
9. Characteristics of LVDT
10. Characteristics of RTD
11. Characteristics of Thermistor
12. Dynamics of pressure transducer

TOTAL: 60 PERIODS

COURSE OUTCOMES

CO1: To be able to perform speed characteristic of different electrical machines
CO2: Become familiar with the fundamentals of Electrical and Mechanical Measurements.

EC5401 TRANSMISSION LINES AND WAVEGUIDES L T P C
3 0 0 3

OBJECTIVES:

- To introduce the various types of transmission lines and to discuss the losses associated.
- To provide thorough understanding about impedance transformation and matching.
- To give insight about the usage of smith chart in problem solving
- To impart knowledge on filter theories and waveguide theories
- To analyze and minimize cross talk in unbounded conductive media.

UNIT I TRANSMISSION LINE FUNDAMENTALS 9

General theory of Transmission lines - the 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 Zo - Input and transfer impedance - reflection factor, reflection loss, insertion loss, S-parameters and its properties.

UNIT II LINE AT RADIO FREQUENCY AND IMPEDANCE MATCHING 9

Transmission line equations at radio frequencies – Input impedance of the dissipation-less line - Open and short circuited lines – Reflection Phenomena – Standing waves – λ/8, λ/4 & λ/2 lines – λ/4 Impedance transformers, Stub Matching – Single and Double Stub – Smith Chart and Applications.

UNIT III NETWORK COMPONENTS 9

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

UNIT IV WAVEGUIDES AND RESONATORS 9

General Wave behaviors along uniform Guiding structures, Transverse Electromagnetic (TEM) waves, Transverse Magnetic (TM) waves, Transverse Electric (TE) waves, TM and TE waves between parallel plates, TM and TE waves in Rectangular wave guides, Bessel's differential equation and Bessel function, TM and TE waves in Circular wave guides, Rectangular cavity Resonators.

UNIT V PLANAR TRANSMISSION LINES AND COUPLING 9

Introduction to strip line – Slot line – Coplanar waveguide - Transmission line reflections – Lattice diagram – Time domain reflectometry – Coupled wave equation – Coupled line analysis – Modal Analysis – Crosstalk Minimization

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

CO1: Ability to comprehend and appreciate the significance and role of this course in the present contemporary world at the end of the course the students will be able to

CO2: Analyze the various types of transmission lines and to discuss the losses associated.

CO3: Understand impedance transformation and matching.

CO4: Use smith chart in problem solving

CO5: Apply knowledge on filter theories and waveguide theories are imparted.

TEXT BOOKS:

1. John D Ryder, "Networks lines and fields", Prentice Hall of India, 2005
2. Stephen H. Hall, Howard L. Heck, "Advanced Signal Integrity For High-Speed Digital Designs", John Wiley & Sons, 2009

REFERENCES:

1. E.C.Jordan and K.G. Balmain, "Electromagnetic Waves and Radiating Systems", Prentice Hall of India, 2011.
2. Bhag Singh Guru &Hüseyin R. Hiziroglu, "Electromagnetic Field Theory Fundamentals", Second edition Cambridge University press, 2005
3. R. K. Shevgaonkar, "Electromagnetic Waves", Tata McGraw Hill Publications, 2006
4. G.S.N Raju "Electromagnetic Field Theory and Transmission Lines", Pearson Education India, First edition, 2005.
5. Reinmut K Hoffman, "Handbook of Microwave Integrated Circuits", Artech House, 1987.

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

EC5402 COMMUNICATION THEORY 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 analysis
- To introduce random processes and their characteristics
- To understand noise impact on modulations
- 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, Stereo FM

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 signal 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

Sampling - Quantization – Uniform and non-uniform quantization – Quantization noise – Companding laws of speech signals – PCM, DPCM, ADPCM, DM, ADM, and Subband Coding. Multiplexing– TDM (E and T lines), FDM

TOTAL: 45 PERIODS

COURSE OUTCOMES:

CO1: Ability to apply transforms for signal modulation techniques

CO2: Ability to develop the architectures of communication systems for analog modulation techniques

CO3: Ability to explore the role of random process in communication systems.

CO4: Ability to analyse the noise performance of analog communication receivers

CO5: Learning the speech coding techniques and communication systems

TEXT BOOKS:

1. S.Haykin, "Communication Systems ", John Wiley, 4th Edition, 2007.
2. D.Roody, J.Coolen, "Electronic Communications", PHI, 4th Edition, 2006.

REFERENCES:

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

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

EC5403 ELECTRONIC CIRCUITS – II L T P C
3 1 0 4

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 study about feedback amplifiers and oscillator principles
- To design Op Amps
- To design oscillators
- To study about tuned amplifiers
- To know the principles of DC-DC convertors

UNIT I FEEDBACK AMPLIFIERS AND STABILITY 6+6

Basic feedback concepts – Properties of Negative feedback – Four feedback topologies– Analysis of series–shunt, series-series, shunt-shunt and shunt-series feedback amplifiers – stability problem – Gain and Phase-margins- Frequency compensation.

UNIT II OPERATIONAL AMPLIFIER 6+6

Design of two stage operational amplifier, Compensation of Op Amps, Cascode Op Amps, Folded Cascode Op Amps, Telescopic Opamp.

UNIT III OSCILLATORS 6+6

Barkhausen criteria for oscillator – Analysis of RC oscillators – Phase shift and Wein bridge oscillators – LC oscillators – Colpitts, Hartley, Clapp, and Ring Oscillators

UNIT IV TUNED AMPLIFIERS 6+6

Basic principles – Inductor losses – Use of transformers – Single tuned amplifier frequency analysis - Amplifier with multiple tuned circuits – Cascade – Synchronous tuning – Stagger tuning– Stability of tuned amplifiers using Neutralization techniques

UNIT V POWER AMPLIFIERS AND DC CONVERTERS 6+6

Power amplifiers- class A-Class B-Class AB-Class C-Power MOSFET-Temperature Effect- Class AB Power amplifier using MOSFET –DC/DC convertors – Buck, Boost, Buck-Boost analysis and design

TOTAL: 30L + 30T: 60 PERIODS

COURSE OUTCOMES:

At the end of the course the students will be able

CO1 : To acquire knowledge about feedback amplifiers and oscillator principles.
CO2 : To design Op Amps.
CO3: To design oscillators.
CO4: To acquire knowledge about tuned amplifiers.
CO5: To design and construct DC-DC convertors.

TEXT BOOKS:

1. Adel .S. Sedra, Kenneth C. Smith, "Micro Electronic Circuits", Oxford University Press, 7th Edition, 2014.
2. Behzad Razavi, "Design of Analog CMOS Integrated Circuits", Tata McGraw Hill, 2007.

REFERENCES

1. Donald.A. Neamen, "Electronic Circuit Analysis and Design", Tata McGraw Hill, 3rd Edition, 2010
2. F. Bogart Jr. "Electronic Devices and Circuits", Pearson Education, 6th Edition, 2007.
3. Muhammad H.Rashid, "Power Electronics", Pearson Education / PHI , 2004.

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

EC5404 DIGITAL SIGNAL PROCESSING L T P C
3 0 0 3

OBJECTIVES:

- To introduce discrete fourier transform and its applications
- To teach the design of infinite and finite impulse response filters for filtering undesired signals
- To introduce signal processing concepts in systems having more than one sampling frequency

UNIT I DISCRETE FOURIER TRANSFORM 9

Review of discrete-time signals & systems - DFT and its properties, FFT algorithms & its applications, Overlap-add & overlap-save methods.

UNIT II DESIGN OF INFINITE IMPULSE RESPONSE FILTERS 9

Analog filters – Butterworth filters, Chebyshev Type I filters (upto 3rd order), Analog Transformation of prototype LPF to BPF /BSF/ HPF. Transformation of analog filters into equivalent digital filters using Impulse invariant method and Bilinear Z transform method- Realization structures for IIR filters – direct, cascade, parallel forms.

UNIT III DESIGN OF FINITE IMPULSE RESPONSE FILTERS 9

Design of linear phase FIR filters windowing and Frequency sampling methods - Realization structures for FIR filters – Transversal and Linear phase structures- Comparison of FIR & IIR.

UNIT IV FINITE WORDLENGTH FFECTS 9

Representation of numbers-ADC Quantization noise-Coefficient Quantization error-Product Quantization error-truncation & rounding errors -Limit cycle due to product round-off error- Round-off noise power-limit cycle oscillation due to overflow in digital filters- Principle of scaling.

UNIT V MULTIRATE SIGNAL PROCESSING 9

Introduction to Multirate signal processing-Decimation-Interpolation - Polyphase Decomposition of FIR filter-Multistage implementation of sampling rate conversion- Design of narrow band filters - Applications of Multirate signal processing.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

CO1: To design systems using spectrum information

CO2: Ability to shape the spectrum of signal through IIR digital filters

CO3: To design FIR digital filters for spectral shaping

CO4: Ability to analyze performance degradation of digital signal processing systems due to finite precision

CO5: Ability to analyze the architectural details of fixed and floating point digital signal processor

TEXTBOOKS:

1. A.V.Oppenheim, R.W. Schafer and J.R. Buck, "Discrete Time Signal Processing", , Pearson, 8th Indian Reprint, 2004.
2. John G Proakis and Manolakis, "Digital Signal Processing Principles Algorithms and Applications", Pearson, 4th Edition, 2007

REFERENCES:

1. I.C.Ifeachor and B.W. Jervis, "Digital Signal Processing A Practical Approach", Pearson, 2002.
2. M.H.Hayes, "Digital Signal Processing", Schaum's outlines, Tata McGraw Hill, 2007.
3. S.K. Mitra," Digital Signal Processing", A Computer Based approach, Tata McGraw-Hill, 1998.
4. D.J. De Fatta, J.G.Lucas and W.S. Hodgkiss, "Digital Signal Processing A system Design Approach", John Wiley & sons, Singapore, 1988.
5. P.P.Vaidyanathan, Multirate Systems & Filter Banks, Prentice Hall, Englewood cliffs, NJ, 1993.

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

EC5405 LINEAR INTEGRATED CIRCUITS 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 study the circuit configuration of linear integrated circuits.
- To introduce practical applications of linear integrated circuits.
- To introduce the concept of analog multiplier and Phase Locked Loop with applications.
- To study the application of ADC and DAC in real time systems.
- To introduce special function ICs and its construction.

UNIT I CIRCUIT CONFIGURATION FOR LINEAR ICS 9

Current sources, Analysis of difference amplifiers with active loads, supply and temperature independent biasing, Band gap references, Monolithic IC operational amplifiers, specifications, frequency compensation, slew rate and methods of improving slew rate. interpretation of TL082 datasheet.

UNIT II APPLICATION 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, Multivibrator and Schmitt trigger, Triangle wave generator, Precision rectifier, Log and Antilog amplifiers, Non-linear function generator.

UNIT III ANALOG MULTIPLIER AND PLL 9

Analysis of four quadrants and variable Transconductance multipliers, Analog multiplier MPY634 features, Voltage controlled oscillator, Closed loop analysis of PLL, AM, PM and FSK modulators and demodulators.

UNIT IV ANALOG TO DIGITAL AND DIGITAL TO ANALOG CONVERTORS 9

Analog switches, High speed sample and hold circuit and IC's, Types of D/A converter, 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 V SPECIAL FUNCTION ICS 9

Timers, Voltage regulators - linear and switched mode types, Switched capacitor filter, SMPS, Frequency to Voltage converters, Tuned amplifiers, Power amplifiers and Isolation Amplifiers, Video amplifiers, Sources for Noises, Op Amp noise analysis and Low noise OP-Amps.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

CO1: Ability to comprehend and appreciate the significance and role of the operational amplifier in the present contemporary world.
CO2: Ability to design new analog linear circuit using operational amplifier.
CO3: Ability to analyzer and develop communication systems using linear ICs.
CO4: Ability to deploy the data converters in real time scenario.
CO5: Ability to select appropriate ICs and circuits for analog system design.

TEXT BOOK:

1. Sergio Franco, "Design with Operational Amplifiers and Analog Integrated Circuits", Mc Graw Hill Education, 2014.

REFERENCES:

1. Gray and Meyer, "Analysis and Design of Analog Integrated Circuits", Wiley International, 2009.
2. Michael Jacob J., "Applications and Design with Analog Integrated Circuits", Prentice Hall of Inida,1996.
3. Ramakant A. Gayakwad, "OP AMP and Linear IC's", Prentice Hall, 2012.
4. Botkar K.R., "Integrated Circuits", Khanna Publishers, 1996.
5. Taub and Schilling, "Digital Integrated Electronics", Mc Graw Hill, 1977.
6. Coughlin and Driscoll, "Operational amplifiers and Linear Integrated Circuits", Prentice Hall, 1989.
7. Millman J. and Halkias C., "Integrated Electronics", Mc Graw Hill, 2001.

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	P10	P11	P12
CO1	2										1	
CO2	2	3	3	2								
CO3	1			2								
CO4	1			2								
CO5	1	2	3	3								3

GE5251 ENVIRONMENTAL SCIENCES L T P C
3 0 0 3

OBJECTIVES:

- To introduce the basic concepts of environment, ecosystems and biodiversity and emphasize on the biodiversity of India and its conservation.
- To impart knowledge on the causes, effects and control or prevention measures of environmental pollution and natural disasters.
- To facilitate the understanding of global and Indian scenario of renewable and non-renewable resources, causes of their degradation and measures to preserve them.
- To familiarize the influence of societal use of resources on the environment and introduce the legal provisions, National and International laws and conventions for environmental protection.
- To inculcate the effect of population dynamics on human and environmental health and inform about human right, value education and role of technology in monitoring human and environmental issues.

UNIT I ENVIRONMENT, ECOSYSTEMS AND BIODIVERSITY 14

Definition, scope and importance of environment – need for public awareness - concept of an ecosystem – structure and function of an ecosystem – producers, consumers and decomposers – energy flow in the ecosystem – ecological succession – food chains, food webs and ecological pyramids – Introduction, types, characteristic features, structure and function of the (a) forest ecosystem (b) grassland ecosystem (c) desert ecosystem (d) aquatic ecosystems (ponds, streams, lakes, rivers, oceans, estuaries) – Introduction to biodiversity definition: genetic, species and ecosystem diversity – bio geographical classification of India – value of biodiversity: consumptive use, productive use, social, ethical, aesthetic and option values – Biodiversity at global, national and local levels – India as a mega-diversity nation – hot-spots of biodiversity – threats to biodiversity: habitat loss, poaching of wildlife, man-wildlife conflicts – endangered and endemic species of India – conservation of biodiversity: In-situ and ex-situ conservation of biodiversity. Field study of common plants, insects, birds Field study of simple ecosystems – pond, river, hill slopes, etc.

UNIT II ENVIRONMENTAL POLLUTION 8

Definition – causes, effects and control measures of: (a) Air pollution (b) Water pollution (c) Soil pollution (d) Marine pollution (e) Noise pollution (f) Thermal pollution (g) Nuclear hazards – soil waste management: causes, effects and control measures of municipal solid wastes – role of an individual in prevention of pollution – pollution case studies – disaster management: floods, earthquake, cyclone and landslides. Field study of local polluted site – Urban / Rural / Industrial / Agricultural.

UNIT III NATURAL RESOURCES 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, land 47 degradation, man induced landslides, soil erosion and desertification – role of an individual in conservation of natural resources – Equitable use of resources for sustainable lifestyles. Field study of local area to document environmental assets – river / forest / grassland / hill / mountain.

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 – 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 – enforcement machinery involved in environmental legislation- central and state pollution control boards- Public awareness.

UNIT V HUMAN POPULATION AND THE ENVIRONMENT 6

Population growth, variation among nations – population explosion – family welfare programme – environment and human health – human rights – value education – HIV / AIDS – women and child welfare – role of information technology in environment and human health – Case studies.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

CO1: To recognize and understand the functions of environment, ecosystems and biodiversity and their conservation.

CO2: To identify the causes, effects and environmental pollution and natural disasters and contribute to the preventive measures in the immediate society.

CO3: To identify and apply the understanding of renewable and non-renewable resources and contribute to the sustainable measures to preserve them for future generations.

CO4: To recognize different forms of energy and apply them for suitable applications in for technological advancement and societal development.

CO5: To demonstrate the knowledge of societal activity on the long and short term environmental issues and abide by the legal provisions, National and International laws and conventions in professional and personal activities and to identify and analyse effect of population dynamics on human value education, consumerism and role of technology in environmental issues.

TEXT BOOKS:

1. Anubha Kaushik and C. P. Kaushik's "Perspectives in Environmental Studies", New Age International Publishers, 6th Edition, 2018.
2. Benny Joseph, "Environmental Science and Engineering", Tata McGraw-Hill, New Delhi, 2016.
3. Gilbert M.Masters, "Introduction to Environmental Engineering and Science", Pearson Education, 2nd Edition, 2004.

REFERENCES:

1. R.K. Trivedi, "Handbook of Environmental Laws", Rules, Guidelines, Compliances and Standards', Vol. I and II, Enviro Media.
2. Cunningham, W.P. Cooper, T.H. Gorhani, "Environmental Encyclopedia", Jaico Publ., House, Mumbai, 2001.
3. Dharmendra S. Sengar, "Environmental law", Prentice hall of India PVT. LTD, New Delhi, 2007.
4. Rajagopalan, R, "Environmental Studies From Crisis to Cure", Oxford University Press, 2005.
5. Erach Bharucha "Textbook of Environmental Studies for Undergraduate Courses" Orient Blackswan Pvt. Ltd., 2013.

EC5411 **DIGITAL SIGNAL PROCESSING LABORATORY** **L T P C**
0 0 4 2

OBJECTIVES:

1. To implement generation of sequences
2. To realize Linear and Circular Convolution
3. To design and realize FIR and IIR filters
4. To implement signal processing algorithms using digital signal processor

DSP Processor Implementation

1. Study of architecture of Digital Signal Processor
2. MAC operation using various addressing modes
3. Implementation of difference equations
4. Linear Convolution
5. Circular Convolution
6. Waveform generation

MATLAB / Equivalent Software package

7. Generation of sequences
8. Linear and Circular Convolutions
9. DFT
10. FIR filter design
11. IIR filter design
12. Finite wordlength effects
13. Decimation and Interpolation

TOTAL: 60 PERIODS

LAB REQUIREMENTS:

TMS 320C5x / TMS 320C6x Kits – 15 Nos.
MATLAB or Equivalent S/w – 15 User License

OUTCOMES:

CO1: Ability to implement simulation of signal processing algorithms
CO2: Ability to demonstrate the frequency domain analysis using DFT
CO3: Ability to demonstrate system realization using digital signal processor

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

EC5412 INTEGRATED CIRCUITS LABORATORY L T P C
0 0 4 2

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 study circuits using feedback concepts and tuned circuits
- To learn circuits using OPAMP,PLL and Timer ICs
- To know the design of power amplifier circuits to meet desired specifications

1. Design and Analysis of Feedback amplifiers
2. Design and analysis of RC phase shift oscillator
3. Design and analysis of Hartley and Colpitts LC Oscillators
4. Design and analysis of single Tuned amplifier
5. Design and analysis of Wien bridge oscillator using OPAMP
6. Design and analysis of Schmitt trigger using OPAMP
7. Design and analysis of Waveform generators using OPAMP
8. Design and analysis of Active filters using OPAMP
9. Design and analysis of Voltage Controlled Oscillator using PLL IC
10. Design and analysis of Astable and Monostable Multivibrators using Timer IC
11. Spice simulation of differential amplifiers and operational amplifiers
12. Spice simulation of Class A and Class B Power Amplifiers.

TOTAL: 60 PERIODS

COURSE OUTCOMES:

At the end of the course student will be able to

CO1: Design Oscillators and Multistage amplifiers.
CO2: Analyze power amplifier circuits.
CO3: Design circuits using PLL, OPAMP and timer ICs
CO4: Simulate amplifiers and analyze its characteristics in SPICE.

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

EC5501 ANTENNAS AND WAVE PROPAGATION L T P C
3 0 0 3

OBJECTIVES:

- To give insight into the radiation phenomena.
- To give a thorough understanding of the radiation characteristics of different types of
- antennas
- To create awareness about the different types of propagation of radio waves at different frequencies

UNIT I FUNDAMENTALS OF RADIATION 9

Antenna parameters - Gain, Directivity, Effective aperture, Radiation Resistance, Bandwidth, Beam width, Impedance analysis using S parameters and Impedance matching: BALUNS, Polarization mismatch, Antenna noise temperature, Radiation from oscillating dipole, half wave dipole and folded dipole, yagiUda array, Spiral antenna, log periodic antenna.

UNIT II ANTENNA ARRAYS 9

Two element array, N-element linear array, Pattern multiplication, Broadside and end fire array, Array synthesis: Binomial array, Tschebyscheff array, planar array antennas.

UNIT III APERTURE ANTENNAS 9

Huygens' principle, radiation from rectangular aperture, design considerations, Babinet's principle, Radiation from sectoral and pyramidal horns, design concepts, parabolic reflector antennas and feeding techniques, microstrip patch antenna .

UNIT IV MODERN ANTENNAS 9

Phased array antennas, Smart antennas – switched beam and adaptive arrays, UWB antennas, RFID Antennas, Wearable antennas, Reconfigurable antennas, Dielectric resonator antennas, bandwidth enhancement techniques, gain enhancement techniques.

