



**R.M.K. ENGINEERING COLLEGE  
AUTONOMOUS INSTITUTIONS  
B.E. ELECTRONICS AND INSTRUMENTATION  
ENGINEERING  
REGULATIONS -2020  
CHOICE BASED CREDIT SYSTEM**



**PROGRAMME EDUCATIONAL OBJECTIVES**

**Bachelors of Electronics and Instrumentation Engineering curriculum is designed to prepare the graduates having attitude and knowledge to**

- I. Encompass strong foundation in fundamentals of Electronics and Instrumentation required to analyze problems concerned with industry and society.
- II. Acquire knowledge in recent technological developments in the field of Electronics and Instrumentation Engineering.
- III. Develop professional and ethical outlook, effective communication skill and team spirit.
- IV. Attain proficiency in identifying, formulating and developing optimal solution for societal growth.

**PROGRAMME OUTCOMES (POs)**

The graduates will have ability to

- a. Apply the knowledge of Mathematics, Science, Engineering Fundamentals, and an Engineering Specialization to the solution of complex engineering problems.
- b. Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of Mathematics, Natural Sciences, and Engineering Sciences.
- c. Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
- d. Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
- e. Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.
- f. Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
- g. Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
- h. Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

- i. Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
- j. Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
- k. Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
- l. Recognize the need for and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

### PEOs & POs

The B.E. Electronics and Instrumentation Engineering Program outcomes leading to the achievement of the objectives are summarized in the following Table.

Programme Educational Objectives	Programme Outcomes											
	a	b	c	d	E	F	g	h	i	j	k	l
I	✓	✓				✓	✓	✓	✓	✓	✓	✓
II			✓	✓	✓	✓	✓	✓			✓	✓
III						✓	✓	✓	✓	✓		
IV				✓	✓	✓	✓	✓				

Sem	Name of the subject	PROGRAM OUTCOMES											
		a	b	c	d	E	f	g	h	i	j	k	l
I	Communicative English & Life Skills		✓							✓	✓		✓
	Engineering Mathematics I	✓	✓	✓	✓	✓	✓	✓					✓
	Computer Aided Engineering Graphics	✓		✓			✓				✓		
	Environmental Science and Engineering	✓	✓				✓	✓			✓		✓
	Problem solving and C Programming	✓	✓	✓						✓			✓
	Core I - Basic Civil & Mechanical Engineering	✓	✓	✓			✓	✓	✓	✓			
	C Programming Lab	✓	✓	✓						✓			✓
	Interpersonal Skills									✓	✓		✓



	and System Design												
	Industrial Instrumentation	✓	✓	✓	✓			✓	✓	✓	✓		✓
	Control System Design	✓	✓	✓	✓	✓	✓						✓
	Linear Integrated Circuits	✓	✓	✓	✓		✓	✓	✓	✓		✓	✓
	Universal Human Values II- Understanding Harmony						✓	✓	✓	✓	✓	✓	✓
	Linear and Digital Integrated Circuits Lab					✓	✓						✓
	Measurements and Transducers Lab					✓	✓						✓
	Foundation Lab on Internet of Things	✓	✓	✓	✓	✓	✓		✓				✓
	Aptitude & Coding Skills-II	✓	✓							✓	✓		
V	Data structures	✓	✓	✓	✓						✓	✓	
	Microprocessors and Microcontrollers	✓	✓	✓	✓	✓				✓		✓	✓
	Digital Signal Processing	✓	✓	✓	✓	✓						✓	✓
	Process Control	✓	✓	✓	✓	✓						✓	✓
	Process Control Lab	✓	✓	✓	✓	✓						✓	✓
	Internship	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
	Microprocessors and Microcontrollers Lab	✓	✓	✓	✓	✓				✓		✓	✓
	Advanced Aptitude & Coding Skills -I	✓	✓	✓	✓	✓	✓			✓	✓	✓	✓
VI	Factory Automation	✓	✓	✓	✓		✓	✓		✓	✓	✓	✓
	Industrial Internet of Things	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓
	Communication Engineering	✓	✓	✓		✓				✓	✓	✓	✓
	Embedded Systems	✓	✓	✓	✓	✓				✓	✓	✓	✓
	Industrial Instrumentation and IoT Lab	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓
	Industrial Automation Lab	✓	✓	✓	✓	✓	✓	✓	✓			✓	✓
	Advanced Aptitude	✓	✓	✓	✓	✓	✓					✓	✓



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**CHOICE BASED CREDIT SYSTEM**  
**I - VIII SEMESTERS CURRICULA & I - VIII SEMESTER- SYLLABI**  
**SEMESTER - I**

S.No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
<b>THEORY</b>								
1.	20EL101	Communicative English & Life Skills	HS	2	2	0	0	2
2.	20MA101	Engineering Mathematics I	BS	5	3	2	0	4
3.	20ME103	Computer Aided Engineering Graphics	ES	6	2	0	4	4
4.	20CH102	Environmental Science and Engineering	HS	3	3	0	0	2
5.	20GE101	Problem solving and C Programming	ES	3	3	0	0	3
6.	20CM106	Core I - Basic Civil & Mechanical Engineering	ES	3	3	0	0	3
<b>PRACTICALS</b>								
7.	20GE111	C Programming Lab	ES	4	0	0	4	2
8.	20EL112	Interpersonal Skills – Listening, Speaking, Reading and Writing Lab	HS	4	0	0	4	2
9.		Induction Program	MC	3 Weeks	-	-	-	-
<b>TOTAL</b>				<b>30</b>	<b>16</b>	<b>2</b>	<b>12</b>	<b>22</b>

**SEMESTER - II**

S.No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
<b>THEORY</b>								
1.	20EL201	Technical English	HS	2	2	0	0	2
2.	20MA201	Engineering Mathematics II	BS	5	3	2	0	4
3.	20PH102	Physics for Electronics Engineering	BS	3	3	0	0	3
4.	20CH101	Engineering Chemistry	BS	3	3	0	0	3
5.	20EI201	Core II –Basic Electronics and Instrumentation Engineering	ES	3	3	0	0	3
6.	20EE202	Core III - Electric Circuit Analysis	ES	5	3	2	0	4
<b>PRACTICALS</b>								
7.	20PC111	Physics & Chemistry Laboratory	BS	4	0	0	4	2
8.	20CS212	Advanced C Programming Lab	ES	4	0	0	4	2
9.	20EM211	Basic Engineering and Circuits Laboratory	ES	4	0	0	4	2
<b>TOTAL</b>				<b>33</b>	<b>17</b>	<b>4</b>	<b>12</b>	<b>25</b>

**SEMESTER - III**

S.No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
<b>THEORY</b>								
1.	20MA301	Transforms and Partial Differential Equations	BS	5	3	2	0	4
2.	20EI301	Instrument Transducers	PC	3	3	0	0	3
3.	20EI302	Electrical and Electronic Measurements	PC	5	3	2	0	4
4.	20EI303	Electrical Machines	ES	3	3	0	0	3
5.	20EC302	Electronic Circuits	ES	3	3	0	0	3
6.	20CS302	Object Oriented Programming	ES	3	3	0	0	3
<b>PRACTICALS</b>								
7.	20EI311	Devices and Machines lab	ES	4	0	0	4	2
8.	20EI312	Mini project	EEC	2	0	0	2	1
9.	20CS311	Object Oriented Programming Laboratory	ES	4	0	0	4	2
10.	20CS313	Aptitude & Coding Skills -I	EEC	2	0	0	2	1
<b>TOTAL</b>				<b>34</b>	<b>18</b>	<b>4</b>	<b>12</b>	<b>26</b>

**SEMESTER - IV**

S.No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
<b>THEORY</b>								
1.	20MA403	Numerical Methods	BS	5	3	2	0	4
2.	20EI401	Digital Principles and System Design	PC	3	3	0	0	3
3.	20EI402	Industrial Instrumentation	PC	3	3	0	0	3
4.	20EI403	Control System Design	PC	5	3	2	0	4
5.	20EE304	Linear Integrated Circuits	PC	3	3	0	0	3
6.	20GE301	Universal Human Values II- Understanding Harmony	HS	4	2	2	0	3
<b>PRACTICALS</b>								
7.	20EI411	Linear and Digital Integrated Circuits Lab	PC	4	0	0	4	2
8.	20EI412	Measurements and Transducers Lab	PC	4	0	0	4	2
9.	20EC312	Foundation Lab on Internet of Things	EEC	2	0	0	2	1
10.	20CS414	Aptitude & Coding Skills-II	EEC	2	0	0	2	1
<b>TOTAL</b>				<b>35</b>	<b>17</b>	<b>6</b>	<b>12</b>	<b>26</b>

**SEMESTER - V**

S.No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
<b>THEORY</b>								
1.	20CS201	Data structures	ES	3	3	0	0	3
2.	20EC402	Microprocessors and Microcontrollers	PC	3	3	0	0	3
3.	20EE603	Digital Signal Processing	PC	5	3	2	0	4
4.	20EI501	Process Control	PC	5	3	2	0	4
5.		Professional Elective I	PE	3	3	0	0	3
6.		Open Elective-I	OE	3	3	0	0	3
<b>PRACTICALS</b>								
7.	20EI511	Process Control Lab	PC	4	0	0	4	2
8.	20EI512	Internship	EEC	0	0	0	0	1
9.	20EC411	Microprocessors and Microcontrollers Lab	PC	4	0	0	4	2
10.	20CS512	Advanced Aptitude & Coding Skills -I	EEC	2	0	0	2	1
<b>TOTAL</b>				<b>32</b>	<b>18</b>	<b>4</b>	<b>10</b>	<b>26</b>

**SEMESTER - VI**

S.No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
<b>THEORY</b>								
1.	20EI601	Factory Automation	PC	5	3	2	0	4
2.	20EI602	Industrial Internet of Things	PC	5	3	2	0	4
3.	20EI603	Communication Engineering	ES	5	3	2	0	4
4.	20EC602	Embedded Systems	PC	3	3	0	0	3
5.		Professional Elective II	PE	3	3	0	0	3
6.		Professional Elective III	PE	3	3	0	0	3
<b>PRACTICALS</b>								
7.	20EI611	Industrial Instrumentation and IoT Lab	PC	4	0	0	4	2
8.	20EI612	Industrial Automation Lab	PC	4	0	0	4	2
9.	20CS614	Advanced Aptitude & Coding Skills -II	EEC	2	0	0	2	1
<b>TOTAL</b>				<b>34</b>	<b>18</b>	<b>6</b>	<b>10</b>	<b>26</b>

**SEMESTER - VII**

S. No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
<b>THEORY</b>								
1.	20EI701	Medical Instrumentation	PC	3	3	0	0	3
2.	20EI702	Industrial Data Networks	PC	3	3	0	0	3
3.		Professional Elective IV	PE	3	3	0	0	3
4.		Professional Elective V	PE	3	3	0	0	3
5.		Professional Elective VI	PE	3	3	0	0	3
6.		Open Elective-II	OE	3	3	0	0	3
<b>PRACTICALS</b>								
7.	20EI711	Instrumentation System Design Lab	PC	4	0	0	4	2
8.	20EI712	Embedded and Robotics lab	PC	4	0	0	4	2
<b>TOTAL</b>				<b>26</b>	<b>18</b>	<b>0</b>	<b>8</b>	<b>22</b>

**SEMESTER - VIII**

S. No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
<b>PRACTICALS</b>								
1.	20EI811	Project Work	EEC	20	0	0	20	10
<b>TOTAL</b>				<b>20</b>	<b>0</b>	<b>0</b>	<b>20</b>	<b>10</b>

\*Course from the curriculum of other UG Programmes.

**PROFESSIONAL ELECTIVE - I**

S. No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1.	20EI901	Introduction to Process data Analytics	PE	3	3	0	0	3
2.	20EI902	Analytical Instrumentation	PE	3	3	0	0	3
3.	20EI903	Robotics and Automation	PE	3	3	0	0	3
4.	20CS404	Operating Systems	PE	3	3	0	0	3
5.	20CB404	Introduction to Innovation, IP Management & Entrepreneurship	PE	3	3	0	0	3

**PROFESSIONAL ELECTIVE - II**

S. No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1.	20EI904	Reliability and Safety Engineering	PE	3	3	0	0	3
2.	20EI905	Electric Vehicle Control Systems	PE	3	3	0	0	3
3.	20EI906	Cyber security for Industrial Automation	PE	3	3	0	0	3
4.	20EI907	Power Electronics and Drives	PE	3	3	0	0	3
5.	20IT927	Indian Constitution	PE	3	3	0	0	3

**PROFESSIONAL ELECTIVE - III**

S. No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1.	20EI908	Fault diagnosis and Tolerance	PE	3	3	0	0	3
2.	20EI909	Introduction to Image and Video Processing	PE	3	3	0	0	3
3.	20EI910	Adaptive Control	PE	3	3	0	0	3
4.	20EE923	Systems Programming (HCL)	PE	3	3	0	0	3
5.	20IT917	Essence of Indian Traditional Knowledge	PE	3	3	0	0	3

**PROFESSIONAL ELECTIVE - IV**

S.No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1.	20EI911	Instrumentation Standards and Calibration	PE	3	3	0	0	3
2.	20EI912	Instrumentation in Process Industries	PE	3	3	0	0	3
3.	20EE932	Automotive Software Engineering Course (KPIT)	PE	3	3	0	0	3
4.	20ME927	Total Quality Management	PE	3	3	0	0	3
5.	20EC601	VLSI Design	PE	3	3	0	0	3

**PROFESSIONAL ELECTIVE - V**

S.No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1.	20EI913	System Identification	PE	3	3	0	0	3
2.	20AI401	Artificial Intelligence	PE	3	3	0	0	3
3.	20ME926	Principles of Management	PE	3	3	0	0	3
4.	20EC903	Introduction to Nano Science and Nano Technology	PE	3	3	0	0	3
5.	20CE917	Professional Ethics in Engineering	PE	3	3	0	0	3

**PROFESSIONAL ELECTIVE - VI**

S.No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1.	20EI914	Project Management and Finance	PE	3	3	0	0	3
2.	20EI915	Advanced Process Control	PE	3	3	0	0	3
3.	20EI916	Fibre Optics and Laser Instrumentation	PE	3	3	0	0	3
4.	20EE926	Linux Kernel and Device Drivers (HCL)	PE	3	3	0	0	3
5.	20CS917	Data science Fundamentals	PE	4	2	0	2	3

**HUMANITIES AND SOCIAL SCIENCES (HS)**

S.No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1.	20EL101	Communicative English & Life Skills	HS	2	2	0	0	2
2.	20CH102	Environmental Science and Engineering	HS	3	3	0	0	2
3.	20EL112	Interpersonal Skills – Listening, Speaking, Reading and Writing Lab	HS	4	0	0	4	2
4.	20EL201	Technical English	HS	2	2	0	0	2
5.	20GE301	Universal Human Values II- Understanding Harmony	HS	4	2	2	0	3

**BASIC SCIENCES (BS)**

S.No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1.	20MA101	Engineering Mathematics I	BS	5	3	2	0	4
2.	20MA201	Engineering Mathematics II	BS	5	3	2	0	4
3.	20PH102	Physics for Electronics Engineering	BS	3	3	0	0	3
4.	20CH101	Engineering Chemistry	BS	3	3	0	0	3
5.	20PC111	Physics & Chemistry Laboratory	BS	4	0	0	4	2
6.	20MA301	Transforms and Partial Differential Equations	BS	5	3	2	0	4
7.	20MA404	Numerical Methods	BS	5	3	2	0	4

### ENGINEERING SCIENCES (ES)

S.No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1.	20ME103	Computer Aided Engineering Graphics	ES	6	2	0	4	4
2.	20GE101	Problem solving and C Programming	ES	3	3	0	0	3
3.	20CM106	Core I - Basic Civil & Mechanical Engineering	ES	3	3	0	0	3
4.	20GE111	C Programming Lab	ES	4	0	0	4	2
5.	20EI201	Core II – <u>Basic Electronics and Instrumentation Engineering</u>	ES	3	3	0	0	3
6.	20EE202	Core III - Electric Circuit Analysis	ES	5	3	2	0	4
7.	20CS212	Advanced C Programming Lab	ES	4	0	0	4	2
8.	20EM211	Basic Engineering and Circuits Laboratory	ES	4	0	0	4	2
9.	20EI303	Electrical Machines	ES	3	3	0	0	3
10.	20EC302	Electronic Circuits	ES	3	3	0	0	3
11.	20CS302	Object Oriented Programming	ES	3	3	0	0	3
12.	20EI311	Devices and Machines lab	ES	4	0	0	4	2
13.	20CS311	Object Oriented Programming Laboratory	ES	4	0	0	4	2
14.	20CS201	Data structures	ES	3	3	0	0	3
15.	20EI603	Communication Engineering	ES	5	3	2	0	4

### PROFESSIONAL CORE (PC)

S.No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1.	20EI301	Instrument Transducers	PC	3	3	0	0	3
2.	20EI302	Electrical and Electronic Measurements	PC	5	3	2	0	4
3.	20EI401	Digital Principles and System Design	PC	3	3	0	0	3
4.	20EI402	Industrial Instrumentation	PC	3	3	0	0	3
5.	20EI403	Control System Design	PC	5	3	2	0	4
6.	20EE304	Linear Integrated Circuits	PC	3	3	0	0	3
7.	20EI411	Linear and Digital Integrated Circuits Lab	PC	4	0	0	4	2

8.	20EI412	Measurements and Transducers Lab	PC	4	0	0	4	2
9.	20EC402	Microprocessors and Microcontrollers	PC	3	3	0	0	3
10.	20EE603	Digital Signal Processing	PC	5	3	2	0	4
11.	20EI501	Process Control	PC	5	3	2	0	4
12.	20EI511	Process Control Lab	PC	4	0	0	4	2
13.	20EC411	Microprocessors and Microcontrollers Lab	PC	4	0	0	4	2
14.	20EI601	Factory Automation	PC	5	3	2	0	4
15.	20EI602	Industrial Internet of Things	PC	5	3	2	0	4
16.	20EC602	Embedded Systems	PC	3	3	0	0	3
17.	20EI611	Industrial Instrumentation and IoT Lab	PC	4	0	0	4	2
18.	20EI612	Industrial Automation Lab	PC	4	0	0	4	2
19.	20EI701	Medical Instrumentation	PC	3	3	0	0	3
20.	20EI702	Industrial Data Networks	PC	3	3	0	0	3
21.	20EI711	Instrumentation System Design Lab	PC	4	0	0	4	2
22.	20EI712	Embedded and Robotics lab	PC	4	0	0	4	2

**EMPLOYABILITY ENHANCEMENT COURSES (EEC)**

S.No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1.	20EI312	Mini project	EEC	2	0	0	2	1
2.	20CS313	Aptitude & Coding Skills – I	EEC	2	0	0	2	1
3.	20EC312	Foundation Lab on Internet of Things	EEC	2	0	0	2	1
4.	20CS414	Aptitude & Coding Skills-II	EEC	2	0	0	2	1
5.	20EI512	Internship	EEC	0	0	0	0	1
6.	20CS512	Advanced Aptitude & Coding Skills -I	EEC	2	0	0	2	1
7.	20CS614	Advanced Aptitude & Coding Skills – II	EEC	2	0	0	2	1
8.	20EI811	Project Work	EEC	20	0	0	20	10

## SUMMARY

	SUBJECT CATEGORY	SEMESTER								TOTAL CREDITS
		I	II	III	IV	V	VI	VII	VIII	
1.	HS	6	2		3					11
2.	BS	4	12	4	4					24
3.	ES	12	11	13		3	4			43
4.	PC			7	17	15	15	10		64
5.	PE					3	6	9		18
6.	OE					3		3		6
7.	EEC			2	2	2	1		10	17
8.	MC	-	-	-	-	-	-	-	-	-
		<b>22</b>	<b>25</b>	<b>26</b>	<b>26</b>	<b>26</b>	<b>26</b>	<b>22</b>	<b>10</b>	<b>183</b>

**OBJECTIVES:**

- Strengthen their basic reading and writing skills.
- Comprehend listening contexts competently.
- Improve their speaking skills to speak fluently in real contexts.
- Develop vocabulary of a general kind and enhance their grammatical accuracy.

**UNIT I COMMUNICATION BASICS 6**

Listening - short texts- short formal and informal conversations. Speaking- introducing oneself - exchanging personal information. Reading- practice in skimming-scanning and predicting. Writing-completing sentences- developing hints-free writing – Everyday expressions- collocations. Life Skills- Overview of Life Skills: significance of life skills.

**UNIT II COMMUNICATION INTERMEDIATE 6**

**Listening-** telephonic conversations. **Speaking** – sharing information of a personal kind—greeting – taking leave. **Reading**—short comprehension passages -pre-reading-post reading-comprehension questions (multiple choice questions and /or short questions/ open-ended questions) - **Writing** –paragraph writing- topic sentence- main ideas, short narrative descriptions using some suggested vocabulary and structures. **Life skills**– Self-awareness: definition, need for self-awareness; Coping with Stress and Emotions.

**UNIT III COMMUNICATION VANTAGE 6**

**Listening** – listening to longer texts and filling up the table - **Speaking-** asking about routine actions and expressing opinions. **Reading-** Long texts (cloze reading) - **Writing-** jumbled sentences - product description - use of reference words and discourse markers. Grammar – Tenses - phrasal verbs - Wh– Questions, yes or no questions and direct / indirect questions–countable & uncountable nouns – modal verbs. **Life skills** – Assertiveness vs Aggressiveness

**UNIT IV SYNERGISTIC COMMUNICATION 6**

**Listening-** listening to dialogues or conversations and completing exercises based on them - **Speaking-** speaking about oneself- speaking about one’s friend –**Reading-** different types of texts- magazines -**Writing-** letter writing, informal or personal letters-e-mails-conventions of personal email - Language development - synonyms – antonyms. **Life Skills**–Problem Solving Techniques.

**UNIT V COMMUNICATION HIGHER 6**

**Listening** – listening to TED talks - **Speaking** – role play – **Reading-** Biographies –**Writing-** writing short essays (analytical & issue-based essays) – dialogue writing. **Life Skills**– Leadership & Decision making.

**TOTAL: 30 PERIODS**

**OUTCOMES:**

- Read articles of a general kind in magazines and newspapers efficiently and identify different life skills.
- Participate efficiently in informal conversations and develop an awareness of the self and apply well-defined techniques to cope with emotions and stress.
- Comprehend conversations and short talks delivered in English.
- Write short essays of a general kind and personal letters and emails in English.
- Develop vocabulary of a general kind by enriching their reading skills.
- Use appropriate thinking and problem- solving techniques to solve new problems.

**TEXT BOOKS:**

1. Kumar, Suresh E and Sreehari,P. Communicative English.Orient Black Swan, 2007.
2. Richards, C. Jack. Interchange Students' Book-2 New Delhi: CUP,2015.

**REFERENCES:**

1. Bailey, Stephen. Academic Writing: A practical guide for students. New York: Rutledge,2011.
2. Dhanavel, S P. English and Soft Skills, Volume Two, Orient Black Swan, ISBN 978 93 528769142.
3. Elbow, Peter. Writing Without Teachers. London: Oxford University Press, 1973. Print.
4. Larry James, The First Book of Life Skills; First Edition, Embassy Books, 2016.
5. Larsen, Kristine, Stephen Hawking: A Biography, Greenwood:Publishing Group,2005.
6. Redston, Chris & Gillies Cunningham Face2Face (Pre-intermediate Student 's Book & Workbook) Cambridge University Press, New Delhi: 2005.

**OBJECTIVES:**

- Explain the concepts of matrix algebra.
- Make the students understand the idea of curvature, evolutes and envelopes.
- Impart the knowledge of functions of several variables.
- Introduce the concepts of Gamma and Beta integral.
- Develop an understanding on the basics of multiple integrals.

**UNIT I MATRICES 9+6**

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

**UNIT II APPLICATIONS OF DIFFERENTIAL CALCULUS 9+6**

Curvature in Cartesian and Polar Co-ordinates – Centre and radius of curvature – Circle of curvature – Evolutes – Envelopes (excluding Evolute as envelope of normals).

**UNIT III FUNCTIONS OF SEVERAL VARIABLES 9+6**

Limits – Continuity – Partial derivatives (excluding Euler's theorem) – Total derivative – Differentiation of implicit functions – Jacobian and properties – Taylor's series for functions of two variables – Maxima and minima of functions of two variables – Lagrange's method of undetermined multipliers.

**UNIT IV GAMMA, BETA INTEGRALS AND APPLICATIONS 9+6**

Gamma and Beta Integrals – Properties – Relation between Gamma and Beta functions, Evaluation of integrals using Gamma and Beta functions.

**UNIT V MULTIPLE INTEGRALS 9+6**

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

**TOTAL: 75 PERIODS****OUTCOMES:**

- Diagonalize a matrix by orthogonal transformation.
- Determine the Evolute and Envelope of curves.
- Examine the maxima and minima of function of several variables.
- Apply Gamma and Beta integrals to evaluate improper integrals.
- Evaluate the area and volume by using multiple integrals.

**TEXT BOOKS:**

1. Erwin Kreyszig, "Advanced Engineering Mathematics", John Wiley and Sons, 10<sup>th</sup> Edition, New Delhi, 2016.
2. B.S. Grewal, "Higher Engineering Mathematics", Khanna Publishers, New Delhi, 43rd Edition, 2014.
3. T. Veerarajan, "Engineering Mathematics", Tata McGraw Hill, 2<sup>nd</sup> Edition, New Delhi, 2011.

**REFERENCES:**

1. M. K. Venkataraman, "Engineering Mathematics, Volume I", 4<sup>th</sup> Edition, The National Publication Company, Chennai, 2003.
2. Sivaramakrishna Dass, C. Vijayakumari, "Engineering Mathematics", Pearson Education India, 4<sup>th</sup> Edition 2019.
3. H. K. Dass, and Er. Rajnish Verma, "Higher Engineering Mathematics", S. Chand Private Limited, 3<sup>rd</sup> Edition 2014.
4. B.V. Ramana, "Higher Engineering Mathematics", Tata McGraw Hill Publishing Company, 6<sup>th</sup> Edition, New Delhi, 2008.
5. S.S. Sastry, "Engineering Mathematics", Vol.I&II, PHI Learning Private Limited, 4<sup>th</sup> Edition, New Delhi, 2014.

**OBJECTIVES:**

- To develop in students, graphic skills for communication of concepts, ideas and design of Engineering products.
- To expose them to existing national standards related to technical drawings.

**UNIT I INTRODUCTION TO CONVENTIONS IN ENGINEERING DRAWING AND CAD COMMANDS 18**

Importance of graphics in engineering applications – Use of drafting instruments – BIS conventions and specifications – Size, layout and folding of drawing sheets – Lettering and dimensioning. Introduction to CAD commands- CAD user interface- coordinate systems, object selection methods, selection of units and precision. Sketching – line, circle, arc, polygon, rectangle and ellipse. Working with object snaps, layers and object properties. Editing the objects – copy, move, trim, extend, working with arrays, mirror, scale, hatch, fillet and chamfer. Conversion of simple pictorial diagrams to orthographic view using CAD software.

**UNIT II PLANE CURVES 16**

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

**UNIT III PROJECTION OF POINTS, LINES AND PLANE SURFACES 18**

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

**UNIT IV PROJECTION OF SOLIDS AND PROJECTION OF SECTIONED SOLIDS 20**

Projection of simple solids like prisms, pyramids, cylinder, cone and truncated solids when the axis is inclined to one of the principal planes by rotating object method. Sectioning of above solids in simple vertical position when the cutting plane is inclined to the one of the principal planes and perpendicular to the other – obtaining true shape of section.

**UNIT V DEVELOPMENT OF SURFACES AND ISOMETRIC PROJECTION 18**

Development of lateral surfaces of simple and sectioned solids – Prisms, pyramids cylinders and cones. Principles of isometric projection – isometric scale –Isometric projections of

simple solids and truncated solids - Prisms, pyramids, cylinders, cones- combination of two solid objects in simple vertical positions.

**TOTAL: 90 PERIODS**

**OUTCOMES:**

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

- Illustrate the fundamentals and standards of engineering drawing and apply the concepts of orthographic projections using CAD software.
- Interpret and construct various plane curves.
- Develop orthographic projections of points, lines and plane surfaces.
- Make use of concepts in projection to draw projections of solids and interpret the concept in section of solids.
- Interpret and visualize development of surfaces.
- Interpret and visualize isometric projection of simple solids.

**TEXT BOOKS:**

1. Natarajan K.V., “A text book of Engineering Graphics”, Dhanalakshmi Publishers, Chennai, 33<sup>rd</sup> Edition, 2020.
2. Venugopal K. and Prabhu Raja V., “Engineering Graphics”, New Age International (P) Limited, 15<sup>th</sup> Edition, 2019.

**REFERENCES:**

1. Bhatt N.D. and Panchal V.M., “Engineering Drawing”, Charotar Publishing House, 2012.
2. Basant Agarwal and Agarwal C.M., “Engineering Drawing”, Tata McGraw Hill Publishing Company Limited, New Delhi, 2<sup>nd</sup> Edition, 2013.
3. Engineering Drawing Practice for Schools and Colleges SP: 46, BIS, 2003.
4. Luzzader, Warren.J. and Duff,John M., “Fundamentals of Engineering Drawing with an introduction to Interactive Computer Graphics for Design and Production, Eastern Economy 11 th Edition, Prentice Hall of India Pvt. Ltd, New Delhi, 1993.
5. Parthasarathy N.S and Vela Murali, “Engineering Graphics”, Oxford University, Press, New Delhi, 2015.
6. Shah M.B., and Rana B.C., “Engineering Drawing”, Pearson, 2<sup>nd</sup> Edition, 2009

**OBJECTIVES:**

The goal of this course is to enlighten and sensitize the students on environmental conservation and social issues. The course is designed to:

- Appreciate the natural resources of environment which are inherently created for supporting life.
- Learn scientific and technological solutions to current day pollution issues.
- Study the interrelationship between living organisms and environment
- Understand the integrated themes of biodiversity.
- Appreciate the importance of environment by assessing its impact on the human world; envision the surrounding environment, its functions and its value.

**UNIT I NATURAL RESOURCES 11**

**Introduction** - scope and importance of environment – need for public awareness.

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

**UNIT II POLLUTION AND ITS MANAGEMENT 11**

**Pollution** – causes, effects and control measures - Air pollution- Water pollution - Soil pollution - Marine pollution - Noise pollution - Thermal pollution - Nuclear hazards - nuclear accidents and holocaust - role of an individual in prevention of pollution –case studies.

**Waste management**- causes, effects and control measures of municipal solid wastes, e- waste, plastic waste.

**UNIT III ECOSYSTEMS AND BIODIVERSITY 9**

**Introduction to ecosystems** – structure and function of an ecosystem – energy flow in the ecosystem – ecological succession – food chains, food webs and ecological pyramids - types, characteristic features, structure and functions of -Forest ecosystem - Grassland ecosystem -Desert ecosystem - Aquatic ecosystems (lakes, oceans)

**Introduction to biodiversity**–types (genetic, species and ecosystem diversity) –values of biodiversity – threats to biodiversity - endangered and endemic species – conservation of biodiversity (in-situ and ex-situ conservation)- India as a mega-diversity nation – hot-spots of biodiversity in India

**UNIT IV SOCIAL ISSUES AND THE ENVIRONMENT 8**

**Sustainable development** – sustainable development goals - water conservation, rain water harvesting, watershed management – resettlement and rehabilitation - consumerism and waste products, value education.

**Disaster management**- floods, drought, earthquake, tsunami, cyclone and landslides - case studies.

**Environmental ethics**-issues and possible solutions – environment protection act – air (prevention and control of pollution) act – water (prevention and control of pollution) act – wildlife protection act – forest conservation act.

## **UNIT V HUMAN POPULATION AND THE ENVIRONMENT**

**6**

**Introduction** - population growth, variation among nations, population explosion, family welfare programme – women and child welfare - environment and human health – endemic/epidemic/pandemic, COVID – 19, HIV / AIDS– role of information technology in environment and human health –environmental impact assessment- case studies.

**TOTAL: 45 PERIODS**

### **OUTCOMES:**

- Illustrate the importance and conservation of natural resources.
- Assess the impact of various pollutants and suggest appropriate pollution control methods.
- Explain the basic structure of ecosystem and the conservation of biodiversity.
- Analyze the social issues related to environment and recommend suitable solutions.
- Investigate the trends in population explosion and assess its impact.

### **TEXT BOOKS:**

1. Anubha Kaushik and C. P. Kaushik, “Perspectives in environmental studies”, New Age International, 6<sup>th</sup> edition, 2018.
2. Benny Joseph, “Environmental Science and Engineering”, Tata McGraw-Hill, New Delhi, 2017.
3. Gilbert M. Masters, Wendell P. Ela “Introduction to Environmental Engineering and Science”, 3<sup>rd</sup> edition, Pearson Education, 2015.

### **REFERENCES:**

1. William P. Cunningham and Mary Ann Cunningham, “Environmental Science: A Global Concern”, McGraw Hill, 14<sup>th</sup> edition, 2017.
2. G. Tyler Miller and Scott E. Spoolman, “Environmental Science”, Cengage Learning India Pvt. Ltd., Delhi, 14<sup>th</sup> edition, 2014.
3. ErachBharucha, “Textbook of Environmental Studies”, Universities Press Pvt. Ltd., Hyderabad, 2<sup>nd</sup> edition, 2015.