UNIT V ANTENNA MEASURMENTS & WAVE PROPAGATION 9

Measurements: Spectrum Analyzer, Network analyzer, Anechoic chamber, Measurement of frequency, S-parameters, Antenna Gain, Radiation pattern and polarization,

Modes of propagation, Structure of atmosphere, Ground wave propagation, Tropospheric propagation, Duct propagation, Troposcatter propagation , Flat earth and Curved earth concept ,Sky wave propagation – Virtual height, critical frequency , Maximum usable frequency – Skip distance, Fading , Multi hop propagation.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

CO1: Comprehend and appreciate the significance and role of this course in the present contemporary world.

CO2: Understand the fundamentals of the antenna by gaining technical knowledge regarding antenna parameters.

CO3: Have insight into the radiation phenomena.

CO4: Have a thorough understanding of the radiation characteristics of different types of Antennas.

CO5: Identify the different types of propagation of radio waves at various frequencies.

TEXT BOOKS:

1. John D Kraus, "Antennas for all Applications", Mc Graw Hill, 5th Edition, 2005.
2. R.E.Collin, "Antennas and Radiowave propagation", Mc Graw Hill, 1985.

REFERENCES:

1. Constantine.A.Balanis, "Antenna Theory Analysis and Design", Wiley student edition,3rd Edition, 2009.
2. Edward C.Jordan and Keith G.Balmain, "Electromagnetic Waves and Radiating Systems", Prentice Hall of India, 2006.
3. S. Drabowitch, "Modern Antennas", Springer Publications, 2nd Edition, 2007.
4. Robert S.Elliott, "Antenna theory and Design", Wiley student edition, 2010.
5. H.Sizun, "Radio Wave Propagation for Telecommunication Applications", First Indian Reprint, Springer Publications, 2007.

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

EC5502 DIGITAL COMMUNICATION 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 demonstrate the concept of information and types of channels
- To understand the various source coding theorems and the fundamental limit of transmission over the channel.
- To understand the various baseband and bandpass processing techniques.
- To understand spread spectrum.

UNIT I BASEBAND TECHINIQUES 9

Overall picture and the relevance of digital communication techniques, Pulse Modulation-PAM,PPM and PDM, Line codes – RZ,NRZ, Manchester, Binary N-zero substitution codes- PSDs– ISI – Nyquist Criterion for distortion less transmission – Pulse shaping – Correlative coding- M-ary schemes – Eye pattern

UNIT II ERROR CONTROL CODING TECHNIQUES 9

Channel coding theorem – Linear block codes – Hamming codes – Cyclic codes – Convolutional codes – Viterbi decoding

UNIT III INFORMATION THEORY 9

Measure of information – Entropy – Source coding theorem – Discrete memoryless channels– lossless, deterministic, noiseless, BEC, BSC – Mutual information – Channel capacity – Shannon-Hartley law- Transform coding – LPC – Shannon-Fano coding, Huffman Coding, Run length coding, LZW algorithm

UNIT IV BANDPASS SIGNALING 9

Introduction to Band Pass Sampling theorem - Comparison of base band and band pass signaling, Geometric representation of signals – ML detection - Correlator and matched filter detection-generation and detection of BPSK, BFSK, QPSK- BER and Power spectral Density Comparison-Structure of non-coherent receivers-generation and detection of BFSK, DPSK, MSK.

UNIT V SYNCHRONISATION AND SPREAD SPECTRUM TECHNIQUES 9

Importance of Synchronizations – Carrier, frame and symbol/Chip synchronization techniques, Spread Spectrum - PN Sequences, Direct Sequence and Frequency Hopping Spread Spectrum Systems, BER Analysis, Processing gain and Jamming Margin, Link Budget

TOTAL: 45 PERIODS

COURSE OUTCOMES:

CO1: Capable of configuring Source coding schemes
CO2: To be able to design Channel coding schemes
CO3: To be able to design base band signaling scheme analyze their performance
CO4: To be able to design various Bandpass signaling schemes and compare their performance
CO5: Capable of designing synchronization schemes
CO6: Capable of designing spread spectrum systems

TEXT BOOKS:

1. S. Haykin, "Digital Communications", John Wiley, 2015.
2. J.G Proakis, "Digital Communication", Tata Mc Graw Hill Company, 5th Edition, 2008.

REFERENCES:

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

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

EC5551 MICROPROCESSORS AND MICROCONTROLLERS L T P C
3 0 0 3

OBJECTIVES:

- To study the architecture of 8085, 8086 , 8051and ARM.
- To study the addressing modes and instruction set of 8085, 8086 8051and ARM .
- To explore the need and use of Peripherals and Interfacing.
- To develop skill to explore system design technique .

UNIT I 8- BIT and 16 - BIT MICROPROCESSOR. 9

8085 Architecture, Instruction set, Addressing modes, Interrupts, Timing diagrams, Memory and I/O interfacing. 8086 Architecture, Instruction set and programming, Minimum and Maximum mode configurations.

UNIT II PERIPHERALS AND INTERFACING 9

Programmable Peripheral Interface (8255), Keyboard display controller (8279), ADC0808 and DAC0808 Interface, Programmable Timer Controller (8254), Programmable interrupt controller (8259), Serial Communication Interface (8251).

UNIT III 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 IV MICROCONTROLLER BASED SYSTEM DESIGN 9

Interfacing to: matrix display, (16x2) LCD, high power devices, optical motorshaft encoder, Stepper Motor, DC Motor speed Control using PWM, RTC and EEPROM interface using I2C protocol.

UNIT V 32- BIT ARM PROCESSOR 9

RISC Vs CISC Architecture, ARM Processor Architecture, ARM Core data flow model, Barrel Shifter, ARM processor modes and families, pipelining , ARM instruction Set and its Programming.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

CO1: Ability to relate any architecture and assembly language for a processor.
CO2: Ability to comprehend the architectural and pipelining concepts for Microprocessors.
CO3: Ability to design and deploy the Interfacing peripherals in real time scenario.
CO4: Ability to discriminate different microprocessor and microcontroller and its special function registers.
CO5: Ability to design, develop and trouble shoot microcontroller based system.

TEXT BOOKS:

1. Ramesh S. Gaonkar, "Microprocessor Architecture, Programming and Applications with 8085". Penram International Publishing reprint, 6th Edition, 2017.
2. Douglas V. Hall, "Microprocessor and Interfacing, Programming and Hardware", Tata McGraw Hill, Revised 2nd Edition 2006, 11th reprint 2015.

REFERENCES:

1. Muhammad Ali Mazidi, Janice Gillispie Mazidi and Rolin D. McKinley, "The 8051 Microcontroller and Embedded Systems", 2nd Edition, Pearson Education 2008. 12th impression 2018
2. Krishna Kant, “Microprocessor and Microcontroller Architecture, programming and system design using 8085, 8086, 8051 and 8096’’, PHI, 2007, 7th Reprint, 2015.
3. Kenneth J. Ayala., “The 8051 Microcontroller, 3rd Edition, Thompson Delmar Learning’’, 2012.
4. A.K. Ray, K.M. Bhurchandi, “Advanced Microprocessor and Peripherals’’, Tata McGraw-Hill, 2nd Edition, 2010.
5. Barry B. Brey, “The Intel Microprocessors Architecture, Programming and Interfacing’’, Pearson Education, 2007, 2nd impression, 2010.

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

EC5503 CONTROL SYSTEMS ENGINEERING L T P C
3 0 0 3

OBJECTIVES:

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

UNIT I SYSTEMS COMPONENTS AND THEIR REPRESENTATION 9

Control System: Terminology and Basic Structure-Feed forward and Feedback control theory-Electrical and Mechanical Transfer Function Models-Block diagram Models-Signal flow graphs models-DC and AC servo Systems-Synchronous -Multivariable control system

UNIT II TIME RESPONSE ANALYSIS 9

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

UNIT III FREQUENCY RESPONSE AND SYSTEM ANALYSIS 9

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

UNIT IV CONCEPTS OF STABILITY ANALYSIS 9

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

UNIT V CONTROL SYSTEM ANALYSIS USING STATE VARIABLE METHODS 9

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

TOTAL:45 PERIODS

COURSE OUTCOMES:

CO1: Ability to comprehend and appreciate the significance and role of this course in the present contemporary world.
CO2: Compute the transfer function of different physical systems.
CO3: Analyse the time domain specification and calculate the steady state error.
CO4: Illustrate the frequency response characteristics of open loop and closed loop system response.
CO5: Analyse the stability using Routh and root locus techniques.
CO6: Illustrate the state space model of a physical system and discuss the concepts of sampled data control system.

TEXT BOOK:

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

REFERENCES:

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

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

MG5451 PRINCIPLES OF MANAGEMENT L T P C
3 0 0 3

OBJECTIVES:

- Sketch the Evolution of Management.
- Extract the functions and principles of management.
- Learn the application of the principles in an organization.
- Study the various HR related activities.
- Analyze the position of self and company goals towards business.

UNIT I INTRODUCTION TO MANAGEMENT AND ORGANIZATIONS 9

Definition of Management – Science or Art – Manager Vs Entrepreneur- types of managers-managerial roles and skills – Evolution of Management –Scientific, human relations , system and contingency approaches– Types of Business organization- Sole proprietorship, partnership, company-public and private sector enterprises- Organization culture and Environment – Current trends and issues in Management.

UNIT II PLANNING 9

Nature and purpose of planning – Planning process – Types of planning – Objectives – Setting objectives – Policies – Planning premises – Strategic Management – Planning Tools and Techniques – Decision making steps and process.

UNIT III ORGANISING 9

Nature and purpose – Formal and informal organization – Organization chart – Organization structure – Types – Line and staff authority – Departmentalization – delegation of authority – Centralization and decentralization – Job Design - Human Resource Management – HR Planning, Recruitment, selection, Training and Development, Performance Management , Career planning and management.

UNIT IV DIRECTING 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 – Communication and IT.

UNIT V CONTROLLING 9

System and process of controlling – Budgetary and non - Budgetary control techniques – Use of computers and IT in Management control – Productivity problems and management – Control and performance – Direct and preventive control – Reporting.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

CO1: Upon completion of the course, students will be able to have clear understanding of managerial functions like planning, organizing, staffing, leading & controlling .
CO2: Have same basic knowledge on international aspect of management.
CO3: Ability to understand management concept of organizing.
CO4: Ability to understand management concept of directing.
CO5: Ability to understand management concept of controlling.

TEXT BOOKS:

1. Harold Koontz and Heinz Weihrich “Essentials of Management”, Tata McGraw Hill, 1998.
2. Stephen P. Robbins and Mary Coulter, “Management”, Prentice Hall (India)Pvt. Ltd., 10th Edition, 2009.

REFERENCES:

1. Robert Kreitner and Mamata Mohapatra, “ Management”, Biztantra, 2008.
2. Stephen A. Robbins and David A. Decenzo and Mary Coulter, “Fundamentals of Management”, Pearson Education, 7th Edition, 2011.
3. Tripathy PC and Reddy PN, “Principles of Management”, Tata McGraw Hill, 1999.

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	√					√			√	√	√	
CO2						√			√		√	
CO3						√			√		√	
CO4						√			√		√	
CO5						√			√		√	

EC5561 MICROPROCESSOR AND MICROCONTROLLER INTERFACING LABORATORY **L T P C 0 0 4 2**

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 study introduce the programming language of 8085, 8086 and 805.
- To develop skill in program writing for microprocessors and controllers.
- To introduce microprocessor and microcontroller based system design.
- To impart knowledge on embedded S/W development.

Experiments:

Assembly Language Programming of 8085 and 8086.

1. Programs for 8 / 16 bit Arithmetic, Sorting, Searching and String operations,
2. Programs for Digital clock, Interfacing ADC and DAC
3. Interfacing and programming 8279, 8259, and 8253.
4. Serial Communication between two microprocessors kits using 8251.
5. Interfacing Stepper Motor, Speed control of DC Motor
6. Parallel communication between two microprocessors kits using Mode 1 and Mode 2 of 8255.
7. Macro assembler Programming for 8086.

8051 based experiments using assembly language and C programming:

8. Programming using Arithmetic, Logical and Bit Manipulation instructions of the 8051 microcontroller.
9. Programming and verifying Timer, Interrupts and UART operations in 8051 microcontroller.
10. Interfacing – DAC and ADC and 8051 based temperature measurement
11. Interfacing – LED and LCD
12. Interfacing – Stepper motor and traffic light control system
13. Communication between 8051 Microcontroller kit and PC.
14. Programming ARM processor using Embedded C.

TOTAL: 60 PERIODS

COURSE OUTCOMES:

CO1 : Ability to develop assembly language program for microprocessors and microcontrollers.
CO2: Ability to comprehend the architectural and pipelining concepts for Microprocessors.
CO3: Ability to interface peripherals, sensors and actuators and in embedded systems.
CO4: Ability to design microprocessor / microcontroller based system.
CO5: Ability to design , develop and trouble shoot microcontroller based system.

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

EC5511 ANALOG AND DIGITAL COMMUNICATION LABORATORY L T P C
0 0 4 2

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
- It is intended to demonstrate the architecture of analog and digital communication link components to the students
- Students must understand the role of each module present in the communication links
- They have to study by evaluating the comparing the performance of each techniques used in various modules.

Simulation using MATLAB/SIMULINK/ SDR equivalent

1. AM / FM Modulator and Demodulator
2. Time Division Multiplexing
3. Signal Sampling and reconstruction
4. Pulse Code Modulation and Demodulation
5. Delta Modulation and Demodulation
6. Line coding schemes
7. FSK, PSK and DPSK schemes (Simulation)
8. Error control coding schemes (Simulation)
9. Symbol Timing Synchronization
10. Spread spectrum communication (Simulation)
11. Communication link simulation

TOTAL: 60 PERIODS

COURSE OUTCOMES:

CO1: Ability to comprehend and appreciate the significance and role of this course in the present contemporary world

CO2: Ability to experimentally analyze the performance of various kinds of signaling used in communication systems and their bandwidth requirement.

CO3: They gets hands on experience on system construction and performance evaluation

CO4: Ability to study issues from communication links and channels, and their equalization techniques

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

EC5651 **DIGITAL VLSI** **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 learn the fundamentals of VLSI design
- To understand the IC Manufacturing Process
- To familiarize with VLSI combinational logic circuits design
- To familiarize with VLSI sequential logic circuits design
- To learn the various arithmetic circuits and testing methodologies
- To familiarize with the different FPGA architectures

UNIT I MOS TRANSISTOR PRINCIPLES 9

MOS Technology and VLSI, Pass transistors, NMOS, CMOS Fabrication process and Electrical properties of CMOS circuits and Device modelling. Characteristics of CMOS inverter, Scaling principles and fundamental limits. Propagation Delays, CMOS inverter scaling, Stick diagram, Layout diagrams, Elmore's constant, Logical Effort. Case study: Study of technology development in MOS.

UNIT II COMBINATIONAL LOGIC CIRCUITS 9

Static CMOS logic Design, Design techniques to improve the speed, power dissipation of CMOS logic, low power circuit techniques, Ratioed logic .Pass transistor Logic, Transmission CPL, DCVSL, Dynamic CMOS logic, Domino logic, Dual Rail logic, NP CMOS logic and NORA logic

UNIT III SEQUENTIAL LOGIC CIRCUITS 9

Static and Dynamic Latches and Registers, Timing Issues, Pipelines, Clocking strategies, Memory Architectures, and Memory control circuits.

UNIT IV DESIGNING ARITHMETIC BUILDING BLOCKS & TESTING 9

Data path circuits, Architectures for Adders, Accumulators, Multipliers, Barrel Shifters, Need for testing- Manufacturing test principles- Design for testability. Case study: Analysis of area, power and delay for 16 bit adder and 8 bit multilpier.

UNIT V IMPLEMENTATION STRATEGIES 9

Full Custom and Semicustom Design, Standard Cell design and cell libraries, FPGA building block architectures, FPGA interconnect routing procedures. Demo: Complete ASIC flow using Backend tool and fabrication flow Overall case study: Development of IC in commercial aspects (design, testing and fab cost)

TOTAL: 45 PERIODS

COURSE OUTCOMES:

CO1: Ability to analyze inverter characteristics and realize modeling of MOS transistors.
CO2: Ability to design combinational logic using various logic styles, satisfying static and dynamic requirements.
CO3: Ability to analyze timing issues of sequential logic and design memories.
CO4: Ability to design data path elements.
CO5: Ability to compare and analyze FPGA architecture and interconnect methodology.

TEXT BOOK:

1. Jan Rabaey, Anantha Chandrakasan, B.Nikolic, "Digital Integrated circuits: A Design Perspective", Prentice Hall of India, 2nd Edition, 2003.

REFERENCES

1. N.Weste, K.Eshraghian, "Principles of CMOS VLSI DESIGN", A system Perspective, 2nd Edition, Addision Wesley, 2004.
2. A.Pucknell, Kamran Eshraghian, "BASIC VLSI DESIGN", Prentice Hall of India, 3rd Edition, 2007.
3. M.J. Smith, "Application Specific Integrated Circuits", Addisson Wesley, 1997.
4. R.Jacob Baker, Harry W.LI., David E.Boyee, "CMOS Circuit Design, Layout and Simulation", Prentice Hall of India, 2005.

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

EC5601 WIRELESS COMMUNICATION L T P C
3 0 0 3

OBJECTIVES:

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

UNIT I WIRELESS CHANNELS 9

Electromagnetic Wave Propagation Mechanisms - Reflection, Diffraction, Scattering Models - 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 toMultipath time delay spread – flat fading – frequency selective fading – Fading due to Doppler spread – fast fading – slow fading.

UNIT II CELLULAR ARCHITECTURE 9

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

UNIT III DIGITAL SIGNALING FOR FADING CHANNELS 9

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

UNIT IV MULTIPATH MITIGATION TECHNIQUES 9

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

UNIT V MULTIPLE ANTENNA TECHNIQUES 9

MIMO systems – spatial multiplexing -System model -Pre-coding - transmitter diversity, receiver diversity- Channel state information-capacity in fading and non-fading channels.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

CO1: Ability to comprehend and appreciate the significance and role of this course in the present contemporary world.

CO2: The student would be capable of characterizing a wireless channel and evolve the system design specifications.

CO3: The student would be capable of designing a cellular system based on resource availability and traffic demands.

CO4: The student would be able to identify suitable signaling and multipath mitigation techniques for the wireless channel and system under consideration.

CO5: The student would be capable of exploiting multiple antenna techniques for capacity/ performance gains.

TEXTBOOKS:

1. Rappaport,T.S., “Wireless communications”, Pearson Education, 3rd Edition, 2010.
2. Andreas.F. Molisch, “Wireless Communications”, John Wiley – India, 2ndEdition 2012.

REFERENCES:

1. David Tse and PramodViswanath, “Fundamentals of Wireless Communication”, Cambridge University Press, 2005.
2. UpenaDalal, “Wireless Communication”, Oxford University Press, 2009.
3. Van Nee, R. and Ramji Prasad, “OFDM for wireless multimedia communications”, Artech House, 2000.
4. Simon Haykins& Michael Moher, “Modern Wireless Communications”, Pearson Education, 2007.
5. Vijay. K. Garg, “Wireless Communication and Networking”, Morgan Kaufmann Publishers, 2007.

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

EC5602 COMMUNICATION NETWORKS 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 layered communication architectures
- To understand various physical, data link and routing layer protocols
- To understand application layer protocols and security issues.
- To understand various digital switching techniques.

UNIT I NETWORK FUNDAMENTALS AND PHYSICAL LAYER 9

Communication Network Evolution and Recent Trends, definition of layers, services, interface and protocols, OSI reference model - layers and duties. TCP/IP reference model – layers and duties. Physical layer - general description, characteristics, signaling media types, topologies, examples physical layer (RS232C, ISDN, ATM, SONET)

UNIT II DATA LINK LAYER AND NETWORK INTERCONNECTION 9

Logical link control Functions: - Framming, Flow control, Error control: CRC, LLC protocols:-HDLC,P to P. Medium access layer: - Random access, Controlled access, Channelization, IEEE standards: - 802.3, 802.4 and 802.5. Internetworking, Interconnection issues, Interconnection devices: - Repeaters, Hubs, Routers/switches and Gateways.

UNIT III MESSAGE ROUTING TECHNOLOGIES 9

Circuit switching, packet switching, message switching. Internet protocols; IPV4, IPV6, ARP, RARP, ICMP, IGMP, VPN. Network Routing Algorithms:- Distance vector routing, OSPF, Dijikstra‘s , Bellaman Ford, Congestion control algorithms.

UNIT IV END-END PROTOCOLS AND SECURITY 9

Process-process delivery: - TCP, UDP and SCTP. Application protocols: WWW, HTTP, FTP and TELNET, Network management protocol: SNMP, Network security.

UNIT V DIGITAL SWITCHING 9

Switching functions, Space Division Switch, Time Division Switch, STS switching, TST switching, No 4 ESS Toll switch, digital cross connect systems, Recent advances in Switching Approaches, Introduction to Software Defined Networking.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

CO1: Ability to comprehend and appreciate the significance and role of this course in the present contemporary world.

CO2: The student would be well versed on the layered communication architectures.

CO3: The student would have gained an understanding of the need for different protocols at the different layers and their interworking.

CO4: The student will have an exposure to the various digital switching techniques, and would be able to appreciate the evolving trends,

TEXT BOOKS:

1. Behrouz.A. Forouzan, "Data Communication and Networking", Tata McGraw Hill, 5th Edition 2007.
2. John C. Bellamy, Digital Telephony, John Wiley, 3rd Edition, 2006.

REFERENCES:

1. Stallings.W., "Data and Computer Communication", Prentice Hall of India, 10thEdition, 1996
2. Tanenboum, A.S, "Computer Networks", Prentice Hall Of India, 6th Edition , 1996
3. Keshav.S. An Engineering Approach To Computer Networking, Addision – Wesley,1999.
4. J.E.Flood, Telecommunication Switching, Traffic and networks, Pearson Education, 1stEdition,2006

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

HM5354 VALUES AND ETHICS L T P C
3 0 0 3

OBJECTIVES:

- Teach definition and classification of values.
- Explain Purusartha.
- Describe Sarvodaya idea.
- Summarize sustenance of life.
- Conclude views of hierarchy of values.

UNIT I DEFINITION AND CLASSIFICATION OF VALUES 9

Extrinsic values- Universal and Situational values- Physical- Environmental-Sensuous- Economic-Social-Aesthetic-Moral and Religious values

UNIT II CONCEPTS RELATED TO VALUES 9

Purusartha-Virtue- Right- duty- justice- Equality- Love and Good

UNIT III IDEOLOGY OF SARVODAYA 9

Egoism- Altruism and universalism- The Ideal of Sarvodaya and Vasudhaiva Kutumbakam

UNIT IV SUSTENANCE OF LIFE **9**

The Problem of Sustenance of value in the process of Social, Political and Technological Changes

UNIT V VIEWS ON HIERARCHY OF VALUES **9**

The Problem of hierarchy of values and their choice, The views of Pt. Madan Mohan Malviya and Mahatma Gandhi

TOTAL: 45 PERIODS

COURSE OUTCOMES:

CO1: Able to understand definition and classification of values.
CO2: Able to understand purusartha.
CO3: Able to understand sarvodaya idea.
CO4: Able to understand sustenance of life.
CO5: Able to understand views of hierarchy of values.

TEXTBOOKS:

1. AwadeshPradhan:MahamanakeVichara, B.H.U., Vanarasi-2007.
2. Little, William, “An Introduction of Ethics”, Allied Publisher, Indian Reprint, 1955.
3. William, K Frankena “ Ethics”, Prentice Hall of India, 1988.

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1								✓	✓			✓
CO2								✓	✓			✓
CO3								✓	✓			✓
CO4								✓	✓			✓
CO5								✓	✓			✓

EC5611 VLSI LABORATORY **L T P C**
0 0 4 2

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 learn the Hardware Description Language (Verilog/VHDL)
- To learn the fundamental principles of VLSI circuit design in digital and analog domain
- To familiarize fusing of logical modules on FPGAs
- To provide hands on design experience with hardware/software based embedded system.

Digital and Analog Experiments

I Digital Experiments - FPGA BASED EXPERIMENTS:

1. Design and simulation of Full adder and full subtractor
2. Design and simulation of multiplexer, Decoder and 4 bit comparator
3. Design and simulation of 8 bit adder

4. HDL based design entry and simulation of Ripple counter, synchronous counter and BCD counter
5. Design and simulation of simple state machines
6. 4 bit multiplier design and simulation using HDL
7. Synthesis, P&R and post P&R simulation of the components simulated in (1-6) above. Critical paths and static timing analysis results to be identified. Identify and verify possible conditions under which the blocks will fail to work correctly.
8. Hardware fusing and testing of each of the blocks simulated in (1-6). Use of either chipscope feature (Xilinx) or the signal tap feature (Altera) is a must. Invoke the PLL and demonstrate the use of the PLL module for clock generation in FPGAs..

II Analog / IC Design Experiments
(Based on Cadence/Any other equivalent SPICE Circuit Simulator and FPAA based experiments)

9. Design and simulation of a simple five transistor differential amplifier – Measure gain, ICMR and CMRR
10. Layout generation, parasitic extraction and resimulation of the five transistor differential amplifier
11. Synthesis and standard cell based design of circuits simulated in 9 above. Identification of critical paths, power consumption
12. For experiment 11 above, P & R, Power and clock routing and post P & R simulation
13. Analysis of results of static timing analysis

FPAA Based Experiments:

14. Design, Simulate and implement an inverting gain amplifier, low pass, high pass filters and full wave rectifier. Analyze the frequency response of filters
15. Design and Implement a circuit which introduces noise tone to the audio and then bring the original audio by removing the noise tone

TOTAL : 60 PERIODS

COURSE OUTCOMES:

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

CO1: Ability to implement digital circuits in FPGA using HDL
CO2: Ability to realize digital circuits satisfying timing and area constraints
CO3: Ability to Synthesize, Place and Route the digital IPs
CO4: Ability to design, simulate and extract the layout of Analog IC Blocks using EDA tools
CO5: Ability to comprehend and appreciate the significance and role of this course in the present contemporary world

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

EC5612 WIRELESS COMMUNICATION AND NETWORKING LABORATORY L T P C
0 0 4 2

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 understand various protocols of physical, MAC and routing layers.
- To understand and implement various modulation techniques.
- To understand the security issues in the wireless and network and implement the security algorithms.

1. Characterization of Wireless Channels (Simulation/Experiment)
2. Equalization Techniques for Wireless Channels
3. Simulation / Implementation of Multicarrier Modulation
4. Simulation / Implementation of Space Time Block Codes
5. Performance Studies of Adaptive Modulation and Coding
6. Performance Studies of Random MAC Protocols
7. Performance Studies of LLC Protocols
8. Wireless Routing Protocols
9. IOS development of applications using prototype router boards, switches.
10. Wired & Wireless Packet Analysis using Open Source Tools.
11. Network Security Protocols
12. QoS Analysis on Wireless Networks

TOTAL: 60 PERIODS

COURSE OUTCOMES:

CO1: Ability to comprehend and appreciate the significance and role of this course in the present contemporary world

CO2: Students will be able to modify the characteristics of wireless channels and develop a new channel model.

CO3: Students will get the exposure to the implementation of modulation techniques and the protocol concerned to different layers.

CO4: Experimentally understand the QoS parameters of the network for different application.

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

EC5701 MILLIMETER AND OPTICAL WAVE COMMUNICATION 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 teach the principle of millimeter waves and millimeter transceivers
- To equip the student with concepts of light propagation through optical fibers and signal distortion
- To introduce the knowledge of optical transmitters and receivers for fiber and free space links

UNIT I MILLIMETER WAVES 9

Millimeter wave characteristics- Channel performance at 60 GHz – Gigabit wireless communication – Development of millimeter wave standards-coexistence with wireless backhaul – review of modulation for millimeter wave – OOK, PSK, FSK and QAM.

UNIT II TRANCEIVERS FOR MILLIMETER WAVES 9

Millimeter wave link budget – Transceiver architecture – Transceiver without mixer- Receiver without local oscillator – Millimeter wave calibration – Millimeter wave antennas – parameters – beam steering antenna- Millimeter wave design consideration.

UNIT III OPTICAL FIBERS CHARACTERISTICS 9

Relevance of optical communication in backhaul/backbone networks and interconnects, fiber optics, optical fiber structure and parameters, ray and mode theory of light propagation in optical fibers, Optical signal attenuation- Optical signal distortion – Dispersion - fiber types, Standard Singlemode and multimode Fibers, Principles of fiber nonlinearities.

UNIT IV OPTICAL TRANSMITTERS AND RECEIVERS 9

Materials for optical sources, light-emitting diodes, semiconductor laser diodes, power-current characteristics, noise, direct and external modulation, Laser sources and transmitters for free space communication – Receivers - Principles of optical detection, spectral responsivity, PIN, APD, preamplifier types, receiver noises.

UNIT V FREE SPACE OPTICS 9

Overview of FSO Optical Transmitters – Receivers – Subsystems – Pointing, Acquisition and Tracking – Line of sight analysis- factors affecting FSO–selecting transmission wave integration of FSO in Optical networks – installation of FSO systems

TOTAL : 45 PERIODS

COURSE OUTCOMES:

CO1: Ability to comprehend and appreciate the significance and role of this course in the present contemporary world.
CO2: Insight about the fibers types characteristics and light propagation.
CO3: Ability to identify , understand and evaluate fiber transmission characteristics for real time link design.
CO4: Thorough knowledge about transmitter and receiver types and design.
CO5: Optical networking concepts with components are explored and compared with conventional ideas.

TEXT BOOKS:

1. Kao-Cheng Huang, "Zhaocheng Wang, Millimeter Wave Communication Systems Wiley", 2011.
2. Gerd Kaiser, "Optical Fiber Communications", Tata McGraw Hill, New Delhi, 5th Edition, 2013.

REFERENCES:

1. HemaniKaushal, V.K. Jain, SubratKar, "Free Space Optical Communication", Springer India, New Delhi, 2017.
2. Govind P. Agrawal, "Fiber-Optic Communication Systems", John Wiley & Sons, reprint, 3rd Edition, 2012.
3. Sergey M. Smolskiy Author, Leonid A. Belov and Victor N. Kochemasov, “Handbook of RF, Microwave, and Millimeter-Wave Components”, Artech House Microwave Library, 2012.

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

HM5353 HUMAN RELATIONS AT WORK L T P C
3 0 0 3

OBJECTIVES:

- Illustrate human relations at work its relationship with self.
- Explain the importance of interacting with people at work to develop teamwork.
- Infer the importance of physical health in maintaining human relations at work.
- Describe the importance of staying psychologically healthy.
- Identify the essential qualities for progressing in career.

UNIT I UNDERSTANDING AND MANAGING YOURSELF 9

Human Relations and You: Self-Esteem and Self-Confidence: Self-Motivation and Goal Setting; Emotional Intelligence, Attitudes, and Happiness; Values and Ethics and Problem Solving and Creativity.

UNIT II DEALING EFFECTIVELY WITH PEOPLE 9

Communication in the Workplace; Specialized Tactics for Getting Along with Others in the Workplace; Managing Conflict; Becoming an Effective Leader; Motivating Others and Developing Teamwork; Diversity and Cross-Cultural Competence.

UNIT III STAYING PHYSICALLY HEALTHY 9

Yoga, Pranayam and Exercise: Aerobic and anaerobic.

UNIT IV STAYING PSYCHOLOGICALLY HEALTHY 9

Managing Stress and Personal Problems, Meditation.

UNIT V DEVELOPING CAREER THRUST 9

Getting Ahead in Your Career, Learning Strategies, Perception, Life Span Changes, and Developing Good Work Habits.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

Students will be able to

CO1: Understand the importance of self-management.

CO2: Know how to deal with people to develop teamwork.

CO3: Know the importance of staying healthy.

CO4: Know how to manage stress and personal problems.

CO5: Develop the personal qualities essential for career growth.

TEXT BOOK:

1. Dubrien, A. J.,"Human Relations for Career and Personal Success: Concepts, Applications, and Skills", Upper Saddle River, NJ: Pearson, 11th Edition, 2017.

REFERENCES:

1. Greenberg, J. S.,"Comprehensive stress Management", New York: McGraw Hill, 14th Edition, 2017.
2. Udai, Y.,"Yogasanaurpranayam", New Delhi: N.S. Publications, 2015.

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1			√		√			√	√			√
CO2		√	√		√				√	√	√	√
CO3					√			√	√		√	√
CO4								√			√	√
CO5						√	√	√	√	√		√

EC5711 HIGH FREQUENCY COMMUNICATION LABORATORY L T P C
0 0 4 2

OBJECTIVES:

- To enable the student to verify the basic principles and design aspects involved in
- high frequency bandpass communication system components design and the performance parameters for the components and the overall system.
- To enable the student to gain insight into the practical aspects of radiation phenomena and thoroughly understand the radiation characteristics of different types of antennas. To enable the student to appreciate the practical aspects of bandpass system design
- Understand the associated link power and risetime budgeting challenges and enable them to design and conduct experiments, as well as to analyze and interpret data to produce meaningful conclusions and match with theoretical concepts.

1. Characterization of Glass and Plastic Optical Fibers – Measurement of Numerical Aperture and Attenuation, Coefficient OTDR Principle
2. DC Characteristics of LEDs and PIN Photodiodes – Determination of external power Efficiency and dark current of detecter Responsivity
3. P-I of LED Characteristics of Laser Diode Sources – Threshold Current Determination and Study of Temperature Effects
4. Gain Characteristics of APDs – Determination of Threshold Voltage and Average gain estimation
5. Analog Transmission Characteristics of a Fiber Optic Link – Determination of Operating Range of LED and System Bandwidth for Glass and Plastic fiber links and determination of device capacity of photo detection
6. Determination of Capacity of a Digital Fiber Optic Link – Maximum Bit Rate estimation for Glass and Plastic fiber links
7. Spectral Characterisation of Optical Sources – Determination of Peak Emission Wavelength and Spectral Width
8. Study of WDM Link Components – WDM Mux / Demux, Isolator, Circulator, Fiber Bragg Grating, EDFA.
9. Gain and Radiation Pattern Measurement of an Antenna - Horn Antenna, Dipole Antenna, Array Antenna,
10. Log-Periodic Antenna, Loop Antenna
11. Determination of Mode Characteristics of a Reflex Klystron Oscillator
12. VSWR and Inpedance Measurement and Impedance Matching
13. Dielectric Constant Measurement
14. Characterisation of Directional Couplers and Multiport junctions

15. Gunn Diode Characteristics
16. Microwave IC – Filter Characteristics

TOTAL: 60 PERIODS

COURSE OUTCOMES:

CO1: The student would be able to design and conduct experiments to demonstrate the trade-offs involved in the design of high frequency bandpass communication links and the associated components.

CO2: The student would be able to comprehensively record and report the measured data, and would be capable of analyzing and interpreting the experimental measurement data and produce meaningful conclusions.

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

EC5001 ADHOC AND WIRELESS SENSOR NETWORKS 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 equip the students with knowledge of 4G networks and its applications
- To teach the students about various MAC and Routing protocols of Ad hoc and WSN.
- To educate the students on introduction and application of 6 low pan.

UNIT I INTRODUCTION AND APPLICATIONS 9

Introduction to Ad hoc Networks, Characteristic features, Need for Ubiquitous Computing network, Applications of Ad hoc ,Mobility Models : - Brownian Model, Column model, Random Walk Model, Random Waypoint model, Random Gauss Markov Model, Reference point Group Mobility Model.

UNIT II ROUTING PROTOCOLS 9

Need for Different routing Protocols, Proactive Vs Reactive Routing. Unicasting: Dynamic Source Routing, Ad Hoc On-Demand Distance Vector Routing, Temporally Ordered Routing Algorithm, Signal Stability Based Routing, Location Aided Routing, Associativity Based Routing, Zone Routing Protocol. Multicasting: Tree Based Algorithm: CAMP, Mesh based Algorithm: On-Demand Multicast Routing Protocol.

UNIT III OVERVIEW OF WIRELES SENSOR NETWORKS 9

Challenges for Wireless Sensor Networks-Characteristics requirements-required mechanisms, Difference between mobile ad-hoc and sensor networks, Applications of sensor networks-.Single- Node Architecture- Hardware Components, Energy Consumption of Sensor Nodes.

UNIT IV NETWORKING OF SENSORS 9

Physical Layer and Transceiver Design Considerations, MAC Protocols for Wireless Sensor Networks, Low Duty Cycle Protocols And Wakeup Concepts- S-MAC , The Mediation Device Protocol, Wakeup Radio Concepts, Address and Name Management, Assignment of MAC Addresses, Routing Protocols - Energy-Efficient Routing, Geographic Routing.

UNIT V INTRODUCTION AND APPLICATION OF LOWPAN 9

Introduction - Architecture, Protocol stack - Link layers – Addressing - Header format – Bootstrapping - Mesh topologies - Internet integration, Functions of an Adaptation Layer, Routing - Mesh-Under -Route-Over –ROLL, Common Protocols –WSP, MQTTS, CAP, Operating system – Contiki - µIPv6, case study - Industrial automation - Health care.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

CO1: Ability to comprehend and appreciate the significance and role of this course in the present contemporary world

CO2: The student would have gained the knowledge on ad hoc and sensor networks

CO3: The student would have the ability to design new MAC and Routing protocols for Ad hoc and sensornetwork.

CO4: The students have attained the capability to learn new operating systems used for WSN.

TEXT BOOKS:

1. Charles E. Perkins, "Ad hoc Networking", Addison-Wesley,2008.
2. Tracy Camp, Jeff Boleng, Vanessa Davies, "A survey on Mobility Models for Ad hoc Network Research Wireless Communications and Mobile Computing", Special Issue on Mobile Ad hoc Networking: Research, Trends and Applications, Vol.2. No. 5. pp.483-502,2002.

REFERENCES:

1. Hongmei Deng, Wei Li and Dharma P. Agrawal, "Routing security in Wireless Ad hoc Networks ", IEEE Communication Magazine, Oct.2002.
2. Holger Karl & Andreas Willig, "Protocols And Architectures for Wireless Sensor Networks", John Wiley,2007.
3. Feng Zhao&LeonidasJ. Guibas, “Wireless Sensor Networks, An Information Processing Approach", Elsevier,2016.
4. Kazem Sohraby, Daniel Minoli, & Taieb Znati, “-Wireless Sensor Networks-Technology, Protocols, And Applications”, John Wiley,2015.
5. ZachShelby,CarstenBormann,“-6LoWPAN:TheWirelessEmbeddedInternet”, John Wiley& Sons, 2009.

EC5002 ADVANCED WIRELESS COMMUNICATION 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 teach the importance of improving capacity of wireless channel using MIMO
- To teach the characteristic of wireless channel
- To teach techniques for channel improvements using space-time block and Trellis codes
- To teach advanced MIMO system like layered space time codes, MU-MIMO System and MIMO-OFDM systems

UNIT I INTRODUCTION 9

The crowded spectrum, need for high data rate, MIMO systems – Array Gain, Diversity Gain, Data Pipes, Spatial MUX, MIMO System Model. MIMO System Capacity – channel known at the TX, Channel unknown to the TX – capacity of deterministic channels, Random channels and frequency selective channels.

UNIT II RADIO WAVE PROPAGATION 9

Radio wave propagation – Macroscopic fading- free space and out door, small scale fading -Fading measurements – Direct pulse measurements, spread spectrum correlation channel sounding frequency domain channel sounding, Antenna Diversity – Diversity combining methods.

UNIT III SPACE TIME BLOCK CODES 9

Delay Diversity scheme, Alamouti space time code – Maximum likelihood decoding maximum ratio combining. Transmit diversity space time block codes for real signal constellation and complex signal constellation - decoding of STBC.

UNIT IV SPACE TIME TRELLIS CODES 9

Space time coded systems, space time code word design criteria, design of space time T C on slow fading channels, design of STTC on Fast Fading channels, performance analysis in slow and fast fading channels, effect of imperfect channel estimation and Antenna correlation on performance, comparison of STBC & STTC.

UNIT V LAYERED SPACE TIME CODES 9

LST transmitter – Horizontal and Vertical LST receiver – ML Rx, Zero forcing Rx; MMSE Rx, SIC Rx, ZF V-blast Rx- MMSE V-blast Rx, Iterative Rx - capacity of MIMO – OFDM systems – capacity of MIMO multi user systems.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

CO1: Ability to comprehend and appreciate the significance and role of this course in the present contemporary world

CO2: The student has gained the knowledge about the importance of MIMO in today's communication

CO3: The student had understood and appreciate the various methods for improving the data rate of wireless communication system.

TEXT BOOKS:

1. Mohinder Jankiraman, "Space Time Codes and MIMO Systems", Artech House, Boston", London . www.artech house.com, 2004.
2. Paulraj Rohit Nabar, Dhananjay Gore, "Introduction of Space Time Wireless Communication Systems", Cambridge University Press, 2003.

REFERENCES:

1. David Tse and PramodViswanath, "Fundamentals of Wireless Communication", CambridgeUniversity Press, 2005.
2. Sergio Verdu "Multi User Detection", Cambridge University Press, 1998.
3. Andre Viterbi, "Principles of Spread Spectrum Techniques", Addison Wesley 1995.
4. Volker Kuhn, "Wireless communication over MIMO channels", John Wiley and Sons Ltd., 2006.

EC5003 COGNITIVE RADIO NETWORKS L T P C
3 0 0 3

OBJECTIVES:

- The students should be made to be understand the concepts of cognitive radio
- Learn spectrum sensing and dynamic spectrum access

UNIT I INTRODUCTION TO SOFTWARE-DEFINED RADIO AND COGNITIVE RADIO 9

Evolution of Software Defined Radio and Cognitive radio: goals, benefits, definitions, architectures, relations with other radios, issues, enabling technologies, radio frequency spectrum and regulations.

UNIT II COGNITIVE RADIO ARCHITECTURE 9

Cognitive Radio – functions, components and design rules, Cognition cycle – orient, plan, decide and act phases, Inference Hierarchy, Architecture maps, Building the Cognitive Radio Architecture on Software defined Radio Architecture, Overview of IEEE 802.22 standard for broadband wireless access in TV bands.

UNIT III SPECTRUM SENSING AND DYNAMIC SPECTRUM ACCESS 9

Introduction – Primary user detection techniques – energy detection, feature detection, matched filtering, cooperative detection , Bayesian Approach, Neyman Pearson fusion rule for spectrum sensing, Optimum spectrum sensing - KullbackLeibler Divergence and other approaches, Fundamental Tradeoffs in spectrum sensing, Spectrum Sharing Models of Dynamic Spectrum Access - Unlicensed and Licensed Spectrum Sharing, Fundamental Limits of Cognitive Radio.