**OBJECTIVES:**

- To make the students understand the fundamentals of problem-solving using Algorithm and Flowchart
- To teach the basic programming constructs for solving simple problems
- To introduce the basic concepts of arrays and strings
- To acquaint the students about functions, pointers, structures and their relationship
- To impart knowledge on the concepts of file handling

**UNIT I INTRODUCTION TO ALGORITHM AND C 9**

Introduction to Computer System – Block diagram, Program Development Life Cycle

**General problem solving concepts:** Algorithm and Flowchart for problem solving with Sequential Logic Structure, Decisions and Loops.

**Imperative languages:** Introduction to imperative language, syntax and constructs of a specific language (ANSI C), Applications

**Types, Operators:** Variable Names, Data Type and Sizes (Little Endian Big Endian), Constants, Declarations, Basic I/O using scanf, printf, Operators – Types, Precedence, Associativity, Proper variable naming and Hungarian Notation.

**UNIT II CONTROL FLOW STATEMENTS 7**

Control Flow with discussion on structured and unstructured programming: Statements and Blocks, If-Else-If, Switch, Loops – while, do, for, break and continue, goto labels, structured and unstructured programming.

**UNIT III ARRAYS AND FUNCTIONS 10**

Arrays and Strings – Initialization, Declaration – One Dimensional and Two Dimensional arrays – Linear search, Binary Search, Matrix Operations (Addition and Subtraction)

Basics of functions, parameter passing and returning type, C main return as integer, External, Auto, Local, Static, Register Variables, Scope Rules, Block structure, Initialisation, Recursion, Pre-processor, Standard Library Functions and return types.

**UNIT IV STRUCTURES AND POINTERS 10**

Basic Structures, Structures and Functions, Array of structures.

Pointers and address, Pointers and Function Arguments, Pointers and Arrays, Address Arithmetic, character Pointers and Functions, Pointer Arrays, Pointer to Pointer, Initialisation of Pointer Arrays, Command line arguments, Pointer to functions, complicated declarations and how they are evaluated.

Pointer of structures, Self-referential structures, Table look up, typedef, unions, Bit-fields

Formatted Output – fprintf, Formated Input – fscanf, Variable length argument list

Files - file access including FILE structure, fopen, fread, fwrite, stdin, stdout and stderr, File Types – Text, Binary - Error Handling including exit, perror and error.h, Line I/O, related miscellaneous functions.

**TOTAL: 45 PERIODS**

**OUTCOMES:**

- Develop algorithmic solutions to simple computational problems
- Develop simple applications using basic constructs
- Write programs using arrays and strings
- Design and implement applications using functions, pointers and structures.
- Design applications using sequential and random access file processing.

**TEXT BOOKS:**

1. Brian W Kernighan and Dennis M Ritchie, The C Programming Language, Pearson Education India, 2nd Edition, 2015.
2. Anita Goel and Ajay Mittal, “Computer Fundamentals and Programming in C”, Dorling Kindersley (India) Pvt. Ltd., Pearson Education in South Asia, 2011.

**REFERENCES:**

1. B. Gottfried, Programming with C, Schaum Outline Series, Fourth Edition, 2018
2. Herbert Schildt, C: The Complete Reference, McGraw Hill, Fourth Edition, 2017
3. Yashavant Kanetkar, Let Us C, BPB Publications, 16<sup>th</sup> Edition, 2018.
4. Reema Thareja, “Programming in C”, 2<sup>nd</sup> Edition, Oxford University Press, 2018.
5. Zed A. Shaw, “Learn C the Hard Way: Practical Exercises on the Computational Subjects You Keep Avoiding (like C)”, (Zed Shaw’s Hard Way Series), 1<sup>st</sup> Edition, Addison-Wesley Professional, 2015.

20CM106

**CORE I - BASIC CIVIL & MECHANICAL  
ENGINEERING**

**L T P C**

**3 0 0 3**

**OBJECTIVES:**

- To introduce various fields of civil engineering with emphasize on measurements, materials and structural components
- To provide an exposure on various applications of Engines, power plants, refrigerator and air conditioning systems

**UNIT I OVERVIEW OF CIVIL ENGINEERING 12**

Overview of Civil Engineering- Civil Engineering contributions to the welfare of Society – Specialized sub disciplines in Civil Engineering – Structural, Construction, Geotechnical, Environmental, Transportation and Water Resources Engineering. Surveying: Objects – classification – principles – measurements of distances – angles – leveling – determination of areas– contours - examples. Civil Engineering Materials: Bricks – stones – sand – cement – concrete – steel - timber – modern materials.

**UNIT II BUILDING COMPONENTS AND STRUCTURES 13**

Overview of Civil Engineering- Civil Engineering contributions to the welfare of Society – Specialized sub disciplines in Civil Engineering – Structural, Construction, Geotechnical, Environmental, Transportation and Water Resources Engineering. Surveying: Objects – classification – principles – measurements of distances – angles – leveling – determination of areas– contours - examples. Civil Engineering Materials: Bricks – stones – sand – cement – concrete – steel - timber – modern materials.

**UNIT III INTRODUCTION TO MECHANICAL ENGINEERING AND  
AIR STANDARD CYCLES 10**

- Overview of Mechanical Engineering:** Mechanical Engineering contributions to the welfare of Society –Specialized sub disciplines in Mechanical Engineering - Production, Automobile, Energy Engineering - Introduction and classification of Engineering materials.
- Air Standard Cycles:** Otto, Diesel, Dual &Brayton Cycle - Analysis & Optimization. Components of Diesel and Gas Turbine power plants. Combined Cycle Power Plants. Integrated Gasifier based Combined Cycle systems.

**UNIT IV INTERNAL COMBUSTION ENGINES ANDPOWER PLANTS 15**

Rankine cycle - improvisations, Classification of Power Plants - Internal combustion engines as automobile power plant – Working principle of Petrol and Diesel Engines – Four stroke and two stroke cycles – Comparison of four stroke and two stroke engines – Working principle of steam, Gas, Diesel, Hydro - electric and Nuclear Power plants. Binary Cycles and Cogeneration systems.

**UNIT V PUMPS, REFRIGERATION AND AIRCONDITIONING SYSTEM 10**

Working principle of Boilers, Turbines, Reciprocating Pumps (single acting and double acting) and Centrifugal Pumps

Terminology of Refrigeration and Air Conditioning. Principle of vapor compression and absorption system–Layout of typical domestic refrigerator–Window and Split type room Air conditioner.

**TOTAL: 60 PERIODS**

**OUTCOMES:**

- Apply the knowledge on Civil engineering fundamentals for practical applications
- Understand various building components, structures and infrastructural facilities.
- Elaborate the mechanical engineering fundamentals for practical applications and Air standard cycles.
- Identify the components used in power plant cycle.
- Interpret the working principles of petrol and diesel engine.
- Elaborate the components of refrigeration and Air conditioning cycle.

**TEXT BOOKS:**

1. Shanmugam G and Palanichamy M S, “Basic Civil and Mechanical Engineering”, Tata McGraw Hill Publishing Co., New Delhi. 2018.

**REFERENCES:**

1. Palanikumar, K. Basic Mechanical Engineering, ARS Publications,2010.
2. Ramamrutham S., “Basic Civil Engineering”, Dhanpat Rai Publishing Co. (P) Ltd.2004.
3. Seetharaman S., “Basic Civil Engineering”, Anuradha Agencies, 2005.
4. ShanthaKumarSRJ., “Basic Mechanical Engineering”, Hi-tech Publications, Mayiladuthurai, 2000.
5. Venugopal K. and Prahua Raja V., “Basic Mechanical Engineering”, Anuradha Publishers, Kumbakonam,2007.
6. Rajput, R.K., “Thermal Engineering”, Laxmi Publications, 2010.

**OBJECTIVES:**

- To make the students write simple programs using basic constructs
- To familiarize the concepts of strings, pointers, functions and structures
- To equip the students on the knowledge of file processing concepts

**LIST OF EXPERIMENTS**

1. Constructing Flow charts using RAPTOR tools.
2. Programs using I/O statements and expression
3. Write a program to find whether the given line is horizontal or vertical.
4. Write a program to calculate the distance between two points  $p1(x1,y1)$ ,  $p2(x2,y2)$ .
5. Write a program to calculate the force for the given mass and acceleration.
6. Write a program to calculate the Young's modulus.
7. Write a program to calculate the type of solution based on its pH value.
8. Write a program to temperature conversion (Fahrenheit to Celsius and vice versa)
9. Programs using decision-making constructs.
10. Write a program to find whether the given year is leap year or Not? (Hint: not every centurion year is a leap. For example 1700, 1800 and 1900 is not a leap year)
11. Design a calculator to perform the operations, namely, addition, subtraction, multiplication, division and square of a number.
12. Check whether a given number is Armstrong number or not?
13. Given a set of numbers like, find sum of weights based on the following conditions.
  - 5 if it is a perfect cube.
  - 4 if it is a multiple of 4 and divisible by 6.
  - 3 if it is a prime number.Sort the numbers based on the weight in the increasing order as shown below  
<10,its weight>, <36,its weight>, <89,its weight>
14. Populate an array with height of persons and find how many persons are above the average height.
15. Populate a two dimensional array with height and weight of persons and compute the BodyMass Index of the individuals.
16. Given a string —a\$bcd./fg| find its reverse without changing the position of special characters.(Example input:a@gh%;j and output:j@hg%;a)
17. Convert the given decimal number into binary, octal and hexadecimal numbers using user
18. From a given paragraph perform the following using built-in functions:
  - a. Find the total number of words.
  - b. Capitalize the first word of each sentence.
  - c. Replace a given word with another word.

19. Solve towers of Hanoi using recursion.
20. Sort the list of numbers using pass by reference.
21. Generate salary slip of employees using structures and pointers. Create a structure Employee with the following members:  
EID, Ename, Designation, DOB, DOJ, Basicpay  
Note that DOB and DOJ should be implemented using structure within structure.
22. Compute internal marks of students for five different subjects using structures and functions.
23. Insert, update, delete and append telephone details of an individual or a company into a telephone directory using random access file.
24. Count the number of account holders whose balance is less than the minimum balance using sequential access file.
25. Mini project: Create a —Railway reservation system with the following modules
  - Booking
  - Availability checking
  - Cancellation
  - Prepare chart

**TOTAL: 60 PERIODS**

## **OUTCOMES**

- Write programs for simple applications making use of basic constructs, arrays and strings.
- Develop programs involving functions, recursion, pointers, and structures.
- Create applications using sequential and random access file processing.

### **TEXT BOOKS:**

1. Brian W Kernighan and Dennis M Ritchie, The C Programming Language, Pearson Education India, 2nd Edition, 2015.
2. Anita Goel and Ajay Mittal, “Computer Fundamentals and Programming in C”, Dorling Kindersley (India) Pvt. Ltd., Pearson Education in South Asia, 2011.

### **REFERENCES:**

1. B. Gottfried, Programming with C, Schaum Outline Series, Fourth Edition, 2018
2. Herbert Schildt, C: The Complete Reference, McGraw Hill, Fourth Edition, 2017
3. Yashavant Kanetkar, Let Us C, BPB Publications, 16<sup>th</sup> Edition, 2018.
4. Reema Thareja, “Programming in C”, 2<sup>nd</sup> Edition, Oxford University Press, 2018.
5. Zed A. Shaw, “Learn C the Hard Way: Practical Exercises on the Computational Subjects You Keep Avoiding (like C)”, (Zed Shaw’s Hard Way Series), 1<sup>st</sup> Edition, Addison-Wesley Professional, 2015.

20EL112

**INTERPERSONAL SKILLS – LISTENING, SPEAKING,  
READING AND WRITING LAB**

**L T P C**

**0 0 4 2**

**OBJECTIVES:**

- Equip and Strengthen the English language skills
- Provide guidance and practice to engage in specific academic speaking activities and enhance writingskills with specific reference to technical writing.
- Improve general and academic listening skills and develop critical thinking skills  
Develop their project, proposal writingandeffective presentation skills.

**UNIT I**

**12**

Listening as a key skill- its importance- speaking - pronunciation basics -Reading - Strategies for effective reading - Writing -Write a descriptive paragraph - Predicting content using photos and title.

**UNIT II**

**12**

Listen for information – Speaking- conversation starters: small talk - Reading - Use of graphic organizers to review and aid comprehension. Writing - Write an opinion paragraph

**UNIT III**

**12**

Listening - listen for detail Speaking - deliver a five-minute talk -Reading - speed reading techniques - Writing –Analytical Essay.

**UNIT IV**

**12**

Listening - Being an active listener: giving verbal and non-verbal feedback – Speaking - participating in a group discussion - summarizing academic readings-Reading - Genre and Organization of Ideas – Writing - Email writing - Job application

**UNIT V**

**12**

Listening - directions and instructions in academic and business contexts - Speaking- group/pair presentations -Reading - Critical reading and thinking -Writing - letter of recommendation - Vision statement

**TOTAL: 60 PERIODS**

**OUTCOMES:**

- Listen and respond appropriatelyin conversations both formal and informal
- Participate in group discussions
- Make effective presentations
- Write different types of essays and winning job applications.
- Read and evaluate texts critically.
- Display critical thinking in various professional contexts.

**TEXT BOOKS:**

1. Brooks, Margret. Skills for Success. Listening and Speaking. Level 4 Oxford University Press, Oxford: 2011.
2. Richards, C. Jack. & David Bholke. Speak Now Level 3. Oxford University Press, Oxford: 2010.

**REFERENCES:**

1. Elbow, Peter. Writing Without Teachers. London: Oxford University Press, 1973. Print.
2. Hughes, Glyn and Josephine Moate. Practical English Classroom. Oxford University Press: Oxford, 2014.
3. Ladousse, Gillian Porter. Role Play. Oxford University Press: Oxford, 2014
4. Richards C. Jack. Person to Person (Starter). Oxford University Press: Oxford, 2006.
5. Vargo, Mari. Speak Now Level 4. Oxford University Press: Oxford, 2013.

**OBJECTIVES:**

- Develop strategies and skills to enhance their ability to read and comprehend engineering and technology texts.
- Foster their ability to write convincing job applications and effective reports.
- Demonstrate their speaking skills to make technical presentations, participate in group discussions.
- Strengthen their listening skill which will help them comprehend lectures and talks in their areas of specialization.

**UNIT I INTRODUCTION - TECHNICAL ENGLISH 6**

**Listening-** Listening to talks mostly of a scientific/technical nature and completing information-gap exercises- **Speaking** –Asking for and giving directions- **Reading** – reading short technical texts from journals- newspapers- **Writing-** purpose statements – extended definitions – writing instructions – checklists – Recommendations-Vocabulary Development-technical vocabulary. Language Development –subject verb agreement - compound words.

**UNIT II READING AND STUDY SKILLS 6**

**Listening-** Listening to longer technical talks and completing exercises based on them- **Speaking** -describing a process-**Reading**– reading longer technical texts- identifying the various transitions in a text- paragraphing- **Writing-** interpreting charts, graphs- Vocabulary Development-vocabulary used in formal letters/emails and reports Language Development- impersonal passive voice, numerical adjectives.

**UNIT III TECHNICAL WRITING AND GRAMMAR 6**

**Listening-** Listening to classroom lectures/ talks on engineering/technology -**Speaking** – introduction to technical presentations- **Reading** – longer texts both general and technical, practice in speed reading; **Writing-**Describing a process, use of sequence words- Vocabulary Development- sequence words- Misspelled words. Language Development- embedded sentences

**UNIT IV REPORT WRITING 6**

**Listening-** Listening to documentaries and making notes. **Speaking** – mechanics of Presentations-**Reading** – reading for detailed comprehension- **Writing-** Report Writing (accident and survey) - minutes of a meeting - Vocabulary Development- finding suitable synonyms-paraphrasing-. Language Development-reported speech.

**UNIT V GROUP DISCUSSION AND JOB APPLICATIONS 6**

**Listening-** TED talks; **Speaking** –participating in a group discussion -**Reading**– reading and understanding technical articles **Writing**– email etiquette- job application – cover letter – Résumé preparation (via email and hard copy)- Vocabulary Development- verbal analogies - Language Development- clauses- if conditionals.

**TOTAL :30 PERIODS**

**OUTCOMES :**

- Read technical texts and write area- specific texts effortlessly.
- Listen and comprehend lectures and talks in their area of specialization successfully.
- Speak appropriately and effectively in varied formal and informal contexts.
- Write reports and winning job applications.

**TEXT BOOKS:**

1. Booth-L. Diana, Project Work, Oxford University Press, Oxford: 2014.
2. Sudharshana.N.P and Saveetha C. English for Technical Communication. Cambridge University Press: New Delhi, 2016.

**REFERENCES:**

1. Grussendorf, Marion, English for Presentations, Oxford University Press, Oxford: 2007.
2. Herbert, A. J. The Structure of Technical English.Longman.1976.
3. Kumar, Suresh. E. Engineering English. Orient Black swan: Hyderabad,2015.
4. Means, L. Thomas and Elaine Langlois, English & Communication for Colleges. Cengage Learning, USA: 2007.
5. Raman, Meenakshi and Sharma, Sangeetha- Technical Communication Principles and Practice. Oxford University Press: New Delhi,2014.

**OBJECTIVES:**

- Explain various techniques in solving ordinary differential equations.
- Make the students understand the concepts of vector differentiation and integration.
- Introduce the concepts of Laplace transforms and its applications.
- Develop an understanding on analytic function, conformal mapping and complex integration.

**UNIT I ORDINARY DIFFERENTIAL EQUATIONS 9+6**

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

**UNIT II VECTOR CALCULUS 9+6**

Gradient, divergence and curl (excluding vector identities) – Directional derivative – Irrotational and solenoidal vector fields – Vector integration – Green's theorem in a plane, Gauss divergence theorem and Stoke's theorem (Statement only) – Simple applications involving cubes and rectangular parallelepipeds.

**UNIT III LAPLACE TRANSFORMS 9+6**

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

**UNIT IV COMPLEX DIFFERENTIATION AND CONFORMAL MAPPING 9+6**

Functions of a complex variable – Analytic functions: Necessary conditions – Cauchy-Riemann equations and sufficient conditions (Statement only) – Harmonic and orthogonal properties of analytic function – Harmonic conjugate – Construction of analytic functions – Conformal mapping:  $w = z+k$ ,  $kz$ ,  $1/z$ ,  $z^2$  and bilinear transformation.

**UNIT V COMPLEX INTEGRATION 9+6**

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

**TOTAL: 60 PERIODS**

**OUTCOMES:**

- Solve the higher order linear differential equations.
- Determine the gradient of a scalar field, divergence and curl of a vector fields and interpret their physical meaning and evaluate line, surface and volume integrals by vector integration.
- Apply Laplace Transforms method for solving linear ordinary differential equation.
- Construct an analytic function and analyze conformal mapping.
- Evaluate the real integrals using complex integration.

**TEXT BOOKS:**

1. Erwin Kreyszig, "Advanced Engineering Mathematics", John Wiley and Sons, 10<sup>th</sup> Edition, New Delhi, 2016.
2. B.S. Grewal, "Higher Engineering Mathematics", Khanna Publishers, New Delhi, 43<sup>rd</sup> Edition, 2014.
3. T. Veerarajan, "Engineering Mathematics", Tata McGraw Hill, 2<sup>nd</sup> Edition, New Delhi, 2011.

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1. M. K. Venkataraman, "Engineering Mathematics, Volume II", 4<sup>th</sup> Edition, The National Publication Company, Chennai, 2003.
2. Sivaramakrishna Dass, C. Vijayakumari, "Engineering Mathematics", Pearson Education India, 4<sup>th</sup> Edition 2019.
3. H. K. Dass, and Er. Rajnish Verma, "Higher Engineering Mathematics", S. Chand Private Limited, 3<sup>rd</sup> Edition 2014.
4. B.V. Ramana, "Higher Engineering Mathematics", Tata McGraw Hill Publishing Company, 6<sup>th</sup> Edition, New Delhi, 2008.
5. S.S. Sastry, "Engineering Mathematics", Vol. I & II, PHI Learning Private Limited, 4<sup>th</sup> Edition, New Delhi, 2014.

**OBJECTIVES:**

- To educate the fundamental important concepts in physics and to apply the knowledge in solving scientific and engineering problems.
- To impart the basic concepts of conducting materials, semiconducting materials, opto and nano electronic devices, light propagation in waveguides and electro-magnetostatics and electrodynamics.

**UNIT I CONDUCTING MATERIALS 9**

Classical free electron theory - Expression for electrical conductivity -Four probe method-determination of resistivity -Expression for Thermal conductivity- Wiedemann-Franz law - Success and failures of CFT -Effect of temperature on Fermi function - Density of energy states- Carrier concentration in metals and average energy of an electron at 0 K – Energy bands in solids.

**UNIT II SEMICONDUCTING MATERIALS 9**

Intrinsic semiconductors – Energy band diagram – Direct and indirect band gap semiconductors – Carrier concentration in intrinsic semiconductors – determination of band gap - Extrinsic semiconductors - n-type and p-type semiconductors (qualitative) – Variation of Fermi level with temperature and impurity concentration – Hall effect and its applications.

**UNIT III OPTO AND NANO ELECTRONIC DEVICES 9**

Carrier generation and recombination processes in semiconductors (concepts only) –LED- Organic LED- Photodetectors- Photodiodes -Solar cell – Electron density in bulk material (qualitative) -Size dependence of Fermi energy- Band gap of nanomaterial -Quantum confinement-Quantum structures -Density of states in quantum well, quantum wire and quantum dot structures - Quantum dot lasers.

**UNIT IV LASER AND FIBRE OPTICS 9**

Population of energy levels, Einstein's A and B coefficients- derivation – Resonant cavity, optical amplification (qualitative) – Semiconductor lasers: homojunction and heterojunction – Engineering applications in communication.

Fibre optics -principle, numerical aperture and acceptance angle, V-number – Types of optical fibre (Material, Refractive index and Mode) – Losses in optical fibre - Fibre optic communication -Fibre optic sensors (pressure and displacement).

**UNIT V ELECTRO-MAGNETOSTATICS AND ELECTRODYNAMICS 9**

Electrostatics: Coulomb's law - Gauss's law, Applications of Gauss's law (qualitative) - Maxwell's equation-I (equation only) - Electric field in matter: dielectrics, electric polarization, electric permittivity and susceptibility, relative permittivity, Types of polarization (electronic, ionic, orientation and space charge) - Internal field – Derivation - Clausius-Mossotti equation.

Magnetostatics: Biot-Savart law and its applications (qualitative) – Ampere’s law and its applications (qualitative)-Lorentz force-Maxwell’s equation-II (equations only).

Electrodynamics: Faraday’s law of induction, Lenz law - Maxwell’s equations-III and IV (equations only) – Electromagnetic waves in dielectric medium -Electromagnetic waves in vacuum.

**TOTAL: 45 PERIODS**

**OUTCOMES:**

- estimate the conducting properties of materials based on CFE and QFE theories and understand the formation of energy band structures.
- understand the basic properties of semiconducting materials and apply the concepts to determine Hall coefficient.
- elucidate the principle and working of various opto and nanoelectronic devices and their applications.
- attain basic knowledge on the concepts of lasers and apply in fibre optic communication.
- correlate electric and magnetic field behavior of electro-magnetostatics and electrodynamics.
- understand the concepts of conducting materials, semiconducting materials and apply the same to determine resistivity and band gap, explicate the principle and working of opto and nanoelectronic devices and analyze Maxwell’s equation in different forms (differential and integral) in Electro-Magnetostatics and Electrodynamics.

**TEXT BOOKS:**

1. M.N. Avadhanulu and P.G. Kshirsagar, “A Textbook of Engineering Physics”, S. Chand and Company, New Delhi, 2014.
2. R.K. Gaur and S.L. Gupta, “Engineering Physics”, Dhanpat Rai Publications (P) Ltd., Eighth Edition, New Delhi, 2001.
3. B.K. Pandey and S. Chaturvedi, “Engineering Physics”, Cengage Learning India, 2012.
4. A. Marikani, “Materials Science”, PHI Learning Private Limited, Eastern Economy Edition, 2017.
5. R. Wolfson, “Essential University Physics”, Volume 1 and 2 with Mastering Physics, Global Edition, 3<sup>rd</sup> Edition, Pearson 2017.
6. S. O. Kasap, “Principles of Electronic Materials and Devices”, McGraw-Hill Education, 2007.
7. David J Griffiths, “Introduction to Electrodynamics”, Pearson Education India Learning Private Limited;, 4 th edition, 2015.
8. “J. D Kraus”, “Electromagnetics”, McGraw-Hill Inc. 4th edition, 1992.

**REFERENCES:**

1. J. Singh, “Semiconductor Optoelectronics: Physics and Technology”, McGraw-Hill Inc., 1995.
2. S.M. Sze, “Semiconductor Devices: Physics and Technology”, Second

Edition, Wiley 2008.

3. R. E. Hummel, "Electronic Properties of Materials", Springer, 2001.
4. G. W. Hanson, "Fundamentals of Nanoelectronics", Pearson Education, 2008.
5. B. Rogers, J. Adams, P. Sumitha, "Nanotechnology: Understanding Small Systems", CRC Press, 2014.
6. D. Halliday, R. Resnick and J. Walker, "Fundamentals of Physics", Wiley Publications, 2008.
7. R. A. Serway and J. W. Jewett, "Physics for Scientists and Engineers", Volume 5, Chapters 40-46, 8<sup>th</sup> Edition, Cengage Learning, 2010.
8. P. M. Fishbane, S. Gasiorowicz, S. Thornton, "Physics for Scientists and Engineers", 3<sup>rd</sup> Edition, Chapters 1-40, 2005.

**OBJECTIVES:**

- Understand the role of chemistry in everyday life.
- Develop an understanding of the basic concepts of electro chemistry and its applications.
- Learn the principles and generation of energy in different types of batteries, fuel cells, nuclear reactors, solar cells and wind mills.
- Make them acquire basic knowledge of polymers, their classification and the applications of speciality polymers in engineering and technology.
- Understand the preparation, properties and applications of nanomaterials in various fields.

**UNIT I CHEMISTRY IN EVERYDAY LIFE 8**

**Importance of chemistry in everyday life-** food additives - types (colours, preservatives, flavours and sweeteners), effects - food adulteration– types of adulteration (intentional, incidental)- effects of food adulterants –cosmetics and personal care products (fairness creams, perfumes, deodorants, shampoos)- effects – beverages-classification – carbonated beverages – nutritive values and effects.

**Water** – impurities – industrial uses of water – hardness, external treatment (demineralization) – desalination (reverse osmosis).

**UNIT II ELECTROCHEMISTRY 10**

**Introduction** – terminology-conductance of electrolytes- specific conductance, equivalent conductance, molar conductance-factors affecting conductance- origin of electrode potential-single electrode potential, standard electrode potential-measurement of single electrode potential-reference electrodes (standard hydrogen electrode, calomel electrode) - electrochemical series, applications –measurement of EMF of the cell – Nernst equation (derivation), numerical problems.

**Chemical sensors** – principle of chemical sensors- breath analyzer and Clark oxygen analyzer.

**UNIT III ENERGY STORAGE DEVICES AND ENERGY SOURCES 9**

**Batteries** – primary battery (alkaline battery) -secondary battery (Pb-acid battery, Ni-metal hydride battery, Li-ion battery) - fuel cells (H<sub>2</sub>-O<sub>2</sub> fuel cell).

**Nuclear Energy** –nuclear reactions –fission, fusion, differences, characteristics– nuclear chain reactions –light water nuclear reactor – breeder reactor.

**Renewable energy sources**-solar energy – thermal conversion (solar water heater and heat collector) - photovoltaic cell– wind energy.

**UNIT IV POLYMERS 9**

**Introduction** – monomer, functionality, degree of polymerization – classification based on sources and applications – effect of polymer structure on properties - types of polymerization (addition, condensation) - thermoplastic and thermosetting resins – preparation, properties and applications of Teflon, polyvinyl chloride, polycarbonate, Bakelite.

**Special polymers** - biodegradable polymers - properties and applications of polycaprolactone, polyhydroxyalkanoate – properties and applications of electrically

conducting polymers (poly aniline, polyvinylidene fluoride).

## **UNIT V      NANO CHEMISTRY**

**9**

**Introduction** –synthesis – top-down process (laser ablation, chemical vapour deposition), bottom-up process (precipitation, electrochemical deposition)– properties of nanomaterials – types (nanorods, nanowires, nanotubes-carbon nanotubes, nanocomposites).

**Applications** of carbon nanotubes – applications of nanomaterials in electronics, information technology, medical and healthcare, energy, environmental remediation, construction and transportation industries.

**TOTAL : 45 PERIODS**

### **OUTCOMES:**

- Illustrate the role of chemistry in everyday life and the industrial uses of water.
- Construct electrochemical cells and to determine the cell potential.
- Compare and analyse the different energy storage devices and to explain potential energy sources.
- Classify different types of polymeric materials and to discuss their properties and applications.
- Explain basic concepts of nano chemistry and to enumerate the applications of nanomaterials in engineering and technology.

### **TEXT BOOKS:**

1. P. C. Jain and Monika Jain, “Engineering Chemistry”, 17<sup>th</sup> edition, Dhanpat Rai Publishing Company Pvt. Ltd., New Delhi, 2018.
2. Prasanta Rath, “Engineering Chemistry”, 1<sup>st</sup> edition, Cengage Learning India Pvt. Ltd., Delhi, 2015.

### **REFERENCES:**

1. S. S. Dara and S. S. Umare, “A Textbook of Engineering Chemistry”, 12<sup>th</sup> edition, S. Chand & Company, New Delhi, 2010.
2. Kirpal Singh, “Chemistry in daily life”, 3<sup>rd</sup> edition, PHI Learning Pvt. Ltd., 2012.
3. J. C. Kuriacose and J. Rajaram, “Chemistry in Engineering and Technology”, Volume-1 & Volume -2, Tata McGraw-Hill Education Pvt. Ltd., 2010.
4. Geoffrey A.Ozin, Andre C. Arsenault, Ludovico Cademartiri, “Nanochemistry: A Chemical Approach to Nanomaterials”, 2<sup>nd</sup> edition, RSC publishers, 2015.
5. Prasanna Chandrasekhar, “Conducting polymers, fundamentals and applications - A Practical Approach”, 1<sup>st</sup> edition, Springer Science &Business Media, New York, 1999.

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**CORE II –BASIC ELECTRONICS AND  
INSTRUMENTATION ENGINEERING**

**L T P C**

**3 0 0 3**

**OBJECTIVES:**

- To contrast the basic operation of PN junction devices and its applications
- To study the construction and working of transistors and special electronic devices
- To acquire knowledge in basic Industrial Instrumentation system
- To study the characteristics of Measurement system
- To explain various types of Measuring Instruments

**UNIT I PN JUNCTION DEVICES AND ITS APPLICATIONS 9**

PN diode structure, operation and V-I characteristics, diffusion and transition capacitance, Zener diode, Zener diode Reverse characteristics, Rectifiers - Half Wave and Full Wave Rectifiers, Filters- Series Inductor Filter, Shunt capacitor filter, LC filter, Zener diode as regulator.

**UNIT II TRANSISTORS AND SPECIAL DEVICES 9**

Structure, operation and characteristics: BJT Common Base, Common Emitter, Common Collector. JFET, MOSFET, UJT, Structure and operation-SCR, DIAC, TRIAC

**UNIT III BASIC INSTRUMENTATION SYSTEM 9**

Classification and Scope of Instrumentation system in industries, Instrumentation and control techniques-Manual control and automatic control, Instrumentation system- Basics, Process variables and parameters.

**UNIT IV BASIC MEASUREMENTS 9**

Units and standards, Calibration methods-Static calibration, Classification of errors, Limiting error and probable error, Error analysis-Statistical methods, Odds and uncertainty, Static characteristics-Accuracy, precision, resolution, sensitivity, linearity, span and range, Dynamic characteristics.

**UNIT V ELECTRICAL AND ELECTRONIC MEASUREMENTS 9**

Types of electrical Instruments, Types of operating forces, Construction and operation of PMMC and moving iron instruments, D'Arsonval galvanometer, Electronic voltmeter and advantages, General purpose cathode ray oscilloscope, Dual trace sampling oscilloscope, Dual beam sampling oscilloscope, Analog and digital storage oscilloscope

**TOTAL: 45 PERIODS**

**OUTCOMES:**

- Understand the structure and operation of PN junction devices and power supply design
- Differentiate the various transistors and special electronic devices for real time applications
- Illustrate the basic knowledge in Industrial Instrumentation system
- Verify the static and dynamic characteristics of Measurement system
- Categorize the various types of Measuring Instruments for the Industrial applications

**TEXT BOOKS:**

1. Robert L. Boylestad, "Electronic Devices and Circuit theory", 11th edition, Published by Pearson, 2013
2. A.K. Sawhney, "A Course in Electrical & Electronic Measurements and Instrumentation", Dhanpat Rai and Co, New Delhi, 2010.

**REFERENCES:**

1. David A. Bell, "Electronic Devices and Circuits", Prentice Hall of India, 2004.
2. Floyd, "Electron Devices" Pearson Asia, 9th Edition, 2012.
3. D. Patranabis, "Sensors and Transducers", 2nd edition, Prentice Hall of India, 2010.
4. D.V.S Murthy, "Transducers and Instrumentation", 2nd Edition, Prentice Hall of India Pvt. Ltd., New Delhi, 2010.
5. S.K.Singh., "Industrial Instrumentation and Control", 3rd Edition, Tata McGraw - Hill Education, 2008.
6. A.D. Helfrick and W.D. Cooper, "Modern Electronic Instrumentation and Measurement Techniques", Prentice Hall India Pvt Ltd., New Delhi, 2010.
7. H.S. Kalsi, "Electronic Instrumentation", Tata McGraw-Hill, New Delhi, 2010.
8. NPTL website link :<https://nptel.ac.in/courses/117/106/117106091/>,  
<https://nptel.ac.in/courses/103/105/103105064/>,  
<https://nptel.ac.in/courses/108/105/108105153/>
9. Website link: <https://new.siemens.com/global/en/products/automation/process-instrumentation.html>

**OBJECTIVES:**

- To develop the basic concepts of network analysis, which is the pre-requisite for all the electrical engineering subjects.
- To solve different complex circuits using various network reduction techniques such as Source transformation, Network theorems etc.
- To analyze the series and parallel resonant circuit and to synthesise coupled circuits
- To comprehend three phase systems with balanced and unbalanced loads and power measurements.
- To evaluate AC and DC transients for complex electrical systems.