UNIT IV MAC AND NETWORK LAYER DESIGN FOR COGNITIVE RADIO 9

MAC for cognitive radios – Multichannel MAC - slotted ALOHA – CSMA, Network layer design – routing in cognitive radios, flow control and error control techniques.

UNIT V ADVANCED TOPICS IN COGNITIVE RADIO 9

Cognitive radio for Internet of Things - Features and applications – Enabling technologies and protocols – M2M technologies - Data storage and analysis techniques - Requirement and challenges of IoT – Energy efficiency– MIMO Cognitive Radio – Power allocation algorithms.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

CO1: Ability to comprehend and appreciate the significance and role of this course in the present contemporary world.
CO2: The students will be able to understand and compare different SDR architectures.
CO3: The students will be able to identify the role of SDR and Cognitive radio communication in XG networks.

TEXT BOOKS:

1. Alexander M. Wyglinski, Maziar Nekovee, Thomas Hou, “Cognitive Radio Communications and Networks”, Academic Press, Elsevier, 2010.
2. Bruce Fette, “Cognitive Radio Technology”, Newnes, 2006.
3. Huseyin Arslan (Ed.), “Cognitive Radio, "Software Defined Radio and Adaptive Wireless Systems", Springer, 2007.

REFERENCES:

1. Markus Dillinger, Kambiz Madani, Nancy Alonistioti, “Software Defined Radio”, John Wiley, 2003.
2. Huseyin Arslan, “Cognitive Radio, SDR and Adaptive System”, Springer, 2007.
3. Joseph Mitola, “Cognitive Radio Architecture”, John Wiley & Sons, 2006.
4. Kwang-Cheng Chen, Ramjee Prasad, “Cognitive Radio Networks”, John Wiley and Sons, 2009.
5. Qusay. H. Mahmoud, “Cognitive Networks : Towards Self Aware Network”, John Wiley & Sons Ltd. 2007.

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

EC5004 **INFORMATION THEORY** **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 teach different types of entropy
- To teach entropy in the context of data compression
- To teach channel capacities over different channels

UNIT I QUANTITATIVE STUDY OF INFORMATION 8

Basic inequalities, Entropy, Kullback - Leibler distance, Mutual information, Bounds on entropy, Fisher information, Cramer Rao inequality, Second law of thermodynamics, Sufficient statistic, Entropy rates of a Stochastic process.

UNIT II CAPACITY OF NOISELESS CHANNEL 8

Fundamental theorem for a noiseless channel, Data compression, Kraft inequality, Shannon-Fano codes, Huffman codes, Asymptotic equipartition, Rate distortion theory.

UNIT III CHANNEL CAPACITY 9

Properties of channel capacity, Jointly typical sequences, Channel Coding Theorem, converse to channel coding theorem, Joint source channel coding theorem.

UNIT IV DIFFERENTIAL ENTROPY AND GAUSSIAN CHANNEL 9

AEP for continuous random variables, relationship between continuous and discrete entropy, properties of differential entropy, Gaussian channel definitions, converse to coding theorem for Gaussian channel, channels with colored noise, Gaussian channels with feedback.

UNIT V NETWORK INFORMATION THEORY 11

Gaussian multiple user channels, Multiple access channel, Encoding of correlated sources, Broadcast channel, Relay channel, Source coding and rate distortion with side information, General multi-terminal networks.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

CO1: Ability to comprehend and appreciate the significance and role of this course in the present contemporary world
CO2: This course helps to understand insight of source coding
CO3: Students will understand the limitations of the channel
CO4: It helps to understand the data rate that can be offered by the channel in the presence of AWGN

TEXT BOOK:

1. Thomas Cover, Joy Thomas, "Elements of Information Theory", Wiley, 2006.

REFERENCE:

1. David Mackay,"Information Theory, Interference &Learning Algorithms", Cambridge University,Press, Ist Edition, 2002.

EC5005 **OPTICAL NETWORKS** **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 enable the student to understand the importance of the backbone infrastructure for our present and future communication needs and familiarize them with the architectures and the protocol stack in use.
- To enable the student to understand the differences in the design of data plane and the control plane and the routing, switching and the resource allocation methods and the network management and protection methods in vogue.
- To expose the student to the advances in networking and switching domains and the future trends.

UNIT I OPTICAL SYSTEM COMPONENTS 9

Light Propagation in optical fibers – Loss & bandwidth, System limitations, NonLinear effects; Solitons; Optical Network Components – Couplers, Isolators & Circulators, Multiplexers & Filters, Optical Amplifiers, Switches, Wavelength Converters.

UNIT II OPTICAL NETWORK ARCHITECTURES 9

Introduction to Optical Networks; SONET / SDH, Metropoliton - Area Networks, Layered Architecture ; Broadcast and Select Networks – Topologies for Broadcast Networks, Media-Access Control Protocols, Testbeds for Broadcast & Select WDM; Wavelength Routing Architecture.

UNIT III WAVELENGTH ROUTING NETWORKS 9

The optical layer, Node Designs, Optical layer cost tradeoff, Routing and wavelength assignment, Virtual topology design, Wavelength Routing Testbeds, Architectural variations.

UNIT IV PACKET SWITCHING AND ACCESS NETWORKS 9

Photonic Packet Switching – OTDM, Multiplexing and Demultiplexing, Synchronisation, Broadcast OTDM networks, Switch-based networks; Access Networks – Network Architecture overview, Future Access Networks, Optical Access Network Architectures; and OTDM networks.

UNIT V NETWORK DESIGN AND MANAGEMENT 9

Transmission System Engineering – System model, Power penalty - transmitter, receiver, Optical amplifiers, crosstalk, dispersion; Wavelength stabilization ; Overall design considerations; Control and Management – Network management functions, Configuration management, Performance management, Fault management, Optical safety, Service interface.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

CO1: Ability to comprehend and appreciate the significance and role of this course in the present contemporary world.
CO2: At the end of the course, the student will be able to use the backbone infrastructure for our present and future communication needs
CO3: Discuss the architectures and the protocol stack in use.
CO4: Compare the differences in the design of data plane, control plane ,routing, switching, resource allocation methods,
CO5: Network management and protection methods in vogue.
CO6: Describe the advances and recent trends in the networking and switching approaches.

TEXT BOOK:

1. Rajiv Ramaswami and Kumar N. Sivarajan,"Optical Networks: A Practical Perspective",Harcourt Asia Ptv Ltd., 3rd Edition, 2004.

REFERENCES:

1. C. Siva Ram Moorthy and Mohan Gurusamy, "WDM Optical Networks: Concept, Design and Algorithms", Prentice Hall of India, Ist Edition, 2002.
2. P.E. Green, Jr., "Fiber Optic Networks", Prentice Hall, NJ, 1993.
3. Biswanath Mukherjee, "Optical WDM Networks", Springer Series, 2006.

EC5006 RF MICROELECTRONICS L T P C
3 0 0 3

OBJECTIVES:

- To introduce radio transceiver architectures
- To understand the design issues in CMOS LNAs , Mixers, Oscillators, PLLs, Synthesizers and Power Amplifiers.

UNIT I TRANSCEIVER ARCHITECTURES 9

Heterodyne and Homodyne architectures, Discrete and CMOS realization passive components for RF, Impedance Matching, Distortion, IIP3 and Blocking Effects, Noise Figure, Noise matching conditions. Friis Formula for cascaded blocks.

UNIT II CMOS LNAS AND MIXERS 9

Noise Figure of and impedance matching issues CS, CG and differential LNAs, Passive mixers and conversion loss, Active mixers, Gilbert cells, linearity and Noise Figure of mixers.

UNIT III OSCILLATORS 9

Negative transconductance, nonlinearity and Differential LC tuned oscillators, Ring oscillators and Colpitts oscillator, Quadrature oscillators–Phase noise.

UNIT IV PLLS AND SYNTHESIZERS 9

Phase Detectors, charge pumps and their transfer functions, Synthesizers based on first, second and third order PLLs and stability issues, Introduction to integer and fractional N synthesizers.

UNIT V POWER AMPLIFIERS 9

Class A, B, C, D, E, F and AB power amplifiers, Linearization and impedance matching issues of power amplifiers.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

The student who undergoes this course will be able to

CO1: Translate the top level wireless communications system specifications into block level specifications of the RF transciever.
CO2: Carry out transistor level design of the entire RF transciever.
CO3: Design and analyze CMOS lnas , mixers, oscillators, plls, synthesizers and power amplifiers.

TEXT BOOKS:

1. B. Razavi, "RF Microelectronics", Pearson Education, 2nd Edition, 2012.
2. Thomas Lee, "The Design of CMOS Radio Frequency Integrated Circuits", Cambridge University Press, 2nd Edition, 2004

REFERENCES:

1. B.Razavi, “Design of Analog CMOS Integrated Circuits”, McGraw Hill, 2001.
2. Recorded lectures and notes available at .http://www.ee.iitm.ac.in/~ani/ee6240/

EC5007 **SATELLITE COMMUNICATION** **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 enable the student to understand the necessity for satellite based communication, the essential elements involved and the transmission methodologies.
- To enable the student to understand the different interferences and attenuation mechanisms affecting the satellite link design
- To expose the student to the advances in satellite based navigation, GPS and the different application scenarios.

UNIT I SATELLITE ORBITS AND TRAJECTORIES 8

Orbital Mechanics—Orbit Equations, Kepler‘s Laws, Orbital Period, Orbits and their types, look angle calculation; Satellite Launch.

UNIT II SATELLITE SUBSYSTEM 10

Satellite Subsystems—AOCS, TTC&M, Power, Transponders, Antennas; earth control-Effects of earth-Perturbation, suntransit, moontransit, satellite power design, MTBF. Basic Equations; System Noise and G/T ratio; Uplink, Downlink and Design for a specified C/N ratio, with GEO and LEO examples; Atmospheric and Rain effects on link performance.

UNIT III LINK DESIGN, MODULATION AND ERROR CONTROL 10

Single link design-double link design aspects, PAM, baseband processing, Digital Modulation for satellite links- BPSK,QPSK and QAM; TDM standards for satellite systems; Error control requirements for satellite link—ARQ, Concatenated Codes, Interleaving, Turbo codes.

UNIT IV MULTIPLE ACCESS FOR SATELLITE COMMUNICATIONS 9

FDM-FM-FDMA - TDMA-structure and system design; Onboard Processing systems; DAMA and PAMA; CDMA-system design and capacity.

UNIT V SOME APPLICATIONS 8

Remote sensing, navigation, scientific and military application, VSAT—Network Architecture, Access Control protocols and techniques, VSAT Earth stations; Satellite Mobile Telephony— Global star, DBS/DTH Television, GPS, Weather satellites.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

CO1: Ability to comprehend and appreciate the significance and role of this course in the present contemporary world

CO2: The student would be able to demonstrate an understanding of the basic principles of satellite orbits, placement and control, satellite link design and the communication system components.

CO3:The student would be able to demonstrate an understanding of the different communication, sensing and navigational applications of satellite and their implementation.

TEXT BOOKS:

1. T.Pratt, C. Bostian and J.Allnutt, "Satellite Communications", John Wiley and Sons, 2nd Edition, 2014.
2. D.Rody, "Satellite Communications", McGraw Hill, 4th Edition, 2006.

REFERENCES:

1. W.L.Pritchard, H G Suyderhoud and R A Nelson, "Satellite Communication System Engineering", Prentice Hall, 2nd Edition, 1993.
2. Tri. T. Ha, "Digital Satellite Communications', McGraw Hill, 2nd Edition, 1990.
3. B.N.Agarwal, "Design of Geosynchronous Space Craft", Prentice Hall, 1986.
4. M. Richharia, "Satellite Systems for Personal Applications", John Wiley, 2010.

EC5008 WIRELESS COMMUNICATION NETWORKS LT P C
3 0 0 3

COURSE OBJECTIVES

- To understand the shortcomings of 4G technology and exploring the architecture of 5G
- To understand the 5G Modulation Schemes and different types of multiple access techniques
- To explore power optimization algorithms for user end data transmission
- To understand and analyse the concept of MIMO and other research areas in 5G

UNIT I EVOLUTION OF 4G AND 5G NETWORKS 9

OFDM principle- Modulation, Cyclic Prefix, Challenges in 4G- Windowing, PAPR, Introduction to 5G, vision and challenges, 5G NR – New Radio – air interface of 5G, radio access, Ultra-Dense Network Architecture and Technologies for 5G- Concept and Challenges of UDN, GPP HeNB Architecture, Key Technologies of UDN- Flexible Networking, Multi-RATs Coordination

UNIT II 5G MODULATION SCHEMES 9

Introduction to Equalization- types - Filter-bank based multi-carrier (FBMC), Universal filtered multi carrier (UFMC), Generalized frequency division multicarrier (GFDM) - Principles, Transceiver Block diagram, Frame structure, Resource structure, allocation, mapping, MIMO-GFDM

UNIT III MULTIPLE ACCESS TECHNIQUES IN 5G 9

NOMA – Principle- Superposition Coding, Successive Interference Cancellation, Power Domain NOMA, Sparse Code NOMA- types, Power Domain Sparse Code NOMA and IDMA **Relaying:** Cooperative NOMA- Benefits and Challenges, Half duplex relaying, Full duplex relaying, Amplify and forward relaying, Decode and forward relaying, Decode and forward relaying with PLNC, BER Analysis, Capacity Analysis.

UNIT IV POWER OPTIMIZATION ALGORITHMS 9

Introduction to Power Optimization- One Dimensional-Multi dimensional, Multi- Objective Optimization- Geometric – Cone Programming - Convex Optimization- Ant Colony- Genetic Algorithms-Fuzzy Logic- Heuristic Algorithms.

UNIT V MIMO AND OTHER 5G RESEARCH TOPICS 9

Introduction, MIMO in LTE, Theoretical background, Single user MIMO, Multi-user MIMO, Capacity of massive MIMO: a summary, Basic forms of massive MIMO implementation, Hybrid beamforming for interference clustering and user grouping, Channel models, Machine type communications, D2D communications and Coordinated Multipoint Transmissions.

TOTAL: 45 PERIODS

COURSE OUTCOMES

CO1: Ability to comprehend the 4G technology and appreciate the significance of 5G technology and its architecture.
CO2: The student would be capable of characterizing the different 5G potential Candidate Waveforms.
CO3: The student would be capable of understanding the different 5G multiple access Schemes.
CO4: The student would be able to identify suitable signaling and power allocation and optimization techniques for the wireless systems.
CO5: The student would be capable of exploiting multiple antenna techniques for capacity/ performance gains and explore other research areas in 5G.

TEXTBOOKS

1.Afif Osseiran, Jose.F.Monserrat and Patrick Marsch, "5G Mobile and Wireless Communications Technology", Cambridge University Press, 2016.
2.Xiang, W; Zheng, K; Shen, X.S; "5G Mobile Communications", Springer, 2016

REFERENCES:

1. Saad Z Asif, "5G Mobile Communication,Concepts and Challenges", CRC Press
2.Thomas L. Marzetta , Erik G. Larsson , Hong Yang , Hien Quoc Ngo, "Fundamentals of Massive MIMO", Cambridge University Press, 2018.

EC5072 CRYPTOGRAPHY AND NETWORK SECURITY 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 teach the importance of security for networks
- To teach the basics of number theory and Galois field concepts
- To teach symmetric and asymmetric key in crypto systems
- To teach authentication and key management techniques
- To teach security specific to network layer

UNIT I NUMBER THEORETIC AND ALGEBRAIC ALGORITHMS 9

Significance of network and data security in todays communication scenario – Overall Classification - Integer Arithmetic Modular Arithmetic – matrices – Linear congruence- Substitution ciphers – Transposition ciphers – Stream cipher- Block ciphers – Algebraic structures – GF(2^n) fields.

UNIT II MODERN SYMMETRIC KEY CIPHERS 9

Modern block ciphers – Modern stream ciphers – DES – AES – uses of modern block ciphers and stream cipher, Application Examples

UNIT III ASYMMETRIC KEY ENCIPHERMENT 9

Mathematics of cryptography – Primality Testing – Factorization – Chinese Remainder Theorem – Quadratic – Exponentiation & Logarithm – RSA, Rabin – Elliptic curve, Application Examples

UNIT IV INTEGRITY AUTHENTICATION AND KEY MANAGEMENT 9

Message integrity – random oracle model – message authentication – SHA-512 – WHIRL POOL- Digital signature schemes Entity anthentication– password – challenge response – zero knowledge – Biometrics – Kerberos – symmetric key management – public key distribution – steganography, Application Examples.

UNIT V NETWORK SECURITY 9

Security at the Application Layer: E-mail – PGP – S/MIME – Security at the transport layer: SSL and TLS – Security at the network layer: IPsec, Two Security Protocol – Security Association – Internet Key Exchange – ISAKMP, Application Examples.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

CO1: Ability to comprehend and appreciate the significance and role of this course in the present contemporary world

CO2: The student have gained the knowledge about the importance of security for networks, use of number theory and Galois field concepts.

CO3: The student would have ability to design new symmetric and Asymmetric key crpto system

CO4: The student would have ability to develop new authentication and key management techniques

CO5: The student would have ability to develop a new network security protocols

TEXT BOOKS:

1. Behrouz A. Ferouzan, "Cryptography & Network Security", 5th Edition, Tata McGraw Hill,.
2. W.Stallings, "Cryptography & Network Security: Principles and Practice", Prentice Hall, 4th Edition, 2003.

REFERENCES:

1. Douglas R.Stlinson, "Cryptography Theory and Practice", CRC Press series on Discrete Mathematics and its application, 1995.
2. Charlie Kaufman, Radia Perlman, Mike Speciner, "Network Security Private Communication in a Public World", Pearson Education, 2nd Edition, 2003.

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

EC5009 DIGITAL SWITCHING AND TRANSMISSION 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 different types of signaling in digital telephony
- To introduce various transmission schemes for telephony and broadband
- 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 TELETRAFFIC ENGINEERING 9

Telecom Network Modeling; Arrival Process; Network Blocking performance; Delay Networks-Queuing system analysis and delay performance.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

CO1: Ability to comprehend and appreciate the significance and role of this course in the present contemporary world.

CO2: Ability to understand the different type of signaling, transmission schemes and switching techniques used in digital telephony.

CO3: Ability to model and analyze the different techniques for data transmission**.**

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", Artech House, 2nd Edition, 2003.
6. T. Viswanathan, "Telecommunication Switching Systems", Prentice-Hall, 1992.

EC5073 ELECTRO MAGNETIC INTERFERENCE AND COMPATIBILITY 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 tutor the basics of EMI,EMC
- To instill knowledge on the EMI coupling mechanism and its mitigation techniques
- To impart comprehensive insight about the current EMC standards and about various measurement techniques

UNIT I BASIC CONCEPTS 7

Definition of EMI and EMC; Intra and Inter system EMI; Sources and victims of EMI, Conducted and Radiated EMI emission and susceptibility; Transient & ESD; Case Histories; Radiation Hazards to humans.

UNIT II COUPLING MECHANISM 9

Common made coupling; Differential mode coupling; Common impedance coupling; Ground loop coupling; Field to cable coupling; Cable to cable coupling; Power mains and Power supply coupling.

UNIT III EMI MITIGATION TECHNIQUES 10

Shielding – principle, choice of materials for H, E and free space fields, and thickness; EMI gaskets; Bonding; Grounding – circuits, system and cable grounding; Filtering; Transient EMI control devices and applications; PCB Zoning, Component selection, mounting, trace routing.

UNIT IV STANDARDS AND REGULATION 7

Units of EMI; National and International EMI Standardizing Organizations – IEC, ANSI, FCC, CISPR, BIS, CENELEC; FCC standards; EN Emission and Susceptibility standards and specifications; MIL461E Standards.

UNIT V TEST METHODS AND INSTRUMENTATION 12

EMI test sites - Open area site; TEM cell; Shielded chamber; Shielded Anechoic chamber; EMI test receivers; Spectrum Analyzer; Transient EMI Test wave Simulators; EMI coupling Networks - Line impedance Stabilization Networks; Feed through capacitors; Antennas and factors; Current probes and calibration factor; MIL-STD test methods; Civilian STD Test methods, Government policies.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

Ability to comprehend and appreciate the significance and role of this course in the present contemporary world Upon Completion of the course, the students will be able to:

CO1: To design a EMI free system.
CO2: To reduce system level crosstalk.
CO3: To design high speed Printed Circuit board with minimum interference.
CO4: To make our world free from unwanted electromagnetic environment.

TEXT BOOKS:

1. V.P. Kodali, “Engineering EMC Principles, Measurements and Technologies”, IEEE Press,New york, 2nd Edition, 2010.
2. Henry W.Ott., “Noise Reduction Techniques in Electronic Systems”, A Wiley Inter Science Publications, John Wiley and Sons, Newyork, 2009.

REFERENCES:

1. Don R.J.White Consultant Incorporate, “Handbook of EMI/EMC”, Vol I-V, 1988
2. Bemhard Keiser, “Principles of Electromagnetic Compatibility”, Artech house, Norwood, 3rd Edition, 1987
3. C.R. Paul, “Introduction to Electromagnetic Compatibility”, John wiley& sons Inc. 2006.

EC5010 **OPTOELECTRONICS** **L T P C**
3 0 0 3

OBJECTIVES:

- To review basic semiconductor theory
- To introduce the concepts of LED
- To teach the principle of stimulated emission and devices based on it
- To equip the student with the knowledge of Photovoltaics and display devices
- To introduce the knowledge of optolectronic modulators

UNIT I SEMICONDUCTOR THEORY 9

Basic quantum mechanics, semiconductor statistics, carrier transport, optical processes, and junction theory, Properties of simple and compound semiconductors, Optical absorption, Optical recombination, Recombination and carrier lifetime,

UNIT II LIGHT EMITTING DIODES 9

Energy Bands. Direct and Indirect Bandgap Semiconductors: *E-k* Diagrams. *pn* Junction Principles. The *pn* Junction Band Diagram. Light Emitting Diodes. LED Materials. Heterojunction High Intensity LEDs. LED Characteristics. LEDs for Optical Fiber Communications, White LED for display and lighting applications.

UNIT III STIMULATED EMISSION DEVICES 9

Stimulated Emission and Photon Amplification. Stimulated Emission Rate and Einstein Coefficients. Optical Fiber Amplifiers. LASER Oscillation Conditions. Principle of the Laser Diode. Heterostructure Laser Diodes. Rate Equation- Characteristics. Light Emitters for Optical Fiber Communications. Quantum Well and Quantum dot Devices. Vertical Cavity Surface Emitting Lasers (VCSELs). Optical Laser Amplifiers.

UNITIV PHOTOVOLTAICS AND DISPLAY DEVICES 9

Photovoltaic Device Principles. *pn* Junction Photovoltaic I-V Characteristics. Solar Cells Materials, Devices and Efficiencies. Liquid crystal displays, Reflective and Trans reflective types, TFT displays, Plasma displays, LED TV

UNIT V POLARIZATION AND MODULATION OF LIGHT 9

Polarization. Light Propagation in an Anisotropic Medium: Birefringence. Electro-Optic Effects.. Acousto-Optic Modulator. Magneto-Optic Effects. Integrated Optical Modulators Electro-absorption modulators.Non-Linear Optics and Second Harmonic Generation.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

Upon completing this course, the students will be able to

CO1: Understand various kinds of semiconductor materials used in optoelectronics
CO2: Understand the mechanisms of light absorption and emission in p-n junctions
CO3: Use photodiodes, LEDs, and laser diodes for various applications.

TEXT BOOKS:

1. S. O. Kasap, "Optoelectronics and Photonics: Principles and Practices", Pearson, 2013.
2. Michael Parker, "Physics of optoelectronics", CRC press, 2018.

REFERENCES:

1. P. N. Prasad, "Nanophotonics", John Wiley & Sons, 2004.
2. Deng-Ke Yang , Shin Tson Wu, "Fundamentals of Liquid Crystal Devices", Revised edition, John Wiley and sons, 2015
3. Saleh and Teich, "Fundamentals of Photonics", Wiley Interscience, 2nd Edition, 2013.
4. J. Singh, "Electronic and Optoelectronic Properties of Semiconductor Structures Cambridge university press, 2007.

EC5011 ADVANCED DIGITAL 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 and adaptive systems for filtering and linear prediction
- To introduce signal processing concepts in the systems having more than one sampling frequency

UNIT I DISCRETE-TIME RANDOM SIGNALS 9

Discrete random process – Ensemble averages, Stationary and ergodic processes, Autocorrelation and Autocovariance properties and matrices, White noise, 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 LINEAR ESTIMATION AND PREDICTION 9

Forward and Backward linear prediction, Filtering - FIR Wiener filter- Filtering and linear prediction, non-causal and causal IIR Wiener filters.

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.

UNIT V MULTIRATE SIGNAL PROCESSING 9

Introduction to Multirate signal processing- Decimation-Interpolation-Polyphase Decomposition of FIR filter-Multistage implementation of sampling rate conversion - Applications of Multirate signal processing.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

CO1: To analyze statistical characteristics of random signals
CO2: To identify appropriate spectrum estimation method based on type of random signal
CO3: To design optimum filters for processing random signal
CO4: To design filters for quasi stationary signals
CO5: To analyze and design systems with varying sample rate

TEXT BOOKS:

1. Monson H, Hayes, "Statistical Digital Signal Processing and Modeling", John Wiley and Sons Inc., New York, Indian Reprint, 2008.
2. John G.Proakis, Dimitris G. Manolakis, "Digital Signal Processing", Pearson, 4th Edition, 2007.

REFERENCES:

1. Sophocles J. Orfanidis, "Optimum Signal Processing, An Introduction", McGraw Hill, 2nd Edition 2007
2. Dwight F. Mix, "Random Signal Processing", Prentice Hall, 1995.

EC5012 VLSI SIGNAL PROCESSING L T P C

3 0 0 3

OBJECTIVES:

- To design DSP architectures that are suitable for VLSI implementation for a given algorithm
- To learn high-level algorithms that reduce the number of multipliers, area of implementation and power consumption.
- To address issues related to high performance VLSI architectures such as pipelining styles.

UNIT I PIPELINING AND PARALLEL PROCESSING 9

Introduction to DSP Systems, Typical DSP algorithms, Data flow graph representations, Loop bound and Iteration bound, Longest Path Matrix algorithm; Pipelining and Parallel processing of FIR digital filters, Pipelining and Parallel processing for low power.

UNIT II RETIMING AND ALGORITHMIC STRENGTH REDUCTION 9

Retiming - definitions and properties; Unfolding – an algorithm for Unfolding, properties of unfolding, sample period reduction and parallel processing application; Algorithmic strength reduction in filters and transforms – 2-parallel FIR filter, 2-parallel fast FIR filter, DCT algorithm architecture transformation, Odd-Even Merge-Sort architecture, Parallel Rank-Order filters.

UNIT III FAST CONVOLUTION AND COMBINED PIPELINING AND PARALLEL PROCESSING OF IIR FILTERS 9

Fast convolution – Cook-Toom algorithm, Modified Cook-Took algorithm; Pipelined and parallel recursive adaptive filters, Look- Ahead pipelining in first- order IIR filters, Look- Ahead pipelining with power-of-two decomposition, Clustered Look-Ahead pipelining, parallel processing of IIR filters, combined pipelining and parallel processing of IIR filters, pipelined adaptive digital filters, relaxed look-ahead, pipelined LMS adaptive filter.

UNIT IV BIT-LEVEL ARITHMETIC ARCHITECTURES 9

Bit-Level Arithmetic Architectures- parallel multipliers with sign extension, parallel carry-ripple array multipliers, parallel carry-save multiplier, 4x 4 bit Baugh-Wooley carry-save multiplication tabular form and implementation, Bit-serial FIR filter, CSD representation, CSD multiplication using Horner‘s rule for precision improvement, Distributed Arithmetic

UNIT V NUMERICAL STRENGTH REDUCTION AND WAVE PIPELINING 9

Numerical Strength Reduction – subexpression elimination, Multiple Constant Multiplications, Synchronous pipelining and Clocking styles, Clock skew in edge-triggered single-phase clocking, Wave pipelining.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

CO1: Ability to determine the parameters influencing the efficiency of DSP architectures and apply pipelining and parallel processing techniques to alter FIR structures for efficiency.
CO2: Ability to analyze and modify the design equations leading to efficient DSP architectures.
CO3: Ability to speed up convolution process and develop fast and area efficient IIR structures.
CO4: Ability to develop fast and area efficient multiplier architectures.
CO5: Ability to reduce multiplications and build fast hardware for synchronous digital systems.

TEXT BOOK:

1. KeshabK.Parhi, "VLSI Digital Signal Processing Systems", Design and implementation Wiley, Inter Science, Reprint 2008.

REFERENCES:

1. Mohammed Ismail and Terri Fiez, "Analog VLSI Signal and Information Processing", McGraw-Hill, 1994.
2. S.Y. Kung, H.J. White House, T. Kailath, "VLSI and Modern Signal Processing", Prentice Hall, 1985.
3. Jose E. France, YannisT sividis, "Design of Analog - Digital VLSI Circuits for Telecommunication and Signal Processing", Prentice Hall, 1994.

EC5080 SPEECH PROCESSING L T P C

3 0 0 3

OBJECTIVES:

- To introduce speech production and related parameters of speech
- To show the computation and use of techniques such as short time Fourier transform, linear predictive coefficients and other coefficients in the analysis of speech
- To understand different speech modeling procedures such as Markov and their implementation issues
- To introduce speech recognition and synthesis techniques

UNIT I BASIC CONCEPTS 10

Speech Fundamentals: Articulatory Phonetics – Production and Classification of Speech Sounds; Acoustic Phonetics – Acoustics of speech production; Review of Digital Signal Processing concepts; Short-Time Fourier Transform, Filter-Bank and LPC Methods.

UNIT II SPEECH ANALYSIS 10

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 8

Hidden Markov Models: Markov Processes, HMMs – Evaluation, Optimal State Sequence – Viterbi Search, Baum-Welch Parameter Re-estimation, Implementation issues.

UNIT IV SPEECH RECOGNITION 8

Large Vocabulary Continuous Speech Recognition: Architecture of a large vocabulary continuous speech recognition system – acoustics and language models – n-grams, context dependent subword units; Applications and present status.

UNIT V SPEECH SYNTHESIS 9

Text-to-Speech Synthesis: Concatenative and waveform synthesis methods, sub-word units for TTS, intelligibility and naturalness – role of prosody, Applications and present status.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

CO1: Ability to use speech related parameters
CO2: Ability to extract significant features from speech to reduce redundancy in speech by using several distortion measures
CO3: Ability to develop models for speech signals
CO4: Ability to develop speech recognition algorithms
CO5: Ability to develop artificial speech generation of human speech

TEXT BOOKS:

1. Lawrence Rabinerand Biing-Hwang Juang, "Fundamentals of Speech Recognition", Pearson Education, 2003.
2. Daniel Jurafsky and James H Martin, "Speech and Language Processing – An Introduction to Natural Language Processing, Computational Linguistics, and Speech Recognition", Pearson Education, 3rd Edition, 2018.

REFERENCES:

1. Frederick Jelinek, "Statistical Methods of Speech Recognition", MIT Press, Reprint 2001
2. Steven W. Smith, "The Scientist and Engineer‘s Guide to Digital Signal Processing", California Technical Publishing, 1997.
3. Thomas F Quatieri, "Discrete-Time Speech Signal Processing Principles and Practice", Pearson Education, 2004.
4. Claudio Becchetti and Lucio Prina Ricotti, "Speech Recognition", John Wiley and Sons, 1999.
5. Ben Gold and Nelson Morgan, "Speech and Audio Signal Processing and Perception of Speech and Music", Wiley- India Edition, 2006 Edition.

EC5076 MULTIMEDIA COMPRESSION AND NETWORKS L T P C
3 0 0 3

OBJECTIVES:

- To introduce probability related study of the characteristics of text, voice, image and video data
- To introduce various compression schemes for text, voice, image and video
- To analyse the compression schemes
- To introduce communication protocols for voice over internet and multimedia networking

UNIT I MULTIMEDIA COMPONENTS 9

Introduction- Multimedia skills- Multimedia components and their characteristics- Text, sound, images, graphics, animation, video, hardware.

UNIT II AUDIO AND VIDEO COMPRESSION 9

Audio compression–DPCM-Adaptive DPCM –adaptive predictive coding-linear Predictive codingcode excited LPC-perpetual coding – Video compression principles-H.261, H.263, MPEG 1, 2, 4.

UNIT III TEXT AND IMAGE COMPRESSION 9

Compression principles-source encoders and destination encoders-lossless and lossy compression-entropy encoding –source encoding- text compression –static Huffman coding dynamic Huffman coding –arithmetic coding –Lempel Ziv-Welsh Compression-image compression

UNIT IV VoIP TECHNOLOGY 9

Basics of IP transport, VoIP challenges, H.323/ SIP –Network Architecture, Protocols, Call establishment and release, VoIP and SS7, Quality of Service – CODEC Methods-VOIP applicability.

UNIT V MULTIMEDIA NETWORKING 9

Multimedia networking- Applications-streamed stored and audio-making – Best Effort service protocols for real time interactive Applications-distributing multimedia-beyond best effort service secluding and policing Mechanisms-integrated services-differentiated Services-RSVP.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

CO1: Ability to characterize the features of multimedia components
CO2: Ability to develop audio and video processing systems
CO3: Ability to develop compression algorithms for processing text and images
CO4: Ability to tackle network issues in the transmission of text, audio and video signals

TEXT BOOKS:

1. Fred Halshall, "Multimedia Communication - Applications, Networks, Protocols and Standards", Pearson education, 2007.
2. Tay Vaughan, "Multideai: Making It Work", TMH, 8th Edition, 2007.

REFERENCES:

1. Kurose and W. Ross, "Computer Networking A Top Down Approach", Pearson education, 3rd Edition, 2005.
2. Marcus Goncalves —Voice over IP Networks, McGraw Hill,
3. KR. Rao,Z S Bojkovic, D A Milovanovic, "Multimedia Communication Systems: Techniques, Standards, and Networks", Pearson Education, 2007
4. R. Steimnetz, K. Nahrstedt, "Multimedia Computing, Communications and Applications", Pearson Education, 1st Edition, 1995.
5. Ranjan Parekh, "Principles of Multimedia", TMH, 2006.

EC5013 FUNDAMENTALS OF DIGITAL IMAGE PROCESSING L T P C
3 0 0 3

OBJECTIVES:

- To study the formation of an image and its acquisition
- To introduce the use and application of transforms in image processing
- To study techniques for improving quality of information in spoilt images
- To introduce schemes for compressing images to save storage space

UNIT I DIGITAL IMAGE FUNDAMENTALS 9

Elements of digital image processing systems, Vidicon and Digital Camera working principles, - Elements of visual perception, brightness, contrast, hue, saturation, mach band effect, Color image fundamentals - RGB, HSI models, Image sampling, Quantization, dither, Two-dimensional mathematical preliminaries, 2D transforms - DFT, DCT, KLT, SVD.

UNIT II IMAGE ENHANCEMENT 9

Point processing, Histograms, Histogram equalization and specification techniques, Noise distributions, Spatial averaging, Directional Smoothing, Median, Geometric mean, Harmonic mean, Contraharmonic mean filters, Homomorphic filtering, Color image enhancement.

UNIT III IMAGE RESTORATION 9

Image Restoration - degradation model, Unconstrained and Constrained restoration, Inverse filtering, Wiener filtering, Geometric transformations-spatial transformations.

UNIT IV IMAGE SEGMENTATION AND MORPHOLOGY 9

Edge detection, Edge linking via Hough transform – Thresholding - Region based segmentation– Region growing – Region splitting and Merging, Morphological Operations – Dilation, Erosion, Opening , Closing- Segmentation by morphological watersheds – Hybrid methods

UNIT V IMAGE COMPRESSION 9

Need for data compression, Huffman, Run Length Encoding, Shift codes, Arithmetic coding, Vector Quantization, Transform coding, JPEG standard, MPEG.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

CO1: To analyze the sampling and quantization effects in images
CO2: To utilize appropriate preprocessing techniques for manipulation of images
CO3: To apply restoration techniques to recover degraded images
CO4: To employ image processing algorithms for extraction of region of interest
CO5: To utilize various image compression techniques

TEXT BOOKS:

1. Rafael C. Gonzalez, Richard E. Woods, "Digital Image Processing"', Pearson, Education, Inc., 4th Edition, 2018.
2. Anil K. Jain, "Fundamentals of Digital Image Processing"', Pearson Education, Inc., 2002.

REFERENCES:

1. Kenneth R. Castleman, "Digital Image Processing", Pearson, 2006.
2. Rafael C. Gonzalez, Richard E. Woods, Steven Eddins, "Digital Image Processing using MATLAB ", Pearson Education, Inc., 2004.

3. D,E. Dudgeon and RM. Mersereau, "Multidimensional Digital Signal Processing", Prentice Hall Professional Technical Reference, 1990.
4. William K. Pratt, "Digital Image Processing", John Wiley, New York, 2002.
5. Milan SonkaetaI, "Image Processing, Analysis and Machine Vision", Brookes/Cole, Vikas Publishing House, 2nd Edition, 1999.
6. Alan C. Bovik, "Handbook of image and Video Processing ", Elsevier Academic press, 2005.
7. S.Sridhar, "Digital Image Processing" Oxford University press, Edition 2011.

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

EC5014 CMOS ANALOG IC DESIGN L T P C
3 0 0 3

OBJECTIVES:

- To study the DC biasing conditions and small signal model of various MOS amplifier configurations
- To understand gm/Id design methodology of various MOS circuits
- To study the noise modeling and analysis procedure associated with various MOS circuits
- To study stability conditions and various compensation techniques in OPAMP and negative feedback amplifiers

UNIT I BASIC BUILDING BLOCKS 9

NMOS and PMOS device operation in saturation and sub-threshold regions, device transconductance, output impedance and equivalent circuit. Introduction to Device models for simulation. CG, CG, and source follower circuits. gm/Id design methodology.

UNIT II MULTIPLE TRANSISTOR STAGES 9

Cascode circuits. folded cascode circuits, , Differential amplifier circuits, quantitative analysis of differential pair, CMRR, Differential pair with MOS loads, Gilbert Cell, Current Mirrors.

UNIT III FREQUENCY RESPONSE, NOISE 9

Frequency response of CS and CG stages. Miller effect and association of poles with nodes. Characteristics of noise – thermal and flicker noise. Noise in CS, CG, Cascode and source follower stages.

UNIT IV OPERATIONAL AMPLIFIERS 9

Two stage op-amps, gain boosting, common mode feedback, input range limitation, slew rate, power supply rejection, noise in op-amps.

UNIT V FEEDBACK AND STABILITY 9

Properties of feedback circuits, topologies, effect of loading and noise in feedback circuits. Stability in multipole systems, phase margin, frequency compensation in two stage op-amps, other compensation techniques.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

Students who complete this course would be in a position

CO1: To carry out design of the various building blocks used in CMOS analog ICs. These include current mirror, cascades, common source amplifiers, differential amplifiers, two stage OTAs, source followers.

CO2: To carry out the paper design based on hand calculations for the above important building blocks. This is normally the first mandatory step in the complete design and fabrication of CMOS Analog ICs, and enables the student to carry out circuit simulations and layout design. In conjunction with other similar courses in this area.

CO3: To pursue design and/or research carriers in the broad field of electronics and communication.

TEXT BOOKS:

1. B.Razavi, **"**Design of CMOS Analog Integrated Circuits", Tata McGraw Hill, 2002.
2. P.R.Gray, Hurst and Meyer "Analysis and Design of Analog Integrated Circuits", John Wiley, 5th Edition, 2009.

REFERENCES:

1. Willy Sansen , **"**Analog Design Essentials:", Springer, 2006
2. NPTEL Course: http://nptel.ac.in/courses/117106030/#

EC5075 MIXED SIGNAL IC DESIGN L T PC
3 0 0 3

OBJECTIVES:

- To introduce various functional modules of Mixed Signal ICs
- To introduce the design issues of analog and digital circuit interoperability
- To introduce power management modules of Mixed Signal ICs

UNIT I REFERENCE CIRCUITS 9

Performance Metrics, Current Mirrors, Self Biased Current Reference, startup circuits, VBE based Current Reference, VT Based Current Reference, Band Gap Reference , Supply Independent Biasing, Temperature Independent Biasing, PTAT and CTAT Current Generation, Constant Gm Biasing

UNIT II LOW DROP OUT REGULATORS 9

Performance Metrics, Shunt regulator, Error amplifier, AC Design, Stability, Internal and External Compensation, PSRR – Internal and External compensation circuits, NMOS vs. PMOS regulators.

UNIT III FREQUENCY SYNTHESIZERS 9

Integer-N Phase Lock Loop(PLL), Fractional-N Phase Lock Loop, Delay-Lock Loop (DLL), multiplying-DLL, Injection-locked PLLs, and Sub-sampled PLLs.

UNIT IV ACTIVE FILTER DESIGN 9

Butterworth Filter approximations, Chebyshev Filter approximations, Frequency Transformations, Continuous time filters- Biquad and Ladder based designs, Active RC and Gm-C Filters, Switch Capacitor Filters, Integrator realization and nonidealities

UNIT V CLOCK AND DATA RECOVERY CIRCUITS 9

Channel characteristics-intersymbol interference, eye diagrams, Linear equalization at the transmitter and receiver; CDR Architectures, Trans Impedance Amplifiers, Linear Half Rate CDR Circuits, Wide capture Range CDR Circuits.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

The student who undergoes this course will be able to

CO1: Design Band gap reference circuits and Low Drop Out regulator for a given specification.
CO2: Design Frequency synthesizers meeting a given specification.
CO3: Choose active filter topology and design for a given specification.
CO4: Design clock generation circuits in the context of high speed I/Os, High speed Broad Band Communication circuits and Data Conversion Circuits.

TEXT BOOKS:

1. Gabriel.A. Rincon-Mora, "Voltage references from diode to precision higher order bandgapcircuits", Johnwiley& Sons, Inc 2002.
2. Gabriel.A. Rincon-Mora, "Analog IC Design With Low-Dropout Regulators",McGraw-Hill Professional Pub, 2nd Edition, 2014
3. Floyd M. Gardner ,"Phase Lock Techniques" John wiley& Sons, Inc 2005.