**UNIT I BASIC CIRCUITS ANALYSIS AND NETWORK REDUCTION 6+6**

Resistive elements – Ohm’s Law -Resistors in series and parallel circuits – Kirchoffs laws - Voltage and current division rule, source transformation -star delta conversion-network reduction techniques– Mesh current and node voltage-methods of analysis for AC and DC circuits-dependent and independent sources

**UNIT II THEOREMS FOR DC AND AC CIRCUITS 6+6**

A.C. circuits – Average and RMS value – Phasor Diagram – Power, Power Factor and Energy. Thevenins and Norton Theorems – Superposition Theorem – Maximum power transfer theorem – Reciprocity Theorem – Millman’s theorem.

**UNIT III RESONANCE AND COUPLED CIRCUITS 6+6**

Series and parallel resonance – their frequency response – Quality factor and Bandwidth – Self and mutual inductance – Coefficient of coupling -Auto Transformer as a coupled circuit– Tuned circuits – Single tuned circuits.

**UNIT IV THREE PHASE CIRCUITS 6+6**

Analysis of three phase 3-wire and 4-wire circuits with star and delta connected loads, balanced & unbalanced – phasor diagram of voltages and currents – power measurement in three phase circuits.

**UNIT V TRANSIENT RESPONSE ANALYSIS 6+6**

L and C elements -Transient response of RL, RC and RLC Circuits using Laplace transform for with step input and sinusoidal input

**TOTAL :60 PERIODS**

**OUTCOMES:**

- Apply the knowledge of basic circuit law and simplify the network using reduction techniques and analyse the circuit using Kirchoff’s law.
- Understand network theorems to simplify the complex networks.
- Design resonant circuits which are used in wireless transmission and communication networks.
- Develop the coupled circuit and tuned circuits for communication networks

- Understand 3-phase ac circuits for designing and analysis of power system networks.
- Solve and analyse AC and DC transients using Laplace transform techniques

**TEXT BOOKS:**

1. William H. Hayt Jr, Jack E. Kemmerly and Steven M. Durbin, “Engineering Circuits Analysis”, McGraw Hill publishers, edition, New Delhi, 2013.
2. Charles K. Alexander, Mathew N.O. Sadiku, “Fundamentals of Electric Circuits”, Second Edition, McGraw Hill, 2013.
3. Allan H. Robbins, Wilhelm C. Miller, “Circuit Analysis Theory and Practice”, Cengage Learning India, 2013.

**REFERENCES :**

1. Chakrabarti A, “Circuits Theory (Analysis and synthesis), Dhanpath Rai & Sons, New Delhi, 1999.
2. Jegatheesan, R., “Analysis of Electric Circuits,” McGraw Hill, 2015.
3. Joseph A. Edminister, Mahmood Nahri, “Electric circuits”, Schaum’s series, McGraw-Hill, New Delhi, 2010.
4. M E Van Valkenburg, “Network Analysis”, Prentice-Hall of India Pvt Ltd, New Delhi, 2015.
5. Mahadevan, K., Chitra, C., “Electric Circuits Analysis,” Prentice-Hall of India Pvt Ltd., New Delhi, 2015.
6. Richard C. Dorf and James A. Svoboda, “Introduction to Electric Circuits”, 7th Edition, John Wiley & Sons, Inc. 2015.
7. Sudhakar A and Shyam Mohan SP, “Circuits and Network Analysis and Synthesis”, McGraw Hill, 2015.

**OBJECTIVES:**

- To introduce different experiments to test basic understanding of physics concepts applied in optics, thermal physics, and properties of matter, semiconductors and liquids.
- To make the students acquire practical skills through volumetric and instrumental analysis.

**PHYSICS LABORATORY****LIST OF EXPERIMENTS** (Any five experiments to be conducted)

1. Determination of wavelength and velocity of ultrasonic waves by Ultrasonic Interferometer.
2. Determination of thermal conductivity of a poor conductor by LEE'S Disc method.
3. Determination of wavelength and divergence angle of semiconductor laser source using diffraction grating.  
Determination of particle size by using diffraction of semiconductor laser beam.  
Analysis of Numerical aperture and acceptance angle of an optical fibre.
4. Determination of Young's Modulus of a beam by non-uniform bending method.
5. Determination of the moment of inertia of the disc and rigidity modulus of wire by Torsional pendulum.
6. Spectrometer - Determination of wavelength of Mercury Spectrum using diffraction grating.
7. Determination of thickness of wire by air wedge method.
8. Determination of Young's Modulus of a beam by Uniform bending method.
9. Determination of band gap of a semiconductor.

**CHEMISTRY LABORATORY**

1. Determination of total, temporary and permanent hardness of water by EDTA method.
2. Conductometric titration of strong acid vs. strong base.
3. Determination of strength of acids in a mixture using a conductivity meter.
4. Determination of strength of given hydrochloric acid using a pH meter.
5. Estimation of the iron content of the given solution using a potentiometer.
6. Estimation of the iron content of the water sample using a spectrophotometer (thiocyanate method).
7. Estimation of sodium present in water using aflame photometer.
8. Determination of the molecular weight of polyvinyl alcohol using Ostwald viscometer.
9. Determination of corrosion rate by weight loss method.

10. Determination of flash and fire point of a lubricating oil (Pensky Martens apparatus).
11. Determination of concentration of a given solution by constructing a galvanic cell.

**TOTAL: 60 PERIODS**

**OUTCOMES:**

- Determine the wavelength of mercury spectrum and also determine the wavelength of a laser source, particle size, divergence angle of semiconductor laser source using diffraction grating and to analyze the numerical aperture and acceptance angle of an optical fibre.
- examine the Young's modulus of a beam by uniform and non-uniform bending and to estimate the moment of inertia of the disc and rigidity modulus of wire by torsional pendulum.
- determine the band gap of a semiconductor
- Analyse the given hard water sample, change in conductivity of an acid(s) when added with base .
- Examine the change in pH when an acid is added with a base, Understand the redox reactions and its impact on emf values.
- Assess the corrosion rate of a given metal, Construct an electrochemical cell to determine the concentration of the given solution.

**REFERENCES:**

1. Physics laboratory manual, Department of Physics, R.M.K.Engineering college, 2019.
2. Wilson J.D. and Hernandez C.A., - Physics Laboratory Experiments, Houghton Mifflin Company, New York, 2005.
3. J. Mendham, R. C. Denney, J. D. Barnes, M. J. K. Thomas and B. Sivasankar, "Vogel's Quantitative Chemical Analysis", 6<sup>th</sup> edition, Pearson Education Pvt. Ltd., 2009.

**OBJECTIVES:**

- To develop programs using Arrays and Strings
- To develop programs using pointers and dynamic memory allocation
- To develop programs using files
- To apply C programming for solving Engineering Problems

**LIST OF EXPERIMENTS**

1. Array Manipulation
2. String Manipulation
3. Pointers
4. Solving polynomial equations
5. Dynamic Memory Allocation
6. File Manipulation
7. Domain specific problems

**INDICATIVE LIST OF EXERCISES**

1. **Arrays:**
  - a) Find the prime factors of a number.
  - b) Find maximum repeating number.
  - c) Find k<sup>th</sup> smallest element in an unsorted array.
  - d) Matrix manipulation – Addition, Subtraction, Multiplication.
  - e) Job Sequencing: Given an array of jobs where every job has a deadline and a profit. Profit can be earned only if the job is finished before the deadline. It is also given that every job takes a single unit of time, so the minimum possible deadline for any job is 1. How to maximize total profit if only one job can be scheduled at a time. Print the sequence of jobID order to maximize total profit.
2. **String Manipulation:**
  - a) Find the frequency of all the characters in a string.
  - b) Given two strings S1 and S2. Remove all the occurrences of S2 in S1 and print the remaining.
  - c) Reversing a set of words.
  - d) Find the number of patterns of form 1[0]1 where [0] represents any number of zeroes (minimum requirement is one 0) there should not be any other character except 0 in the [0] sequence in a given binary string.
3. **Pointers:**
  - a) Manipulating two dimensional arrays using pointers.
  - b) Print the odd positioned characters and then even positioned characters using pointers.
  - c) Programs using double pointers in C.
  - d) Print all permutations of a given string using pointers.

4. **Numerical Solutions of Polynomials**
  - a) Solve a polynomial equation.
  - b) Find the value of the derivative of the polynomial equation given by the user who provides the value of the unknown variable x.
5. **Dynamic Memory Allocation:**
  - a) Find Largest Number Using Dynamic Memory Allocation.
  - b) Print the list of elements in reverse order.
6. **File Manipulation:**
  - a) Merge the content of two files.
  - b) Merge two lists given.
  - c) Print the odd positioned characters from a file content.
7. **Solve domain specific problems in C:**
  - Civil**
    - 1) Find the area of the irregular land using Trapeziodal rule.
    - 2) Find the area of the irregular land using simpson rule.
  - EEE & EIE**
    - 1) Find the current through a resistor, for voltage varying from 5V to 20V in steps of 5V, using Ohm's Law.
    - 2) Find equivalent resistance when resistors are connected in series, equivalent capacitance when capacitors are connected in parallel.
  - Mechanical**
    - 1) Compute the volume of solids (prism, pyramids, cylinder and cone) from Engineering Graphics problems.
    - 2) Draw a projectile from Engineering mechanics problems.

**TOTAL: 60 PERIODS**

**OUTCOMES:**

- Apply array and string concepts to solve problems.
- Employ pointers to solve various problems.
- Implement dynamic memory allocation.
- Understand file manipulations.
- Design and develop real-world applications utilizing the concepts of arrays, strings, pointers, dynamic memory allocation and files.

**OBJECTIVES:**

- To gain hands on experience in plumbing, welding and Foundry
- To gain hands on experience in basic house wiring
- To gain Practical knowledge in measurement and analysis of electrical quantities in complicated electric circuits using various methods of analysis
- To learn how to analyze an electrical circuit using simulation software
- To wiring, and electric circuits.

**LIST OF EXPERIMENTS**

**GROUP A**

1. Hand-on-exercise  
Basic pipe connections -Mixed pipe connection- pipe connection with different joining points.
2. Study Of pipeline joints-its location -valves-function-tabs-unions-reducers-elbows in household fittings.
3. Welding - preparation of butt joints and T joints by metal arc welding.
4. Foundry operation like mould preparation for gear and step cone pulley

**GROUP B**

5. Prelab session on
  - a) Various safety devices and Safety Measures in Electrical System
  - b) Analog and Digital Oscilloscopes for measuring various Electrical Quantities
  - c) Various Power tools and troubleshooting of Electric Iron and fan
6. Draw and demonstrate the layout for a residential house wiring using energy meter, switches, fuse, indicator, LED lamp, fluorescent lamp with one of the lamps to be controlled by 2 different switches
7. Design and develop PCB board for a rectifier circuit and troubleshoot the same
8. Measurement of electrical Quantities Voltage, current, power and p.f in RLC circuits.
9. Measurement of energy using energy meter.
10. Simulation and experimental verification of electrical circuit problems using Kirchhoff's voltage and current laws.
11. Simulation and experimental verification of electrical circuit problems using Superposition theorem.
12. Simulation and experimental verification of electrical circuit problems using Thevenin's theorem and Norton's theorem.
13. Simulation and experimental verification of Maximum Power transfer Theorem.
14. Design and Simulation of series and parallel resonance circuit.
15. Simulation and experimental verification of three phase balanced and unbalanced star and delta networks circuits.

**16.** Simulation and Experimental validation of RL and RC electric circuit transients.

**TOTAL: 60 PERIODS**

**OUTCOMES**

- Identify and rectify faults in plumbing, understand the working of and application of welding machine and foundry
- Identify and rectify or propose remedial measures faults in in simple circuits
- Apply the appropriate methods for simplifying complicated circuits and calculate power, current and voltage in various parts of the circuits



2. B.S. Grewal, "Higher Engineering Mathematics", 44th Edition, Khanna Publishers New Delhi, 2017.

**REFERENCES:**

1. N.P. Bali, and Manish Goyal, "A Textbook of Engineering Mathematics", 7th Edition, Laxmi Publications Pvt Ltd, 2007.
2. B.V. Ramana, "Higher Engineering Mathematics", 6th Edition, Tata McGraw Hill Publishing Company Limited, New Delhi, 2008.
3. Glyn James, "Advanced Modern Engineering Mathematics", 3rd Edition, Pearson Education, 2007.
4. C. Ray Wylie and L.C. Barrett, "Advanced Engineering Mathematics" 6th Edition, Tata McGraw Hill Education Pvt Ltd, New Delhi, 2012.
5. K.B. Datta, "Mathematical Methods of Science and Engineering", 1st Edition, Cengage Learning India Pvt Ltd, Delhi, 2013.

**OBJECTIVES:**

- To understand the classification of transducers and model of the transducer.
- To discuss different types of resistive transducers and their application areas.
- To explain the principles of variable inductive transducer.
- To understand the characteristics of the different capacitive transducers for the measurement of physical quantities
- To discuss on variety of transducers and understand MEMS and Smart transducers.

**UNIT I CLASSIFICATION AND MATHEMATICAL MODEL OF TRANSDUCERS 09**

Introduction to sensors and transducers - Classification of transducers – Selection of transducers. Types of test signals, Mathematical model of transducer, Zero, I and II order transducers, Response to impulse, step, ramp and sinusoidal inputs.

**UNIT II VARIABLE RESISTANCE TRANSDUCERS 09**

Principles of operation - Construction details -Characteristics of resistance transducers -Resistance potentiometers -Strain gauges- Strain gauge based load cells, torque sensors, force sensors and pressure sensors - Resistance thermometers -Thermistors - Hot wire anemometer - Piezoresistive sensor and humidity sensor

**UNIT III VARIABLE INDUCTANCE TRANSDUCERS 09**

Induction potentiometer -Variable reluctance transducers - Linear Variable Differential Transformer - LVDT Pressure transducer- Rotary Variable Differential Transformer- Synchros– Microsyn

**UNIT IV VARIABLE CAPACITIVE TRANSDUCERS 09**

Principle of operation, construction details - Variable air gap type - Variable area type - Variable permittivity type - capacitance proximity pickup - Capacitor microphone – Capacitive tachometer.

**UNIT V OTHER TRANSDUCERS 09**

Piezoelectric transducer- Ultrasonic transducer - Magnetostrictive transducer - Fibre optic transducers -Hall effect transducers - Digital transducers – Environmental Monitoring sensors (Water Quality & Air pollution) – Introduction to MEMS – Introduction to Smart transducers.

**TOTAL:45 PERIODS**

**OUTCOMES:**

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

**CO1:** Understand the physical quantities for measurement

**CO2:** Compare the mathematical model of Zero, First and Second order transducer

**CO3:** Explain the construction and operation of variable resistance transducer.

**CO4:** Describe the knowledge of inductance transducer.

**CO5:** Illustrate the knowledge of capacitance transducers.

**CO6:** Differentiate the construction and operation of other transducers and sensors.

**TEXT BOOKS:**

1. A. K.Shawney, A course in Electrical and Electronic Measurements and Instrumentation, Dhanpat Rai and Sons, Jan 2015.
2. S. Renganathan, Transducer Engineering, Allied Publishers, 2003.

**REFERENCES:**

1. D. Patranabis, Sensors and Transducers, 2ndEdition, Prentice Hall of India, 2010.
2. D.V.S. Murthy, Transducers and Instrumentation, 2nd Edition, Prentice Hall of India Pvt. Ltd., New Delhi,2010.
3. Ian Sinclair, Sensors and Transducers, 3rd Edition, Elsevier,2012.
4. Neubert H.K.P., “Instrument Transducers – An Introduction to their Performance and Design”, Oxford University Press, Cambridge,2005.
5. NPTEL video lecture on “Sensors and Actuators” by Dr. Hardik J. Pandya, Department of Electrical Engineering, IISc Bangalore.  
(<https://nptel.ac.in/courses/108/108/108108147/>)

<b>20EI302</b>	<b>ELECTRICAL AND ELECTRONIC MEASUREMENTS</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		<b>3</b>	<b>2</b>	<b>0</b>	<b>4</b>

**OBJECTIVES:**

- To understand an overview of current, voltage and power measuring electrical, electronics and digital instruments.
- To explain the design of bridges for the measurement of resistance, capacitance and inductance.
- To summarize an overview of test and measuring instruments.
- To discuss the working knowledge of various waveform generators, analyzers.
- To understand the errors occurring in the instrument and its compensation techniques.

**UNIT I MEASUREMENT OF CURRENT, VOLTAGE AND RESISTANCE 12**

Classification of electro mechanical instruments, Principles, construction and Errors of dynamometer type instruments, induction type instruments, thermal type instruments, Extension of instrument range: shunt and multipliers. Ammeter-Voltmeter method, Loss of Charge, Megger, Earth Resistance Measurement.

**UNIT II MEASUREMENT OF POWER AND ENERGY 12**

Electrodynamic wattmeter's, Low Power Factor (LPF) wattmeter, errors, calibration of wattmeter. Single and three phase power measurement, Induction type Energy Meter, Errors and Adjustments in Energy meter. Three phase energy meter – Trivector meter and maximum demand meter.

**UNIT III D.C. BRIDGES AND A.C. BRIDGES 12**

General equation for bridge balance, D.C. bridges, Wheatstone bridge, Kelvin's double bridge, General form of an A.C. bridge, Maxwell's inductance-capacitance bridge, Hay's bridge, Schering bridge, Wien's bridge, Sources of errors in bridge measurement, Wagner earthing device.

**UNIT IV ELECTRONIC MEASURING INSTRUMENTS 12**

True RMS meter, Digital voltmeter (DVM) – Ramp ADC, Flash ADC, Successive approximation ADC, Measurement of quality factor (Q), Digital frequency meters. Digital LCR meter, Digital wattmeter and energy meters. Recorders - X-Y recorders, Digital Data Recording.

**UNIT V SIGNAL GENERATORS AND WAVEFORM ANALYZERS 12**

Signal generators – AF Sine and Square Wave Generator, Function Generator, Waveform analyzers - Frequency Selective Wave Analyzer, Super heterodyne Wave Analyzer, Spectrum analyzers - Super heterodyne spectrum analyzer, Filter Bank spectrum analyzer, Distortion analyzers.

**TOTAL: 60 PERIODS**

**OUTCOMES:**

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

**CO1:** Compare various measuring instruments and extension of range of instruments.

**CO2:** Construct the wattmeter and energy meter to measure power and energy.

**CO3:** Design DC and AC bridges for the measurement of R, L, C and Frequency measurement.

**CO4:** Classify the kind of instrument suitable for typical electronic measurements.

**CO5:** Compare various signal generators and waveform analyzers.

**CO6:** Minimize the errors occurring in the instrument.

**TEXT BOOKS:**

1. A. K. Shawney, A course in Electrical and Electronic Measurements and Instrumentation, Dhanpat Rai and Sons, Jan 2015.
2. David A. Bell, Electronic Instrumentation and Measurements, Oxford University Press India; 3rd Edition, 2013.
3. H. S. Kalsi, Electronic Instrumentation, McGraw Hill Education; 3rd Edition, 2017.

**REFERENCES:**

1. Golding's, Electrical Measurements and Measuring Instruments, 6th Edition, (Revised & Enlarged): With Solved Examples & MCQ's (In M.K.S. Units), Medtech, Jan 2019.
2. Prithwiraj Purkait, Budhaditya Biswas, Santanu Das, Chiranjib Koley, Electrical and Electronics Measurements and Instrumentation, by McGraw Hill Education (India) Private Limited, 2013.
3. Albert D. Helfrick, William D. Cooper, Modern Electronic Instrumentation and Measurement Techniques, 1st Edition, Pearson, 2016.
4. Ernest O Doebelin and Dhanesh N Manik, "Measurements systems Application and Design", McGraw Hill publication, 5th Edition, 2015.
5. NPTEL video lecture on "Electrical Measurements and Electronic Instruments" by Prof. Avishek Chatterjee, Department of Electrical Engineering, IIT Kharagpur.  
(<https://nptel.ac.in/courses/108/105/108105153/>)

**OBJECTIVES:**

- To summarize the operation of DC motor and generator
- To understand the characteristic of Transformer
- To classify the performance of 3 phase induction motor
- To explain the working principle of synchronous motor and generator
- To discuss the starting characteristic of special motors

**UNIT I D.C. MACHINES 09**

Operation and Construction of Motor and Generator – EMF and Torque Equation – Types and Characteristics of Motor and Generator – Starting, Speed Control of D.C. Motor.

**UNIT II TRANSFORMERS 09**

Principle, Construction and Types of Transformers – EMF Equation – Tests on Transformers - Equivalent Circuit – Phasor Diagram on Load-Regulation and Efficiency of Transformer- Introduction to Three Phase Connection - Current and Potential Transformer.

**UNIT III THREE PHASE INDUCTION MOTORS 09**

Construction and Principle of Operation-Types - Torque-Slip Characteristics- Starting Methods and Speed Control of Induction Motors.

**UNIT IV SYNCHRONOUS MACHINES 09**

Alternators: Principle of Operation, Construction Details - Induced EMF Equation - Voltage Regulation. Synchronous Motor: Principle of Operation, Starting Methods- Torque – V Curves, Inverted V Curves.

**UNIT V SPECIAL MACHINES 09**

Single Phase Induction Motor – Capacitor Start Capacitor Run Motors – Shaded Pole Motor, Repulsion Motor, Universal Motor, Hysteresis Motor, Permanent Magnet Synchronous Motor, Introduction to Stepper Motors- Switched Reluctance Motor

**TOTAL: 45 PERIODS****OUTCOMES:**

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

**CO1:** Identify the starting and control techniques of DC Machine.

**CO2:** Solve the performance calculation of Transformer

**CO3:** Compare the starting and control techniques of 3 phase induction motor

**CO4:** Explain the performance characteristic of Synchronous Machines

**CO5:** Interpret the performance characteristic of Special motors

**CO6:** Design Electrical Machines for Industrial Drive Applications

**TEXT BOOKS:**

1. A.E.Fitzgerald, Kingsley C., Stephen D. Umans., “Electric Machinery”, McGraw-Hill, Singapore, 6th Edition, 2005.
2. B.L.Theraja, “A Text book of Electrical Technology”, Vol.II, S.C Chand and Co., New Delhi, 2007.

**REFERENCES:**

1. Abhijit Chakrabarti, Sudipta Debnath, “Electrical Machines” McGraw-Hill, 2015
2. M.V. Deshpande, “Electrical Machines” PHI Learning Pvt. Ltd., 2011
3. NPTEL video lecture on “Electrical Machines” by Prof. G. BHUVANESWARI, Department of Electrical Engineering, IIT Delhi.  
(<https://nptel.ac.in/courses/108/102/108102146/>)

**OBJECTIVES:**

- To analyze biasing of BJT and BJT amplifiers
- To analyze biasing of MOSFET and MOSFET amplifiers.
- To compute the frequency response of BJT and MOSFET.
- To acquire knowledge of feedback amplifiers and oscillators.
- To illustrate the operation of power amplifiers.

**UNIT I      BIASING OF DISCRETE BJT AND BJT AMPLIFIERS      09**

Load line, Q-point, Biasing methods for BJT, Analysis of CE, CB and CC amplifiers using hybrid- pi equivalent circuit, BJT Differential amplifier – CMRR, Multistage amplifiers - Cascade amplifier, Darlington amplifier, Cascode amplifier.

**UNIT II      BIASING OF DISCRETE MOSFET AND MOSFET AMPLIFIERS      09**

Load line, Q-point, Biasing methods for MOSFET, Analysis of CS, CD and CG MOSFET amplifiers using hybrid-pi equivalent circuits, MOSFET Differential amplifier – CMRR, Multistage Amplifiers - Cascade amplifier, Cascode amplifier.

**UNIT III      FREQUENCY RESPONSE OF BJT AND MOSFET      09**

Frequency response of BJT– Transistor amplifier with circuit capacitors, Short circuit current gain, Miller effect and Miller capacitance, High frequency analysis of CE amplifier, Frequency response of MOSFET –High frequency MOSFET model, Unit gain bandwidth, Miller effect and Miller capacitance, High frequency analysis of MOSFET CS amplifier.

**UNIT IV      FEEDBACK AMPLIFIERS AND OSCILLATORS      10**

Feedback Concepts – gain with feedback – effect of feedback on gain stability, distortion, bandwidth, input and output impedances; topologies of feedback amplifiers – analysis of series-series, shunt-shunt and shunt-series feedback amplifiers, Barkhausen criterion, Colpitts, Hartley, Clapp oscillator, Phase shift, Wien bridge and crystal oscillators.

**UNIT V      POWER AMPLIFIERS      08**

Classification of large signal amplifiers, Class A, B, AB, C, D, Conversion efficiency, Class C tuned amplifier.

**TOTAL: 45 PERIODS****OUTCOMES:**

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

- CO1:** Analyze biasing of BJT and BJT amplifiers  
**CO2:** Analyze biasing of MOSFET and MOSFET amplifiers  
**CO3:** Compute the frequency response of amplifiers  
**CO4:** Acquire the knowledge of feedback amplifiers.  
**CO5:** Acquire the knowledge of oscillators.  
**CO6:** Illustrate the operation of power amplifiers.

**TEXT BOOKS:**

1. Donald. A. Neamen, Electronic Circuits Analysis and Design, 3rd Edition, McGraw- Hill Education (India) Private Ltd., 2010.

2. Robert L. Boylestad and Louis Nasheresky, Electronic Devices and Circuit Theory, 11th Edition, Pearson Education / PHI, 2015.

**REFERENCES:**

1. David A. Bell, Electronic Devices and Circuits, 5th Edition, Oxford University Press, 2010.
2. Sedra and Smith, Micro Electronic Circuits, 7th Edition, Oxford University Press, 2015.
3. Millman J, Halkias.C. and Sathyabrada Jit, Electronic Devices and Circuits, 4th Edition, Mc Graw Hill Education (India) Private Ltd., 2015.
4. Jacob Millman and Arvin Gabel, Micro Electronics, 2nd Edition, McGraw-Hill Education (India) Pvt Limited, 2017.
5. Floyd, Electronic Devices, 9th Edition, Pearson Education, 2012.
6. <https://nptel.ac.in/courses/108/102/108102097/>
7. <https://nptel.ac.in/courses/108/102/108102095/>

**OBJECTIVES:**

- To explain object oriented programming concepts and fundamentals of Java
- To apply the principles of packages, inheritance, interfaces and exceptions
- To develop a java application with I/O streams, threads and generics classes
- To use the functionalities of Strings and Collections
- To design and build simple Graphical User Interfaces

**UNIT I INTRODUCTION TO OOP AND JAVA FUNDAMENTALS 09**

An Overview of Java - Data Types, Variables, and Arrays – Operators - Control Statements – Class Fundamentals – Declaring objects – Methods – Constructors – this keyword – Overloading methods - Overloading constructors - Access Control – Static – Final.

**UNIT II INHERITANCE, INTERFACES AND EXCEPTION HANDLING 09**

Inheritance: Inheritance basics, Using super, Method Overriding, Using Abstract Classes, Using final with Inheritance – Package and Interfaces: Packages, Packages and member access, Importing Packages, Interfaces, Static Methods in an Interface – Exception Handling: Exception - Handling Fundamentals, Exception Types, Uncaught Exceptions, Using try and catch, Multiple catch Clauses, Nested try Statements, throw, throws, finally, Java's Built-in Exceptions.

**UNIT III MULTITHREADING, I/O AND GENERIC PROGRAMMING 09**

Multithreaded Programming: Creating a Thread, Thread Priorities, Synchronization, Interthread Communication – I/O: I/O Basics, Reading Console Input, Writing Console Output, Reading and Writing Files – Generics: Introduction, Generic class, Bounded Types, Generic Methods, Generic Interfaces, Generic Restrictions

**UNIT IV STRING HANDLING AND COLLECTIONS 09**

Lambda Expressions - String Handling – Collections: The Collection Interfaces, The Collection Classes – Iterator – Map - Regular Expression Processing.

**UNIT V EVENT DRIVEN PROGRAMMING 09**

Event Handling - Introducing the AWT: Working with Windows, Graphics, and Text - Using AWT Controls, Layout Managers, and Menus - Introducing Swing - Exploring Swing.

**TOTAL: 45 PERIODS****OUTCOMES:**

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

- CO1:** Explain the object oriented programming concepts and fundamentals of Java  
**CO2:** Develop Java programs with the packages, inheritance, interfaces and exceptions  
**CO3:** Develop Java programs with the packages, inheritance, interfaces and exceptions  
**CO4:** Apply strings and collections in applications  
**CO5:** Develop interactive Java applications using swings and event handling mechanism.

**TEXT BOOKS:**

1. Herbert Schildt, —Java: The complete reference, 11th Edition, McGraw Hill Education, 2019.

**REFERENCES:**

1. Herbert Schildt, —Java: The complete reference, 11th Edition, McGraw Hill Education, 2019.
2. Cay S. Horstmann, Gary Cornell, “Core Java Volume –I Fundamentals”, 11th Edition, Prentice Hall, 2019.
3. Paul Deitel, Harvey Deitel, —Java SE 8 for programmers, 3rd Edition, Pearson, 2015.
4. Steven Holzner, —Java 2 Black book, Dreamtech press, 2011.
5. Timothy Budd, —Understanding Object-oriented programming with Java, Third Edition, Pearson Education, 2008.

**OBJECTIVES:**

- Interpret the study the characteristics of various semiconductor devices.
- Provide practical knowledge on the analysis of regulators, amplifiers and oscillators.
- Derive the no load and load characteristics of D.C machines.
- Sketch the speed characteristics of D.C motor.
- Illustrate the regulation characteristics of Transformer.

**LIST OF EXPERIMENTS**

1. Experimental Characterisation of Semiconductor diode and Zener diode
2. Experimental Characterisation of a NPN Transistor under common emitter configurations
3. Experimental Characterisation of FET and JFET (Draw the equivalent circuit)
4. Experimental Characterisation of UJT and generation of saw tooth waveforms
5. Experimental Characterisation of RC Phase shift oscillator
6. Experimental Characterisation of Hartley and Colpitts oscillators.
7. Experimental Characterisation of Monostable and Astable Multivibrators using BJT
8. Experimental Single Phase half-wave and full wave rectifiers with inductive and capacitive filters.
9. Characteristics of SCR and application as a controlled rectifier.
10. Open circuit characteristics of D.C. shunt generator
11. Load characteristics of D.C. shunt generator.
12. Load test on D.C. shunt motor
13. Speed control of D.C. shunt motor
14. Open circuit and short circuit tests on single phase transformer (Determination of equivalent circuit parameters).
15. Load test on single phase induction motor.

**TOTAL :60 PERIODS****OUTCOMES**

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

**CO1:** Differentiate the usage of various electronic equipment and simulation tools for design and analysis of electronic circuits.

**CO2:** Demonstrate the hands-on experience in studying the characteristics of semiconductor devices.

**CO3:** Analyze various electronic circuits such as voltage regulators, transistor amplifiers and oscillators.

**CO4:** Interpret the various speed control techniques of DC machines.

**CO5:** Compute the equivalent circuit parameters of single-phase transformer under short circuit test and No-load test

**CO6:** Illustrate the characteristics of transformer and Induction motor under load test

20EI312

**MINI PROJECT**

<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
<b>0</b>	<b>0</b>	<b>2</b>	<b>1</b>

**OBJECTIVES:**

- To use the fundamental knowledge gained in Electronics and Instrumentation Engineering to do a mini project, which allows the students to come up with a prototype of proposed system.
- To prepare the students to find solutions to societal problems expressing their ideas in a novel way.

**STRATEGY:**

- To identify a topic of interest in consultation with Faculty/Supervisor. Review the literature and gather information pertaining to the chosen topic. State the objectives and develop a methodology to achieve the objectives. Carry out the circuit connection and upload the program into the hardware after debugging. Demonstrate the novelty of the project through the results and outputs.

**TOTAL: 30 PERIODS**

**COURSE OUTCOMES:**

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

**CO1:** Apply fundamental engineering knowledge to the identified problem.

**CO2:** Analyse and design the technical aspects of the project with comprehensive and systematic approach using new technology.