REFERENCES:

1. R. Best, Phase-Locked Loops : "Design, Simulation, and Applications", McGraw Hill, 2003.
2. Williams and Taylor, "Electronic Filter Design Handbook", McGraw-Hill, 3rd Edition, 1995
3. Deliyannis, Sun, and Fidler, "Continuous-Time Active Filter Design", CRC Press 1998,
4. BehzadRazavi, "Design of Analog CMOS Integrated Circuits", Tata McGraw Hill, 2001

EC5015 DATA CONVERTERS L T P C
3 0 0 3

OBJECTIVES:

- To design MOS circuits applied for various data conversion stages namely, sample and hold, comparators, switched capacitor amplifiers
- To, study the various CMOS design considerations of ADC architectures used in practice including SAR, Pipeline, Flash ADCs
- To study the general design principles design sigma delta converters

UNIT I INTRODUCTION 9

Quantization noise, anti aliasing filters, gain and offset errors, definitions of INL and DNL, SNR, SFDR, ENOB of ADC/DACs, finite duration pulse aperture effects, transistor matching, Bandgap reference design.

UNIT II D/A CONVERTER DESIGN, SAMPLE AND HOLD CIRCUITS 9

Current Steering DACs, current cell design issues. Properties of MOS Switches, charge injection, bootstrapping, sampling jitter, thermal noise, Quantization noise and nonlinearity effects.

UNIT III COMPARATOR DESIGN 9

Comparator architectures, metastibility and yield, Clock feed through effects, switched capacitor amplifiers and offset cancellation.

UNIT IV ADC/DAC ARCHITECTURES 9

SAR, Flash, Pipeline and time interleaved ADC topologies and their CMOS realizations issues. Error correction procedures for ADCs.

UNIT V OVER SAMPLING CONVERTERS 9

Delta sigma modulators, alternative modulator architectures, quantization and noise shaping, decimation filtering, implementation of Delta sigma modulators, delta sigma DACs.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

Students who complete this course would be in a position

CO1: To carry out the design of the various building blocks used in mixed signal (A/D and D/A converters) CMOS IC Design. These include sample and hold circuits, comparators and switched capacitor amplifiers, and simple designs of flash ADCs, pipeline ADCs, Current Steering DACs and sigma delta converters.

CO2: To carry out the paper design based on hand calculations for the above important functional blocks and enables the student to carry out circuit simulations and layout design.

CO3: To pursue design and/or research carriers in the broad field of electronics and communication.

TEXT BOOKS:

1. Marcel Pelgrom, "Analog to Digital Conversion", Springer Verlag, 2nd Edition, 2013.
2. Shanthi Pavan, Richard Schreier, Gabor C. Temes , “Understanding Delta-Sigma Data Converters”, Willey –IEEE Press, 2nd Edition, 2017.

REFERENCES:

1. Franco Malobreti "Data Converters", Springer Verlag, 2007
2. VLSI Data Conversion Circuits EE658 recorded lectures available at http://www.ee.iitm.ac.in/~nagendra/videolecture

EC5016 INTRODUCTION TO EMBEDDED CONTROLLERS 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 learn about the designing of an embedded system for commercial applications
- To learn the features, architecture and programming of PIC microcontrollers
- Interfacing Input/Output devices with the PIC microcontroller
- To learn about the communication protocols in a microcomputer system

UNIT I 8-BIT CONTROLLER 9

Microprocessors and microcontrollers, introducing PIC 16F877- architecture, memory technologies, timing circuits, power-up and reset, parallel ports, ADC, interrupt, serial peripheral buses (UART, I2C, SPI), PWM, counters and timers, instruction set and assembly language programming.

UNIT II 16-BIT CONTROLLER 9

DsPIC30F microcontroller- architecture, DSP engine, memory, parallel ports, system and power management, ADC, interrupt, PWM.

UNIT III PIC DEVELOPMENT TOOLS AND PROGRAMMING 9

Software development tools- editor, assembler, compiler, cross-compiler and simulator, Hardware development tools- development board, device programmer, in-circuit emulator and debuggers. Embedded C Programming, data types and variables, data type modifiers, storage Class modifiers, C statements, structures and operations, pointers, libraries, in-line assembly programming, optimizing and testing embedded C programs.

UNIT IV MULTITASKING AND THE REAL-TIME OPERATING SYSTEM 9

The challenge of multitasking and real time, multitasking with sequential programming, State machines, Real time operating system, RTOS services, synchronization and messaging tools, CCS PIC C Compiler RTOS. Design example: Voltmeter with RS232 serial output.

UNIT V PERIPHERAL INTERFACING WITH PIC MICROCONTROLLER 9

Human and physical interfaces- switches to keyboard, LED display, liquid crystal display, Actuators and sensors, PWM, serial communication protocols (UART, I2C, SPI), programming interrupt, timers and counter.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

CO1: Ability to design and develop PIC microcontroller based systems.
CO2: Ability to comprehend and appreciate DSP in PIC microcontrollers.
CO3: Ability to analyze ,demonstrate and apply proper development tools for PIC microcontrollers.
CO4: Ability to apply the concept of multitasking and RTOS in embedded system design.
CO5: Ability to implement various communication protocols and interfacing concepts in embedded system.

TEXT BOOKS:

1. David. E. Simon, "An Embedded Software Primer", Addison-Wesley, Reprint 2015.
2. Kirk Zurell, "C programming for Embedded Systems", CRC Press, 2016.
3. Dogan Ibrahim, "Advanced PIC microcontroller projects in C", Newnes publication, 2012.
4. Tim Wilmshurst, "Designing Embedded Systems with PIC microcontrollers-Principles and Applications", Newnes Publications, 2007.

REFERENCES:

1. Douglas V.Hall, "Microprocessor and Interfacing, Programming and Hardware", Tata Mc Graw Hill Revised, 2nd Edition 2016, 11th Reprint 2011.
2. Muhammad Ali Mazidi, RolinMcKinlay, Danny Causey, "PIC Microcontroller and Embedded Systems: Using Assembly and C for PIC18", Prentice Hall publications, 2007.
3. Julio Sanchez Maria P.Canton, “Microcontroller Programming: The microchip PIC”, CRC Press, Taylor & Francis Group,2007.
4. Martin Bates, "Interfacing PIC microcontrollers-Embedded Design by Interactive Simulation", Newnes Publication, 2006.

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

EC5071 ADVANCED MICROCONTROLLERS 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 concept of microcontroller based system development.
- To introduce the concept of RISC and CISC microcontrollers.
- To study the architecture of PIC, R8C and MSP430 family microcontrollers

UNIT I RISC PROCESSORS 9

RISC Vs CISC, RISC properties and evolution, Advanced RISC microcontrollers, PIC18xx microcontroller family, Architecture, Instruction set, ROM, RAM, Timer programming, Serial port programming, Interrupt programming, ADC and DAC interfacing, CCP module and programming.

UNIT II CISC PROCESSORS 9

RL78 16 BIT Microcontroller architecture, addressing modes, on-Chip memory, ADC, interrupts, MAC unit, Barrel shifter, internal and external clock generation, memory CRC, on chip debug function and self programming.

UNIT III MSP430 16 - BIT MICROCONTROLLER 9

The MSP430 Architecture, CPU Registers, Instruction Set, addressing modes, the MSP430 family viz. MSP430x2x, MSP430x4x, MSP430x5x. Low power aspects of MSP430 : low power modes, active Vs standby current consumption, FRAM Vs Flash for low power and reliability.

UNIT IV PROGRAMMING AND PERIPHERAL INTERFACE USING MSP430 FAMILIES 9

Memory mapped peripherals, I/O pin multiplexing, Timers, RTC, watchdog timer, PWM control, Analog interfacing and data acquisition, DMA, programming with above internal peripherals using optimal power consumption. Case study: Remote control of air conditioner and home appliances.

UNIT V COMMUNICATION INTERFACE USING MSP 430 MICROCONTROLLER 9

Serial and parallel communication, synchronous and asynchronous interfaces , Implementing and programming of : UART, I2C and SPI protocol. wireless connectivity : NFC, Zigbee, bluetooth and WiFi. MSP430 development tools. Case study: Implementing WiFi connectivity in smart electric meter.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

CO1: Ability to discriminate RISC and CISC processors, and work with PIC microcontrollers.
CO2: Ability to work with the 16 bit microcontroller RL78 and design microcontroller based systems for a Real world application.
CO3: Gaining design knowledge and concepts on MSP430 family of Microcontroller.
CO4: Ability to design real time systems by deploy the Interfacing peripherals.
CO5: Ability to design and develop microcontroller based smart electronic system and home appliances.

TEXT BOOK:

1. Alaxander G, James M. Conard, " Creating fast, Responsive and energy efficient Embedded systems using the Renesas RL78 microcontroller", Micrium press, USA, Reprinted by S.P Printers, 2011

REFERENCES:

1. Muhammad Ali Mazidi, Rolind D. Mckinlay and Danny Causey. "PIC Microcontroller and Embedded Systems", Pearson Education, 2008.
2. John H. Davies, "MSP 430 Micro controller basics", Elsevier, 2008.

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

EC5017 **MEMS** **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 enable the student to understand the basic principles of sensors and actuators, materials and fabrication aspects of MEMS and Microsystems.
- To make the student familiar with the mechanical and the electrostatic design and the associated system issues.

UNIT I INTRODUCTION TO MEMS 9

MEMS and Microsystems, Miniaturization, Typical products, Micro sensors, Micro actuation, MEMS with micro actuators, Microaccelorometers and Micro fluidics, MEMS materials, Micro fabrication

UNIT II MECHANICS FOR MEMS DESIGN 9

Elasticity, Stress, strain and material properties, Bending of thin plates, Spring configurations, torsional deflection, Mechanical vibration, Resonance, Thermo mechanics – actuators, force and response time, Fracture and thin film mechanics

UNIT III ELECTRO STATIC DESIGN AND SYSTEM ISSUES 9

Electrostatics: basic theory, electro static instability. Surface tension, gap and finger pull up, Electro static actuators, Comb generators, gap closers, rotary motors, inch worms, Electromagnetic actuators. bistable actuators. Electronic Interfaces, Feed back systems, Noise, Circuit and system issues.

UNIT IV MEMS APLLICATION 9

Case studies – Capacitive accelerometer, Peizo electric pressure sensor, Microfluidics application, Modeling of MEMS systems, CAD for MEMS.

UNIT V INTRODUCTION TO OPTICAL AND RF MEMS 9

Optical MEMS, - System design basics – Gaussian optics, matrix operations, resolution. Case studies- MEMS scanners and retinal scanning display, Digital Micro mirror devices. RF Mems – design basics, case study – Capacitive RF MEMS switch, performance issues.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

CO1: Develop electrical and mechanical model MEMS sensors and actuators

CO2: Analyse circuit issues in MEMs

CO3: Simulate electro mechanical model of MEMS

CO4: Model static and dynamic characteristic of MEMS

TEXT BOOKS:

1. Stephen Santeria,"Microsystems Design", Springer, 2016.
2. NadimMaluf,"An Introduction to Micro Electro Mechanical System Engineering, Artech House, 2004.

REFERENCES:

1. Ai Qun Liu,"Photonic MEMS Devices", CRC press Bocaraton, 2009.
2. Tai Ran Hsu, "MEMS & Micro Systems Design, Manufacture and Nanoscale Engineering", John Wiley, New Jersy, 2008.
3. Chang Liu, "Foundations of MEMS", Pearson Education, 2012.

EC5077 REAL TIME EMBEDDED 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 study the architecture and programming of ARM processors.
- To introduce the basic concepts of hard real time multiprocessing.
- To introduce the analytical concepts for effective programming.

UNIT I INTRODUCTION TO EMBEDDED COMPUTING AND ARM PROCESSORS 9

Complex systems and microprocessors – Embedded system design process – Formalism for system design– Design example: Model train controller- ARM Processor Fundamentals- Instruction Set and Programming using ARM Processor

.

UNIT II COMPUTING PLATFORM 9

CPU: Programming input and output – Supervisor mode, exception and traps – Coprocessor – Memory system mechanism – CPU performance – CPU power consumption- CPU buses – Memory devices – I/O devices – Component interfacing- System Level Performance Analysis- Parallelism. Design Example: Data Compressor.

UNIT III PROGRAM DESIGN AND ANALYSIS 9

Program design – Model of programs – Assembly and Linking – Basic compilation techniques – Program Optimization- Analysis and optimization of execution time, power, energy, program size – Program validation and testing- Example: Software Modem.

UNIT IV PROCESS AND OPERATING SYSTEMS 9

Multiple tasks and Multi processes – Processes – Context Switching – Operating Systems – Priority based Scheduling- RMS and EDF - Inter Process Communication mechanisms – Evaluating operating system performance – Power optimization strategies for processes.

UNIT V HARDWARE ACCELERATORS & NETWORKS 9

Multiprocessors- CPUs and Accelerators – Performance Analysis- Distributed Embedded Architecture – Networks for Embedded Systems: - I2C, CAN Bus, Ethernet, Myrinet – Network based design – Internet enabled systems. Design Example: Elevator Controller.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

CO1: Ability to design and develop ARM processor based systems.
CO2: Ability to comprehend and appreciate the significance and role of microcontrollers in embedded systems.
CO3: Ability to analyze and demonstrate program design and optimization and proper scheduling of the process.
CO4: Ability to apply the concept of process, multiprocesses and operating systems in embedded system design.
CO5: Ability to implement various communication protocols in distributed embedded computing platform.

TEXT BOOKS:

1. Wayne Wolf, "Computers as Components - Principles of Embedded Computing System Design", Morgan Kaufmann Publisher (An imprint of Elsevier), 3rd Edition, 2008.
2. Andrew N Sloss, Dominic Symes, Chris Wright, "ARM System Developer's Guide-Designing and Optimizing System Software", Elsevier/Morgan Kaufmann Publisher, 2008.

REFERENCES:

1. David E-Simon, "An Embedded Software Prime", Pearson Education, 2010.
2. K.V.K.K.Prasad, "Embedded Real-Time Systems: Concepts, Design & Programming", Dreamtech press, 2005.
3. Jane. W. S. Liu, "Real-Time Systems", Pearson Education Asia, 2011
4. Sriram V Iyer, Pankaj Gupta, "Embedded Real Time Systems Programming", Tata Mc-Graw Hill, 2004.
5. Tammy Noergaard, "Embedded Systems Architecture", Elsevier, 2006.

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

EC5078 **ROBOTICS** **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 electronics and software aspects in the design of robots
- To bring out the different languages for programming robot
- To specify robot requirements in the industry
- To introduce latest state of the art robots

UNIT I SCOPE OF ROBOTS 9

The scope of industrial Robots - Definition of an industrial robot - Need for industrial robots – Economic and Social Issues- applications.

UNIT II ROBOT COMPONENTS 9

Fundamentals of Robot Technology - Automation and Robotics - Robot anatomy - Work volume - Precision of movement - End effectors - Sensors.

UNIT III ROBOT PROGRAMMING 9

Robot Programming - Methods - interlocks textual languages. Characteristics of Robot level languages, characteristic of task level languages.

UNIT IV ROBOT WORK CELL 9

Robot Cell Design and Control - Remote Center compliance - Safety in Robotics.

UNIT V FUTURE TRENDS 14 9

Telepresence robot, Autonomous mobile robots, Walker Robots, Solar-ball Robot, Underwater bots, Aerobots, Advanced robotics in Space - Specific features of space robotics systems - long-term technical developments, Next generation robots.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

CO1: Ability to comprehend and appreciate the significance and role of this course in the present contemporary world

CO2: Ability to design and develop robotic based systems.

CO3: Ability to develop system for industrial automation and medical applications.

CO4: Ability to provide automatic solution for replacing humans in life threatening area.

TEXT BOOKS:

1. Barry Leatham - Jones, "Elements of industrial Robotics", Pitman Publishing, 1987.
2. J. M. Selig, "Introductory Robotics", Prentice Hall, 1992.
3. John Iovine, "Robots, Android and Animatronics", 2nd Edition, McGraw-Hill, 2012.
4. John M. Holland, "Designing Autonomous Mobile Robots-Inside the mind of an Intelligent Machine", Newnes Publication, 2004.
5. Robert J. Schilling, "Fundamentals of Robotics- Analysis and Control", Pearson Education, 2006.

REFERENCES:

1. MikellP.Groover, Mitchell Weiss, Roger N.Nagel Nicholas G.Odrey, "Industrial Robotics Technology, Programming and Applications", McGraw Hill Book Company, 1986.
2. Fu K.S. Gonzaleaz R.C. and Lee C.S.G., "Robotics Control Sensing, Vision and Intelligence", McGraw Hill, International Editions, 1987.
3. Bernard Hodges and Paul Hallam, "Industrial Robotics", British Library Cataloging in Publication, 1990.
4. Deb, S.R. , "Robotics Technology and Flexible Automation", Tata McGraw Hill, 1994.

EC5018 **DISPLAY TECHNOLOGIES** **L T P C**
3 0 0 3

OBJECTIVES:

- To introduce the different display technologies available for the Electronics Technology
- To understand the different 3D display techniques available
- To explore the applications of Display Technologies in daily life.

UNIT I INTRODUCTION TO OPTICS 9

Properties of Light, Geometric Optics, Optical Modulation; Vision and Perception: Anatomy of Eye, Light Detection and Sensitivity, Spatial Vision and Pattern Perception, Binocular Vision and Depth Perception; Driving Displays: Direct Drive, Multiplex and Passive Matrix, Active Matrix Driving, Panel Interfaces, Graphic Controllers.

UNIT II DISPLAY GLASSES 9

Display Glasses, Inorganic Semiconductor TFT Technology, Organic TFT Technology; Transparent Conductors, Patterning Processes: Photolithography for Thin Film LCD, Wet Etching, Dry Etching; Flexible Displays: Attributes, Technologies Compatible with Flexible Substrate and Applications, Touch Screen Technologies.

UNIT III DISPLAY DEVICES 9

Inorganic Phosphors, Cathode Ray Tubes, Vacuum Florescent Displays, Filed Emission Displays; Plasma Display Panels, LED Display Panels; Inorganic Electroluminescent Displays: Thin Film Electroluminescent Displays, AC Powder Electroluminescent Displays; Organic Electroluminescent Displays: OLEDs, Active Matrix for OLED Displays; Liquid Crystal Displays: Fundamentals and Materials, Properties of Liquid Crystals, Optics and Modeling of Liquid Crystals; LCD Device Technology: Twisted Numeric and Super twisted Numeric Displays,

UNIT IV 3-D DISPLAY TECHNOLOGY. 9

Paper like and Low Power Displays: Colorant Transposition Displays, MEMs Based Displays, -D Displays, 3-D Cinema Technology, Autostereoscopic 3-D Technology, Volumetric and 3-DVolumetric Display Technology, Holographic 3-D Technology; Mobile Displays: Trans-reflective Displays for Mobile Devices, Liquid Crystal Optics for Mobile Displays, Energy Aspects of Mobile Display Technology.

UNIT V MICRO DISPLAY TECHNOLOGY . 9

Micro display Technologies: Liquid Crystals on Silicon Reflective Micro display, Transmissive Liquid Crystal Micro display, MEMs Microdisplay, DLP Projection Technology; Micro display Applications: Projection Systems, Head Worn Displays; Electronic View Finders, Multi focal Displays, Occlusion Displays, Cognitive Engineering and Information Displays; Display Metrology, Standard Measurement Procedures,

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

CO1: Understand the material properties of display devices

CO2: Understand the projection technology of 3D display devices

TEXT BOOK:

1. Janglin Chen, Wayne Cranton, Mark Fihn , “Handbook of Visual Display Technology”, Springer Publication.

REFERENCES:

1. Joseph A Castellano, “Hand book of Display Technology” , Elsevier, 1992.
2. Achintya K. Bhowmik, “Interactive Displays: Natural Human–Interface Technologies”, Wiley SID Series, 2014.

EC5019 DIGITAL CONTROL ENGINEERING 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
- This course is extended to deliver the concepts of continuous-time control systems to digital domain where the design and stability aspects are introduced.

UNIT I CONTINUOUS TIME SYSTEMS 6

Review of frequency and time response analysis and specifications of control systems, need for controllers, continuous time compensations, continuous time PI, PD, PID controllers.

UNIT II SIGNAL PROCESSING IN DIGITAL CONTROL 12

Sampling, time and frequency domain descriptions, aliasing, hold operations, mathematical model of sample and hold, zero and first order hold, factors limiting the choice of sample rate, reconstruction, Difference equation description, Z-transform method of description, pulse transfer function, time and frequency response of discrete time control systems.

UNIT III DESIGN OF DIGITAL CONTROL ALGORITHMS 9

Review of principle of compensator design, Z-plane specifications, digital compensator design using frequency response plots, discrete integrator, discrete differentiator, development of digital PID controller, transfer function, design in Z-plane.

UNIT IV STATE VARIABLE TECHNIQUES 9

Discrete State Variable concepts, Characteristic equation, Eigen values and Eigenvectors, Jordan canonical models, Phase Variable companion forms.

UNIT V CONTROLLABILITY, OBSERVABILITY AND STABILITY 9

Definitions and Theorems of Controllability and Observability, Relationships between Controllability, Observability and Transfer Functions, Jury, Routh, Lyapunov stability analysis, Principles of state and output feedback.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

CO1: Ability to comprehend and appreciate the significance and role of this course in the present contemporary world
CO2:Acquire working knowledge of discrete system science related mathematics.
CO3:Design a discrete system, component or process to meet desired needs.
CO4: Identify, formulate and solve discrete control engineering problems.
CO5:Use the techniques, tools and skills related to discrete signals, computer science and modern discrete control engineering in modern engineering practice.
CO6: Communicate system related concepts effectively.

TEXT BOOK:

1. Benjamin C.Kuo, Digital Control Systems, OXFORD University Press, 2nd Edition, 2007.

REFERENCES:

1. M.Gopal, "Digital Control and State Variable Methods", Tata McGraw Hill, 2nd Edition, 2007.
2. K.Ogata,"Discrete-Time Control Systems", PHI, 2nd Edition,2007.
3. Gene. F.Franklin, J.D.Powell, M.Workman, "Digital Control of Dynamic Systems", Addison Wesley, 3rd Edition, 2000.

EC5020 MEASUREMENTS AND INSTRUMENTATION 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 principles of various measurement techniques using analog and digital equipments
- To teach Importance of signal generators and analyzers in measurements
- To emphasize the need for data acquisition systems and optical domain measurement techniques

UNIT I SCIENCE OF MEASUREMENT 9

Measurement System – Instrumentation – Characteristics of measurement systems – Static and Dynamic – Errors in Measurements – Calibration and Standards

UNIT II TRANSDUCERS 9

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

UNIT III SIGNAL CONDITIONING AND SIGNAL ANALYZERS 9

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

UNIT IV DIGITAL INSTRUMENTS 9

Digital Voltmeters – Millimeters – automation in Voltmeter – Accuracy and Resolution in DVM - Guarding techniques – Frequency counter- Data Loggers – Introduction to IEEE 488/GPIB Buses.

UNIT V DATA DISPLAY RECORDING AND SYSTEMS 9

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

TOTAL : 45 PERIODS

COURSE OUTCOMES:

CO1: Discuss about the principles of various measurement techniques.
CO2: Analyze the transducers and its impact.
CO3: Explain about the signal conditioning system and signal analyzers.
CO4: Illustrate the digital measurement equipments.
CO5: Emphasize the need for data acquisition, recording and display systems.

TEXT BOOKS:

1. Albert D.Helfrick and William D. Cooper, "Modern Electronic Instrumentation and Measurement Techniques", Prentice Hall of India, 2007.
2. Ernest o Doebelin and Dhanesh N Manik, "Measurement Systems", McGraw-Hill, 5th Edition ,2007.

REFERENCE:

1. Albert D.Helfrick and William D. Cooper, "Modern Electronic Instrumentation and Measurement Techniques", Prentice Hall of India, 2nd Edition, 2008.

EC5074 FOUNDATIONS FOR NANO ELECTRONICS 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
- The objectives of the course is to introduce quantum mechanics concepts, approximations and statistical mechanics for understanding nano systems

UNIT I INTRODUCTION TO QUANTUM MECHANICS 9

Particles, waves, probability amplitudes, schrodinger equation, wave packets solutions, operators, expectation values, eigenfuntions, piecewise constant potentials.

UNIT II SIMPLE HARMONIC OSCILLATORS AND APPROXIMATIONS 9

SHM Operators, SHM wavepacket solutions, Quantum LC circuit, WKB approximations, variational methods.

UNIT III SYSTEMS WITH TWO AND MANY DEGREES OF FREEDOM 9

Two level systems with static and dynamic coupling, problems in more than one dimensions, electromagnetic field quantization, density of states.

UNIT IV STATISTICAL MECHANICS 9

Basic concepts, microscopic, quantum systems in equilibrium, statistical models applied to metals and semiconductors

UNIT V APPLICATIONS 9

Hydrogen and Helium atoms, electronic states, Atomic force microscope, Nuclear Magnetic Resonance, carbon nanotube properties and applications

TOTAL : 45 PERIODS

COURSE OUTCOMES:

CO1: Ability to comprehend and appreciate the significance and role of this course in the present contemporary world

CO2: The student would have gained the knowledge on quantum mechanics concepts, approximations and statistical mechanics for understanding nano systems

TEXT BOOKS:

1. Hagelstein, Peter L., Stephen D. Senturia, and Terry P. Orlando, "Introduction to Applied Quantum and Statistical Physics", New York, NY: Wiley, 2004.
2. Rainer Waser, "Nanoelectronics and Information Technology", Wiley, 3rd Edition, 2012
3. Michael A. Nielsen and Isaac L. Chuang, "Quantum Computation and Quantum Information", Cambridge University Press, 2000.

REFERENCES:

1. Neil Gershenfeld, "The Physics of Information Technology", Cambridge University Press, 2000.
2. Adrian Ionesu and Kaustav Banerjee eds. "Emerging Nanoelectronics Life with and after CMOS", , Vol I, II, and III, Kluwer Academic, 2005.

EC5021 MEDICAL ELECTRONICS L T P C
3 0 0 3

OBJECTIVES:

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

UNIT I ELECTRO-PHYSIOLOGY AND BIOPOTENTIAL RECORDING 9

The origin of Bio-potentials, biopotential electrodes, bioamplifiers, ECG, EEG, EMG,PCG, lead systems and recording methods, typical waveforms and signal characteristics.

UNIT II BIO-CHEMICAL AND NON ELECTRICAL PARAMETER MEASUREMENT 9

pH, PO2, PCO2, colorimeter, Auto analyzer, Blood flow meter, cardiac output, respiratory measurement, Blood pressure, temperature, pulse rate, Blood cell counters.

UNIT III ASSIST DEVICES 9

Cardiac pacemakers – Need, different types, DC defibrillators - asynchronous and synchronous, Hemodialyser- Membrane, Dialysate. Heart lung machine - Block diagram, oxygenators and pumps

UNIT IV PHYSICAL MEDICINE AND BIOTELEMETRY 9

Diathermies- Shortwave, ultrasonic and microwave type and their applications, Surgical Diathermy Telemetry principles, frequency selection, biotelemetry, radiopill, electrical safety

UNIT V RECENT TRENDS IN MEDICAL INSTRUMENTATION 9

Thermography- principle, detectors, Endoscopy unit, Applications of Laser in medicine, cryogenic application, Introduction to telemedicine

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

CO1: Acquire and analyze the various biosignals and vital parameters.

CO2: Explain the function and application of various diagnostic and therapeutic equipment.

CO3: Explain about the recent developments in the field of biomedical engineering

TEXT BOOKS:

1. Leslie Cromwell, Fred J. Weibell, "Erich A. Pfeiffer, Biomedical Instrumentation and Measurements", Pearson Education India, 2nd Edition, 2015.
2. John G.Webster, "Medical Instrumentation Application and Design", John Wiley and Sons, New York, 4th Edition, 2009.

REFERENCES:

1. Khandpur R.S, "Handbook of Biomedical Instrumentation", Tata McGraw Hill, New Delhi, 3rd Edition, 2014.
2. Joseph J. Carr and John M. Brown, "Introduction to Biomedical Equipment Technology", Pearson Education, 4th Edition, 2014.

EC5022 IoT ENABLED SYSTEMS DESIGN L T P C
3 0 0 3

OBJECTIVES:

- To understand the basics of IoT.
- To get knowledge about the various services provided by IoT**.**
- To familiarize themselves with various communication techniques and networking.
- To know the implementation of IoT with different tools.
- To understand the various applications in IoT.

UNIT I INTRODUCTION TO INTERNET OF THINGS 9

Rise of the machines – Evolution of IoT – Web 3.0 view of IoT – Definition and characteristics of IoT – IoT Enabling Technologies – IoT Architecture -– Fog, Edge and Cloud in IoT – Functional blocks of an IoT ecosystem – Sensors, Actuators, Smart Objects and Connecting Smart Objects - IoT levels and deployment templates – A panaromic view of IoT applications.

UNIT II MIDDLEWARE AND PROTOCOLS OF IOT 9

Middleware technologies for IoT system (IoT Ecosystem Overview – Horizontal Architecture Approach for IoT Systems – SOA based IoT Middleware) Middleware architecture of RFID,WSN,SCADA,M2M –Interoperability challenges of IoT-Protocols for RFID,WSN,SCADA,M2M- Zigbee, KNX,BACNet,MODBUS - Challenges Introduced by 5G in IoT Middleware(Technological Requirements of 5G Systems - Perspectives and a Middleware Approach Toward 5G (COMPaaS Middleware) – Resource management in IoT.

UNIT III COMMUNICATION AND NETWORKING 9

IoT Access Technologies: Physical and MAC layers, topology and Security of IEEE 802.15.4, 802.15.4g, 802.15.4e, 1901.2a, 802.11ah and LoRaWAN – Network Layer: IP versions, Constrained Nodes and Constrained Networks – Optimizing IP for IoT: From 6LoWPAN to 6Lo, Routing over Low Power and Lossy Networks – Application Transport Methods: Supervisory Control and Data Acquisition –Application Layer Protocols: CoAP and MQTT- Data aggregation & dissemination.

UNIT IV IOT IMPLEMENTATION TOOLS 9

Introduction to Python, Introduction to different IoTtools, Developing applications through IoT tools, Developing sensor based application through embedded system platform, Implementing IoT concepts with python, Implementation of IoT with Raspberry Pi.

UNIT V APPLICATIONS AND CASE STUDIES: 9

Home automations - Smart cities – Environment – Energy – Retail – Logistics – Agriculture – Industry - Health and life style – Case study.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

CO1: Articulate the main concepts, key technologies, strength and limitations of IoT.
CO2: Identify the architecture, infrastructure models of IoT.
CO3: Analyze the networking and how the sensors are communicated in IoT .
CO4: Analyze and design different models for IoT implemention.
CO5: Identify and design the new models for market strategic interaction.

TEXT BOOKS:

1. Honbo Zhou, “Internet of Things in the cloud:A middleware perspective”, CRC press, 2012.
2. Vijay Madisetti and ArshdeepBahga, “Internet of Things (A Hands-onApproach)”, VPT, 1st Edition, 2014.

REFERENCES:

1. Pethuru Raj and Anupama C. Raman, "The Internet of Things: Enabling Technologies, Platforms, and Use Cases", CRC Press.
2. Constandinos X. Mavromoustakis, George Mastorakis, Jordi MongayBatalla, “Internet of Things (IoT) in 5G Mobile Technologies” Springer International Publishing Switzerland 2016.
3. Dieter Uckelmann, Mark Harrison, Florian Michahelles, “Architecting the Internet of Things” Springer-Verlag Berlin Heidelberg, 2011.

EC5023 CAD FOR VLSI CIRCUITS L T P C
3 0 0 3

OBJECTIVES:

- The design of all VLSI circuits is carried out by making extensive use Computer Aided Design (CAD)VLSI design tool. Due to continuous scaling of semiconductor technology, most of the VLSI designs employ millions of transistors and circuits of this size can only be carried out with the aid of CAD VLSI design tools.

- The VLSI design professional needs to have a good understanding of the operation of these CAD VLSI design tools as these are developed primarily for and by the VLSI design professionals.
- As part of the present introductory course the principles of operation of all the important modules that go into the construction of a complete VLSI CAD tool will be discussed. These include the design flow organization for VLSI, the standard cell based synthesis methodologies for digital VLSI, floor planning and placement principles and related topics will all be covered.

UNIT I VLSI DESIGN METHODOLOGIES 9

Introduction to VLSI Design methodologies - Review of Data structures and algorithms - Review of VLSI Design automation tools - Algorithmic Graph Theory and Computational Complexity – Tractable and Intractable problems - general purpose methods for combinatorial optimization.

UNIT II DESIGN RULES 9

Layout Compaction - Design rules - problem formulation - algorithms for constraint graph compaction - placement and partitioning - Circuit representation - Placement algorithms – partitioning

UNIT III FLOOR PLANNING 9

Floor planning concepts - shape functions and floor plan sizing - Types of local routing problems - Area routing - channel routing - global routing - algorithms for global routing.

UNIT IV SIMULATION 9

Simulation - Gate-level modeling and simulation - Switch-level modeling and simulation - Combinational Logic Synthesis - Binary Decision Diagrams - Two Level Logic Synthesis.

UNIT V MODELLING AND SYNTHESIS 9

High level Synthesis - Hardware models - Internal representation - Allocation assignment and scheduling - Simple scheduling algorithm - Assignment problem - High level transformations.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

CO1: Ability to comprehend and appreciate the significance and role of this course in the present contemporary world.
CO2: Apply VLSI design methodologies and design rules for digital circuits.
CO3: Use floor planning and rooting concepts for digital circuits.
CO4: Apply Gate level and Switch level modelling and Simulation.
CO5: Apply high level logic synthesis and scheduling.

TEXT BOOK:

1. S.H. Gerez, "Algorithms for VLSI Design Automation", John Wiley & Sons,2002.

REFERENCES:

1. N.A. Sherwani, "Algorithms for VLSI Physical Design Automation", Kluwer Academic Publishers,2002.

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

EC5024 FUNDAMENTALS OF OPERATING SYSTEMS L T P C
3 0 0 3

OBJECTIVES:

- To learn the concepts of operating systems.
- To learn about the various issues in operating systems.
- To familiarize with the important mechanisms in operating systems. To appreciate the emerging trends in operating systems

UNIT I OPERATING SYSTEMS OVERVIEW 9

Introduction to operating systems – Computer system organization, architecture – Operating system structure, operations – Process, memory, storage management – Protection and security – Distributed systems – Computing Environments – Open-source operating systems – OS services – User operating-system interface – System calls – Types – System programs – OS structure – OS generation – System Boot – Process concept, scheduling – Operations on processes – Cooperating processes – Inter-process communication – Examples – Multithreading models – Thread Libraries – Threading issues – OS examples

UNIT II PROCESS MANAGEMENT 9

Basic concepts – Scheduling criteria – Scheduling algorithms – Thread scheduling – Multiple-processor scheduling – Operating system examples – Algorithm Evaluation – The critical-section problem – Peterson‘s solution – Synchronization hardware – Semaphores – Classic problems of synchronization – Critical regions – Monitors – Synchronization examples – Deadlocks – System model – Deadlock characterization – Methods for handling deadlocks – Deadlock Prevention – Deadlock Avoidance – Deadlock detection – Recovery from deadlock

UNIT III STORAGE MANAGEMENT 9

Memory Management – Swapping – Contiguous memory allocation – Paging –Segmentation – Example: The Intel Pentium - Virtual Memory: Background – Demand paging – Copy on write – Page replacement – Allocation of frames – Thrashing**.**

UNIT IV I/O SYSTEMS 9

File concept – Access methods – Directory structure – File-system mounting –Protection – Directory implementation – Allocation methods – Free-space management – Disk scheduling – Disk management – Swap-space management – Protection

UNIT V CASE STUDY 9

The Linux System – History – Design Principles – Kernel Modules – Process Management – Scheduling – Memory management – File systems – Input and Output – Inter-process Communication – Network Structure – Security – Windows 7 – History – Design Principles – System Components – Terminal Services and Fast User – File system – Networking.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

On Completion of the course, the students will be able to:

CO1: Articulate the main concepts, key ideas, strengths and limitations of operating systems
CO2: Explain the core issues of operating systems
CO3: Know the usage and strengths of various algorithms of operating systems

TEXT BOOK:

1. Abraham Silberschatz, Peter B. Galvin, Greg Gagne, "Operating System Concepts Essentials", John Wiley & Sons Inc., 2nd Edition, 2013.

REFERENCES:

1. Andrew S. Tanenbaum, "Modern Operating Systems", Addison Wesley, 2nd Edition, 2001.
2. Charles Crowley, "Operating Systems: A Design-Oriented Approach", Tata McGraw Hill Education, 1996.
3. M Dhamdhere, "Operating Systems: A Concept-based Approach", Tata Mc Graw-Hill Education, 2nd Edition, 2007
4. William Stallings, "Operating Systems: Internals and Design Principles", Prentice Hall, 7th Edition, 2011.

EC5025 INTRODUCTION TO WEB TECHNOLOGY 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 features of object oriented programming languages using Java
- To design and create user interfaces using Java frames and applets
- To have a basic idea about network programming using Java
- To create simple Web pages and provide client side validation
- To create dynamic web pages using server side scripting

UNIT I JAVA FUNDAMENTALS 9

Java Data types – Class – Object – I / O Streams – File Handling concepts – Threads – Applets – Swing Framework – Reflection

UNIT II JAVA NETWORKING FUNDAMENTALS 9

Overview of Java Networking - TCP - UDP - InetAddress and Ports - Socket Programming - Working with URLs - Internet Protocols simulation - HTTP - SMTP - POP - FTP - Remote Method Invocation - Multithreading Concepts

UNIT III CLIENT SIDE TECHNOLOGIES 9

XML - Document Type Definition - XML Schema - Document Object Model - Presenting XML - Using XML Parsers: DOM and SAX – JavaScript Fundamentals - Evolution of AJAX - AJAX Framework - Web applications with AJAX - AJAX with PHP - AJAX with Databases

UNIT IV SERVER SIDE TECHNOLOGIES 9

Servlet Overview - Life cycle of a Servlet - Handling HTTP request and response - Using Cookies - Session tracking - Java Server Pages - Anatomy of JSP - Implicit JSP Objects – JDBC - Java Beans - Advantages - Enterprise Java Beans - EJB Architecture - Types of Beans - EJB Transactions

UNIT V APPLICATION DEVELOPMENT ENVIRONMENT 9

Overview of MVC architecture - Java Server Faces: Features - Components - Tags - **Struts:** Working principle of Struts - Building model components -View components- Controller components - Forms with Struts - Presentation tags - Developing Web applications -**Hibernate:** Configuration Settings - Mapping persistent classes - Working with persistent objects -Concurrency - Transactions - Caching - Queries for retrieval of objects - **Spring:** Framework -Controllers - Developing simple applications

TOTAL: 45 PERIODS

COURSE OUT COMES:

CO1: Ability to comprehend and appreciate the significance and role of this course in the present contemporary world.

CO2: The students will gain knowledge about Java and basic Web concepts and enable the student to create simple Web based applications.

TEXT BOOK:

1. Deitel, Deitel, Goldberg, "Internet & World Wide Web How To Program", Pearson Education, 5th Edition, 2006.

REFERENCES:

1. Marty Hall and Larry Brown, "Core Servlets And Javaserver Pages", 2nd Edition
2. Bryan Basham, Kathy Siegra, Bert Bates, Head First Servlets and JSP, 2nd Edition
3. Uttam K Roy, "Web Technologies", Oxford University Press, 2011.

EC5079 SOFT COMPUTING AND APPLICATIONS 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
- This course gives an idea and principles of various soft computing techniques, which are applicable to core areas such as networks , pattern recognition, image processing
- To introduce fuzzy set theory
- To teach different optimization techniques
- To introduce neural networks and neuro-fuzzy modeling
- To teach various applications of computational intelligence

UNIT I FUZZY SET THEORY 10

Introduction to Neuro – Fuzzy and Soft Computing – Fuzzy Sets – Basic Definition and Terminology – Set-theoretic Operations – Member Function Formulation and Parameterization – Fuzzy Rules and Fuzzy Reasoning – Extension Principle and Fuzzy Relations – Fuzzy If-Then Rules – Fuzzy Reasoning – Fuzzy Inference Systems – Mamdani Fuzzy Models – Sugeno Fuzzy Models – Tsukamoto Fuzzy Models – Input Space Partitioning and Fuzzy Modeling.

UNIT II OPTIMIZATION 8

Derivative-based Optimization – Descent Methods – The Method of Steepest Descent – Classical Newton‘s Method – Step Size Determination – Derivative-free Optimization – Genetic Algorithms– Simulated Annealing – Random Search – Downhill Simplex Search.

UNIT III NEURAL NETWORKS 10

Supervised Learning Neural Networks – Perceptrons - Adaline – Backpropagation MutilayerPerceptrons – Radial Basis Function Networks – Unsupervised Learning Neural Networks – Competitive Learning Networks – Kohonen Self-Organizing Networks – Learning Vector Quantization – Hebbian Learning.

UNIT IV NEURO FUZZY MODELING 9

Adaptive Neuro-Fuzzy Inference Systems – Architecture – Hybrid Learning Algorithm – Learning Methods that Cross-fertilize ANFIS and RBFN – Coactive Neuro Fuzzy Modeling– Framework Neuron Functions for Adaptive Networks – Neuro Fuzzy Spectrum.

UNIT V APPLICATIONS OF COMPUTATIONAL INTELLIGENCE 8

Printed Character Recognition – Inverse Kinematics Problems – Automobile Fuel Efficiency Prediction – Soft Computing for Color Recipe Prediction**.**

TOTAL : 45 PERIODS

COURSE OUTCOMES:

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

CO1: Apply various soft computing frame works.
CO2: Design of various neural networks.
CO3: Use fuzzy logic.
CO4: Discuss hybrid soft computing

TEXT BOOKS:

1. J.S.R.Jang, C.T.Sun and E.Mizutani, "Neuro Fuzzy and Soft Computing", Pearson Education, 2004.
2. N.P.Padhy, "Artificial Intelligence and Intelligent Systems", Oxford University Press, 2006.