**CO3:** Develop projects with sustainability, understanding the societal and environmental importance.

**CO4:** Integrate as an individual or as a team in development of technical projects, applying ethical principles.

**CO5:** Understand and write technical report effectively on the project related activities and findings.

**CO6:** Explore the challenging practical problems and find solution by formulating proper methodology.

**EVALUATION PROCEDURE:**

The method of evaluation will be as follows:

1. Internal Marks  
(Decided by conducting 3 reviews by the project committee formulated by the department) : **60 Marks**
2. Viva voce examination : **40 Marks**  
(Evaluated by the internal examiner appointed by the CoE with the approval of the HoD)
  - a) Project Report : **20 Marks**  
(Every student belonging to the same group gets the same mark)
  - b) Presentation/ Demonstration : **20 Marks**

**Total: 100 Marks**

**OBJECTIVES:**

- To build software development skills using java programming for real-world applications.
- To implement the concepts of classes, packages, interfaces, collections, exception handling, regular expressions and file processing.
- To develop applications using event handling

**LIST OF EXPERIMENTS**

1. Develop a Java application to generate Electricity bill. Create a class with the following members: Consumer no., consumer name, previous month reading, current month reading, type of EB connection (i.e domestic or commercial). Compute the bill amount using the following tariff  
If the type of the EB connection is domestic, calculate the amount to be paid as follows: First 100 units - Rs. 1 per unit  
101-200 units - Rs. 2.50 per unit  
201 -500 units - Rs. 4 per unit  
>501 units - Rs. 6 per unit  
If the type of the EB connection is commercial, calculate the amount to be paid as follows:  
First 100 units - Rs. 2 per unit  
101-200 units - Rs. 4.50 per unit  
201 -500 units - Rs. 6 per unit  
> 501 units - Rs. 7 per unit
2. Arrays Manipulations:
  - a) Find kth smallest element in an unsorted array
  - b) Find the sub array with given sum
  - c) Matrix manipulations – Addition, Subtraction, Multiplication
  - d) Remove duplicate elements in an Array
  - e) Accept an integer value N and print the Nth digit in the integer sequence 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15 and so on till infinity. Example: The 11th digit in the sequence 12345678910111213.... is 0.
3. Develop a java application to implement currency converter (Dollar to INR, EURO to INR, Yen to INR and vice versa), distance converter (meter to KM, miles to KM and vice versa), time converter (hours to minutes, seconds and vice versa) using packages.
4. Develop a java application with Employee class with Emp\_name, Emp\_id, Address, Mail\_id, Mobile\_no as members. Inherit the classes, Programmer, Assistant Professor, Associate Professor and Professor from employee class. Add Basic Pay (BP) as the member of all the inherited classes with 97% of BP as DA, 10 % of BP as HRA, 12% of BP as PF, 0.1% of BP for staff club fund. Generate pay slips for the employees with their gross and net salary.
5. Design a Java interface for ADT Stack. Implement this interface using array. Provide necessary exception handling in both the implementations.
6. Write a Java Program to create an abstract class named Shape that contains two integers and an empty method named print Area(). Provide three classes named Rectangle, Triangle and Circle such that each one of the classes extends the class Shape. Each one of

- the classes contains the methods print Area () that prints the area of the given shape and Numberofsides() that prints the number of sides of the given shape.
7. Write a Java program to apply built-in and user defined exceptions.
  8. String Manipulation:
    - a) Reversing a set of words and count the frequency of each letter in the string.
    - b) Pattern Recognition - Find the number of patterns of form 1[0]1 where [0] represents any number of zeroes (minimum requirement is one 0) there should not be any other character except 0 in the [0] sequence in a given binary string.
    - c) Remove all the occurrences of string S2 in string S1 and print the remaining.
    - d) Find the longest repeating sequence in a string
    - e) Print the number of unique string values that can be formed by rearranging the letters in the string S.
  9. Write a Java program that correctly implements producer consumer problem using the concept of inter thread communication.
  10. Write a Java program to read and copy the content of one file to other by handling all file related exceptions.
  11. Collections:
    - a. Write a program to perform string operations using ArrayList. Write functions for the following
      - i. Append - add at end
      - ii. Insert – add at particular index
      - iii. Search
      - iv. List all string starts with given letter
    - b. Find the frequency of words in a given text.
  12. Write a java program to remove all non-alphanumeric characters from a string using regular expression
  13. Design a calculator using event-driven programming paradigm of Java with the following options.
    - a. Decimal manipulations
    - b. Scientific manipulations
  14. Develop a mini project for any application using Java concepts.

**TOTAL :60 PERIODS**

## **OUTCOMES**

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

**CO1:** Develop and implement Java programs for simple applications that make use of classes, packages and interfaces.

**CO2:** Develop and implement Java programs with collections, exception handling, regular expressions and multithreading.

**CO3:** Design applications using file processing and event handling.

20CS313

**APTITUDE AND CODING SKILLS – I**  
(Common to All Branches)

**L T P C**  
**0 0 2 1**

**OBJECTIVES:**

- To develop vocabulary for effective communication and reading skills.
- To build the logical reasoning and quantitative skills.
- To develop error correction and debugging skills in programming.

**LIST OF EXERCISES:**

**1. English – Phase I**

Vocabulary: Synonyms, Antonyms, Grammar: Subject-Verb Agreement, Tenses and Articles, Prepositions and Conjunctions, Speech and Voices, Comprehension: Inferential and Literal Comprehension, Contextual Vocabulary, Comprehension ordering.

**2. Logical Reasoning – Phase I**

Deductive Reasoning: Coding deductive logic, Directional sense, Blood relations, Objective Reasoning, Selection decision tables, Puzzles, Inductive reasoning: Coding pattern and Number series pattern recognition, Analogy and Classification pattern recognition, Abductive Reasoning: Logical word sequence, Data sufficiency.

**3. Quantitative Ability - Phase I**

Basic Mathematics: Divisibility, HCF and LCM, Numbers, decimal fractions and power, Applied Mathematics: Profit and Loss, Simple and Compound Interest, Time, Speed and Distance, Engineering Mathematics: Logarithms, Permutation and Combinations, Probability.

**4. Automata Fix – Phase I**

Logical, Compilation and Code reuse

**TOTAL: 30 PERIODS**

**OUTCOMES**

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

**CO1:** Develop vocabulary for effective communication and reading skills.

**CO2:** Build the logical reasoning and quantitative skills.

**CO3:** Develop error correction and debugging skills in programming.

## IV SEMESTER

20MA403

**NUMERICAL METHODS**  
(Common to Civil, EEE and EIE)

**L T P C**  
**3 2 0 4**

### OBJECTIVES:

- Develop the skills of solving algebraic, transcendental and the system of equations using various methods.
- Determine the interpolation in various intervals by numerical techniques.
- Compute the differentiation and integration by numerical techniques.
- Illustrate the various techniques of solving ordinary differential equations and partial differential equations.

### UNIT I SOLUTION OF EQUATIONS AND EIGENVALUE PROBLEMS 15

Solution of algebraic and transcendental equations – Fixed point iteration method – Newton Raphson method – Solution of linear system of equations – Gauss elimination method – Pivoting – Gauss Jordan method – Iterative methods of Gauss Jacobi and Gauss Seidel – Eigenvalues of a matrix by Power method.

### UNIT II INTERPOLATION AND APPROXIMATION 15

Interpolation with unequal intervals – Lagrange's interpolation – Newton's divided difference interpolation – Cubic Splines – Interpolation with equal intervals – Newton's forward and backward difference formulae.

### UNIT III NUMERICAL DIFFERENTIATION AND INTEGRATION 15

Approximation of derivatives using interpolation polynomials – Numerical integration using Trapezoidal, Simpson's 1/3 rule – Romberg's Method – Two point and threepoint Gaussian quadrature formulae – Evaluation of double integrals by Trapezoidal and Simpson's 1/3 rules.

### UNIT IV NUMERICAL SOLUTION OF ORDINARY DIFFERENTIAL EQUATIONS 15

Single step methods – Taylor's series method – Euler's method – Modified Euler's method – Fourth order Runge-Kutta method for solving first order equations – Multi step methods – Milne's and Adam's-Bashforth predictor and corrector methods for solving first order equations – Finite difference methods for solving second order – two-point linear boundary value problems.

### UNIT V NUMERICAL SOLUTION OF PARTIAL DIFFERENTIAL EQUATIONS 15

Finite difference techniques for the solution of two dimensional Laplace's and Poisson's equations on rectangular domain – One dimensional heat flow equation by explicit and implicit (Crank Nicholson) methods – One dimensional wave equation by explicit method.

**TOTAL :75 PERIODS**

### OUTCOMES:

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

**CO1:** Compute the solutions of algebraic, transcendental and the system of equations.

**CO2:** Implement the numerical techniques of interpolation in equal and unequal intervals.

**CO3:** Apply the numerical techniques of differentiation and integration for engineering problems.

**CO4:** Employ the various techniques and methods for solving first and second order ordinary differential equations.

**CO5:** Solve the partial differential equations with initial and boundary conditions by using certain techniques with engineering applications.

**TEXT BOOKS:**

1. R.L. Burden, and J.D. Faires, "Numerical Analysis", 9th Edition, Cengage Learning, 2016.
2. B.S. Grewal, and J.S. Grewal, "Numerical Methods in Engineering and Science", Khanna Publishers, 10th Edition, New Delhi, 2015.

**REFERENCES:**

1. Brian Bradie, "A Friendly Introduction to Numerical Analysis", Pearson Education, Asia, New Delhi, 2007.
2. C.F. Gerald and P.O. Wheatley, "Applied Numerical Analysis", Pearson Education, Asia, 6th Edition, New Delhi, 2006.
3. J.H. Mathews, "Numerical Methods for Mathematics, Science and Engineering", 2nd Edition, Prentice Hall, 1992.
4. K. Sankara Rao, "Numerical Methods for Scientists and Engineers", Prentice Hall of India Pvt. Ltd, 3rd Edition, New Delhi, 2007.
5. S.S. Sastry, "Introductory Methods of Numerical Analysis", PHI Learning Pvt. Ltd, 5th Edition, 2015.

**OBJECTIVES:**

- To design digital circuits using simplified Boolean functions
- To analyze and design combinational circuits
- To analyze and design synchronous and asynchronous sequential circuits
- To understand programmable logic devices
- To write HDL code for combinational and sequential circuits

**UNIT I                    BOOLEAN ALGEBRA AND LOGIC GATES                    9**

Review of Number Systems - Arithmetic Operations - Binary Codes- Boolean Algebra and rules- Boolean Functions - Canonical and Standard Forms - Simplification of Boolean Functions using Karnaugh Map –Basic Logic Gates – Universal gates-NAND and NOR Implementations- Conversion.

**UNIT II                    COMBINATIONAL LOGIC                    9**

Combinational Circuits – Analysis and Design Procedures -Circuits for arithmetic operations: Full adder, Carry look-ahead adder, binary adder, adder-subtractor- Binary Multiplier -Comparator – Code Converters- Decoders – Encoders –Multiplexers and De-multiplexers - Introduction to HDL – Verilog HDL Models of Combinational circuits.

**UNIT III                    SYNCHRONOUS SEQUENTIAL LOGIC                    9**

Sequential Circuits - Flip-Flops: Triggering, Types, Conversions, Excitation tables - Analysis of Clocked Sequential Circuits - State Reduction and Assignment –Shift Registers- Counters –Verilog HDL Models of Sequential Circuits.

**UNIT IV                    ASYNCHRONOUS SEQUENTIAL LOGIC                    9**

Analysis and Design of Asynchronous Sequential Circuits – Reduction of State and Flow Tables – Race-free State Assignment – Hazards-Types and Reduction.

**UNIT V                    MEMORY AND PROGRAMMABLE LOGIC DEVICES                    9**

RAM and ROM types – Memory decoding - Error detection and correction – DRAM, Flash Memory, Programmable logic devices: Programmable Array Logic – Programmable Logic Array – Sequential Programmable Devices- CPLD – FPGA.

**TOTAL :45 PERIODS****OUTCOMES:**

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

**CO1:** Design Digital Circuits using simplified Boolean functions

**CO2:** Analyze and Design Combinational Circuits

**CO3:** Analyze and Design Synchronous Sequential Circuits

**CO4:** Analyze and Design Asynchronous Sequential Circuits

**CO5:** Interpret designs using Programmable Logic Devices

**CO6:** Write HDL code for Combinational and Sequential Circuits

**TEXT BOOKS:**

1. Thomas L. Floyd, “Digital Fundamentals”, 11<sup>th</sup> Edition, Prentice Hall, 2015
2. Morris Mano, M. and Michael D. Ciletti, “Digital Design with an Introduction to the Verilog HDL”, 5<sup>th</sup> Edition, Prentice Hall, 2017.

**REFERENCES:**

1. John F. Wakerly, “Digital Design Principles and Practices”, Fifth Edition, Pearson Education, 2018.
2. Charles H. Roth Jr, Larry L. Kinney, “Fundamentals of Logic Design”, First Edition, CENGAGE Learning, 2020
3. Donald P Leach, Albert Paul Malvino and GoutamSaha, “Digital Principles and Applications”, 8th Edition, McGraw-Hill, 2015.
4. NPTEL video lectures on “Digital systems Design”, Prof. D. Roychoudhury, IIT Kharagpur
  - a. <https://nptel.ac.in/courses/117/105/117105080/>
5. <https://learnabout-electronics.org/>
6. <http://www.pyroelectro.com/edu/digital/>

**OBJECTIVES:**

- To summarize the importance of process variable measurements.
- To discuss the various measurement techniques used for the measurement of temperature, flow, pressure, level, humidity, speed, density and viscosity in process industries.
- To explain the selection and maintenance of new technology flow instruments.
- To discuss the selection, installation and troubleshooting of process instruments.
- To understand the applications of various industrial sensors.

**UNIT I TEMPERATURE MEASUREMENT 09**

Definitions and standards – Primary and secondary fixed points – Different types of filled in system thermometers – Sources of errors in filled in systems and their compensation – Bimetallic thermometers– Thermocouples: Laws of thermocouple and types – Radiation fundamentals – Radiation methods of temperature measurement – Total radiation pyrometers – Optical pyrometers – Two color radiation pyrometers –Fiber optic sensor for temperature measurement – Temperature sensor selection, Installation and Calibration.

**UNIT II PRESSURE MEASUREMENT 09**

Units of pressure – Manometers: Different types, Elastic type pressure gauges: Bourdon tube, Bellows, Diaphragms and Capsules – Electrical methods: Elastic elements with LVDT and strain gauges – Capacitive type pressure gauge – Piezo resistive pressure sensor-Resonator pressure sensor– Measurement of vacuum: McLeod gauge, Thermal conductivity gauge, Ionization gauges, Cold cathode type and hot cathode type – Pressure gauge selection, installation and calibration using dead weight tester.

**UNIT III LEVEL AND HUMIDITY MEASUREMENT 09**

Level measurement: Float gauges – Displacer type – Bubbler system– Conductivity sensors – Capacitive sensors – D/P methods – Nucleonic gauge – Ultrasonic gauge, DIP ultrasonic sensors – Boiler drum level measurement: Differential pressure transmitter and Hydra step methods – Solid level measurement. Humidity: Dry and wet bulb psychrometers – Resistive and capacitive type hygrometers, Dew cell.

**UNIT IV FLOW MEASUREMENT 09**

Introduction, definition and units, classification of flow meters, variable head type flow meters – Orifice Plate, Venturi tube, flow nozzle, Pitot tube, Positive displacement flow meters - Nutating disc, Reciprocating piston and oval gear flow meters, Rotameter, Mass flow meter: Thermal and Coriolis type mass flow meters, Electro Magnetic flow meters, laser Doppler anemometer, ultrasonic, vortex, Guidelines for selection of flow meter.

**UNIT V MEASUREMENT OF SPEED, DENSITY AND VISCOSITY 09**

Speed measurement: Capacitive tacho, Drag cup type tacho, D.C and A.C tacho generators - Stroboscope. Units of density and specific gravity – Baume scale and API scale – Densitometers: Pressure type densitometers, Float type densitometers, Ultrasonic densitometer and gas densitometer - Viscosity: Saybolt viscometer – Rotameter type and Torque type viscometers.

**TOTAL: 45 PERIODS**

**OUTCOMES:**

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

**CO1:** Differentiate the construction and working of various temperature measurement devices.

**CO2:** Explain the construction and working of instruments used for the measurement of Pressure.

**CO3:** Describe the construction and working of instruments used for the measurement of level and humidity.

**CO4:** Study the different flow measurement techniques used in process industries.

**CO5:** Describe the construction and working of instruments used for the measurement of speed, density and viscosity.

**CO6:** Identify a suitable measuring instrument for an application.

**TEXT BOOKS:**

1. Ernest.O.Doebelin and Dhanesh.N.Manik, Doebelin's Measurement Systems, McGraw Hill Education, 6th Edition, 2017.
2. Patranabis D, Principles of Industrial Instrumentation, Tata McGraw Hill, 3rd Edition, 2010.

**REFERENCES:**

1. B.G.Liptak, Process Measurement and Analysis, CRC Press, 4th Edition, 2003.
2. Singh,S.K., Industrial Instrumentation and Control, Tata McGrawHill Education Pvt. Ltd., New Delhi, 2009.
3. B.E.Noltingk, Instrumentation Reference Book, Butterworth Heinemann Ltd., 2nd Edition, 1995.
4. Douglas M. Considine, Process / Industrial Instruments & Controls Handbook, McGraw Hill, Singapore, 5th Edition, 1999.
5. Andrew W.G, Applied Instrumentation in Process Industries – A survey, Vol I &Vol II, Gulf Publishing Company, Houston, 2001
6. Spitzer D. W., Industrial Flow measurement, ISA press, 3rd Edition, 2005.
7. Tony.R.Kuphaldt, Lessons in Industrial Instrumentation, Version 2.02, April 2014
8. NPTEL video lecture on "Industrial Instrumentation" by Prof. Alok Barua, Department of Electrical Engineering, IIT Kharagpur (<https://nptel.ac.in/courses/108/105/108105064/>)

**OBJECTIVES:**

- To discuss the formulation of linear models like state variable model and Transfer function model.
- To understand time domain specifications and steady error for the different order systems to various inputs
- To analyze the stability of linear systems in time domain and frequency domain.
- To design compensator based on the time and frequency domain specifications.
- To discuss state variable representation of physical systems

**UNIT I      MODELLING OF LINEAR TIME INVARIANT SYSTEMS      12**

Control system: Open loop and Closed loop – Feedback control system characteristics – First principle modeling: Mechanical and Thermal systems – Transfer function representations: Block diagram and Signal flow graph. Transfer function of DC and AC servomotors.

**UNIT II      TIME DOMAIN AND STABILITY ANALYSIS      12**

Standard test inputs –Time domain specifications for second order system –Type and order of the system - Steady state error and error coefficients, Stability analysis: Concept of stability – Routh Hurwitz stability criterion – Root locus: Construction and Interpretation.

**UNIT III      FREQUENCYDOMAINANALYSIS      12**

Bode plot, Polar plot and Nyquist plot: Construction, Interpretation and stability analysis – Frequency domain specifications - Introduction to closed loop Frequency Response.

**UNIT IV      DESIGN OF FEEDBACKCONTROLSYSTEM      12**

Electrical network and frequency response of Lead, Lag and Lag-lead compensators - Design of Lead, Lag and Lag-lead compensators using Bode plot technique.

**UNIT V      STATE SPACE MODEL OF LTIV ANDLTVSYSTEMS      12**

State variable formulation – Non uniqueness of state space model – State transition matrix – Free and forced responses for Time Invariant and Time Varying Systems – Controllability – Observability- State Observer - State Feedback Control.

**TOTAL: 60 PERIODS****OUTCOMES:**

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

**CO1:** Develop various representations of system based on the first principles approach.

**CO2:** Determine steady state error and error coefficients for various input signals.

**CO3:** Construct and interpret root locus, Bode plot, polar plot and Nyquist plot and infer the time domain and frequency domain specifications from the response.

**CO4:** Analyze and infer the stability of systems in time and frequency domain.

**CO5:** Design and implement lag, lead, lag-lead compensators to meet the time and frequency domain specifications.

**CO6:**Determine the system equations in state variable form.

**TEXT BOOKS:**

1. Nagarath, I.J. and Gopal, M., “Control Systems Engineering”, New Age International Publishers, 2017.
2. Benjamin C. Kuo, “Automatic Control Systems”, Wiley, 2014.

**REFERENCES:**

1. Katsuhiko Ogata, “Modern Control Engineering”, Pearson, 2015.
2. Richard C.Dorf and Bishop, R.H., “Modern Control Systems”, Pearson Education,2009.
3. John J.D., Azzo Constantine, H. and HoupisSttuart, N Sheldon, “Linear Control System Analysis and Design with MATLAB”, CRC Taylor& Francis Reprint 2009.
4. RamesC.Panda and T. Thyagarajan, “An Introduction to Process Modelling Identification and Control of Engineers”, Narosa Publishing House, 2017.
5. M.Gopal, “Control System: Principle and Design”, McGraw Hill Education, 2012.
6. NPTEL Video Lecture Notes on “Control Engineering” by Prof. S. D. Agashe, IIT Bombay.<https://nptel.ac.in/courses/108/101/108101037/>

**OBJECTIVES:**

- To expose the students to linear integrated circuits and its fabrication.
- To summarize the concepts of operational amplifier and relate its various applications.
- To compare and contrast DAC and ADC Conversions.
- To acquire the basic knowledge of special function IC, switched capacitor filters, voltage regulators.

**UNIT I IC FABRICATION 09**

IC classification, fundamental of monolithic IC technology, epitaxial growth, masking and etching, diffusion of impurities, Realisation of monolithic ICs and packaging, Fabrication of diodes, capacitance, resistance and FETs, PV cell, thick and thin film technology, Recent Technology trends in IC fabrication.

**UNIT II CHARACTERISTICS OF OPAMP 09**

Ideal OP-AMP characteristics, DC characteristics, AC characteristics, differential amplifier; frequency response of OP-AMP; Basic applications of op-amp – Inverting and Non-inverting Amplifiers-V/I & I/V converters, summer, differentiator and integrator.

**UNIT III APPLICATIONS OF OPAMP 09**

Instrumentation amplifier and its applications for transducer Bridge, Log and Antilog Amplifiers, Analog multiplier & Divider, first and second order active filters, comparators, multivibrators, clippers, clampers, peak detector, S/H circuit, D/A converter (R- 2R ladder and weighted resistor types) using opamps, A/D Converter using opamps.

**UNIT IV SPECIAL ICs 09**

Functional block diagram, characteristics of IC - 555 Timer circuit and its PWM application - Schmitt Trigger, IC - 566 Voltage Controlled Oscillator (VCO) circuits, IC 565- Phase Locked Loop (PLL) IC and its applications.

**UNIT V APPLICATION ICs 09**

AD623 Instrumentation Amplifier and its application as load cell weight measurement – IC voltage regulators –LM78XX, LM79XX; Fixed voltage regulators its application as Linear power supply - LM317,723 Variability voltage regulators, switching regulator- SMPS – ICL 8038 function generator IC.

**TOTAL: 45 PERIODS**

**OUTCOMES:**

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

**CO1:** Demonstrate the fabrication of IC's.

**CO2:** Analyze the performance characteristics of Op-Amp.

**CO3:** Design Op-Amp based circuits for engineering applications.

**CO4:** Classify and comprehend the working principle of data converters.

**CO5:** Illustrate the function of application specific IC's such as VCO, PLL and its applications.

**CO6:** Classify the different voltage regulators using Op-Amp.

**TEXT BOOKS:**

1. D.Roy Choudhary, SheilB.Jani, 'Linear Integrated Circuits', IV edition, New Age, 2018.
2. David A.Bell, 'Op-amp & Linear ICs', Oxford, 2018.
3. Ramakant A.Gayakward, 'Op-amps and Linear Integrated Circuits', IV edition, Pearson Education, 2003 / PHI. 2018.

**REFERENCES:**

1. Richard Floyd, Buchla, "Fundamentals of Analog Circuits", Pearson, 2013.
2. Robert F.Coughlin, Fredrick F. Driscoll, "Op-amp and Linear ICs", PHI Learning, 6<sup>th</sup>edition, 2012.
3. Fiore, "Opamps & Linear Integrated Circuits Concepts & Applications", Cengage, 2010.
4. Jacob Millman, Christos C.Halkias, "Integrated Electronics - Analog and Digital circuits system", Tata McGraw Hill, 2010.

<b>20GE301</b>	<b>UNIVERSAL HUMAN VALUES II: UNDERSTANDING HARMONY</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		<b>2</b>	<b>2</b>	<b>0</b>	<b>3</b>

**OBJECTIVES:**

The objective of the course is fourfold:

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

**COURSE TOPICS:**

The course has 28 lectures (2 lecture hours) and 14 practice sessions (2 Tutorial hour) in 5 Units.

**UNIT I COURSE INTRODUCTION - NEED, BASIC GUIDELINES, CONTENT AND PROCESS FOR VALUE EDUCATION 4**

1. Purpose and motivation for the course, recapitulation from Universal Human Values-I
2. Self-Exploration–what is it? - Its content and process; ‘Natural Acceptance’ and Experiential Validation- as the process for self-exploration
3. Continuous Happiness and Prosperity- A look at basic Human Aspirations
4. Right understanding, Relationship and Physical Facility- The basic requirements for fulfillment of aspirations of every human being with their correct priority
5. Understanding Happiness and Prosperity correctly- A critical appraisal of the current scenario
6. Method to fulfil the above human aspirations: Understanding and living in harmony at various levels.

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

**UNIT II UNDERSTANDING HARMONY IN THE HUMAN BEING HARMONY IN MY SELF! 3**

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

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

**UNIT III UNDERSTANDING HARMONY IN THE FAMILY AND SOCIETY- HARMONY IN HUMAN-HUMAN RELATIONSHIP 3**

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

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

**UNIT IV UNDERSTANDING HARMONY IN THE NATURE AND EXISTENCE - WHOLE EXISTENCE AS COEXISTENCE 3**

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

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

**UNIT V IMPLICATIONS OF THE ABOVE HOLISTIC UNDERSTANDING OF HARMONY ON PROFESSIONAL ETHICS 5**

1. Natural acceptance of human values
2. Definitiveness of Ethical Human Conduct
3. Basis for Humanistic Education, Humanistic Constitution and Humanistic Universal Order
4. Competence in professional ethics:
  - a. Ability to utilize the professional competence for augmenting universal human order
  - b. Ability to identify the scope and characteristics of people friendly and eco-friendly production systems,
  - c. Ability to identify and develop appropriate technologies and

management patterns for above production systems.

5. Case studies of typical holistic technologies, management models and production systems.
6. Strategy for transition from the present state to Universal Human Order: a. At the level of individual: as socially and ecologically responsible engineers, technologists and managers b. At the level of society: as mutually enriching institutions and organizations
7. Sumup.

Include practice Exercises and Case Studies will be taken up in Practice (tutorial)Sessions eg. To discuss the conduct as an engineer or scientist etc.

**TOTAL: 18 HOURS**

### **OUTCOMES:**

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

**CO1:** Become more aware of themselves, and their surroundings (family, society, nature);

**CO2:** Become more responsible in life, and in handling problems with sustainable solutions, while keeping human relationships and human nature in mind.

**CO3:** Have better critical ability.

**CO4:** Become sensitive to their commitment towards what they have understood (human values, human relationship and human society).

**CO5:** Apply what they have learnt to their own self in different day-to-day settings in real life, at least a beginning would be made in this direction.

### **TEXT BOOKS:**

1. Human Values and Professional Ethics by R R Gaur, R Sangal, G P Bagaria, Excel Books, NewDelhi, 2010.

### **Reference Books**

1. A Nagaraj, "Jeevan Vidya: Ek Parichaya", Jeevan Vidya Prakashan, Amarkantak, 1999.
2. E. F Schumacher, "Small is Beautiful", Vintage classics, London, 1993.
3. A.N. Tripathi, "Human Values", New Age Intl. Publishers, New Delhi, Third Edition 2020.
4. Maulana Abdul Kalam Azad, "India Wins Freedom", Oriental blackswan private limited, Hyderabad, 2020.
5. Mahatma Gandhi, "Hind Swaraj or Indian Home Rule", Maheswari Publications, Delhi 2020.
6. Romain Rolland, "The life of Vivekananda and the universal gospel", Publication house of Ramakrishna Math, Kolkata, Thirty second edition 2018.
7. Romain Rolland, "Mahatma Gandhi: The man who become one with the universal being", Srishti Publishers & Distributors, New Delhi, Sixth Edition 2013.
8. Heaton, Dennis P. "The story of stuff." (2010): 553-556.
9. Gandhi, Mohandas Karamchand, "The story of my experiments with truth: An autobiography", Om Books International, 2018.
10. Andrews, Cecile, "Slow is beautiful: new visions of community, leisure, and joie de vivre", New society publishers, 2006.
11. Kumarappa, Joseph Cornelius, "The economy of permanence. CP", All India Village Industries Assn., 1946.

**Outcomes:**

By the end of the course, students

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

**OBJECTIVES:**

- To develop the fundamental knowledge on designing of Digital ICs.
- To summarize and develop an adequate knowledge on Coders and Counters.
- To facilitate the students to design various application of OPAMP
- To design, test and study the characteristics of circuits behaviour with Analog ICs.
- To facilitate the students to design voltage to frequency converters.

**LIST OF EXPERIMENTS**

1. Implementation of Boolean Functions, Adder and Subtractor circuits.
2. Code converters: Excess-3 to BCD and Binary to Gray code converter and vice-versa
3. Parity generator and parity checking
4. Encoders and Decoders
5. Counters: Design and implementation
6. Shift Registers: Design and implementation of 4-bit shift registers in SISO, SIPO, PISO, PIPO modes using suitability IC's.
7. Study of multiplexer and de multiplexer
8. Timer IC application: Study of NE/SE 555 timer in Astability, Monostability operation.
9. Application of Op-Amp: inverting and non-inverting amplifier, Adder, comparator, Integrator and Differentiator.
10. Voltage to frequency characteristics of NE/SE 566 IC.
11. Variability Voltage Regulator using IC LM317.
12. Design of Combinational circuits using Verilog.
13. Design of Sequential circuits using Verilog.

**TOTAL: 60 PERIODS****OUTCOMES:**

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

**CO1:** Implement Boolean Functions.

**CO2:** Interpret the importance of code conversion.

**CO3:** Execute 4-bit shift registers.

**CO4:** Design and implement counters using specific counter IC.

**CO5:** Acquire knowledge on Application of OPAMP and Regulators.

**CO6:** Construct Voltage frequency converters and Regulators.

**OBJECTIVES:**

- To understand the basic concepts of measurement and operation of different types of transducers.
- To evaluate the static and dynamic characteristics of different types of transducers.
- To analyse step response of RTD, Thermocouple
- To design the circuit for measure resistance, inductance and capacitance.
- To apply calibration method for the electrical instruments

**LIST OF EXPERIMENTS**

1. To study the characteristics of potentiometric transducer.
2. Determination of Characteristic study of load cell
3. Determination of Characteristics of linear displacement transducers (LVDT)
4. To study the characteristics of photoelectric tachometer
5. To study the voltage – intensity characteristics of a photo – transistor, LDR
6. To study step response of RTD and thermocouple
7. Determination of Static and Dynamic characteristics of Thermocouple
8. Determination of Static and Dynamic characteristics of RTD and Thermistor.
9. Measurement of an unknown medium resistance using Wheatstone bridge.
10. Measurement of an unknown low resistance using Kelvin’s double bridge
11. Measurement of an unknown inductance using Anderson Bridge.
12. Measurement of Capacitance using Schering Bridge
13. Determination of Characteristics of angular displacement transducers
14. Calibration of Ammeter and Voltmeter using Potentiometer.
15. Calibration of Single-phase Energy meter and wattmeter.
16. Real time temperature measurement using LabVIEW.
17. Measurement of Resistance using DAQ VI card.

**TOTAL: 60 PERIODS****OUTCOMES:**

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

**CO1:** Apply different types of transducers for measurement applications.

**CO2:** Evaluate the static and dynamic characteristics of measuring instruments.

**CO3:** Design signal conditioning circuit for various transducers

**CO4:** Construct the measurement systems using different types of resistance, capacitance and inductance transducers.

**CO5:** Interpret the results of analysis in oral form as well as in written form and draw meaningful conclusions.

**CO6:** Develop and test the real time application using LabVIEW.

**OBJECTIVES:**

- To impart necessary and practical knowledge of components of Internet of Things and develop skills required to build real-life IoT based projects.
- To interpret the results of analysis and depict the significant conclusions.
- To design and test the various application circuits by using appropriate hardware.
- To understand and present the results in written and oral forms.
- To integrate as a member in a group.

**LIST OF EXPERIMENTS**

1. Familiarization with Arduino/Raspberry Pi and perform necessary software installation.
2. To interface LED/Buzzer with Arduino/Raspberry Pi and write a program to turn ON LED for 1 sec after every 2 seconds.
3. To interface Push button/Digital sensor (IR/LDR) with Arduino/Raspberry Pi and write a program to turn ON LED when push button is pressed or at sensor detection.
4. To interface DHT11 sensor with Arduino/Raspberry Pi and write a program to print temperature and humidity readings.
5. To interface motor using relay with Arduino/Raspberry Pi and write a program to turn ON motor when push button is pressed.
6. To interface OLED with Arduino/Raspberry Pi and write a program to print temperature and humidity readings on it.
7. To interface Bluetooth with Arduino/Raspberry Pi and write a program to send sensor data to smartphone using Bluetooth.
8. To interface Bluetooth with Arduino/Raspberry Pi and write a program to turn LED ON/OFF when '1'/'0' is received from smartphone using Bluetooth.
9. Write a program on Arduino/Raspberry Pi to upload temperature and humidity data to ThingSpeak cloud.
10. Write a program on Arduino/Raspberry Pi to retrieve temperature and humidity data from ThingSpeak cloud.
11. To install MySQL database on Raspberry Pi and perform basic SQL queries.
12. Write a program on Arduino/Raspberry Pi to publish temperature data to MQTT broker.
13. Write a program on Arduino/Raspberry Pi to subscribe to MQTT broker for temperature data and print it.
14. Write a program to create TCP server on Arduino/Raspberry Pi and respond with humidity data to TCP client when requested.
15. Write a program to create UDP server on Arduino/Raspberry Pi and respond with humidity data to UDP client when requested.