REFERENCES:

1. Timothy J.Ross, "Fuzzy Logic with Engineering Applications", McGraw-Hill, 1997.
2. Davis E.Goldberg, "Genetic Algorithms: Search, Optimization and Machine Learning, Addison Wesley, N.Y., 1989.
3. S. Rajasekaran and G.A.V.Pai, "Neural Networks, Fuzzy Logic and Genetic Algorithms", PHI, 2003.
4. R.Eberhart, P. Simpson and R. Dobbins, "Computational Intelligence - PC Tools", AP, Professional, Boston, 1996.
5. Dr.S.N.Sivanandam and S.N.Deepa, "Principles of Soft Computing", Wiley India, 2007.

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	√	√										√
CO2		√	√		√							√
CO3		√	√		√							√
CO4		√	√		√							√
CO5			√	√	√	√	√	√	√	√	√	√

EC5026 PARALLEL AND DISTRIBUTED PROCESSING 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 study the principles of parallel processing
- To understand the concept of shared memory architecture in multiprocessing
- To study the parallel programming models.

UNIT I PARALLEL ARCHITECTURE 9

Parallel Computer Models, Program and Network properties, Principles of scalable performance

UNIT II PROCESSORS AND MEMORY HIERARCHY, BUS 9

Advanced processor Technology, Super scalar and vector processor, Memory hierarchy technology, Virtual Memory Technology, Backplane Bus systems.

UNIT III PIPELINING AND SUPER SCALAR TECHNIQUES 9

Linear Pipeline, Nonlinear pipeline, Instruction pipeline, Arithmetic pipeline, Superscalar and super pipeline design, Parallel and scalable architectures- Multiprocessor and Multicomputers.

UNIT IV SOFTWARE FOR PARALLEL PROGRAMMING 9

Parallel programming models, languages, compliers- Parallel Program Development and Environments.

UNIT V DISTRIBUTED SYSTEMS 9

Models, Hardware concepts, communication, synchronization mechanism, case study: MPI and PVM, Distributed file systems.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

CO1: Use different Processor and memory hierarchy technology.
CO2: Apply various types of Pipelining methodologies.
CO3: Identify models, Languages and compilers for Parallel Programming
CO4: Design distributed systems

TEXT BOOKS:

1. Hwang. K, "Advanced computer Architecture", Parallelism, Scalability, Programmability, Tata McGraw Hill, 3rd Edition, 1993.
2. Tanenbaum A.S, "Distributed Operating Systems", Pearson Education Asia, 2002.
3. DezsoSima, Terence Fountain, Peter Kacsuk, "Advanced Computer Architectures", Pearson Education, 2007.

REFERENCES:

1. V.Rajaraman and C.Siva Ram Murthy, "Parallel Computers Architecture and Programming", PHI, 2000.
2. Quinn, M.J., "Designing Efficient Algorithms for Parallel Computers", McGraw - Hill, 2003.
3. Culler, D.E., "Parallel Computer Architecture, A Hardware – Software approach", Morgan Kaufmann Publisher, 1998.

GE5073	FOUNDATION SKILLS IN INTEGRATED PRODUCT DEVELOPMENT	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To understand the global trends and development methodologies of various types of products and services
- To conceptualize, prototype and develop product management plan for a new product based on the type of the new product and development methodology integrating the hardware, software, controls, electronics and mechanical systems
- To understand requirement engineering and know how to collect, analyze and arrive at requirements for new product development and convert them in to design specification
- To understand system modeling for system, sub-system and their interfaces and arrive at the optimum system specification and characteristics
- To develop documentation, test specifications and coordinate with various teams to validate and sustain up to the EoL (End of Life) support activities for engineering customer

UNIT I FUNDAMENTALS OF PRODUCT DEVELOPMENT 9

Global Trends Analysis and Product decision - Social Trends - Technical Trends- Economical Trends - Environmental Trends - Political/Policy Trends **- Introduction to Product Development Methodologies and Management -** Overview of Products and Services - Types of Product Development - Overview of Product Development methodologies **-** Product Life Cycle – Product Development Planning and Management.

UNIT II REQUIREMENTS AND SYSTEM DESIGN 9

Requirement Engineering - Types of Requirements - Requirement Engineering - traceability Matrix and Analysis - Requirement Management - **System Design & Modeling -** Introduction to System Modeling - System Optimization - System Specification - Sub-System Design - Interface Design.

UNIT III DESIGN AND TESTING 9

Conceptualization - Industrial Design and User Interface Design - Introduction to Concept generation Techniques – **Challenges in Integration of Engineering Disciplines** - Concept Screening & Evaluation - **Detailed Design -** Component Design and Verification – **Mechanical, Electronics and Software Subsystems** - High Level Design/Low Level Design of S/W Program **-** Types of Prototypes, S/W Testing- Hardware Schematic, Component design, Layout and Hardware Testing – **Prototyping -** Introduction to Rapid Prototyping and Rapid Manufacturing - **System Integration, Testing, Certification and Documentation**

UNIT IV SUSTENANCE ENGINEERING AND END-OF-LIFE (EOL) SUPPORT 9

Introduction to Product verification processes and stages - Introduction to Product Validation processes and stages - Product Testing Standards and Certification - Product Documentation - **Sustenance -**Maintenance and Repair – Enhancements - **Product EoL -** Obsolescence Management – Configuration Management - EoL Disposal

UNIT V BUSINESS DYNAMICS – ENGINEERING SERVICES INDUSTRY 9

The Industry - Engineering Services Industry - Product Development in Industry versus Academia –**The IPD Essentials -** Introduction to Vertical Specific Product Development processes -Manufacturing/Purchase and Assembly of Systems - Integration of Mechanical, Embedded and Software Systems – Product Development Trade-offs - Intellectual Property Rights and Confidentiality – Security and Configuration Management.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

CO1: Define, formulate and analyze a problem
CO2: Solve specific problems independently or as part of a team
CO3: Gain knowledge of the Innovation & Product Development process in the Business Context
CO4: Work independently as well as in teams
CO5: Manage a project from start to finish

TEXTBOOKS:

1. Book specially prepared by NASSCOM as per the MoU.
2. Karl T Ulrich and Stephen D Eppinger, "Product Design and Development", Tata McGraw Hill, 5th Edition, 2011.
3. John W Newstorm and Keith Davis, "Organizational Behavior", Tata McGraw Hill, 11thEdition, 2005.

REFERENCES:

1. Hiriyappa B, “Corporate Strategy – Managing the Business”, Author House, 2013.
2. Peter F Drucker, “People and Performance”, Butterworth – Heinemann [Elsevier], Oxford, 2004.
3. Vinod Kumar Garg and Venkita Krishnan N K, “Enterprise Resource Planning – Concepts”, Prentice Hall, 2nd Edition, 2003.
4. Mark S Sanders and Ernest J McCormick, "Human Factors in Engineering and Design", McGraw Hill Education, 7th Edition, 2013

EC5027 ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING L T P C
3 0 0 3

OBJECTIVES:

- To understand problem solving methods and learning design of intelligent systems.
- To understand the concepts of machine learning
- To appreciate supervised and unsupervised learning and their applications
- To build systems those learns and adapt using real-world applications.
- Writing software/project implementations of learning algorithms applied to real-world

UNIT I INTRODUCTION TO AI 6

Computerized reasoning - Artificial Intelligence (AI) - characteristics of an AI problem - Problem representation in AI - State space representation - problem reduction-Concept of small talk programming.

UNIT II SEARCH PROCESS: 12

AI and search process - Brute force search techniques, Depth first, Breadth first search techniques, Hill climbing, Best first search, AND/OR graphs, A* algorithm - Constraint satisfaction. **KNOWLEDGE REPRESENTATION**: Logic, Propositional logic - Tautology - Contradiction - Normal forms - Predicate logic - Rules of inference - Resolution - Unification algorithm - Production rules - Semantic networks - Frames – Scripts - Conceptual dependency.

UNIT III INTRODUCTION TO MACHINE LEARNING 9

Introduction to Machine Learning - Types of Machine learning - Basic Concepts in Machine Learning - **SUPERVISED LEARNING :**Linear Models for Classification: Discriminant Functions - Probabilistic Generative Models - Probabilistic Discriminative Models - Bayesian Logistic Regression. Neural Networks: Feed forward Network Functions - Error Backpropagation – Regularization in Neural Networks - Mixture Density Networks - Bayesian Neural Networks. Kernel Methods - Dual Representations - Radial Basis Function Networks - Ensemble learning: Boosting - Bagging.

UNIT IV UNSUPERVISED LEARNING 9

Clustering - K-means - Mixtures of Gaussians - The EM Algorithm in General – Model Selection for Latent Variable Models - High-Dimensional Spaces. Dimensionality Reduction: Factor analysis - Principal Component Analysis - Probabilistic PCA - Independent components analysis.

UNIT V APPLICATION 9

Examples of Machine Learning Applications - Linear Models for Regression - Linear Basis Function Models - The Bias-Variance Decomposition - Bayesian Linear Regression - Bayesian Model Comparison. Radar for target detection, Deep Learning Automated ECG Noise Detection and Classification, ML in Network for routing, traffic prediction and classification, Application of ML in Cognitive Radio Network (CRN).

TOTAL : 45 PERIODS

TEXTBOOKS:

1. Stuart Russel and Peter Norvig, “Artificial Intelligence – A Modern Approach”, Prentice Hall, 2009.
2. Elaine Rich, Kevin Knight and Shivashankar B Nair, “Artificial Intelligence”, Tata McGraw Hill, 2010.

REFERENCES:

1. Patrick Henry Winston, “Artificial Intelligence”, Addison Wesley, 2000.
2. Luger George F and Stubblefield William A, “Artificial Intelligence: Structures and Strategies for Complex Problem Solving”, Pearson Education, 2002.
3. Christopher Bishop, “Pattern Recognition and Machine Learning” Springer, 2007.
4. Kevin P. Murphy, “Machine Learning: A Probabilistic Perspective”, MIT Press, 2012.
5. Ethem Alpaydin, “Introduction to Machine Learning”, MIT Press, 3rd Edition, 2014
6. Sayed, A.H., 2014. Adaptation, learning, and optimization over networks. Foundations and Trends® in Machine Learning, 7(4-5), pp.311-801.

AD5091 CONSTITUTION OF INDIA L T P C

3 0 0 0

OBJECTIVES:

- Teach history and philosophy of Indian Constitution.
- Describe the premises informing the twin themes of liberty and freedom from a civil rights perspective.
- Summarize powers and functions of Indian government.
- Explain emergency rule.
- Explain structure and functions of local administration.

UNIT I INTRODUCTION 9

History of Making of the Indian Constitution-Drafting Committee- (Composition & Working) - Philosophy of the Indian Constitution-Preamble-Salient Features

UNIT II CONTOURS OF CONSTITUTIONAL RIGHTS & DUTIES 9

Fundamental Rights-Right to Equality-Right to Freedom-Right against Exploitation Right to Freedom of Religion-Cultural and Educational Rights-Right to Constitutional Remedies Directive Principles of State Policy-Fundamental Duties

UNIT III ORGANS OF GOVERNANCE 9

Parliament-Composition-Qualifications and Disqualifications-Powers and Functions-Executive President-Governor-Council of Ministers-Judiciary, Appointment and Transfer of Judges, Qualifications Powers and Functions

UNIT IV EMERGENCY PROVISIONS 9

Emergency Provisions - National Emergency, President Rule, Financial Emergency

UNIT V LOCAL ADMINISTRATION 9

District's Administration head- Role and Importance-Municipalities- Introduction- Mayor and role of Elected Representative-CEO of Municipal Corporation-Pachayati raj- Introduction- PRI- Zila Pachayat-Elected officials and their roles- CEO ZilaPachayat- Position and role-Block level-Organizational Hierarchy (Different departments)-Village level- Role of Elected and Appointed officials-Importance of grass root democracy

TOTAL: 45 PERIODS

COURSE OUTCOMES:

CO1: Able to understand history and philosophy of Indian Constitution.
CO2: Able to understand the premises informing the twin themes of liberty and freedom from a civil rights perspective.
CO3: Able to understand powers and functions of Indian government.
CO4: Able to understand emergency rule.
CO5: Able to understand structure and functions of local administration.

TEXTBOOKS:

1. Basu D D, Introduction to the Constitution of India, Lexis Nexis, 2015.
2. Busi S N, Ambedkar B R framing of Indian Constitution, 1st Edition, 2015.
3. Jain M P, Indian Constitution Law, Lexis Nexis, 7th Edition, 2014.
4. The Constitution of India (Bare Act), Government Publication,1950

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1									✓			✓
CO2									✓			✓
CO3									✓			✓
CO4									✓			✓
CO5									✓			✓

AD5092 VALUE EDUCATION L T P C

3 0 0 0

OBJECTIVES:

- Develop knowledge of self-development
- Explain the importance of Human values
- Develop the overall personality through value education
- Overcome the self destructive habits with value education
- Interpret social empowerment with value education

UNIT I INTRODUCTION TO VALUE EDUCATION 9

Values and self-development –Social values and individual attitudes, Work ethics, Indian vision of humanism, Moral and non- moral valuation, Standards and principles, Value judgements

UNIT II IMPORTANCE OF VALUES 9

Importance of cultivation of values, Sense of duty, Devotion, Self-reliance, Confidence, Concentration, Truthfulness, Cleanliness. Honesty, Humanity, Power of faith, National Unity, Patriotism, Love for nature, Discipline

UNIT III INFLUENCE OF VALUE EDUCATION 9

Personality and Behaviour development - Soul and Scientific attitude. Positive Thinking, Integrity and discipline, Punctuality, Love and Kindness, Avoid fault Thinking, Free from anger, Dignity of labour, Universal brotherhood and religious tolerance, True friendship Happiness Vs suffering, love for truth.

UNIT IV REINCARNATION THROUGH VALUE EDUCATION 9

Aware of self-destructive habits, Association and Cooperation, Doing best for saving nature Character and Competence –Holy books vs Blind faith, Self-management and Good health, Science of reincarnation

UNIT V VALUE EDUCATION IN SOCIAL EMPOWERMENT 9

Equality, Non violence, Humility, Role of Women, All religions and same message, Mind your Mind, Self-control, Honesty, Studying effectively

TOTAL: 45PERIODS

COURSE OUTCOMES:

CO1: Gain knowledge of self-development
CO2: Learn the importance of Human values
CO3: Develop the overall personality through value education
CO4: Overcome the self destructive habits with value education
CO5: Interpret social empowerment with value education

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1							√	√				√
CO2							√	√	√			√
CO3							√	√	√			√
CO4							√	√				√
CO5							√	√				√

REFERENCES:

1. Chakroborty , S.K. “Values and Ethics for organizations Theory and practice”, Oxford University Press ,New Delhi

AD5093 **PEDAGOGY STUDIES** **L T P C**
3 0 0 0

OBJECTIVES:

- Understand the methodology of pedagogy.
- Compare pedagogical practices used by teachers in formal and informal classrooms in developing countries.
- Infer how can teacher education (curriculum and practicum) and the school curriculum and guidance materials best support effective pedagogy.
- Illustrate the factors necessary for professional development.
- Identify the Research gaps in pedagogy.

UNIT I INTRODUCTION AND METHODOLOGY 9

Aims and rationale, Policy background, Conceptual framework and terminology - Theories of learning, Curriculum, Teacher education - Conceptual framework, Research questions **-** Overview of methodology and Searching.

UNIT II THEMATIC OVERVIEW 9

Pedagogical practices are being used by teachers in formal and informal classrooms in developing countries - Curriculum, Teacher education.

UNIT III EVIDENCE ON THE EFFECTIVENESS OF PEDAGOGICAL PRACTICES 9

Methodology for the in depth stage: quality assessment of included studies - How can teacher education (curriculum and practicum) and the school curriculum and guidance materials best support effective pedagogy? - Theory of change - Strength and nature of the body of evidence for effective pedagogical practices - Pedagogic theory and pedagogical approaches - Teachers' attitudes and beliefs and Pedagogic strategies.

UNIT IV PROFESSIONAL DEVELOPMENT 9

Professional development: alignment with classroom practices and follow up support - Peer support - Support from the head teacher and the community - Curriculum and assessment - Barriers to learning: limited resources and large class sizes

UNIT V RESEARCH GAPS AND FUTURE DIRECTIONS 9

Research design – Contexts – Pedagogy - Teacher education - Curriculum and assessment - Dissemination and research impact.

TOTAL: 45PERIODS

COURSE OUTCOMES:

CO1: Understand the methodology of pedagogy.
CO2: Understand Pedagogical practices used by teachers in formal and informal classrooms in developing countries.
CO3: Find how can teacher education (curriculum and practicum) and the school curriculum and guidance materials best support effective pedagogy.
CO4: Know the factors necessary for professional development.
CO5: Identify the Research gaps in pedagogy.

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1												√
CO2												√
CO3												√
CO4												√
CO5												√

REFERENCES:

1. Ackers J, Hardman F (2001) Classroom interaction in Kenyan primary schools, Compare, 31 (2): 245-261.
2. Agrawal M (2004) Curricular reform in schools: The importance of evaluation, Journal of Curriculum Studies, 36 (3): 361-379.
3. Akyeampong K (2003) Teacher training in Ghana - does it count? Multi-site teacher education research project (MUSTER) country report 1. London: DFID.
4. Akyeampong K, Lussier K, Pryor J, Westbrook J (2013) Improving teaching and learning of basic maths and reading in Africa: Does teacher preparation count? International Journal Educational Development, 33 (3): 272–282.
5. Alexander RJ (2001) Culture and pedagogy: International comparisons in primary education. Oxford and Boston: Blackwell.

AD5094 STRESS MANAGEMENT BY YOGA L T P C
3 0 0 0

OBJECTIVES:

- Develop healthy mind in a healthy body thus improving social health also improve efficiency
- Invent Do's and Don't's in life through Yam
- Categorize Do's and Don't's in life through Niyam
- Develop a healthy mind and body through Yog Asans
- Invent breathing techniques through Pranayam

UNIT I INTRODUCTION TO YOGA 9

Definitions of Eight parts of yog. (Ashtanga)

UNIT II YAM 9

Do`s and Don't's in life.
Shaucha, santosh, tapa, swadhyay, ishwarpranidhan

UNIT III NIYAM 9

Do`s and Don't's in life.
Ahinsa, satya, astheya, bramhacharya and aparigraha

UNIT IV ASAN **9**

Various yog poses and their benefits for mind & body

UNIT V PRANAYAM **9**

Regularization of breathing techniques and its effects-Types of pranayam

TOTAL: 45PERIODS

COURSE OUTCOMES:

CO1 – Develop healthy mind in a healthy body thus improving social health also improve efficiency
CO2 – Learn Do's and Don't's in life through Yam
CO3 – Learn Do's and Don't's in life through Niyam
CO4 – Develop a healthy mind and body through Yog Asans
CO5 – Learn breathing techniques through Pranayam

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1							√	√				√
CO2							√	√				√
CO3							√	√				√
CO4							√	√				√
CO5							√	√				√

REFERENCES:

1. "Rajayoga or conquering the Internal Nature" by Swami Vivekananda, Advaita Ashrama (Publication Department), Kolkata
2. 'Yogic Asanas for Group Tarining-Part-I" : Janardan Swami Yogabhyasi Mandal, Nagpur

AD5095 PERSONALITY DEVELOPMENT THROUGH LIFE ENLIGHTENMENT SKILLS **L T P C 3 0 0 0**

OBJECTIVES:

- Develop basic personality skills holistically
- Develop deep personality skills holistically to achieve happy goals
- Rewrite the responsibilities
- Reframe a person with stable mind, pleasing personality and determination
- Discover wisdom in students

UNIT I NEETISATAKAM-HOLISTIC DEVELOPMENT OF PERSONALITY - I **9**

Verses- 19,20,21,22 (wisdom) - Verses- 29,31,32 (pride & heroism) – Verses- 26,28,63,65 (virtue)

UNIT II NEETISATAKAM-HOLISTIC DEVELOPMENT OF PERSONALITY - II 9

Verses- 52,53,59 (dont's) - Verses- 71,73,75,78 (do's)

UNIT III APPROACH TO DAY TO DAY WORK AND DUTIES 9

Shrimad Bhagwad Geeta: Chapter 2-Verses 41, 47,48 - Chapter 3-Verses 13, 21, 27, 35 Chapter 6-Verses 5,13,17,23, 35 - Chapter 18-Verses 45, 46, 48

UNIT IV STATEMENTS OF BASIC KNOWLEDGE – I 9

Statements of basic knowledge - Shrimad Bhagwad Geeta: Chapter2-Verses 56, 62, 68 Chapter 12 -Verses 13, 14, 15, 16,17, 18

UNIT V PERSONALITY OF ROLE MODEL - SHRIMAD BHAGWADGEETA 9

Chapter2-Verses 17, Chapter 3-Verses 36,37,42 - Chapter 4-Verses 18, 38,39 Chapter18 – Verses 37,38,63

TOTAL: 45PERIODS

COURSE OUTCOMES:

CO1: To develop basic personality skills holistically
CO2: To develop deep personality skills holistically to achieve happy goals
CO3: To rewrite the responsibilities
CO4: To reframe a person with stable mind, pleasing personality and determination
CO5: To awaken wisdom in students

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1									✓			✓
CO2									✓			✓
CO3									✓			✓
CO4									✓			✓
CO5									✓			✓

REFERENCES:

1. Gopinath,Rashtriya Sanskrit Sansthanam P, Bhartrihari's Three Satakam , Niti-sringar-vairagya, New Delhi,2010
2. Swami Swarupananda , Srimad Bhagavad Gita, Advaita Ashram,Publication Department, Kolkata,2016.