**TOTAL: 30PERIODS**

**OUTCOMES:**

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

**CO1:** Acquire knowledge on Internet of Things and its hardware and software components.

**CO2:** Demonstrate to interface I/O devices, sensors & communication modules.

**CO3:** Analyze by connecting and exchanging data with other devices and systems over the Internet.

**CO4:** Analyze to remotely monitor data and control devices.

**CO5:** Develop real life IoT based projects.

**CO6:** Integrate as a member in a group.

**REFERENCES:**

1. Vijay Madiseti, ArshdeepBahga, Internet of Things, A Hands-on Approach, University Press,2014.
2. Dr. SRN Reddy, RachitThukral and Manasi Mishra, Introduction to Internet of Things: A practical Approach, ETI Labs.
3. Pethuru Raj and Anupama C. Raman, The Internet of Things: Enabling Technologies, Platforms, and Use Cases, CRC Press,1st Edition, Auerbach Publications,2017.
4. Jeeva Jose, Internet of Things, Khanna Publishing House, Delhi, 1<sup>st</sup> Edition, Khanna Publishing House,2018.
5. Adrian McEwen, Designing the Internet of Things, 1<sup>st</sup> Edition, Wiley,2013.

**OBJECTIVES:**

- To develop advanced vocabulary for effective communication and reading skills.
- To build an enhanced level of logical reasoning and quantitative skills.
- To develop error correction and debugging skills in programming.
- To apply data structures and algorithms in problem solving.

**LIST OF EXERCISES:****1. English – Phase II**

Vocabulary: Synonyms, Antonyms, Grammar: Subject-Verb Agreement, Tenses and Articles, Prepositions and Conjunctions, Speech and Voices, Comprehension: Inferential and Literal Comprehension, Contextual Vocabulary, Comprehension ordering.

**2. Logical Reasoning – Phase II**

Deductive Reasoning: Coding deductive logic, Directional sense, Blood relations, Objective Reasoning, Selection decision tables, Puzzles, Inductive reasoning: Coding pattern and Number series pattern recognition, Analogy and Classification pattern recognition, Abductive Reasoning: Logical word sequence, Data sufficiency.

**3. Quantitative Ability - Phase II**

Basic Mathematics: Divisibility, HCF and LCM, Numbers, decimal fractions and power, Applied Mathematics: Profit and Loss, Simple and Compound Interest, Time, Speed and Distance, Engineering Mathematics: Logarithms, Permutation and Combinations, Probability.

**4. Automata Fix – Phase I**

Logical, Compilation and Code reuse

**5. Automata Fix – Phase I**

Data Structure Concepts: Array and Matrices, Linked list, String processing and manipulation, Stack/Queue, Sorting and Searching  
Advanced Design and Analysis Techniques: Greedy Algorithms, Minimum Spanning Trees, String Matching, Divide and Conquer, Computational Geometry

**TOTAL: 30 PERIODS****OUTCOMES**

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

**CO1:** Develop advanced vocabulary for effective communication and reading skills.

**CO2:** Build an enhanced level of logical reasoning and quantitative skills.

**CO3:** Develop error correction and debugging skills in programming.

**CO4:** Apply data structures and algorithms in problem solving

## V SEMESTER

20CS201

DATA STRUCTURES

L T P C  
3 0 0 3

### OBJECTIVES:

- To understand the concepts of ADTs
- To learn linear data structures – lists, stacks, and queues
- To understand and apply Tree data structures
- To understand and apply Graph structures
- To analyze sorting, searching and hashing algorithms

### UNIT I LINEAR DATA STRUCTURES – LIST 9

Algorithm analysis-What to analyze-running time calculations-Abstract Data Types (ADTs) – List ADT – array-based implementation – linked list implementation –singly linked lists-circularly linked lists- doubly-linked lists – applications of lists –Polynomial Manipulation – All operations (Insertion, Deletion, Merge, Traversal).

### UNIT II LINEAR DATA STRUCTURES – STACKS, QUEUES 9

Stack ADT – Stack Model - Implementations: Array and Linked list - Applications - Balancing symbols - Evaluating arithmetic expressions - Conversion of Infix to postfix expression- Queue ADT – Queue Model - Implementations: Array and Linked list - Circular Queue – Priority Queue - deQueue – applications of queues.

### UNIT III NON LINEAR DATA STRUCTURES – TREES 9

Tree ADT – tree traversals - Binary Tree ADT – expression trees – applications of trees – binary search tree ADT –Threaded Binary Trees- AVL Trees – B-Tree - B+ Tree – Priority Queues – Applications of priority queues.

### UNIT IV NON LINEAR DATA STRUCTURES - GRAPHS 9

Definition – Representation of Graph – Types of graphs - Breadth-first traversal - Depth-first traversal – Topological Sort – Bi-connectivity – Cut vertex – Euler circuits – Applications of graphs.

### UNIT V SEARCHING, SORTING AND HASHING TECHNIQUES 9

Searching- Linear Search - Binary Search. Sorting - Bubble sort - Selection sort - Insertion sort - Shell sort – Radix sort. Hashing- Hash Functions – Separate Chaining – Open Addressing – Rehashing – Extendible Hashing.

**TOTAL: 45 PERIODS**

**OUTCOMES:**

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

**CO1:** Implement abstract data types for linear data structures.

**CO2:** Apply the appropriate linear data structures to solve problems.

**CO3:** Identify and use appropriate tree data structures in problem solving.

**CO4:** Choose appropriate Graph representations and solve real-world applications.

**CO5:** Critically analyze the various sorting and searching algorithms.

**TEXT BOOKS:**

1. Mark Allen Weiss, "Data Structures and Algorithm Analysis in C", 2nd Edition, Pearson Education, 2016.
2. Reema Thareja, "Data Structures Using C", Second Edition, Oxford University Press, 2014.

**REFERENCES:**

1. Narasimha Karumanchi, "Data Structure and Algorithmic Thinking with Python: Data Structure and Algorithmic Puzzles", CareerMonk Publications, 2020.
2. Jean-Paul Tremblay and Paul Sorenson, "An Introduction to Data Structures with Application", McGraw-Hill, 2017.
3. Mark Allen Weiss, "Data Structures and Algorithm Analysis in Java", Third Edition, Pearson Education, 2012.
4. Ellis Horowitz, Sartaj Sahni, Susan Anderson-Freed, "Fundamentals of Data Structures in C", Second Edition, University Press, 2008.
5. Ellis Horowitz, Sartaj Sahni, Dinesh P Mehta, "Fundamentals of Data Structures in C++", Second Edition, Silicon Press, 2007.



**OUTCOMES:**

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

- CO1:** Acquire knowledge on the architecture of 8086 microprocessor and 8051 microcontroller.
- CO2:** Apply programming techniques in developing the assembly language program for microprocessor applications.
- CO3:** Apply programming techniques in developing the assembly language program for microcontroller applications.
- CO4:** Analyze various types of interfacing devices with other peripheral devices.
- CO5:** Design and Construct Memory Interfacing Circuits.
- CO6:** Design and construct Microprocessor and Microcontroller based systems.

**TEXT BOOKS:**

1. Yu-Cheng Liu, Glenn A.Gibson, Microcomputer Systems: The 8086 / 8088 Family - Architecture, Programming and Design, 2nd Edition, Pearson, 2015.
2. Mohamed Ali Mazidi, Janice Gillispie Mazidi, Rolin McKinlay, The 8051 Microcontroller and Embedded Systems: Using Assembly and C, 2nd Edition, Pearson Education, 2011.

**REFERENCES:**

1. Douglas V.Hall, Microprocessors and Interfacing, Programming and Hardware, TMH,2012.
2. A.K.Ray,K.M.Bhurchandi, Advanced Microprocessors and Peripherals 3rd Edition, Tata McGraw Hill, 2012.
3. Martin P Bates, Programming 8 – bit PIC Microcontroller in C with Interactive Hardware Simulation, Newnes, 2008.
4. Walter A Triebel and Avatar Singh, The 8088 and 8096 Microprocessors – Programming, Interfacing, Software, Hardware and Applications, 4th Edition, Pearson, 2007.
5. Scott MacKenzie, Raphael Chung-Wei Phan, The 8051 Microcontroller, 4th Edition, Pearson Education, 2008.
6. NPTEL LINK: <https://nptel.ac.in/courses/108/105/108105102/>

**OBJECTIVES:**

- To Describe discrete time signals & systems and represent in frequency domain
- To Apply the principles of z-transforms to finite difference equations
- To Get familiarized with various structures of IIR and FIR systems.
- To Design and realize various digital filters for digital signal processing.
- To Understand the architecture of various digital signal processors.

**UNIT I INTRODUCTION 9**

Classification of systems: Continuous, discrete, linear, causal, stability, dynamic, recursive, time variance; classification of signals: continuous and discrete, energy and power; mathematical representation of signals, sampling techniques, quantization, quantization error, Nyquist rate, aliasing effect.

**UNIT II DISCRETE TIME SYSTEM ANALYSIS 9**

Z-transform and its properties, inverse z-transforms; difference equation – Solution by z transform, application to discrete systems - Stability analysis, frequency response – Convolution – (Linear and circular convolution.

**UNIT III DISCRETE FOURIER TRANSFORM & COMPUTATION 9**

Discrete Fourier Transform- properties, magnitude and phase representation - Computation of DFT using FFT algorithm – DIT &DIF using radix 2 FFT – Butterfly structure.

**UNIT IV DESIGN OF DIGITAL FILTERS 9**

FIR & IIR filter realization – Parallel & cascade forms. FIR design: Windowing Techniques – Need and choice of windows – Linear phase characteristics. Analog filter design – Butterworth and Chebyshev approximations; IIR Filters, digital design using impulse invariant and bilinear transformation Warping, pre warping.

**UNIT V DIGITAL SIGNAL PROCESSORS 9**

Introduction – Architecture of TMS320C50X– Features – Addressing Formats – Functional modes -Architecture of TMS320C54X

**TOTAL: 45 PERIODS**

**OUTCOMES:**

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

**CO1:** Analyze the properties of Signals and Systems.

**CO2:** Apply Z transform in Discrete Time signal analysis.

**CO3:** Analyze Discrete Time LTI systems using DTFT

**CO4:** Compute decimation-in time - FFT and decimation-in-frequency - FFT for reducing computational complexity of DFT.

**CO5:** Analyze IIR and FIR Filters on digital signal processors

**CO6:** Summarize the architecture of programmable digital signal processors

**TEXT BOOKS:**

1. S.K.Mitra, Digital Signal Processing, 2013, 4th edition, TMH, New Delhi, India.
2. J. G. Proakis, D.G. Manolakis and D.Sharma, Digital Signal Processing Principles, Algorithms and Applications, 2012, 4th edition, Pearson Education, Noida, India
3. Lonnie C.Ludeman ,”Fundamentals of Digital Signal Processing”,Wiley,2013

**REFERENCES:**

1. Poorna Chandra S, Sasikala. B, Digital Signal Processing, Vijay Nicole/TMH,2013.
2. Robert Schilling & Sandra L.Harris, Introduction to Digital Signal Processing using Matlab”, Cengage Learning,2014.
3. SenM.kuo, woonseng...s.gan, “Digital Signal Processors, Architecture, Implementations & Applications, Pearson, 2013
4. Dimitris G.Manolakis, Vinay K. Ingle, applied Digital Signal Processing,Cambridge,2012
5. Oppenheim V.A.V and Schaffer R.W, Discrete – time Signal Processing, 2013, 3rd edition, Prentice Hall, New Jersey, US



- CO2:** Build models using first principles approach as well as analyze models.  
**CO3:** Design PID Controllers to achieve desired performance for various processes  
**CO4:** Analyse Systems and design and implement control Schemes for various Processes.  
**CO5:** Identify, formulate and solve problems in the Process Control Domain.  
**CO6:** Analyse various model based control schemes

**TEXT BOOKS:**

4. Ramesh C. Panda., T.Thyagarajan., An Introduction to Process Modelling Identification and Control for Engineers Narosa Publishing house Pvt. Ltd, 2017.
5. Bequette, B.W., Process Control Modelling, Design and Simulation, Prentice Hall of India, 2004.
6. Stephanopoulos, G., Chemical Process Control – An Introduction to Theory and Practice, Prentice Hall of India, 2005.

**REFERENCES:**

6. Coughanowr, D.R., Process Systems Analysis and Control, McGraw- Hill International Edition, 2004.
7. Curtis D. Johnson, Process Control Instrumentation Technology, 8th Edition, Pearson, 2006.
8. Considine, D.M., Process Instruments and Controls Handbook, Second Edition, McGraw, 1999.
9. Bela.G.Liptak., Process Control and Optimization., Instrument Engineers Handbook., volume 2, CRC press and ISA, 2005.
10. Seborg, D.E., Edgar, T.F. and Mellichamp, D.A., Process Dynamics and Control, Wiley John and Sons, 2nd Edition, 2003.
11. NPTEL Video Lecture Notes on “Process Control and Instrumentation” by Dr. A.K. Jana, Dr. D. Sarkar, IIT Kharagpur. <https://nptel.ac.in/courses/103105064>

**OBJECTIVES:**

- To experimentally verify the process control concepts on the selected process control loops.
- To impart theoretical and practical skills in process identification and PID controller tuning
- To make the students aware of basic and advanced control schemes
- To demonstrate the working of control valves with and without Positioner
- To understand the concept of AC and DC drive

**LIST OF EXPERIMENTS****Simulation Based Experiments**

1. Mathematical model of a typical industrial process using nonparametric identification Methods
2. Internal Model Controller for mathematically described processes
3. Tuning of PID Controller for mathematically described processes
4. PID Enhancements (Cascade and Feed-forward Control Schemes)
5. Design and Implementation of Multi-loop PID Controller on the simulated model of a typical industrial process.
6. Study of AC and DC drives.

**Hardware based experiments**

7. Characteristics of Pneumatically Actuated Control Valve (with and without Positioner).
8. Study and control of flow process using Compact Flow Control Unit.
9. Control of Level and Pressure using Process Control Training Plant.
10. Design and implementation of ON/OFF Controller for the Temperature Process.
11. Design and implementation of Interacting and non-Interacting system

**TOTAL :60 PERIODS****OUTCOMES**

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

**CO1:** Understand and analyze process control engineering problems.

**CO2:** Build dynamic models using input – output data of a process

**CO3:** Demonstrate real time control loops for flow and level process

**CO4:** Demonstrate real time control loops for temperature process

**CO5:** Demonstrate real time control loops pressure process

**CO6:** Simulate tools such as MATLAB/LABVIEW

**OBJECTIVES:**

- To provide practice-oriented and ‘hands-on’ working experience in the real world or industry, and to enhance the student’s learning experience.
- To give an opportunity to develop a right work attitude, self-confidence, interpersonal skills and ability to work as a team in a real organisational setting.
- To give an opportunity to further develop and enhance operational, customer service and other life-long knowledge and skills in a real-world work environment.
- To provide Pre-employment training opportunities and an opportunity for the company or organisation to assess the performance of the student and to offer the student an employment opportunity after his/her graduation, if it deems fit.

**INSTRUCTIONS TO STUDENTS**

- The Industrial / Practical Training, Summer Project, Internship, should be completed in the V semester.
- The Industrial / Practical Training, Summer Project, Internship, shall carry 100 marks and shall be evaluated through internal assessment only.
- At the end of Industrial/Practical training/internship/Summer Project, the candidate shall submit a certificate from the organization where he / she has undergone training and a brief report.
- The evaluation will be made based on this report and a Viva-Voce Examination, conducted internally by a three - member Departmental Committee constituted by the Head of the Institution.
- The certificates (issued by the organization) submitted by the students and mark list shall be forwarded to the Controller of Examinations with the approval of the Head of the Institution.

**OUTCOMES**

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

- CO1:** Demonstrate the application of knowledge and skill sets acquired from the course and workplace in the assigned job functions.
- CO2:** Solve real life challenges in the workplace by analysing work environment and conditions, and selecting appropriate skill sets acquired from the course.
- CO3:** Articulate career options by considering opportunities in company, sector, industry, professional and educational advancement.
- CO4:** Communicate and collaborate effectively and appropriately with different professionals in the work environment through written and oral means.
- CO5:** Exhibit critical thinking and problem-solving skills by analysing underlying issue/s to Challenges.
- CO6:** Demonstrate appreciation and respect for diverse groups of professionals by engaging harmoniously with different company stakeholders.

<b>20EC411</b>	<b>MICROPROCESSORS AND MICROCONTROLLERS</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
	<b>LABORATORY</b>				
		<b>0</b>	<b>0</b>	<b>4</b>	<b>2</b>

**OBJECTIVES:**

- To familiarize Assembly Language Program concepts, features and Coding methods.
- To write Assembly Language Program for arithmetic and logical operations in 8086.
- To differentiate Serial and Parallel Interface.
- To write Assembly Language Program for arithmetic and logical operations in 8051.
- To interface different I/Os with Microprocessors.

**LIST OF EXPERIMENTS**

**8086 Programs**

12. Basic arithmetic and Logical operations
13. Move a data block without overlap
14. Code conversion and decimal arithmetic.
15. Sorting and searching

**8051 Experiments**

16. Basic arithmetic and Logical operations
17. Square and Cube program
18. Find 2's complement of a number
19. Unpacked BCD to ASCII

**Interfacing Experiments of 8086/8051**

20. Traffic light controller
21. Key board and Display – 8279
22. Programmable Timer - 8253/8254
23. Programmable peripheral Interface - 8255
24. A/D and D/A interface
25. Stepper motor control
26. Serial Communication between two kits

**TOTAL :60 PERIODS**

**OUTCOMES**

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

**CO1:** Write ALP Programs for Arithmetic and logical operations.

**CO2:** Analyze to interface different I/Os with processor.

**CO3:** Analyze waveforms using Microprocessors.

**CO4:** Write programs in 8051.

**CO5:** Demonstrate to interface different I/Os with Microcontroller.

**CO6:** Demonstrate to perform serial communications between two kits.

**OBJECTIVES:**

- To develop vocabulary for effective communication and reading skills.
- To build the logical reasoning and quantitative skills.
- To develop error correction and debugging skills in programming.

**LIST OF EXERCISES:****1. English – Phase I Advanced**

Vocabulary: Synonyms, Antonyms, Grammar: Subject-Verb Agreement, Tenses and Articles, Prepositions and Conjunctions, Speech and Voices, Comprehension: Inferential and Literal Comprehension, Contextual Vocabulary, Comprehension ordering

**2. Logical Reasoning – Phase I Advanced**

Deductive Reasoning: Coding deductive logic, Directional sense, Blood relations, Objective Reasoning, Selection decision tables, Puzzles, Inductive reasoning: Coding pattern and Number series pattern recognition, Analogy and Classification pattern recognition, Abductive Reasoning: Logical word sequence, Data sufficiency

**3. Quantitative Ability - Phase I Advanced**

Basic Mathematics: Divisibility, HCF and LCM, Numbers, decimal fractions and power, Applied Mathematics: Profit and Loss, Simple and Compound Interest, Time, Speed and Distance, Engineering Mathematics: Logarithms, Permutation and Combinations, Probability

**4. Automata Fix – Phase I Advanced**

Logical, Compilation and Code reuse

**TOTAL: 30 PERIODS****OUTCOMES**

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

**CO1:** Develop vocabulary for effective communication and reading skills.

**CO2:** Build the logical reasoning and quantitative skills.

**CO3:** Develop error correction and debugging skills in programming.



**OUTCOMES:**

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

**CO1:** Understand all the important components such as PLC, SCADA, DCS, I/O modules and field devices of an industrial automation system.

**CO2:** Develop PLC program in different languages for industrial sequential applications.

**CO3:** Configure and develop Feedback Control Schemes using PLC and DCS.

**CO4:** Select and use most appropriate automation technologies for a given application.

**CO5:** Ability to gain knowledge on the recent developments in industrial automation.

**CO6:** Understand the communication protocols

**TEXT BOOKS:**

1. F.D. Petruzella, Programmable Logic Controllers, TataMc-GrawHill, Third edition, 2010
2. Clarke, G., Reynders, D. and Wright, E., Practical Modern SCADA Protocols: DNP3,4. 60870.5 and Related Systems, Newnes, 1st Edition, 2004.
3. Hughes, T.A., Programmable Logic Controllers: Resources for Measurements and Control Series, 3rd Edition, ISA Press,2004.

**REFERENCES:**

1. Michael P. Lukas, Distributed Control Systems: Their Evaluation and Design, Van Nostrand Reinhold Co.,1986
2. D. Popovic and V.P.Bhatkar, Distributed computer control for industrial Automation MarcelDekker, Inc., Newyork ,1990.
3. McMillan, G.K., Process/Industrial Instrument and Controls Handbook, 5thEdition, McGraw- Hill handbook, NewYork, 1999.
4. NPTEL Video Lecture on, “Programmable Logic Control System” by Department of Electrical Engg., IIT Kharagpur.

**OBJECTIVES:**

- To understand the fundamentals of Internet of Things
- To learn about the basics of IOT protocols
- To build a small low-cost embedded system using Raspberry Pi.
- To apply the concept of Internet of Things in the real-world scenario.
- To study various case studies related to Industrial Internet of Things.

**UNIT I INTRODUCTION TO INDUSTRY 4.0 12**

Sensing & actuation- Communication - Networking- Globalization and Emerging Issues, The Fourth Revolution, LEAN Production Systems, Smart and Connected Business Perspective, Smart Factories

**UNIT II IOT DATA LINK LAYER & NETWORK LAYER PROTOCOLS 12**

Protocol Standardization for IoT – Efforts – PHY/MAC Layer (3GPP MTC, IEEE 802.11, IEEE 802.15), Wireless HART, Z-Wave, Bluetooth Low Energy, Zigbee Smart Energy - Network Layer-IPv4, IPv6, 6LoWPAN, 6TiSCH, ND, DHCP, ICMP, RPL, CORPL, CARP.

**UNIT III IOT TRANSPORT, SESSION, SERVICE AND SECURITY LAYER PROTOCOLS 12**

Transport Layer (TCP, MPTCP, UDP, DCCP, SCTP) - (TLS, DTLS) – Session Layer-HTTP, CoAP, XMPP, AMQP, MQTT. Service Layer -oneM2M, ETSI M2M, OMA, BBF – Security in IoT Protocols – MAC 802.15.4, 6LoWPAN, RPL, Application Layer.

**UNIT IV INDUSTRIAL IoT 12**

Industrial Sensing & Actuation- Industrial Internet Systems- IIoT- Introduction, Industrial IoT: Business Model and Reference Architecture- IIoT Sensing, IIoT Processing, IIoT communication, IIoT Networking

**UNIT V APPLICATION AND CASE STUDIES 12**

Application Domains: Healthcare, Power Plants, Inventory Management & Quality Control, Plant Safety and Security (Including AR and VR safety applications), Facility Management, Oil, chemical and pharmaceutical industry, Applications of UAVs in Industries, Real case studies: Milk Processing and Packaging Industries, Manufacturing Industries, Virtual Reality Lab, Steel Technology Lab.

**TOTAL: 60 PERIODS**

**OUTCOMES:**

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

**CO1:** Understand IoT value chain structure (device, data cloud), application areas and technologies involved.

**CO2:** Understand various protocols in Data Link and Network Layer

**CO3:** Understand various protocols in Transport, Session, Service and Security Layer

**CO4:** Learn about Internet of Things with the help of projects designed for Raspberry P.

**CO5:** Explore various Case Studies related to Industrial Internet of Things

**CO6:** Understand IoT sensors and technological challenges faced by IoT devices, with a focus on wireless, energy, power, and sensing modules.

**TEXT BOOKS:**

1. Arshdeep Bahga, Vijay Madisetti, —Internet of Things – A hands-on approach, Universities Press, 2015
2. Dieter Uckelmann, Mark Harrison, Michahelles, Florian (Eds), —Architecting the Internet of Things, Springer, 2011.
3. Olivier Hersent, David Boswarthick, Omar Elloumi, —The Internet of Things – Key applications and Protocols, Wiley, 2012

**REFERENCES:**

1. Honbo Zhou, —The Internet of Things in the Cloud: A Middleware Perspective, CRC Press, 2012.
2. Jan Ho" ller, Vlasios Tsiatsis , Catherine Mulligan, Stamatis , Karnouskos, Stefan Avesand. David Boyle, "From Machine-to-Machine to the Internet of Things - Introduction to a New Age of Intelligence", Elsevier, 2014.
3. "Industry 4.0: The Industrial Internet of Things", by Alasdair Gilchrist (Apress)
4. "Industrial Internet of Things: Cyber manufacturing Systems" by Sabina Jeschke, Christian Brecher, Houbing Song, Danda B. Rawat (Springer)
5. Peter Waher, "Learning Internet of Things", PACKT publishing, BIRMINGHAM – MUMBAI.
6. NPTEL Video Lecture Notes on "Introduction to Industry 4.0 and Industrial Internet of Things" by Prof. Sudip Misra, IIT Kharagpur. <https://nptel.ac.in/courses/106105195>

**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 various analog and digital modulation techniques
- To study the principles behind information theory and coding
- To study the various digital communication techniques
- To study the various multiple access techniques

**UNIT I ANALOG MODULATION 12**

Amplitude Modulation – AM, DSBSC, SSBSC, VSB – PSD, modulators and demodulators  
 Angle modulation – PM and FM – PSD, modulators and demodulators – Superheterodyne receivers

**UNIT II PULSE MODULATION 12**

Low pass sampling theorem – Quantization – PAM – Line coding – PCM, DPCM, DM, and ADPCM And ADM, Channel Vocoder - Time Division Multiplexing, Frequency Division Multiplexing.

**UNIT III DIGITAL MODULATION AND TRANSMISSION 12**

Phase shift keying – BPSK, DPSK, QPSK – Principles of M-ary signaling M-ary PSK & QAM – Comparison, ISI – Pulse shaping – Duo binary encoding – Cosine filters – Eye pattern, equalizers.

**UNIT IV INFORMATION THEORY AND CODING 12**

Measure of information – Entropy – Source coding theorem – Shannon–Fano coding, Huffman Coding, LZ Coding – Channel capacity – Shannon-Hartley law – Shannon's limit – Error control codes – Cyclic codes, Syndrome calculation – Convolution Coding, Sequential and Viterbi decoding

**UNIT V SPREAD SPECTRUM AND MULTIPLE ACCESS 12**

PN sequences – properties – m-sequence – DSSS – Processing gain, Jamming – FHSS – Synchronisation and tracking – Multiple Access – FDMA, TDMA, CDMA

**TOTAL: 60 PERIODS**

**OUTCOMES:**

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

**CO1:** Identify and understand analog communication techniques.

**CO2:** Discuss about the pulse modulation techniques.

**CO3:** Identify and Understand Digital communication techniques.

**CO4:** Understand the various source coding techniques and apply the suitable error control codes.

**CO5:** Understand about Spread Spectrum Techniques.

**CO6:** Understand about Multiple Access Techniques

**TEXT BOOKS:**

1. H Taub, D L Schilling, G Saha, "Principles of Communication Systems" 3/e, TMH 2011
2. S. Haykin "Digital Communications" John Wiley 2013
3. John G. Proakis and Masoud Salehi "Fundamentals of Communication Systems" Pearson Education, Inc, 2013

**REFERENCES:**

1. B.P.Lathi, "Modern Digital and Analog Communication Systems", 3rd edition, Oxford University Press, 2007
2. H P Hsu, Schaum Outline Series – "Analog and Digital Communications" TMH 2006
3. B. Sklar, Digital Communications Fundamentals and Applications" 2/e Pearson Education 2007.
4. NPTEL course "Introduction to Communication Engineering" Website link: <https://nptel.ac.in/courses/117102059>

**OBJECTIVES:**

- Be familiar with the embedded computing platform design and analysis.
- Learn the architecture and programming of ARM processor.
- Be exposed to the basic concepts of real time operating system and scheduling.
- Be familiar with different applications of embedded system
- To learn the applications of embedded systems in various domains.

**UNIT I INTRODUCTION TO EMBEDDED SYSTEM DESIGN 9**

Complex systems and microprocessors– Embedded system design process –Design example: Model train controller- Design methodologies- Design flows – Requirement Analysis – Specifications-System analysis and architecture design – Quality Assurance techniques - Designing with computing platforms – consumer electronics architecture –platform-level performance analysis.

**UNIT II ARM PROCESSOR AND PERIPHERALS 9**

ARM Architecture Versions – ARM Architecture – Instruction Set – Stacks and Subroutines – Features of the LPC 214X Family – Peripherals – The Timer Unit – Pulse Width Modulation Unit – UART – Block Diagram of ARM9 and ARM Cortex M3 MCU.

**UNIT III EMBEDDED PROGRAMMING 9**

Components for embedded programs- Models of programs- Assembly, linking and loading – compilation techniques- Program level performance analysis – Software performance optimization – Program level energy and power analysis and optimization – Analysis and optimization of program size- Program validation and testing.

**UNIT IV PROCESSES AND OPERATING SYSTEMS 9**

Introduction – Multiple tasks and multiple processes – Multirate systems- Preemptive real time operating systems- Priority based scheduling- Interprocess communication mechanisms – Evaluating operating system performance- power optimization strategies for processes –Example Real time operating systems-POSIX-Windows CE. – Distributed embedded systems.

**UNIT V APPLICATIONS OF EMBEDDED SYSTEMS 9**

Data compressor - Alarm clock - Audio player - Software modem-Digital still camera - Telephone answering machine-Engine control unit – Video accelerator.

**TOTAL: 45 PERIODS**

**OUTCOMES:**

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

**CO1:** Acquire knowledge on basic components of embedded system design

**CO2:** Analyze the concepts of embedded systems.

**CO3:** Describe the architecture and programming of ARM processor.

**CO4:** Use the system design techniques to develop software for embedded systems.

**CO5:** Acquire knowledge on fundamentals of RTOS and its various scheduling policies

**CO6:** Model real-time consumer/industrial applications using embedded-system concepts

**TEXT BOOKS:**

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

**REFERENCES:**

1. LylaB.Das,— Embedded Systems: An Integrated Approach PearsonEducation,2013.
2. JonathanW.Valvano,— Embedded Microcomputer Systems Real Time Interfacing, Third Edition Cengage Learning, 2012.
3. Raymond J.A. Buhr, DonaldL. Bailey, —AnIntroductiontoReal-TimeSystems From Design to Networking with C/C++, PrenticeHall, 1999.
4. C.M.Krishna,KangG.Shin,—Real-timeSystems,InternationalEditions,McGrawHill1997.
5. Sriram V Iyer, Pankaj Gupta, Embedded Real Time Systems Programming, Tata McGrawHill, 2017.
6. NPTEL LINK :<https://nptel.ac.in/courses/106/105/106105193/>

**OBJECTIVES:**

- To impart an adequate knowledge and expertise to handle equipment generally available in an industry
- To make the students aware about calibration of meters, sensors and transmitters.
- To make the students conscious about the working and operation of different types of analytical Instruments.
- To identify, formulate, and analyze problems regarding sensors and transmitter
- To impart the knowledge of IoT in Instrumentation to store and monitor the data in cloud

**LIST OF EXPERIMENTS**

- 1 Measurement of speed and torque
- 2 Calibration of ammeter, voltmeter and wattmeter using multifunction calibrator
- 3 Calibration of pressure gauge using dead weight tester.
- 4 Measurement of level using d/p transmitter.
- 5 Measurement of flow using Discharge coefficient of orifice plate.
- 6 Measurement of Absorbance and Transmittance of Test solutions using UV-Spectrometer.
- 7 Measurement of Conductivity, Moisture and Viscosity of test solutions.
- 8 Standardization and measurement of pH values of different solutions
- 9 Measurement and analysis of ECG and pulse rate.
- 10 Measuring and Monitoring of Temperature, Level, Vibration using IoT

**TOTAL :60 PERIODS****OUTCOMES**

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

**CO1:** Experiment the industrial process parameters such as flow, level and temperature.

**CO2:** Experiment the industrial process parameters such as pressure and viscosity.

**CO3:** Analyze pH, conductivity, UV absorbance and transmittance

**CO4:** Analyze physiological parameters such as BP, ECG and pulse rate.

**CO5:** Apply sensor output in cloud and IoT.

**CO6:** Evaluate the Calibration of ammeter and Voltmeter

**OBJECTIVES:**

- To understand the programming of PLC, SCADA and DCS
- To work with industrial automation system
- To design and implement control schemes in PLC & DCS
- To Interface field devices with PLC & DCS
- To understand various communication protocols

**LIST OF EXPERIMENTS**

- 1 Study of PLC field device interface modules (AI,AO,DI,DO modules)
- 2 Programming Logic Gates Function in PLC
- 3 Implementing Mathematical Operations in PLC
- 4 Programming Jump-to-subroutine & return operations in PLC
- 5 PLC Exercises:- 1. Traffic Light Control and Filling/Draining Control Operation
- 6 PLC Exercise: 1. Reversal of DC Motor Direction 2. ON/OFF Controller for Thermal Process
- 7 PC based control of Level Process
- 8 On-line Monitoring and Control of a Pilot plant using DCS
- 9 PLC based Control of Flow Process
- 10 Study of Foundation Fieldbus /IOT/Wireless HART Enabled Transmitter

**TOTAL :60 PERIODS****OUTCOMES**

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

**CO1:** Understand and Programming of PLC, SCADA and DCS

**CO2:** Ability to working with industrial automation system

**CO3:** Design and implement control schemes in PLC & DCS

**CO4:** Interface field devices with PLC & DCS

**CO5:** Understand various communication protocols

**CO6:** Identify a separate Team to do mini project as Team work.

**OBJECTIVES:**

- To develop advanced vocabulary for effective communication and reading skills.
- To build an enhanced level of logical reasoning and quantitative skills.
- To develop error correction and debugging skills in programming.
- To apply data structures and algorithms in problem solving.

**LIST OF EXERCISES:****1.English – Phase II Advanced**

Vocabulary: Synonyms, Antonyms, Grammar: Subject-Verb Agreement, Tenses and Articles, Prepositions and Conjunctions, Speech and Voices, Comprehension: Inferential and Literal Comprehension, Contextual Vocabulary, Comprehension ordering

**2. Logical Reasoning – Phase II Advanced**

Deductive Reasoning: Coding deductive logic, Directional sense, Blood relations, Objective Reasoning, Selection decision tables, Puzzles, Inductive reasoning: Coding pattern and Number series pattern recognition, Analogy and Classification pattern recognition, Abductive Reasoning: Logical word sequence, Data sufficiency

**3. Quantitative Ability - Phase II Advanced**

Basic Mathematics: Divisibility, HCF and LCM, Numbers, decimal fractions and power, Applied Mathematics: Profit and Loss, Simple and Compound Interest, Time, Speed and Distance, Engineering Mathematics: Logarithms, Permutation and Combinations, Probability

**4. Automata Fix – Phase II Advanced**

Logical, Compilation and Code reuse

**5. Automata - Phase II Advanced**

Data Structure Concepts: Array and Matrices, Linked list, String processing and manipulation, Stack/Queue, Sorting and Searching Advanced Design and Analysis Techniques: Greedy Algorithms, Minimum Spanning Trees, String Matching, Divide and Conquer, Computational Geometry

**TOTAL :30 PERIODS****OUTCOMES**

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

**CO1:** Develop advanced vocabulary for effective communication and reading skills.

**CO2:** Build an enhanced level of logical reasoning and quantitative skills.

**CO3:** Develop error correction and debugging skills in programming.

**CO4:** Apply data structures and algorithms in problem solving.

## VII SEMESTER

20EI701

MEDICAL INSTRUMENTATION

L T P C  
3 0 0 3

### OBJECTIVES:

- To provide an overview about various physiological signal measurements.
- To provide an overview about electrical parameter acquisition and recording.
- To provide knowledge on electrical safety.
- To make students understand various biomedical Instruments used for non-electrical parameter measurement.
- To make students familiarized with various medical imaging systems.

### UNIT I BASIC CONCEPTS OF MEDICAL INSTRUMENTATION 09

Medical Instrumentation systems – Classification of Biomedical instruments –Transducers  
Selection criteria – Bio-potentials – Electrical activity of excitable cells – Bio-potential Electrodes  
–Types of electrodes - Electrode behavior and circuit models.

### UNIT II BIOMEDICAL SIGNAL ACQUISITION AND ANALYSIS 09

Types and Classification of biological signals – Electrical parameters acquisition: Origin,  
recording schemes – ECG, EEG, EMG, ERG – Lead systems and recording methods –Typical  
waveforms – Noise and artifacts – Electrical safety: Physiological Effect of Electrical  
Current, shock hazards – leakage current.

### UNIT III MEASUREMENT OF NON ELECTRICAL PARAMETERS 09

Measurement of blood pressure – Cardiac output – Blood flow – Heart rate – Heart sound –  
Pulmonary function measurements – Spirometer – Photo Plethysmography, Body  
Plethysmography– Blood Gas analyzers, pH of blood – Measurement of blood pCO<sub>2</sub>, pO<sub>2</sub>,  
fingertip oximeter.

### UNIT IV MEDICAL IMAGING SYSTEMS 09

X-ray machine- Computer radiography – Computer tomography – Magnetic resonance imaging-  
Nuclear medicine – Single photo emission computer tomography – Positron emission  
tomography– Ultrasonography – Endoscopy – Thermal Imaging.

### UNIT V THERAPEUTIC DEVICES AND TELEMETRY 9 09

Pacemakers – Defibrillators – Ventilators – Nerve and muscle stimulators – Diathermy – Heart –  
Lung machine – Audio meters – Dialyzers – Therapeutic and Prosthetic Devices – Infant  
Incubators – Drug Delivery Devices – Surgical Instruments-Artificial limb and hands –Telemetry.

**TOTAL: 45 PERIODS**

**OUTCOMES:**

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

- CO1:** Analyze and compare the operation of different medical devices.
- CO2:** Measure, detect and analyze the bio-signals.
- CO3:** Apply the appropriate medical instruments for measurement.
- CO4:** Design medical devices for diagnosis and therapeutic applications.
- CO5:** Analyze simple bio-sensing and transduction problems.
- CO6:** Apply safety standards and select disposal method and procedures for electrical diagnostic equipment.

**TEXT BOOKS:**

1. John G. Webster, "Medical Instrumentation Application and Design", John Wiley and sons, Hoboken NJ, 4th Edition New York, 2010.
2. Leslie Cromwell, "Biomedical Instrumentation and Measurement", Prentice Hall of India, 2nd edition October 17, 2020.
3. James E. Moore Jr, Duncan J. Maitland, "Biomedical Technology and Devices", CRC press, 2nd Edition 2013.

**REFERENCES:**

1. Khandpur R.S, "Handbook of Biomedical Instrumentation", Tata McGraw-Hill, 3rd Edition, New Delhi, 2014.
2. Joseph J. Carr and John M. Brown, "Introduction to Biomedical Equipment Technology", John Wiley and sons, 4th Edition, New York, 2000.
3. Monte Ross, "Laser Applications", McGraw-Hill, 1968. Ed. Joseph D. Bronzino, "The Biomedical Engineering Hand Book", 2nd Edition, Boca Raton, CRC Press LLC, 2000.
4. Suh, Sang, Gurupur, Varadraj P., Tanik, Murat M., "Health Care Systems, Technology and techniques", Springer, 1st Edition, 2011.
5. NPTEL course "Biomedical Signal Processing" by Sudipta Mukhopadhyay Website link: <https://nptel.ac.in/courses/108105101>

**OBJECTIVES:**

- To educate on the basic concepts of data networks
- To introduce the basics of internetworking and serial communications
- To provide details on HART and Field buses
- To educate on MODBUS, PROFIBUS and other communication protocol
- To introduce industrial Ethernet and wireless communication.

**UNIT I DATA NETWORK FUNDAMENTALS 09**

Networks hierarchy and switching – Open System Interconnection model of ISO - Data link control protocol - Media access protocol - Command / response - Token passing -CSMA/CD, TCP/IP

**UNIT II INTERNET WORKING AND RS 232, RS485 09**

Bridges - Routers - Gateways - Standard ETHERNET and ARCNET configuration special requirement for networks used for control - RS 232, RS 485 configuration Actuator Sensor (AS) – interface, Devicenet

**UNIT III HART AND FIELD BUS 09**

Introduction - Evolution of signal standard - HART communication protocol - HART networks - HART commands - HART applications - Fieldbus - Introduction - General Fieldbus architecture - Basic requirements of Fieldbus standard - Fieldbus topology - Interoperability - Interchangeability - Introduction to OLE for process control (OPC).

**UNIT IV MODBUS AND PROFIBUS PA/DP/FMS AND FF 09**

MODBUS protocol structure - function codes – troubleshooting Profibus, Introduction, Profibus protocol stack, Profibus communication model - communication objects - system operation - troubleshooting - review of foundation fieldbus - Data Highway

**UNIT V INDUSTRIAL ETHERNET AND WIRELESS COMMUNICATION 09**

Industrial Ethernet, Introduction, 10 Mbps Ethernet, 100 Mbps Ethernet - Radio and wireless communication, Introduction, components of radio link - radio spectrum and frequency 83 allocation - radio MODEMs-Introduction to wireless HART and ISA100.

**TOTAL: 45 PERIODS****OUTCOMES:**

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

**CO1:** Understand basic concepts of data communication and its importance.

**CO2:** Explain the various internetworking devices involved in industrial networks.

**CO3:** Discuss the various serial communication used in process industries

**CO4:** compare the working of HART and Field bus used in process digital communication

**CO5:** Summarize the operation of MODBUS, PROFIBUS protocol & its applications.

**CO6:** Interpret the different Industrial Ethernet protocol and usage of wireless communication in process applications.

**TEXT BOOKS:**

1. Steve Mackay, Edwin Wrijut, Deon Reynders, John Park, Practical Industrial Data Networks Design, Installation and Troubleshooting' Newnes Publication, Elsevier First Edition, 2004
2. Andrew S. Tanenbaum, David J. Wetherall, Computer Networks, Prentice Hall of India Pvt. Ltd., 5th Edition. 2011.
3. BehrouzForouzan, Data Communications & Networking, 5th edition, Tata McGraw hill,2012.

**REFERENCES:**

1. Andrew S. Tanenbaum, David J. Wetherall, Computer Networks, Prentice Hall of India Pvt. Ltd., 5th Edition. 2011.
2. Theodore S Rappaport, Wireless Communication: Principles and Practice, Prentice Hall of India 2nd Edition, 2001.
3. William Stallings, Wireless Communication & Networks, Prentice Hall of India, 2nd Edition, 2005.
4. William Buchanan, Computer Buses, CRC Press, 2000.
5. Nptel Course "Computer Networks and Internet Protocol" by Prof. Soumya Kanti Ghosh, Prof. Sandip Chakraborty, IIT Kharagpur

**OBJECTIVES:**

- To obtain adequate knowledge in design of various signal conditioning circuits and instrumentation systems.
- To impart design knowledge of controller.
- To acquire the knowledge of piping diagram of industrial standard
- To make the students aware of industry project, planning and scheduling.
- To impart design knowledge of control valve and transmitter.

**LIST OF EXPERIMENTS**

1. Design of Instrumentation amplifiers.
2. Design of active filters – LPF, HPF and BPF
3. Design of V/I converters and I/V converters
4. Design of regulated power supply.
5. Design of linearizing circuits and cold-junction compensation circuits for thermocouples.
6. Design of signal conditioning circuit for strain gauge and RTD.
7. Design of orifice plate and rotameter.
8. Design of Control valve (sizing and flow-lift characteristics)
9. Design of PID controller (using operational amplifier and microprocessor)
10. Piping and Instrumentation Diagram – case study.
11. Preparation of documentation of instrumentation project and project scheduling for the above case study. (Process flow sheet, instrument index sheet and instrument specifications sheet, job scheduling, installation procedures and safety regulations).

**TOTAL :60 PERIODS**

**OUTCOMES**

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

**CO1:** Understand signal conditioning circuits and instrumentation systems.

**CO2:** Design controllers, I/P and P/I transmitters

**CO3:** Design and draw the piping diagram for industrial application projects.

**CO4:** Design the multi-channel data acquisition system and transmitter

**CO5:** Design digital controllers

**CO6:** Design control valves

**OBJECTIVES:**

- To impart knowledge about basic mathematics related to industrial robots for their control, design and application in robotics & automation Industries
- To Understanding electronic basic and familiar with electrical components used in Robotics
- To introduce embedded system and its fundamental building blocks
- To introduce embedded C programming and Learn team development by doing Projects
- To make the students familiar with the architectural features and instruction set of microcontrollers/microprocessors

**LIST OF EXPERIMENTS**

1. Study of Introduction to Embedded systems using Firebird V Robot
2. Design basic IO Interfacing on Firebird-V
3. Program for Motion Control of Firebird-V Robot
4. Design Motion control using Pulse Width Modulation
5. Demonstrate LCD Interfacing on Firebird V Robot
6. Program the Interrupts on Firebird-V Robot
7. Design ADC on Firebird-V Robot
8. Demonstrate the USB to Serial Communication using Zigbee
9. Perform various task on gripper using servo motor

**TOTAL :60 PERIODS****OUTCOMES**

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

**CO1:** Create coding using Embedded C for Microcontroller

**CO2:** Perform kinematic and dynamic analyses to make a robot to move by learning programming

**CO3:** Design control laws for a simple robot.

**CO4:** Integrate mechanical and electrical hardware for a real prototype of robotic device

**CO5:** Understand how to control stepper motors for gripper movement.

**CO6:** Identify a separate Team to do mini project as Team work.

## PROFESSIONAL ELECTIVE – 1

<b>20EI901</b>	<b>INTRODUCTION TO PROCESS DATA ANALYTICS</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>

### OBJECTIVES:

- To discuss the review of linear algebra concepts
- To describe the linear regression analysis concepts
- To explain the linear model selection and regularization
- To classify discriminant analysis
- To implement the process monitoring and soft sensor design.

### **UNIT I INTRODUCTION 09**

Introduction to Process data analytics and Statistical learning - Review of Linear Algebra Concepts – Review of Probability & Statistics - Design of experiments - Industrial case studies on factorial experiments.

### **UNIT II REGRESSION 09**

Linear Regression:- Simple Linear Regression, Multiple Linear Regression-K-nearest neighbors regression – Practical Consideration in the Regression Model - Validation methods to assess model quality:-The validation set approach, Leave-One-Out Cross Validation, k-Fold Cross Validation – Bias-variance Trade-off for k-Fold Cross Validation

### **UNIT III LINEAR MODEL SELECTION & REGULARIZATION 09**

Subset Selection: - Best Subset Selection, Step-wise Selection and Choosing the Optimal Model – Shrinkage Methods: - LASSO, Ridge regression, Elastic nets – Dimension reduction Methods:- Principal Components Regression, Partial Least Squares.

### **UNIT IV SUPERVISED LEARNING TECHNIQUES 09**

Logistic regression– Linear Discriminant Analysis - Quadratic Discriminant Analysis – Regression & Classification Trees – Support Vector Machines - Random forests, Bagging and boosting - Neural Networks – Deep Learning

### **UNIT V APPLICATIONS 09**

Process data analysis for system identification (under open and closed loops) – Controller Performance Monitoring - Principal components analysis (PCA) for Process Monitoring and Partial Least Squares (PLS) for soft-sensor design - Data-based causality analysis for identification of process topology.

**TOTAL: 45 PERIODS**

**OUTCOMES:**

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

**CO1:** Understand the statistical terms related to data analytics.

**CO2:** Select the right regression method for a given application.

**CO3:** Analyze the performance of various model selection and regularization methods.

**CO4:** Develop right classifier for a given application.

**CO5:** Utilize appropriate data analysis tool for soft sensor development system

**CO6:** Apply appropriate software tools for data driven analysis.

**TEXT BOOKS:**

1. Gareth James, Daniela Witten, Trevor Hastie, Robert Tibshirani, An Introduction to Statistical Learning with Applications in R, Springer Texts in Statistics,2013.
2. Ethem Alpaydin, Introduction to Machine Learning, MIT Press,2013
- 3 Thomas A. Runkler, Data Analytics: Models and Algorithms for Intelligent Data Analysis, Springer Vieweg, 2nd Edition,2016.

**REFERENCES:**

1. Arun K. Tangirala, Principles of System Identification – Theory and Practice, CRC Press,2015.
2. Huang, B. and Shah, S.L., Performance Assessment of Control Loops: Theory and Applications, Springer-Verlag,1999.
3. Fan Yang, Ping Duan, Sirish L Shah, TongwenChen, Capturing Connectivity and Causality in Complex Industrial Processes, Springer,2014.
4. NPTEL: Introduction to Data Analytics, Prof. Nandan Sudarsanam, Dr. Balaraman Ravindran, IIT Madras

**OBJECTIVES:**

- To understand the theory and operational principles of instrumental methods for identification and quantitative analysis of chemical substances by different types of spectroscopy.
- To impart fundamental knowledge on gas chromatography and liquid chromatography.
- To integrate a fundamental understanding of the underlining principles of physics as they relate to specific instrumentation used for gas analyzers and pollution monitoring instruments.
- To impart knowledge on the important measurement in many chemical processes and laboratories handling liquids or solutions.
- To understand the working principle, types and applications of NMR and Mass spectroscopy.

**UNIT I SPECTROPHOTOMETRY 09**

Spectral methods of analysis – Beer-Lambert law – UV-Visible spectroscopy – IR Spectrophotometry - FTIR spectrophotometry – Atomic absorption spectrophotometry - Flame emission and atomic emission photometry – Construction, working principle, sources detectors and applications.

**UNIT II CHROMATOGRAPHY 09**

General principles – classification – chromatographic behavior of solutes – quantitative determination – Gas chromatography – Liquid chromatography – High-pressure liquid chromatography – Applications.

**UNIT III INDUSTRIAL GAS ANALYZERS AND POLLUTION MONITORING INSTRUMENTS 09**

Gas analyzers – Oxygen, NO<sub>2</sub> and H<sub>2</sub>S types, IR analyzers, thermal conductivity detectors, analysis based on ionization of gases. Air pollution due to carbon monoxide, hydrocarbons, nitrogen oxides, sulphur dioxide estimation - Dust and smoke measurements.

**UNIT IV pH METERS AND DISSOLVED COMPONENT ANALYZERS 09**

Selective ion electrodes - Principle of pH and conductivity measurements – dissolved oxygen analyzer – Sodium analyzer – Silicon analyzer – Water quality Analyzer.

**UNIT V NUCLEAR MAGNETIC RESONANCE AND MASS SPECTROMETRY 09**

NMR – Basic principles – Continuous and Pulsed Fourier Transform NMR spectrometer – Mass Spectrometry – Sample system – Ionization methods – Mass analyzers – Types of mass spectrometry.

**TOTAL: 45 PERIODS**

**OUTCOMES:**

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

**CO1:** Understand the fundamental principles of selective analytical instruments used in medical diagnosis, quality assurance & control and research studies.

**CO2:** Assess and suggest a suitable analytical method for a specific purpose, and evaluate sensitivity, important sources of interferences and errors, and also suggest alternative analytical methods for quality assurance.

**CO3:** Evaluate the strengths and limitations of the various instrumental methods.

**CO4:** Develop critical thinking for interpreting analytical data.

**CO5:** Understand the working principle, types and applications of NMR

**CO6:** Understand the working principle, types and applications of Mass spectroscopy

**TEXT BOOKS:**

1. Willard, H.H., Merritt, L.L., Dean, J.A., Settle, F.A., "Instrumental methods of analysis", CBS publishing & distribution, 7th Edition, 2012.
2. Braun, R.D., "Introduction to Instrumental Analysis", Pharma Book Syndicate, Singapore, 2019.
3. Robert E. Sherman., "Analytical Instrumentation", Instruments Society of America, 1996.

**REFERENCES:**

1. Khandpur, R.S., "Handbook of Analytical Instruments", Tata McGraw-Hill publishing Co. Ltd., 2nd Edition 2007.
2. Ewing, G.W., "Instrumental Methods of Chemical Analysis", McGraw-Hill, 5th Edition reprint 1985. (Digitized in 2007).
3. Liptak, B.G., "Process Measurement and Analysis", CRC Press, 5th Edition, 2015.
4. NPTEL lecture notes on, "Modern Instrumental methods of Analysis" by Dr.J.R. Mudakavi, IISC, Bangalore.

**OBJECTIVES:**

- To study the kinematics, drive systems and programming of robots.
- To study the basics of robot laws and transmission systems.
- To familiarize students with the concepts and techniques of robot manipulator, its kinematics.
- To familiarize students with the various Programming and Machine Vision application in robots.
- To build confidence among students to evaluate, choose and incorporate robots in engineering systems.

**09****UNIT I FUNDAMENTALS OF ROBOT**

Overview of a robotic system, applications and significance of a robotic system, elements of a robotic system, future advances in robotics

**UNIT II MODELING A ROBOTIC SYSTEM****09**

Introduction to common terms and nomenclature used in robotics- workspace, joint space, Euler angles, reference systems, robot manipulator – links and joints, DH- parameters, kinematics and dynamics of a two link robot manipulator

**UNIT III ACTUATORS****09**

Electrical actuators-DC motor, stepper motor, drives, servo motor, relays and solenoids. Hydraulic and pneumatic devices- design. Gear trains, limit switches, power supply and hazards

**UNIT IV CONTROL DESIGN****09**

Basics of a control system – closed loop and open loop, feedback and feedforward control, PID controller. PLC programming and ladder logic, analog input output, microprocessor applications in mechatronics, programming interfacing

**UNIT V CASE STUDY OF ROBOTICS SYSTEM****09**

Control of a robotic manipulator and role of robots in inspection, assembly, material handling, underwater, space, medical fields, vehicle and drone

**TOTAL: 45 PERIODS****OUTCOMES:**

On successful completion of this Course, the students will be able

**CO1:** Interpret the features of robots and technology involved in the control

**CO2:** Apply the basic engineering knowledge and laws for the design of robotics.

**CO3:** Explain the basic concepts like various configurations, classification and parts of end effectors compare various end effectors and grippers and tools and sensors used in robots.

**CO4:** Explain the concept of kinematics, degeneracy, dexterity and trajectory planning.

**CO5:** Demonstrate the image processing and image analysis techniques by machine vision system.

**CO6:** Understand the Robotic Manipulator for Inspection and assembly.

**TEXT BOOKS:**

1. Mikell Groover, “Industrial Robotics: Technology, Programming, and Applications”, 2nd edition, Tata McGraw-Hill, 2017
2. Devdas Shetty & Richard Kolk “Mechatronics System Design”, 3rd edition. PWS Publishing, 2009.
3. Mark W. Spong, Seth Hutchinson, and M. Vidyasagar, “Robot Dynamics and Control”, 2nd edition, 2004.
4. Ganesh.S.Hedge ,”A textbook of Industrial Robotics”, Lakshmi Publications, 2006. McGraw Hill 2th edition 2012.

**REFERENCES:**

1. Oussama Khatib, “Handbook of Robotics”, Springer, 2008
2. Mikell.P.Groover , “Industrial Robotics – Technology, Programming and applications”
3. John. J.Craig, “Introduction to Robotics: Mechanics and Control” 2nd Edition, 2002
4. Jazar, “Theory of Applied Robotics: Kinematics, Dynamics and Control”, Springer India reprint, 2010.
5. NPTEL video lecture on Robotics, IIT Bombay by Prof. B. Seth, Prof. C. Amarnath, Prof. K. Kurien Issac, Prof. P.S. Gandhi, Prof. P. Seshu

**OBJECTIVES:**

- To explain the basic concepts of operating systems and process.
- To discuss threads and analyse various CPU scheduling algorithms.
- To describe the concept of process synchronization and deadlocks.
- To analyse various memory management schemes.
- To describe I/O management and file systems.

**09****UNIT I INTRODUCTION TO OPERATING SYSTEMS AND PROCESSES**

Introduction to OS –Computer system organization - architecture – Resource management - Protection and Security – Virtualization - Operating System Structures - Services - User and Operating-System Interface - System Calls - System Services -Design and Implementation - Building and Booting an Operating System - Process Concept - Process Scheduling - Operations on Processes – Inter process Communication - IPC in Shared-Memory Systems - IPC in Message-Passing Systems

**UNIT II THREADS AND CPU SCHEDULING****09**

Threads & Concurrency: Overview - Multicore Programming - Multithreading Models - Thread Libraries - Implicit Threading - Threading Issues - CPU Scheduling: Basic Concepts - Scheduling Criteria - Scheduling Algorithms - Thread Scheduling - Multi-Processor Scheduling - Real-Time CPU Scheduling

**UNIT III PROCESS SYNCHRONISATION AND DEADLOCKS****09**

Process Synchronization - The critical-section problem, Peterson's Solution - Synchronization hardware, Mutex locks, Semaphores, monitors, Liveness - Classic problems of synchronization – Bounded Buffer Problem - Reader's & Writer Problem, Dining Philosopher Problem, Barber's shop problem. Deadlock - System model - Deadlock characterization, Methods for handling deadlocks - Deadlock prevention - Deadlock avoidance - Deadlock detection - Recovery from deadlock.

**UNIT IV MEMORY MANAGEMENT****09**

Memory Management: Contiguous Memory Allocation - Paging - Structure of the Page Table – Swapping - Virtual Memory: Demand Paging – Copy-on write – Page Replacement – Allocation of frames – Thrashing Memory – Compression

**UNIT V FILE MANAGEMENT****09**

File Management: File Concept – Access Methods – Directory Structure – Protection - Memory-Mapped File - Disk Management: Disk structure, Disk scheduling - FCFS, SSTF, SCAN, C-SCAN, Disk reliability, Disk formatting, Boot-block, Bad blocks - I/O Hardware: I/O devices, Device controllers, Direct Memory Access - Case Study-Linux.

**TOTAL: 45 PERIODS**

**OUTCOMES:**

On successful completion of this Course, the students will be able

**CO1:** Implement the basic concepts of operating systems and process.

**CO2:** Analyse various CPU scheduling algorithms and thread mechanism.

**CO3:** Implement the concepts of process synchronization and deadlocks.

**CO4:** Design various memory management schemes to given situation

**CO5:** Implement various I/O and file management techniques.

**TEXT BOOKS:**

1. Silberschatz Abraham, Greg Gagne, Peter B. Galvin. "Operating System Concepts", Tenth Edition, Wiley, 2018.

**REFERENCES:**

1. William Stallings, Operating Systems – Internals and Design Principles, Pearson Education, New Delhi, 2018.
2. Achyut S.Godbole, Atul Kahate, Operating Systems, McGraw Hill Education, 2016.
3. Andrew S. Tanenbaum, "Modern Operating System", 4 th Edition, PHI Learning, New Delhi, 2018.

20CB404

**INTRODUCTION TO INNOVATION, IP  
MANAGEMENT & ENTREPRENEURSHIP**

**L T P C**  
**3 0 0 3**

**OBJECTIVES:**

- Develop mindsets to pursue entrepreneurship.
- Understand the basics of Innovation and Entrepreneurship
- Create, protect, assetize and commercialize intellectual property?
- Identify and discover market needs
- Manage an innovation program
- Understand opportunities and challenges for entrepreneurs through Startup Models

**UNIT I INNOVATION 09**

Innovation Types of Innovation Incremental, disruptive, Lifecycle of Innovation (idea, literature survey, PoT, PoC, etc.), Challenges in Innovation (time, cost, data, infrastructure, etc.)

**UNIT II IPR 09**

Types of IPR (patents, copyrights, trademarks, GI, etc.) Lifecycle of IP (creation, protection, assetization, commercialization), Balancing IP Risks and Rewards (Right Access and Right Use of Open Source and 3rd party products, technology transfer and licensing).

**UNIT III ENTREPRENEURSHIP 09**

Opportunity Identification in Technology Entrepreneurship (customer pain points, competitive context) Market Research, Segmentation and Sizing Product Positioning, Pricing, and Go-To-Market Strategy IP Valuation (methods, examples, limitations).

**UNIT IV TYPES OF STARTUP BUSINESS MODEL 09**

Startup Business Models (fund raising, market segments, channels, etc.) Co- innovation and Open Innovation (academia, startups, corporates) Technology Innovation: Two Case Studies.

**UNIT V PROCESSES IN STARTUP BUSINESS MODEL 09**

Innovation, Incubation and Entrepreneurship in Corporate Context Technology-driven Social Innovation and Entrepreneurship Manage Innovation, IP and Entrepreneurship Programs – Processes, Governance and Tools

**TOTAL: 45 PERIODS**

**OUTCOMES:**

On successful completion of this Course, the students will be able

**CO1:** Understand the basics of Innovation and Entrepreneurship

**CO2:** Manage an innovation program

**CO3:** Create, protect, assetize and commercialize intellectual property

**CO4:** Understand opportunities and challenges for entrepreneurs

**CO5:** Developing mindsets to pursue entrepreneurship.

**CO6:** Identify and discover market needs

**TEXT BOOKS:**

1. Jugaad Innovation: Think Frugal, Be Flexible, Generate Breakthrough Growth Navi Radjou, Jaideep Prabhu, Simone Ahuja , John Wiley & Sons, 2012.

**REFERENCES:**

1. Identifying Entrepreneurial Opportunities: Cognition and Categorization in Nascent Entrepreneurs, Matthew J. Karlesky, University of Michigan, 2015.
2. <http://www.businessdictionary.com/definition/entrepreneurship>.
3. <https://www.infoentrepreneurs.org/en/guides/use-innovation-to-grow-your-business/>
4. <http://sourcesofinsight.com/innovation-life-cycle/>
5. <https://www.investottawa.ca/>
6. <https://www.Lead-innovation.com>

## PROFESSIONAL ELECTIVE – II

20EI904

RELIABILITY AND SAFETY ENGINEERING

L	T	P	C
3	0	0	3

### OBJECTIVES:

- To educate the students about the basic things of work conditions which includes ventilation, comfort, lighting and its effect based on various nature of work.
- To provide knowledge on effective and safe layout design of an industry.
- To provide knowledge on basics of electrical fire and statutory requirements for electrical safety.
- To understand the causes of accidents due to electrical hazards.
- To know the various protection systems in Industries from electrical hazard

### UNIT I RELIABILITY CONCEPT

09

Reliability function – failure rate – mean time between failures (MTBF) – mean time to failure (MTTF) – A priori and a posteriori concept - mortality curve – useful life – availability – maintainability – system effectiveness.

### UNIT II RELIABILITY MANAGEMENT

Reliability testing – Reliability growth monitoring – non-parametric methods – Reliability and life cycle costs – Reliability allocation – Replacement model.

### UNIT III SAFETY CONCEPTS AND STATUTORY REQUIREMENTS

09

Introduction – electrostatics, electro magnetism, stored energy, energy radiation and electromagnetic interference – Working principles of electrical equipment-Indian electricity act and rules-statutory requirements from electrical inspectorate-international standards on electrical safety – first aid-cardio pulmonary resuscitation (CPR).

### UNIT IV ELECTRICAL HAZARDS

09

Primary and secondary hazards-shocks, burns, scalds, falls-human safety in the use of electricity. Energy leakage-clearances and insulation-classes of insulation-voltage classifications-excess energy current surges-Safety in handling of war equipment -over current and short circuit current-heating effects of current-electromagnetic forces-corona effect-static electricity –definition, sources, hazardous conditions, control, electrical causes of fire and explosion-ionization, spark and arc ignition energy-national electrical safety code ANSI. Lightning, hazards, lightning arrestor, installation – earthing, specifications, earth resistance, earth pit maintenance.

### UNIT V HAZARDOUS ZONES

09

Classification of hazardous zones-intrinsically safe and explosion proof electrical apparatus-increase safe equipment-their selection for different zones-temperature classification-grouping of gases-use of barriers and isolators-equipment certifying agencies.

**TOTAL: 45 PERIODS**

**OUTCOMES:**

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

- CO1:** Identify equipment requirements for a specific process and for various locations and working conditions.
- CO2:** Design an efficient material handling system.
- CO3:** Apply basic concepts in electrical circuit and find the hazards involved in it.
- CO4:** Evaluate the electrical hazards in Industries.
- CO5:** Understand the operation of various protection systems from electrical hazards
- CO6:** Recognize different hazardous zones in Industries

**TEXT BOOKS:**

1. Ajit Kumar Verma, Ajit Srividya, Durga Rao Karanki “Reliability and Safety Engineering” Part of the book series: Springer Series in Reliability Engineering, 2010
2. B.S. Dhillon “Engineering system Reliability, safety and Maintenance” CRC press, 2017
3. A. K. Guptha, “Reliability, Maintenance and Safety Engineering” Laxmi Publications, Ltd, 2009

**REFERENCES:**

1. Srinath L.S, “Reliability Engineering”, Affiliated East-West Press Pvt Ltd, New Delhi, 1998.
2. John Davidson, “The Reliability of Mechanical system” published by the Institution of Mechanical Engineers, London, 1988.
3. “Accident prevention manual for industrial operations”, N.S.C., Chicago, 1982.
4. Indian Electricity Act and Rules, Government of India.
5. Power Engineers – Handbook of TNEB, Chennai, 1989.



**OUTCOMES:**

On successful completion of this Course, the students will be able

**CO1:** Explain the basics of electric vehicles, their architecture, technologies and fundamentals.

**CO2:** Analyze the use of different power electronics converters and electrical machines in electric vehicles.

**CO3:** Explain the use of different energy storage systems used for electric vehicles, their control techniques, and select appropriate energy balancing technology

**CO4:** Interpret the working of different Motors and Controllers for electric vehicles

**CO5:** Design of different Controllers for electric vehicles

**CO6:** Understand the control and configurations of EV charging stations.

**TEXT BOOKS:**

1. Iqbal Husain, "Electric and Hybrid Vehicles-Design Fundamentals", CRC Press,2010
2. Mehrdad Ehsani, "Modern Electric, Hybrid Electric and Fuel Cell Vehicles", CRC, 2018
3. Sheldon S. Williamson, "Energy Management Strategies for Electric and Plug-in Hybrid Electric Vehicles", Springer, 2013

**REFERENCES:**

1. James Larminie and John Lowry, "Electric Vehicle Technology Explained" John Wiley & Sons, 2012
2. Lino Guzzella, "Vehicle Propulsion System" Springer Publications, 2013
3. Tariq Muneer and Irene IllescasGarcía, "The automobile, In Electric Vehicles: Prospects and Challenges", Elsevier, 2017
4. Emadi, A. (Ed.), Miller, J., Ehsani, M., "Vehicular Electric Power Systems" Boca Raton, CRC Press, 2003
5. NPTEL VIDEO: Electric Vehicles, By Prof. Amit Jain, IIT Delhi

**OBJECTIVES:**

- To understand the Industrial security environment and cyberattacks
- To analyze and assess risks in the industrial environment
- To access and design cybersecurity
- To implement the designed cybersecurity
- To test and troubleshoot the industrial network security system

**UNIT I INTRODUCTION 09**

Industrial security environment-Industrial automation and control system (IACS) culture Vs IT Paradigms-Cyberattacks: Threat sources and steps to successful cyberattacks

**UNIT II RISK ANALYSIS 09**

Risk identification, classification and assessment, Addressing risk: Cybersecurity Management System(CSMS), organizational security, physical and environmental security, network segmentation, access control, risk management and implementation.

**UNIT III ACCESSING THE CYBERSECURITY OF IACS 09**

Identifying the scope of the IACS- generation of cybersecurity information-identification of vulnerabilities- risk assessment-evaluation of realistic threat scenarios- Gap assessment-capturing Ethernet traffic- documentation of assessment results

**UNIT IV CYBERSECURITY DESIGN AND IMPLEMENTATION 09**

Cybersecurity lifecycle- conceptual design process- detailed design process- firewall design remote access design- intrusion detection design

**UNIT V TESTING AND MAINTENANCE 09**

Developing test plans- cybersecurity factory acceptance testing- site acceptance testing- network and application diagnostics and troubleshooting- cybersecurity audit procedure- IACS incident response

**TOTAL: 45 PERIODS**

**OUTCOMES:**

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

**CO1:** Apply basis of science and engineering to understand Industrial security environment and cyberattacks.

**CO2:** Analyze and assess risks in the industrial environment

**CO3:** Access the cybersecurity of IACS

**CO4:** Design and implement cyber security

**CO5:** Test and troubleshoot the industrial network security system.

**CO6:** Understand, investigate and explore feasible solution for a moderate industrial problem.

**TEXT BOOKS:**

1. Ronald L and Krutz, Industrial Automation and Control System Security Principles,ISA, 2013.
2. David J.Teumim, Network Security, Second edition,ISA,2010
3. Pascal Ackerman, Industrial Cybersecurity, Packt publishing, 2021

**REFERENCES:**

1. Edward J.M. Colbert and Alexander Kott, Cyber-security of SCADA and other industrial control systems, Springer, 2016.
2. Perry S. Marshall and John S. Rinaldi, Industrial Ethernet, Second edition, ISA, 2004
3. NPTEL Course: Industry 4.0, <https://nptel.ac.in/courses/106105195>

**OBJECTIVES:**

- To introduce various power electronic devices, their structure, operating principle and characteristics
- To expose various topologies, working principle and analysis of controlled rectifiers and AC controllers
- To get Detailed knowledge on Classifications, structure, operating principle of dc choppers
- To introduce different types of Inverters, their principle of operation and waveform control
- To give overview on dc and ac drives and their control using power electronic circuits.

**UNIT I POWER SEMICONDUCTOR DEVICES AND CHARACTERISTICS 09**

Operating principle and switching Characteristics: Power diodes, Power BJT, Power MOSFET, IGBT, SCR, TRIAC, GTO, MCT, Power integrated circuits (PIC) – Drive and Protection circuits  
– Series and parallel operation – Commutation – Simulation tools.

**UNIT II CONTROLLED RECTIFIERS AND AC CONTROLLERS 09**

Single phase – Three phase – Half controlled – Fully controlled rectifiers – Dual converters -Effect of source and load inductance - AC voltage controllers –Introduction to Cyclo converters, Matrix converters.

**UNIT III DC TO DC CONVERTERS 09**

Step up and Step down Chopper – Chopper classification - quadrant of operation – Switching mode Regulators – Buck, Boost, Buck-Boost, and Cuk Regulators.

**UNIT IV INVERTERS 09**

Voltage source Inverters – Half bridge – Full bridge – Three Phase Bridge Inverters – Voltage control– PWM Techniques – Current Source Inverters: Capacitor Commutated Inverter- Resonant inverters: Series, Parallel, ZVS, ZCS – Introduction to multilevel Inverters.

**UNIT V DRIVES AND CONTROL 09**

Static and Dynamic equations of dc and ac machines – Electrical breaking – Rectifier and chopper control of DC drives – Principles of v/f control of AC drives – Open loop and Closed loop schemes for DC and AC drives (Block diagram approach only) – Introduction to vector control of AC drives.

**TOTAL: 45 PERIODS****OUTCOMES:**

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

**CO1:** Understand various devices and their structure, operating characteristics in the field of electronics.

**CO2:** Analyze, classify and design Control rectifier, chopper and inverter.

**CO3:** Apply power electronic circuits for the control of popular applications.

**CO4:** Analyse the classification of Inverters

**CO5:** Apply Converter techniques in Electric Drives

**CO6:** Exposure to design and analyze PE circuits using simulation software.

**TEXT BOOKS:**

1. Rashid, M.H., “Power Electronics – Circuits, Devices and Applications”, PHI, 3rd Edition, 2004.
2. P.S Bhimbra, “Power Electronics”, Khanna Publishers,17-feb-2019
3. M.D. Singh”Power Electronics” Tata McGraw-Hill, 2008

**REFERENCES:**

1. Singh, M.D., and Khanchandani, K.B., “Power Electronics”, 2nd Edition., Tata McGraw-Hill, 2011.
2. Bose, B.K., “Modern Power Electronics and AC Drives”, Pearson Education, 2002.
3. Bimbra, P.S., “Power Electronics”, Khanna Publishers, 2006.
4. Moorthi, V.R., “Power Electronics - Devices, Circuits and Industrial Applications”, Oxford University Press, 2005.
5. NPTEL Lecture Series on “Power Electronics”, Electrical Engineering by Dr.G.Bhuvaneshwari, IIT Delhi.

**OBJECTIVES:**

- To have some knowledge about Indian Constitution.
- To understand the concept of fundamental rights
- To learn about Lok Sabha and Rajya Sabha
- To have some knowledge about Legislative Assembly and Legislative Council
- To learn about Local Self Government

**UNIT I INTRODUCTION 09**

Meaning and Importance of Constitution - Preamble and Salient Features of the Constitution.

**UNIT II FUNDAMENTAL RIGHTS 09**

Fundamental Rights, Right to Equality, Right to Freedom, Right against exploitation, Right to freedom of religion, Cultural and Educational Rights, Right to Constitutional Remedies and Duties, Directive Principles of State Policy.

**UNIT III LOK SABHA AND RAJYA SABHA 09**

Union Government – Lok Sabha and Rajya Sabha Composition, Powers and functions: The President, The Prime Minister and Supreme Court: Role Position and Powers/ functions.

**UNIT IV LEGISLATIVE ASSEMBLY AND LEGISLATIVE COUNCIL 09**

State Government - Legislative Assembly and Legislative Council: Composition, Powers and functions: The Governor, Chief Minister and High Court: Role, Position and Powers/ functions.

**UNIT V LOCAL SELF GOVERNMENT 09**

Local Self-Government, Panchayat Raj System in India; Election Commission; Public Service Commissions, Role, powers and function

**TOTAL: 45 PERIODS**

**OUTCOMES:**

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

**CO1:** Interpret the knowledge on Indian Constitution.

**CO2:** Demonstrate the knowledge gained through fundamental rights concept.

**CO3:** Relate the concept of Lok Sabha and Rajya Sabha.

**CO4:** Illustrate the concept of Legislative Assembly and Legislative Council.

**CO5:** Analyze the concept of Local Self Government.

**TEXT BOOKS:**

1. M V Pylee, An Introduction to The Constitution of India, Vikas Publishing House Pvt. Ltd., 5th Edition.

**REFERENCES:**

1. Durga Das Basu, Introduction to the Constitution of India, 19th Edition Reprint, 2009.
2. Sharma, Brij Kishore, "Introduction to the Constitution of India", Prentice Hall of India, 7<sup>th</sup> Edition, 2015.

## PROFESSIONAL ELECTIVE – III

20EI908

FAULT DIAGNOSIS AND TOLERANCE

L	T	P	C
3	0	0	3

### OBJECTIVES:

- To classify the fault detection approaches
- To discuss the fault detection schemes using limit checking and component analysis.
- To design and detect the sensor faults using residual approaches.
- To design and detect the sensor faults using GLR and MLR based approaches
- To detect and quantify fault in motor and centrifugal pump

### UNIT I

#### INTRODUCTION

09

Types of faults and different tasks of Fault Diagnosis and Implementation – Different approaches to FDD: Model free and Model based approaches- Mathematical representation of Faults and Disturbances-Additive and Multiplicative types – Design of Residual generator – Residual specification and Implementation.

### UNIT II

#### FAULT DETECTION AND DIAGNOSIS -I

09

Limit checking of absolute values – Trend checking – Change detection using binary thresholds – adaptive thresholds – Change detection with Fuzzy thresholds – Fault detection using Process Identification methods and Principle Component Analysis.

### UNIT III

#### FAULT DETECTION AND DIAGNOSIS - II

09

Residual structure of single fault Isolation: Structural and Canonical structures- Residual structure of multiple fault Isolation: Diagonal and Full Row canonical concepts – Introduction to parity equation implementation and alternative representation – Directional Specifications: Directional specification with and without disturbances – Parity Equation Implementation.

### UNIT IV

#### FAULT DIAGNOSIS USING STATE ESTIMATORS

09

Review of State Estimators – Fault Detection and Diagnosis using Generalized Likelihood Ratio Approach and Marginalized Likelihood Ratio Approach

### UNIT V

#### CASE STUDIES

09

Fault detection and diagnosis of DC Motor Drives – Fault detection and diagnosis of a Centrifugal pump-pipe system – Fault detection and diagnosis of an automotive suspension and the tire pressures - Automatic detection, quantification and compensation of valve stiction.

**TOTAL: 45 PERIODS**

**OUTCOMES:**

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

**CO1:** Describe the different approaches to Fault Detection and Diagnosis.

**CO2:** Examine faults using Limit checking and component approaches

**CO3:** Interpret faults using structured residual approaches

**CO4:** Select faults in sensor and actuators using Likelihood Ratio based approaches.

**CO5:** Diagnosis fault using state estimators approaches.

**CO6:** Apply fault approaches. in compensate stiction in control valves.

**TEXT BOOKS:**

1. Janos J. Gertler, "Fault Detection and Diagnosis in Engineering systems", 2nd Edition, Marcel Dekker, 2019.
2. Rolf Isermann, "Fault-Diagnosis Systems an Introduction from Fault Detection to Fault Tolerance", Springer Verlag, 2006.
3. Demetgul M, INTECH, "Fault Diagnosis And Detection" 2018 Edition

**REFERENCES:**

1. Steven X. Ding, "Model based Fault Diagnosis Techniques: Schemes, Algorithms, and Tools", Springer Publication, 2012.
2. Hassan Noura, Didier Theilliol, Jean-Christophe Ponsart and Abbas Chamseddine, "Fault-Tolerant Control Systems: Design and Practical Applications", Springer Publication, 2009.
3. Blanke, Mogens; Kinnaert, Michel; Lunze, Jan; Staroswiecki, Marcel, "Diagnosis and Fault-Tolerant Control", Springer, 2015.
4. Ali Ahammad Shoukat Choudhury, Sirish L. Shah and Nina F. Thornhill, "Diagnosis of Process Nonlinearities and Valve Stiction: Data Driven Approaches", Springer, 2008.
5. NPTEL: Machinery Fault Diagnosis and Signal Processing, Prof. A.R. Mohanty, IIT Kharagpur

<b>20EI909</b>	<b>INTRODUCTION TO IMAGE AND VIDEO PROCESSING</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>

**OBJECTIVES:**

- To study the formation of an image and its acquisition
- To introduce the application of transforms in image processing
- To study techniques for improving quality of information in images
- To get familiarized with image and video processing techniques
- To apply image and video processing in industrial applications

**UNIT I DIGITAL IMAGE FUNDAMENTALS 09**

Elements of digital image processing systems – Digital Image Representation- Elements of visual perception – Image acquisition - Image sampling and Quantization – Image geometry – Discrete Image Transforms- Properties- Color image fundamentals: - RGB, HSI models.

**UNIT II IMAGE PREPROCESSING AND ENHANCEMENT 09**

Point processing methods: - Contrast stretching – Gray level slicing- Histograms, Histogram equalization and specification techniques, Spatial filtering, Directional Smoothing, Median, Geometric mean, and Harmonic mean filters - Color image enhancement.

**UNIT III IMAGE SEGMENTATION AND ANALYSIS 09**

Detection of Discontinuities, Edge linking, Boundary detection, Thresholding – Region oriented segmentation-Watershed segmentation – Object detection - Pattern Recognition – Classification

**UNIT IV DIGITAL VIDEO PROCESSING 09**

Video acquisition - Inter-frame processing, Motion Estimation and Compensation – Filtering – Video segmentation – Tracking by detection – Tracking multiple objects

**UNIT V APPLICATIONS OF IMAGE AND VIDEO PROCESSING 09**

Applications in measurements, manufacturing, medicine, agriculture and food industry – Case studies.

**TOTAL: 45 PERIODS**

**OUTCOMES:**

On successful completion of this Course, the students will be able

**CO1:** Understand the technical terms associated with image and video processing.

**CO2:** Select the appropriate preprocessing techniques for manipulation of images

**CO3:** Utilize the different approaches of image enhancement, segmentation and analysis techniques

**CO4:** Apply appropriate software tools (Example: Matlab, Open CV and Python) for image and video processing

**CO5:** Apply different digital video processing methods

**CO6:** Design automated techniques for image based applications

**TEXT BOOKS:**

1. Rafael C. Gonzalez, Richard E. Woods, “Digital Image Processing”, Pearson, Education, Inc., Second Edition, 2004.
2. Anil K. Jain, “Fundamentals of Digital Image Processing”, Pearson Education, Inc., 2002.
3. Thomas. B. Moeslund, “Introduction to Video and Image Processing”, Springer, 2012

**REFERENCES:**

1. Rafael C. Gonzalez, Richard E. Woods, Steven Eddins, “Digital Image Processing using MATLAB” Pearson Education, Inc., 2004.
2. John W. Woods, “Multidimensional Signal, Image and Video Processing”, Elsevier, 2<sup>nd</sup> Edition 2011.
3. William K. Pratt, “Digital Image Processing”, John Wiley, New York, 2002.
4. Alan C. Bovik, “Handbook of image and video processing” Elsevier Academic press, 2005.
5. A. Murat Tekalp, “Digital Video Processing”, Prentice Hall, 2nd Edition, 2015.
6. NPTEL video lecture on Digital Image Processing by Prof. Prabir Kr. Biswas, IIT Kharagpur.

**OBJECTIVES:**

- To understand the principle of Adaptive Control Systems
- To identify the advanced tools for stability of Non Autonomous system
- To identify the stability of prototypical adaptive control systems
- To estimate the model reference adaptive control
- To implement adaptive controllers for nonlinear systems

**UNIT I INTRODUCTION 09**

Overview of Adaptive Control Systems- Direct and indirect adaptive control. The principle of certainty-equivalence.

**UNIT II ADVANCED TOOLS FOR STABILITY OF NON-AUTONOMOUS NONLINEAR SYSTEMS 09**

Definitions. Converse Lyapunov theorems. LaSalle/Yoshizawa theorem. Passivity theory. Zero-state detectability. Positive real and strictly positive real transfer functions. Kalman-Yakubovich-Popov lemma.

**UNIT III STABILITY OF PROTOTYPICAL ADAPTIVE CONTROL SYSTEMS 09**

The role of the persistency of excitation condition. Uniform observability. Exponential convergence vs. exponential stability and uniform asymptotic stability. Adaptive observers for linear systems - Systems in adaptive observer form. Filtered transformations.

**UNIT IV MODEL REFERENCE ADAPTIVE CONTROL. 09**

Parametrization of the certainty-equivalence controller. MRAC schemes for linear systems with relative degree one and two. Uniform global asymptotic stability of MRACs: uniform persistency of excitation condition.

**UNIT V ADAPTIVE CONTROLLERS FOR NONLINEAR SYSTEMS. 09**

Adaptive back stepping. Design with over parameterization. Tuning functions method. Output-feedback design. Geometric theory of adaptive systems-Invariant manifold techniques. Slow adaptation. Two-time scales and averaging. Robust redesign of adaptive control systems. Robustness of adaptive systems. Dead-zone and projection-based techniques.

**TOTAL: 45 PERIODS**

**OUTCOMES:**

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

**CO1:** Classify the advanced tools for stability of non-autonomous system

**CO2:** Select the stability of prototypical adaptive control systems

**CO3:** Describe the model reference adaptive control

**CO4:** Identify the adaptive controllers for nonlinear systems

**CO5:** Experiment the geometric theory of adaptive systems

**CO6:** Apply the principle of adaptive control Systems

**TEXT BOOKS:**

1. P. Ioannou and B Fidan, Adaptive Control Tutorial, SIAM, 2006.  
<http://www.siam.org/books/dc11/>
2. K. S. Narendra and A. M. Annaswamy, Stable Adaptive Systems, Prentice-Hall, 1989
3. S. Sastry and M. Bodson, Adaptive Control, Prentice- Hall, 1989 (available at  
[http://www.ece.utah.edu/%7Ebodson/acscr/index.ht ml2.](http://www.ece.utah.edu/%7Ebodson/acscr/index.html)

**REFERENCES:**

1. A. Isidori, L. Marconi, and A. Serrani, Robust Autonomous Guidance. An Internal Model Approach. Springer-Verlag, 2003.
2. Loan Dore Landau, Rogelio Lozano, "Adaptive Control Algorithms, Analysis and Applications, Springer 2011
3. Vance VanDoren, "Techniques for Adaptive Control", 31 October 2002
4. Benosman Mouhacine, "Learning-Based Adaptive Control", 2011.
5. NPTEL: Nonlinear and Adaptive Control, Prof. Shubhendu Bhasin IIT Delhi

**OBJECTIVES:**

This course is meant to give them a broad exposure to the understanding of various concepts of System Programming. The course will provide the students with

1. the concept of advanced Embedded C Language,
2. the knowledge of microcontroller architecture,
3. the methodology to write Program for chosen microcontroller, and
4. the skill to use basic technique for debugging in Linux environment and
5. basic understanding of system programming.

Experiments will run in synchronism with the lectures to support the methods and techniques taught in the lectures. Through the experiments, the students will

1. learn how to use Linux commands and programming environment,
2. gain confidence to do system programming in Linux environment, and learn how to test and debug the developed programs.

Learning Outcome of students are

1. Perform advanced C programming using linked list, Function pointers, arrays, sorting, etc.,
2. Basic scripting in Linux environment
3. Demonstrate programming using Linux System calls
4. Demonstrate various debugging techniques when the program throws error
5. Plan and execute projects simple system programming projects.

**UNIT I          EMBEDDED C PROGRAMMING****09**

Essential C Programming Concepts, Variables and Constants, IO operation, Memory Layouts, Operators and Expression, Control Statements, Functions, Arrays, Pointer, Structure and Union, Debugging Methods.

**Lab work**

1. Programs to understand the various C memory layouts and variable storage locations.
2. Programs to understand the control and conditional statements extensively.
3. Programs to understand the passing of 1-D, 2-D arrays to functions as argument.
4. Programs to understand the pointer usage and passing argument by reference.
5. Programs to understand the structure, union, enum, typedef and bitwise logical operations.

**Project**

1. Projects based on the modular programming design.
2. Projects based on event handlers
3. Projects based on finite state machine

**UNIT II          EMBEDDED SYSTEM SOFTWARE****09**

Assembly and C Microcontroller Programming, IO Port Programming, Timer Programming, Handling Interrupts, Interfacing with external peripherals and memory, ADC Programming, LCD & Keypad Programming, Interfacing with Sensors.

### **Lab work**

1. Programs to understand the GPIO input, output and alternate functionalities.
2. Programs to understand the timer functionalities in the microcontroller.
3. Programs to understand various interrupts and interrupt service handler and interrupt service routines.
4. Programs to understand the external interrupts and external peripheral interface with the microcontroller.
5. Programs to understand the ADC and DAC interfaces with the microcontroller.
6. Programs to understand the display and keypad interfaces with the microcontroller.
7. Programs to understand the external sensor signal handling in the microcontroller.

### **Project**

1. Constructing the circuit in the breadboard to execute the lab work exercises in the actual hardware.
2. Developing programs for microcontroller with modular programming using state machines approaches.

## **UNIT III EMBEDDED LINUX SYSTEM PROGRAMMING**

**09**

System Programming Concepts, File Operation Programming, IO Operation Programming, Advance Process Management Programming and Thread Programming and Mutex.

### **Lab work**

1. Programs to understand the file management in Linux C.
2. Programs to understand the process handling in Linux C.
3. Programs to understand the threads and mutex in Linux C.

### **Project**

1. Developing multi processes project in Linux C.
2. Developing project using threads and mutex.

## **UNIT IV      EMBEDDED LINUX SYSTEM PROGRAMMING IPCs**

**09**

Essential Inter Process Communication and Synchronization, Pipes, Signals, Timers, Shared Memory, Message Queues and Semaphores.

1. Programs to understand the Pipes in Linux C.
2. Programs to understand the Signals and Timers in Linux C.
3. Programs to understand the Shared Memory and Semaphores in Linux C.
4. Programs to understand the Message Queues in Linux C.

### **Project**

1. Developing event-based project using Linux IPC and synchronization mechanism.
2. Developing message queue-based project using message queue and synchronization mechanism.

## **UNIT V      ADVANCE MICROCONTROLLER PROGRAMMING**

**09**

Introduction of Advanced Microcontroller Architectures, Buses, Memory, Clock Tree, Reset, Interrupts Management, IOs, Timers, and external interfaces.

### **Lab work**

1. Programs to understand the various clock configurations.
2. Programs to understand the timer configurations and event handlers.
3. Programs to understand various interrupts and interrupt service handler and interrupt service routines.
4. Programs to understand the external interrupts and external peripheral interface with the microcontroller.
5. Programs to understand the handling of external signals.

**TOTAL: 45 PERIODS**

### **OUTCOMES:**

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

**CO1:** Write System programs in Linux environment.

**CO2:** Design and implement simple system projects.

**CO3:** Perform advanced C programming using linked list, Function pointers, arrays, sorting.

**CO4:** Demonstrate various debugging techniques

**CO5:** Design simple Embedded system projects.

### **TEXT BOOKS:**

1. P. Advanced Embedded C Programming
2. The C Language Programming, Brian W. Kernighan • Dennis M. Ritchie, 1998.
3. Linux System Programming
4. Linux System Programming, Robert Love, 2013.

5. Advanced Microcontroller Programming
6. Discovering the STM32 Microcontroller, Geoffrey Brown, 2012.

## **REFERENCES:**

### **Advanced Embedded C Programming**

1. THE FIRMWARE HANDBOOK, Jack Ganssle, 2004.
2. C Programming for Embedded Systems, Kirk Zurell, 2000.
3. Making Embedded Systems, Elecia White, 2011.

### **Linux System Programming**

1. Beginning Linux Programming, Neil Matthew & Richard Stones, 2008.
2. Hands-On System Programming with Linux, Kaiwan N Billimoria, 2018.

### **Advanced Microcontroller Programming**

1. Mastering STM32, Carmine Noviello, 2016.
2. ARM Cortex M4 Cookbook, Dr. Mark Fisher, 2016.
3. RM0090, Reference manual, STM32F405/415, STM32F407/417, STM32F427/437 and STM32F429/439 advanced ARM based 32-bit MCUs.
4. PM0214 Programming manual STM32 Cortex-M4 MCUs and MPUs programming manual.

**20IT917**                      **ESSENCE OF INDIAN TRADITIONAL KNOWLEDGE**                      **L T P C**  
**3 0 0 3**

**OBJECTIVES:**

- Facilitate the students with the concepts of Indian traditional knowledge and to make them understand the Importance of roots of knowledge system.
- Make the students understand the traditional knowledge and analyze it and apply it to their day-to-day life

**UNIT I                      INTRODUCTION TO TRADITIONAL KNOWLEDGE                      09**

Define traditional knowledge, nature and characteristics, scope and importance, kinds of traditional knowledge, Indigenous Knowledge (IK), characteristics, traditional knowledge vis-a-vis indigenous knowledge, traditional knowledge Vs western knowledge traditional knowledge.

**UNIT II                      PROTECTION OF TRADITIONAL KNOWLEDGE                      09**

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

**UNIT III                      LEGAL FRAMEWORK AND TK                      09**

The Scheduled Tribes and Other Traditional Forest Dwellers (Recognition of Forest Rights) Act, 2006, Plant Varieties Protection and Farmer's Rights Act, 2001 (PPVFR Act); The Biological Diversity Act 2002 and Rules 2004, the protection of traditional knowledge bill, 2016.

**UNIT IV                      TRADITIONAL KNOWLEDGE AND INTELLECTUAL PROPERTY                      09**

Systems of traditional knowledge protection, Legal concepts for the protection of traditional knowledge, Patents and traditional knowledge, Strategies to increase protection of traditional knowledge.

**UNIT V                      TRADITIONAL KNOWLEDGE IN DIFFERENT SECTORS                      09**

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

**TOTAL: 45 PERIODS**

**OUTCOMES:**

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

**CO1:** Illustrate the concepts of Indian traditional knowledge.

**CO2:** Apply the concept of protection of traditional knowledge.

**CO3:** Analyze the legal framework and traditional knowledge.

**CO4:** Interpret the concept of traditional knowledge and intellectual property.

**CO5:** Analyze and apply traditional knowledge to their day-to-day life.

**TEXT BOOKS:**

1. P. Amit Jha, Traditional Knowledge System in India, Atlantic Publishers, 2002

**REFERENCES:**

1. A. Kapil Kapoor, Michel Danino, Knowledge Traditions and Practices of India, Central Board of Secondary Education, 2012.



**OUTCOMES:**

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

**CO1:** Understand the role of standards organization.

**CO2:** Explain different standards related to installation and control system, programming, documentation, equipment in hazardous area and instrument specification forms.

**CO3:** Discuss the different standards related to control valves and actuators.

**CO4:** Interpret standards related to power plant and nuclear power plant.

**CO5:** Describe different standards related to orifice sizing, RTD, and thermocouples.

**CO6:** Compare and select standards related to Process industries.

**TEXT BOOKS:**

1. BS EN 60584-1, "Thermocouples - EMF specifications and tolerances", British Standard, 2013.
2. Andrew W.G, Applied Instrumentation in Process Industries – A survey, Vol I & Vol II, Gulf Publishing Company, Houston, 2001.
3. Dale E. Seborg, Thomas F. Edgar, Duncan A. Mellichamp, and Francis J. Doyle III, "Process Dynamics and Control" Wiley India Pvt Ltd, 2021.

**REFERENCES:**

1. API Recommended Practice 554, "Process Instrumentation and Control – 3 parts", American Petroleum Institute, Washington, D.C., First Edition, October 2008.
2. ISA standard 5, "Documentation of Measurement and Control Instruments and Systems", ISA, North Carolina, USA.
3. ISA standard 12, "Electrical Equipment for Hazardous Locations", ISA, North Carolina, USA.
4. API Recommended Practice 551, "Process Measurement Instrumentation", American Petroleum Institute, Washington, D.C., Second Edition, May 2001.
5. ISA standard 20, "Instrument Specification Forms", ISA, North Carolina, USA.
6. ISA standard 37, "Measurement Transducers", ISA, North Carolina, USA.
7. ISA standard 75, "Control Valve Standards", ISA, North Carolina, USA.
8. ISA standard 96, "Valve Actuator", ISA, North Carolina, USA.
9. ISA standard 77, "Fossil Power Plant Standards", ISA, North Carolina, USA.
10. ISA standard 67, "Nuclear Power Plant Standards", ISA, North Carolina, USA.
11. Noltingk B.E., Instrumentation Reference Book, Butterworth Heinemann, 2nd Edition, 1995.
12. NPTEL video lecture on "Safety Practices in Chemical and Nuclear Industries", by Prof. T. Swaminathan, Dr. Raghuram Chetty, IIT Madras. (<https://nptel.ac.in/courses/103106071>)

<b>20EI912</b>	<b>INSTRUMENTATION IN PROCESS INDUSTRIES</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>

**OBJECTIVES:**

- To introduce common unit operations carried out in process industries.
- To impart knowledge about the important unit operations taking place in process industries.
- To prepare them to take up a case study on selected process industries like petrochemical industry, power plant industry and paper & pulp industry.
- To understand the different measurement and control techniques for important processes.
- To explain the appropriate measurement technique and control strategy for a given process.

**UNIT I            COMMON UNIT OPERATIONS IN PROCESS INDUSTRIES -I            09**

Unit Operation, Measurement and Control: -Transport of solid, liquid and gases - Evaporators – Crystallizers-Dryers

**UNIT II            COMMON UNIT OPERATIONS IN PROCESS INDUSTRIES -II            09**

Unit Operation, Measurement and Control: - Distillation – Refrigeration processes – Chemical reactors.

**UNIT III            PROCESS MEASUREMENT AND CONTROL IN            09**  
**PETROCHEMICAL INDUSTRY**

Process flow diagram of Petro Chemical Industry - Gas oil separation in production platform – wet gas processing – Fractionization Column – Catalytic Cracking unit – Catalytic reforming unit.

**UNIT IV            PROCESS MEASUREMENT AND CONTROL IN THERMAL            09**  
**POWER PLANT INDUSTRY**

Process flow diagram of Coal fired thermal Power Plant– Coal pulverizer - Deaerator – Boiler drum - Superheater – Turbines.

**UNIT V            PROCESS MEASUREMENT AND CONTROL IN PAPER & PULP            09**  
**INDUSTRY**

Process flow diagram of paper and pulp industry – Batch digester – Continuous sulphate digester – Control problems on the paper machine

**TOTAL: 45 PERIODS**

**OUTCOMES:**

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

**CO1:** Understand common unit operations in process industries.

**CO2:** Explain the dynamics of important unit operations in the petrochemical industry

**CO3:** Develop an understanding of important processes taking place in selected case studies namely the petrochemical industry, power plant industry, and paper & pulp industry

**CO4:** Recognize to select appropriate measurement techniques for selective processes.

**CO5:** Analyse the selection of controller structure based on the process knowledge.

**CO6:** Interpret the operation and challenges in integrated industrial processes.

**TEXT BOOKS:**

1. Walt Boyes, "Instrumentation Reference Book", Burlington: Elsevier Science & Technology., 2010.
2. Warren McCabe, Julian Smith and Peter Harriott, "Unit Operations of Chemical Engineering" McGraw Hill Education; Seventh edition, 2017.
3. Liptak B.G., "Instrument and Automation Engineers' Handbook: Process Measurement and Analysis", Fifth Edition, CRC Press, 2016.

**REFERENCES:**

1. Waddams, A.L., "Chemical from Petroleum", Butter and Janner Ltd., 1968.
2. Austin G.T and Shreeves, A.G.T., "Chemical Process Industries", McGraw-Hill International student, Singapore, 1985.
3. Noltingk B.E., Instrumentation Reference Book, Butterworth Heinemann, 2nd Edition, 1995.
4. Balchan.J.G., and Mumme K.I., "Process Control Structures and Applications", Van Nostrand Reinhold Company, New York, 1995.
5. NPTEL video lecture on "Principles and Practices of Process Equipment and Plant Design" by Prof S. Ray, Prof. Gargi Das, IIT Kharagpur. (<https://nptel.ac.in/courses/103105210>)

**OBJECTIVES:**

- Understand the techniques for the implementation of quality management in manufacturing and services processes.
- Explain the Quality Management principles and process.
- Discuss the importance of Quality in an organization.
- Understand the ISO Quality systems.
- Summarise the quality concepts adopted in industry scenario.

**UNIT I INTRODUCTION 09**

Introduction - Need for quality - Evolution of quality - Definitions of quality - Dimensions of product and service quality - Basic concepts of TQM - TQM Framework - Contributions of Deming, Juran and Crosby - Barriers to TQM - Customer focus - Customer orientation, Customer satisfaction, Customer complaints, and Customer retention.

**UNIT II TQM PRINCIPLES 09**

Leadership – Quality Statements, Strategic quality planning, Quality Councils - Employee involvement - Motivation, Empowerment, Team and Teamwork, Recognition and Reward, Performance appraisal - Continuous process improvement - PDCA cycle, 5S and case study, Kaizen - Supplier partnership - Partnering, Supplier selection, Supplier Rating.

**UNIT III TQM TOOLS & TECHNIQUES I 09**

The seven traditional tools of quality - New management tools - Six sigma: Concepts, Methodology, applications to manufacturing, service sector including IT - Bench marking - Reason to bench mark, Bench marking process – FMEA and Applications in the Industry - Stages, Types.

**UNIT IV TQM TOOLS & TECHNIQUES II 09**

Quality Circles, Cost of Quality, Quality Function Development (QFD) and case study- Taguchi quality loss function - TPM - Concepts, improvement needs - Performance measures.

**UNIT V QUALITY SYSTEMS 09**

Introduction - Benefits of ISO Registration - ISO 9000 Series of Standards - Sector-Specific Standards - AS 9100, TS16949 and TL 9000 - ISO 9001 Requirements – Implementation – Documentation - Internal Audits - Registration- ENVIRONMENTAL MANAGEMENT SYSTEM: Introduction - ISO 14000 Series Standards - Concepts of ISO 14001 - Requirements of ISO 14001 - Benefits of EMS.

**TOTAL: 45 PERIODS**

**OUTCOMES:**

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

**CO1:** Understand the quality philosophies and customer focused managerial system

**CO2:** Summarize the quality management principles

**CO3:** Apply the six sigma concepts in manufacturing and service sector

**CO4:** Determine the tools and techniques for quality improvement.

**CO5:** Discuss the standards and auditing system on implementation of TQM.

**CO6:** Analyze standards for the operation of EMS

**TEXT BOOKS:**

1. Dale H.Besterfield, Carol B.Michna, Glen H. Besterfield, Mary B.Sacre, Hemant Urdhwareshe and Rashmi Urdhwareshe, Total Quality Management, Pearson Education Asia, Revised Third Edition, Indian Reprint, Sixth Impression, 2020.

**REFERENCES:**

1. Waddams, James R. Evans and William M. Lindsay, "The Management and Control of Quality", 8th Edition, First Indian Edition, Cengage Learning, 2019.
2. Janakiraman. B and Gopal. R.K., "Total Quality Management - Text and Cases", Prentice Hall (India) Pvt. Ltd., 2018.
3. Suganthi.L and Anand Samuel, "Total Quality Management", Prentice Hall (India) Pvt. Ltd., 2020.
4. ISO 9001-2015 standards

**OBJECTIVES:**

- To study the fundamentals of CMOS circuits and its characteristics.
- To learn the design and realization of combinational digital circuits.
- To learn the design and realization of sequential digital circuits.
- To summarize architectural choices and performance tradeoffs involved in designing and realizing the circuits in CMOS technology
- To learn the different FPGA architectures and testability of VLSI circuits

**UNIT I INTRODUCTION TO MOS TRANSISTOR 09**

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

**UNIT II COMBINATIONAL MOS LOGIC CIRCUITS 09**

Circuit Families: Static CMOS, Ratioed Circuits, Cascode Voltage Switch Logic, Dynamic Circuits, Pass Transistor Logic, Transmission Gates, Domino, Dual Rail Domino, CPL, DCVSPG, DPL, Power: Dynamic Power, Static Power, Low Power Architecture, Design of combinational circuits using Verilog.

**UNIT III SEQUENTIAL CIRCUIT DESIGN 09**

Static latches and Registers, Dynamic latches and Registers, Pulse Registers, Pipelining, Schmitt Trigger, Monostable Sequential Circuits, Astable Sequential Circuits. Timing Issues: Timing Classification Of Digital System, Synchronous Design, Design of sequential circuits using Verilog.

**UNIT IV DESIGN OF ARITHMETIC BUILDING BLOCKS AND SUBSYSTEM 09**

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

**UNIT V IMPLEMENTATION STRATEGIES AND TESTING 09**

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

**TOTAL: 45 PERIODS**

**OUTCOMES:**

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

**CO1:** Examine the basics of CMOS technology.

**CO2:** Analyze and discuss the issues in designing Combinational logic circuits.

**CO3:** Analyze and discuss the issues in designing sequential logic circuits.

**CO4:** Design of arithmetic building blocks.

**CO5:** Define the basics of FPGA design.

**CO6:** Understand the logic of Testing of ICs.

**TEXT BOOKS:**

1. Neil H.E. Weste, David Money Harris —CMOS VLSI Design: A Circuits and Systems Perspective II, 4th Edition, Pearson , 2017.
2. Jan M. Rabaey ,AnanthaChandrakasan, Borivoje. Nikolic, Digital Integrated Circuits: A Design perspectiveII, Second Edition , Pearson , 2016.

**REFERENCES:**

1. Waddams, M.J. Smith, —Application Specific Integrated CircuitsII, Addison Wesley, 1997.
2. Sung-Mo kang, Yusuf leblebici, Chulwoo Kim —CMOS Digital Integrated Circuits:Analysis& Design,4th edition McGraw Hill Education,2013.
3. Wayne Wolf, —Modern VLSI Design: System On Chip, Pearson Education, 2007.
4. John F walkerly, Digital Design Principles and Practices, 3rd ed., PHI/Pearson Education, 2005.
5. Samir Palnitkar, Verilog HDL: A Guide to Digital Design and Synthesis, Prentice Hall PTR Second Edition, 2003.



**OUTCOMES:**

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

**CO1:** Classify the non-parametric methods for system identification

**CO2:** Select the parametric methods for system identification

**CO3:** Describe parameter estimation using different identification techniques

**CO4:** Identify plants online using recursive estimation methods

**CO5:** Experiment the nominal model to assess the accuracy and precision

**CO6:** Apply appropriate design tools to validate the model.

**TEXT BOOKS:**

1. Seborg, D.E., Edgar, T.F. and Mellichamp, D.A., Process Dynamics and Control, Wiley John and Sons, 2nd Edition, 2003.
2. Bequette, B.W., Process Control Modeling, Design and Simulation, Prentice Hall of India, 2004.
3. Stephanopoulos, G., Chemical Process Control – An Introduction to Theory and Practice, Prentice Hall of India, 2005.

**REFERENCES:**

1. Jung, L. System Identification: Theory for the User, 2nd Edition, Prentice-Hall, 1999, ISBN 0-13- 656695-2.
2. Torsten Soderstrom, PetreStoica, System Identification, Prentice Hall International (UK) Ltd. 1989.
3. Karel J. Keesman, System Identification, An introduction, Springer, 2011.
4. Zhu, Y. Multivariable System Identification for Process Control, Pergamon, 2001.
5. Landan ID, "System Identification and Control Design," Prentice Hall
6. ArunK.Tangirala, Principles of System Identification: Theory and Practice, CRC Press, 2014.
7. NPTEL: System Identification, Dr. Arun K.Tangirala IIT Madras

**OBJECTIVES:**

- To explain the foundations of AI and various intelligent agents
- To discuss problem solving search strategies and game playing
- To describe logical agents and first-order logic
- To illustrate problem-solving strategies with knowledge representation mechanism for solving hard problems
- To explain the basics of learning and expert systems.

**UNIT I            ARTIFICIAL INTELLIGENCE AND INTELLIGENT AGENTS            09**

Introduction to AI – Foundations of Artificial Intelligence - Intelligent Agents – Agents and Environments - Concept of rationality – Nature of environments – Structure of agents - Problem solving agents – Example Problems - Search Algorithms – Uninformed Search Strategies

**UNIT II            PROBLEM SOLVING            09**

Heuristic search strategies – heuristic functions- Game Playing – Mini-max Algorithm - Optimal decisions in games – Alpha-beta search –Monte-Carlo search for Games - Constraint satisfaction problems – Constraint propagation – Backtracking search for CSP – Local search for CSP – Structure of CSP.

**UNIT III           LOGICAL AGENTS            09**

Knowledge-based agents – Logic - Propositional logic – Propositional theorem proving – Propositional model checking – Agents based on propositional logic - First-Order Logic – Syntax and semantics – Using First-Order Logic - Knowledge representation and engineering – Inferences in first-order logic – Propositional Vs First-Order Inference - Unification and First-Order Inference - Forward chaining – Backward chaining - Resolution.

**UNIT IV           KNOWLEDGE REPRESENTATION AND PLANNING            09**

Ontological engineering – Categories and objects – Events – Mental objects and modal logic – Reasoning systems for categories – Reasoning with default information  
Classical planning – Algorithms for classical planning – Heuristics for planning – Hierarchical planning – Non-deterministic domains – Time, schedule, and resources - Analysis

**UNIT V            LEARNING AND EXPERT SYSTEMS            09**

Forms of Learning – Developing Machine Learning systems – Statistical Learning - Deep Learning: Simple feed-forward network - Neural Networks – Reinforcement Learning: Learning from rewards – Passive and active Reinforcement learning.

Expert Systems: Functions – Main structure – if-then rules for representing knowledge – developing the shell – Dealing with uncertainty.

**TOTAL: 45 PERIODS**

**OUTCOMES:**

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

**CO1:** Explain the foundations of AI and various Intelligent agents

**CO2:** Apply search strategies in problem solving and game playing

**CO3:** Explain logical agents and first-order logic

**CO4:** Apply problem-solving strategies with knowledge representation mechanism for solving hard problems

**CO5:** Describe the basics of learning and expert systems.

**TEXT BOOKS:**

1. Peter Norvig and Stuart Russel, Artificial Intelligence: A Modern Approach, Pearson, 4th Edition, 2020.
2. Bratko, Prolog: Programming for Artificial Intelligence, Fourth edition, Addison-Wesley Educational Publishers Inc., 2011.

**REFERENCES:**

1. Elaine Rich, Kevin Knight and B.Nair, Artificial Intelligence 3rd Edition, McGraw Hill, 2017.
2. Melanie Mitchell, Artificial Intelligence: A Guide for Thinking Humans. Series: Pelican Books, 2020
3. Ernest Friedman-Hill, Jess in Action, Rule-Based Systems in Java, Manning Publications, 2003
4. Nils J. Nilsson, The Quest for Artificial Intelligence, Cambridge University Press, 2009
5. Dan W. Patterson, Introduction to Artificial Intelligence and Expert Systems, 1st Edition by Patterson, Pearson, India, 2015

**OBJECTIVES:**

- Understand the roles of Management and the principles of an organization.
- Discuss the functions and responsibilities of managers.
- Demonstrate the tools and techniques to be used in the performance of the managerial job.
- Analyze and understand the environment of the organization.
- Develop the cognizance of the importance of management principles

**UNIT I INTRODUCTION TO MANAGEMENT AND ORGANIZATIONS 09**

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. Fundamentals of Entrepreneurship, Circular flow of income.

**UNIT II PLANNING 09**

Nature and purpose – Formal and informal organization – organization chart – organization structure – types – Line and staff authority–departmentalization–delegation of authority–centralizationanddecentralization–JobDesign-HumanResource Management – HR Planning, Recruitment, selection, Training and Development, Performance Management ,Career planning and management. Managing personnel records

**UNIT III ORGANISING 09**

Linear regression, least square estimation, statistical analysis of LS methods, Minimizing prediction error- identifiability, bias, Least squares, relation between minimizing the prediction error and the MLE, MAP, Convergence and consistency, asymptotic distribution of parameter estimates, Instrumental Variable Method.

**UNIT IV DIRECTING 09**

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. Organizational behaviour

**UNIT V CONTROLLING 09**

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 .SQC techniques

**TOTAL: 45 PERIODS**

**OUTCOMES:**

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

- CO1:** Understand the management thoughts and various challenges of managerial activities in a global business environment.
- CO2:** Demonstrate the various strategies in Decision making at various levels management in the Organizations.
- CO3:** Discuss the various types of Organization structure.
- CO4:** Describe the steps in Staffing process and stages in Career development.
- CO5:** Explain the elements in Direction.
- CO6:** Summarise the various Controlling techniques to maintain standards in Organizations.

**TEXT BOOKS:**

1. Koontz, H, & Weihrich, H (2016). Essentials of Management: An International Perspective (8th ed.), Tata McGraw Hills, New Delhi..
2. Ghuman, K & Aswathapa, K, (2017). Management concepts and cases (10th ed.), Tata McGraw Hills, New Delhi.
3. Telsan, M.T. (2016). Industrial and Business Management, (4th ed.), S. Chand, New Delhi.

**REFERENCES:**

1. Robbins, S. (2017). Management, (13th ed.), Pearson Education, New Delhi.
2. Saxena, P.K., Principles of Management: A Modern Approach, Global India publicaions.(2016).



**OUTCOMES:**

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

**CO1:** Identify the basics and scale of nanotechnology.

**CO2:** Analyze the different classes of nanomaterials.

**CO3:** Apply synthesis of nanomaterials.

**CO4:** Analyze the fabrication and characterization of nanostructures.

**CO5:** Use of sensors in nanotechnology

**CO6:** Discuss the application of micro technologies and nanotechnology.

**TEXT BOOKS:**

1. T. Pradeep, A Textbook of Nanoscience and Nanotechnology, Tata McGraw Hill Education Pvt. Ltd.,2012.
2. Hari Singh Nalwa, Nanostructured Materials and Nanotechnology, Academic Press, 2008.

**REFERENCES:**

1. C.Dupas, P.Houdy, M.Lahmani, Nanoscience: Nanotechnologies and Nanophysics, Springer-VerlagBerlin Heidelberg, 2007.
2. A. S. Edelstein and R. C. Cammarata, Nanomaterials: Synthesis, Properties and Applications, Institute of Physics Pub., 2001
3. Jacob Fraden, Handbook of Modern Sensors: Physics, Designs, and Applications, Springer; 4th ed. 2010.
4. Gerard Meijer, Smart sensor systems, Wiley, 2008
5. W Gopel, J. Hesse, J. N. Zemel, Sensors A Comprehensive Survey Vol. 9, Wiley-VCH, 1995.
6. NPTEL LINK:<https://nptel.ac.in/courses/118/104/118104008/>

**OBJECTIVES:**

- To familiarize with Engineering Ethics and Human Values.
- To impart knowledge on codes of ethics, safety, responsibilities and rights of engineers.
- To create awareness on global issues related to environmental ethics, computer ethics, weapons development and corporate social responsibility

**UNIT I HUMAN VALUES 09**

Morals, values and Ethics – Integrity – Work ethic – Service learning – Civic virtue – Respect for others – Living peacefully – Caring – Sharing – Honesty – Courage – Valuing time – Cooperation – Commitment – Empathy – Self confidence – Character – Spirituality – Introduction to Yoga and meditation for professional excellence and stress management.

**UNIT II ENGINEERING ETHICS 09**

Senses of ‘Engineering Ethics’ – Variety of moral issues – Types of inquiry – Moral dilemmas – Moral Autonomy – Kohlberg’s theory – Gilligan’s theory – Consensus and Controversy – Models of professional roles - Theories about right action – Self-interest – Customs and Religion – Uses of Ethical Theories.

**UNIT III ENGINEERING AS SOCIAL EXPERIMENTATION 08**

Engineering as Experimentation – Engineers as responsible Experimenters – Codes of Ethics – A Balanced Outlook on Law - The Challenger Case Study.

**UNIT IV SAFETY, RESPONSIBILITIES AND RIGHTS 09**

Safety and Risk – Assessment of Safety and Risk – Risk Benefit Analysis and Reducing Risk - Case Studies: Chernobyl and Bhopal Disasters - Respect for Authority – Collective Bargaining – Confidentiality – Conflicts of Interest – Occupational Crime – Professional Rights – Employee Rights – Intellectual Property Rights (IPR) – Discrimination.

**UNIT V GLOBAL ISSUES 09**

Multinational Corporations – Environmental Ethics – Computer Ethics – Weapons Development – Engineers as Managers – Consulting Engineers – Engineers as Expert Witnesses and Advisors – Moral Leadership – Code of Conduct – Corporate Social Responsibility.

**TOTAL: 45 PERIODS**

**OUTCOMES:**

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

**CO1:** Summarize the importance of human values in work place

**CO2:** Discuss the senses of engineering ethics, moral dilemmas, moral autonomy and uses of ethical theories.

**CO3:** Describe the role of engineers as responsible experimenters and necessity of codes of ethics in engineering.

**CO4:** Explain safety, risk, responsibilities and rights in the society.

**CO5:** Analyze the global issues related to environmental ethics, computer ethics, weapons development and the role of engineers as expert witnesses and advisors.

**CO6:** Apply ethics in society and discuss the ethical issues related to engineering

**TEXT BOOKS:**

1. Mike W. Martin and Roland Schinzinger, "Ethics in Engineering", Tata McGraw Hill, New Delhi, 2014.
2. Govindarajan M, Natarajan S, Senthil Kumar V. S, "Engineering Ethics", Prentice Hall of India, New Delhi, 2013.

**REFERENCES:**

1. Charles B. Fleddermann, "Engineering Ethics", Pearson Prentice Hall, New Jersey, 2012.
2. Charles E. Harris, Michael S. Pritchard and Michael J. Rabins, "Engineering Ethics – Concepts and Cases", Cengage Learning, 2018.
3. John R Boatright, "Ethics and the Conduct of Business", Pearson Education, New Delhi, 2012.
4. Edmund G Seebauer and Robert L Barry, "Fundamentals of Ethics for Scientists and Engineers", Oxford University Press, Oxford, 2001.

## PROFESSIONAL ELECTIVE – VI

<b>20EI914</b>	<b>PROJECT MANAGEMENT AND FINANCE</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>

### OBJECTIVES:

- To understand what are the objectives of project management.
- To outline the principles followed in carrying out a project.
- To demonstrate knowledge and understanding of engineering and management principles.
- To function effectively as an individual, and as a member or leader in diverse teams.
- To understand the concepts of finance and accounts carried out in project management.

### **UNIT I PROJECT MANAGEMENT, PROJECT SELECTION AND PROJECT 09**

Objectives of project management: Types of Projects: Project Management Life Cycle: Project Selection: Feasibility study: Estimation of Project Cost, Cost of Capital, Network analysis Techniques: PERT, CPM, Government regulations and statutory for various projects:

### **UNIT II PROJECT IMPLEMENTATION, MONITORING AND CONTROL 09**

Project representation: Role of project managers, relevance with objective of organization, preliminary manipulations, Basic Scheduling concepts: Resource levelling, Resource allocation, Setting a base line, Project management information system: Importance of contracts in projects: Team work in Project Management: Formation of Effective terms.

### **UNIT III PROJECT EVALUATION, AUDITING AND OTHER RELATED TOPICS IN PROJECT MANAGEMENT 09**

Project Evaluation: Project auditing: Phase of project audit Project closure reports, computers, e-markets in Project Management:

### **UNIT IV WORKING CAPITAL MANAGEMENT AND CAPITAL BUDGETING 09**

Current assets management: Estimation of working capital requirements: Capital budgeting: Capital budgeting methods: Present value method: Accounting rate of return methods.

### **UNIT V FINANCE AND ACCOUNTING 09**

Source of finance: Term Loans: Capital Structure: Financial Institution Accounting Principles: Preparation and Interpretation of balance sheets, profit and loss statements, Fixed Assets, Current assets, Depreciation methods: Break even analysis:

**TOTAL: 45 PERIODS**

### OUTCOMES:

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

**CO1:** Study the current market trends and choose projects.

**CO2:** Prepare project feasibility reports.

**CO3:** Implement the project effectively meeting government norms and conditions.

**CO4:** Understand the role and responsibility of the Professional Engineer.

**CO5:** Analyze social, health, safety issues based on the reasoning received from the contextual knowledge.

**CO6:** Evaluate projects which benefit the society and organization.

### TEXT BOOKS:

1. Project Management Institute “A Guide to the Project Management Body of Knowledge” PMBOK Guide (Sixth Edition), Sept 2017.
2. James C.Van Horne, “Fundamentals of Financial Management”, Person Education 2004.
3. Project Management by Erik W.Larson, Clifford F.Gray,8th edition,24-sep-2021.

## **REFERENCES:**

1. Küster J., Huber, E., Lippmann, R., Schmid, A., Schneider, E., Witschi, U., Wüst, R. "Project Management Handbook", 2015
2. Khanna, R.B. "Project Management", PHI 2011.
3. Prasanna Chandra, "Financial Management", Tata McGraw-Hill,2008.
4. By Carl S. Warren, James M. Reeve, Jonathan Duchac, "Financial & Managerial Accounting", 2016
5. PaneerSelvam, R., and Senthilkumar, P., "Project Management", PHI, 2011.
6. NPTEL video series on "Project Management" By Dr.Raghunandan Sengupta ,IIT Kanpur.

**OBJECTIVES:**

- To teach students to build and analyze models for time-varying systems and non-linear systems.
- To develop the skills needed to design adaptive controllers such as gain-scheduled adaptive controller, Model-reference adaptive controller and Self-tuning controller for various applications
- To make the students learn to formulate optimal control schemes
- To provide basic knowledge about Fractional-order systems and Fractional-order-controller and to lay the foundation for the systematic approach to Design controller for fractional order systems
- To introduce FDI Techniques, such as Principal component Analysis, state observer to detect and diagnose faults in sensors and actuators.

**UNIT I CONTROL OF TIME-VARYING AND NONLINEAR SYSTEMS 09**

Models for Time-varying and Nonlinear systems – Input signal design for Identification – Realtime parameter estimation – Model Validation - Types of Adaptive Control - Gain scheduling - Adaptive Control - Deterministic Self-tuning Controller and Model Reference Adaptive Controller – Control of Hammerstein and Wiener Systems.

**UNIT II OPTIMAL CONTROL & FILTERING 09**

Introduction – Performance Measure for optimal control problem – Dynamic Programming – Computational Procedure for solving Control Problem – LQR – Introduction to Optimal Filtering – Discrete Kalman Filter – Linear Quadratic Gaussian (LQG)

**UNIT III FRACTIONAL ORDER SYSTEM & CONTROLLER 09**

Fractional-order Calculus and Its Computations – Frequency and Time Domain Analysis of FractionalOrder Linear Systems - Filter Approximations to Fractional-Order Differentiations – Model reduction Techniques for Fractional Order Systems –Controller Design Studies for Fractional Order.

**UNIT IV H-INFINITY CONTROLLER 09**

Introduction – Norms for Signals – Robust Stability – Robust Performance – Small Gain Theorem – Optimal H2 Controller Design - H-Infinity Controller Design — Effects of Weighting Functions in H-Infinity Control.

**UNIT V FAULT DIAGNOSIS AND FAULT-TOLERANT CONTROL 09**

Process Monitoring - Introduction – Statistical Process Control – Fault Detection with Principal Component Analysis – Fault Detection with State Observers – Fault Detection with signal models - Fault Detection of Control Loops- Sensor and Actuator Fault-Tolerant Control Design.

**TOTAL: 45 PERIODS**

**OUTCOMES:**

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

- CO1:** Apply knowledge of mathematics, science, and engineering to build and analyze models for time-varying systems and non-linear systems.
- CO2:** Design and implement adaptive controllers such as gain-scheduled adaptive controller, Model-reference adaptive controller and Self-tuning controller
- CO3:** Identify, formulate, and solve optimal controller
- CO4:** Analyze Fractional-order systems, Fractional-order- controller and Design controller for fractional order systems
- CO5:** Create and implement H2 and H-infinity Controllers
- CO6:** Understand how to use the FDI Techniques, such as Principal component Analysis, state observer to detect and diagnose faults in sensors and actuators.

**TEXT BOOKS:**

1. Cecil L. Smith, "Advanced Process Control: Beyond Single-Loop Control" John Wiley & Sons, Inc, 2010
2. C D Johnson, "Process control Instrumentation Technology" Pearson New International Edition, 2016
3. Rainer Dittmar, "Advanced Process Control", De Gruyter Publications, 2017.

**REFERENCES:**

1. K.J. Astrom and B.J.Wittenmark, "Adaptive Control", Pearson Education, Second Edition, 2008.
2. Donald E.Kirk, "Optimal Control Theory – An Introduction", Dover Publications, Inc. Mineola, New York, 2012
3. D.Xue, Y.Q.Chen, D.P.Atherton, "Linear Feedback Control Analysis and Design with MATLAB, Advances In Design and Control", Society for Industrial and Applied Mathematics, 2008.
4. R. Isermann, "Fault-Diagnosis Systems: An Introduction from Fault Detection to Fault Tolerance", Springer, 2006.

**OBJECTIVES:**

- To expose the students to the basic concepts of optical fibers and their properties.
- To provide adequate knowledge about the Industrial applications of optical fibers.
- To expose the students to the Laser fundamentals.
- To provide adequate knowledge about Industrial application of lasers.
- To provide adequate knowledge about holography and Medical applications of Lasers.

**UNIT I OPTICAL FIBRES AND THEIR PROPERTIES 09**

Construction of optical fibre cable: Guiding mechanism in optical fibre and Basic component of optical fibre communication, –Different types of fibres and their properties– fibre characteristics: Mechanical characteristics and Transmission characteristics, – Absorption losses – Scattering losses – Dispersion – Connectors and splicers –Fibre termination – Optical sources: Light Emitting Diode (LED), – Optical detectors: PIN Diode.

**UNIT II INDUSTRIAL APPLICATION OF OPTICAL FIBRES 09**

Fibre optic sensors: Fibre optic instrumentation system – Different types of modulators: Electro-optic modulator (EOM)–Interferometry method of measurement of length – Moire fringes – Measurement of pressure, temperature, current, voltage, liquid level and strain.

**UNIT III LASER FUNDAMENTALS 09**

Fundamental characteristics of lasers – Level Lasers: Two-Level Laser, Three Level Laser, Quasi Three and four level lasers – Properties of laser–Laser modes – Resonator configuration – Q-switching and mode locking – Cavity damping – Types of lasers; – Gas lasers, solid lasers, liquid lasers and semiconductor lasers

**UNIT IV INDUSTRIAL APPLICATION OF LASERS 09**

Laser for measurement of distance, Laser for measurement of length, Laser for measurement of velocity, Laser for measurement of acceleration, Laser for measurement of current, voltage and Laser for measurement of Atmospheric Effect: Types of LIDAR, Construction And Working, and LIDAR Applications – Material processing - Laser trimming of material - Process Of Laser Trimming, Types Of Trim, Construction And Working Advantages – Material Removal and vaporization: Process Of Material Removal.

**UNIT V HOLOGRAM AND MEDICAL APPLICATIONS 09**

Holography: Principle Of Hologram Recording, Condition For Recording A Hologram, Reconstructing and viewing the holographic image– Holography for non-destructive testing – Holographic components – Medical applications of lasers, laser-Tissue Interactions Photochemical reactions, Thermalisation, collisional relaxation, Types of Interactions and Selecting an Interaction Mechanism – Laser instruments for surgery, removal of tumours of vocal cards, brain surgery, plastic surgery, gynaecology and oncology.

**TOTAL: 45 PERIODS**

**OUTCOMES:**

On successful completion of this Course, the students will be able

**CO1:** Understand the principle, transmission, dispersion and attenuation characteristics of optical fibers

**CO2:** Apply the gained knowledge on optical fibers for its use as communication medium and as sensor as well which have important applications in production, manufacturing industrial and biomedical applications.

**CO3:** Understand laser theory and laser generation system.

**CO4:** Apply laser theory for the selection of lasers for a specific Industrial Applications

**CO5:** Interpret holography techniques

**CO6:** Compare the various medical applications of LASER

**TEXT BOOKS:**

1. J.M. Senior, "Optical Fibre Communication - Principles and Practice", Prentice Hall of India, 2010.
2. J. Wilson and J.F.B. Hawkes, "Introduction to Opto Electronics", Prentice Hall of India, 2001.
3. Eric Udd, William B., and Spillman, Jr., "Fiber Optic Sensors: An Introduction for Engineers and Scientists", John Wiley & Sons, 2011

**REFERENCES:**

1. G. Keiser, 'Optical Fibre Communication', McGraw Hill, 2010.
2. Mr. Arumugam, 'Optical Fiber Communication and Sensors', Anuradha Agencies, 2012.
3. John F. Ready, "Industrial Applications of Lasers", Academic Press, Digitized in 2008.
4. Monte Ross, 'Laser Applications', McGraw Hill, 1968.
5. John and Harry, "Industrial lasers and their application", McGraw-Hill, 2002.
6. NPTEL course "Fiber Optics" by Prof. Vipul Rastogi, IIT Roorkee.  
<https://nptel.ac.in/courses/115107095>

**OBJECTIVES:**

This course is meant to give them a broad exposure to the understanding of various concepts of Linux Kernel and Device Driver Programming.

The course will provide the students with

- (i) The core concepts of operating systems
- (ii) the knowledge of Linux Kernel architecture and device driver framework,
- (iii) the methodology to write Programs for chosen embedded devices, and
- (iv) the skill to use basic techniques for debugging in Linux device drivers and
- (v) basic understanding of Linux based embedded system design.

Experiments will run in synchronism with the lectures to support the methods and techniques taught in the lectures. Through the experiments, the students will

- (i) learn how to setup environment for developing and debugging device drivers,
- (ii) gain confidence to write/customise Linux device drivers, debug and test them using a target platform.

Learning Outcome of students are

- (i) Understanding of complex Linux Kernel framework and extending this knowledge to understand any type of operating system
- (ii) Writing device drivers for simple embedded devices
- (iii) Basic scripting to building the Linux Kernel and Device Drivers
- (iv) Demonstrate end-end data flow from device to application
- (v) Demonstrate various debugging techniques when the system crashes due to a malfunctioning Kernel or Device Driver
- (vi) Plan and execute simple device driver development projects.

**Teaching and Learning Strategy**

Teaching and Learning Strategy	Description of Work	Class Hours	Out-of-Class Hours
Lectures supported by tutorials, assignments and experiments	Practical in Debian or Ubuntu Linux Environment and an embedded evaluation kit	15 hours	45 hours

**Pre-requisites**

1. Advanced C Programming
2. Basic Linux utilities
3. Comfortable with Linux text editors (Vim, Gedit, etc.)
4. Experience with major Linux distribution (Ubuntu, Debian, etc.)
5. Free course from Linux Foundation: A Beginner's Guide to Linux Kernel Development (LFD103)
6. Free course from Linux Foundation: Introduction to Linux (LFS101)

Preliminaries - UNIX Vs Linux, Types of Kernels, Versions, Kernel repository, Object-Oriented approach in Linux Kernel, Important Kernel tasks, User-Space and Kernel-Space.

Programming Preview - Error numbers and Getting Kernel output, Task structure, Memory allocations, Kernel data structures, Jiffies

Kernel Architecture Preview - Processes Vs Threads Vs Tasks, Process address space and Process context, Process limits and capabilities, Kernel Preemption, Real Time Preemption Patch, Dynamic Kernel Patching, Porting to a New Platform

Kernel Initialization - System initialization, System boot, U-Boot

Kernel Configuration - Layout of the Kernel source, Kernel configuration files, Kernel Building and Makefiles, initrd and initramfs

Kernel style & general considerations - Coding style, kernel-doc, using generic Kernel routines and methods, sparse, Using likely () and unlikely (), Writing portable code (CPU, 32/64-bit, Endianness), Writing for SMP, Writing for high memory systems, Power management, Keeping security in mind, Mixing user and Kernel space headers

Modules - What are modules? Compiling modules, modules vs built-in, Module utilities, Automatic loading/unloading of modules, Module usage count, the module struct, Module licensing, exporting symbols, Resolving symbols

**Lab work**

1. Browsing/searching the Kernel source code
2. Booting a target development board over ethernet
3. Add a new system call
4. Code walkthrough for system initialisation code in Kernel
5. Create your first module and send it for review

## **UNIT II      DEVICE DRIVERS I**

**09**

Device Driver Overview - Types of devices, Mechanism vs. Policy, avoiding binary blobs, Power management, How applications use device drivers, Walking through a system call accessing a device, Error numbers, printk(), devres: Managed device resources, Device driver binding

Platform Drivers - Platform devices, I2C subsystem, Device trees, Pin-muxing, Memory management overview, I/O memory and ports

Character Drivers - Character devices, Interaction of user space applications with the kernel, ioctl

Memory addressing - Virtual memory management, Systems with and without MMU and the TLB, Memory addresses, High and low memory, Memory zones, Special device nodes, NUMA, Paging, Page tables, page structure, Kernel Samepage Merging (KSM), Huge page support, libhugetlbf, Transparent huge pages

Memory allocation - Requesting and releasing pages, Buddy system, Slabs and cache allocations, Memory pools, kmalloc(), vmalloc(), Early allocations and bootmem(), Memory defragmentation

### **Lab work**

1. Implement a module that registers as an I2C driver
2. Modify the Device Tree to list the I2C device
3. Get the driver called when the device is enumerated at boot time
4. Configure the pin-mux for the I2C bus to communicate with the driver
5. Extend the driver to communicate with a I2C device
6. Extend the driver to communicate with user space
7. Extend the driver to implement ioctl
8. Demonstrate driver binding using udev
9. Write a module to gather memory statistics
10. Write a module to create a private memory cache
11. Write a module to setup a memory pool
12. Write a module to check the memory allocation limits

## **UNIT III      KERNEL FRAMEWORK I**

**09**

Race conditions & synchronization - Concurrency and synchronization Methods, Atomic operations, Bit operations, Spinlocks, Seqlocks, Disabling preemption, Mutexes, Semaphores, Completion functions, RCU, Reference counts

SMP and Threads - SMP Kernels and modules, Processor affinity, CPUSSETS, SMP algorithms (Scheduling, Locking, etc.), Per-CPU variable

Scheduling - Main scheduling tasks, SMP, Scheduling priorities, Scheduling system calls, the schedule () function, O(1) Scheduler, Time slices and priorities, Load balancing, Priority inversion and priority inheritance, The CFS scheduler, Calculating priorities and fair times, Scheduling classes, CFS Scheduler Details

Disk caches and swapping – Caches, Page cache basics, what is swapping, Swap areas, swapping

pages In and Out, Controlling swappiness, The swap cache, Reverse mapping, OOM Killer

Signals - What are Signals? Available signals, System calls for signals, Sigaction, Signals and threads, How the Kernel installs signal handlers, How the Kernel sends signals, How the Kernel invokes signal handlers, Real time signals

### **Lab work**

1. Write module to get the current CPU ID
2. Create threads in Kernel and run them in different CPUs
3. Write a Kernel module to launch a user process
4. Write a program to simulate CFS
5. Write a program to defragment memory
6. Write a module to manipulate signals installed from user process

## **UNIT IV      DEVICE DRIVERS II**

**09**

Input Subsystem – Principles of Kernel Input subsystem, API offered to kernel drivers to expose input devices capabilities to user space applications, User space API offered by the input subsystem

the misc Subsystem - What the misc kernel subsystem is useful for? API of the misc kernel subsystem (both the kernel side and user space side)

GPIO Subsystem - API of the GPIO kernel subsystem (both the kernel side and user space side)

PCI Drivers - What is PCI? Locating PCI Devices, Accessing Configuration Space, Accessing I/O and Memory Spaces, PCI Express

Sleeping and Interrupts, Locking - Monitoring & debugging

### **Lab work**

1. Create a module to handle input events
2. Create a platform driver and hook it to the misc subsystem
3. Write a program to communicate with the GPIO port
4. Create a module to register a simple interrupt handler
5. Make a process sleep and wake-up from a module
6. Handle a variable from 3 simple modules using mutex
7. Handle a variable from 3 simple modules using Semaphore
8. Compute the average time slices of a process
9. Write a program to examine and modify the scheduling policies and priority

10. Write a basic PCI driver
11. Write interrupt example programs from LDD3

## **UNIT V      KERNEL FRAMEWORK II**

**09**

DMA - What is DMA? DMA directly to user, DMA and Interrupts, DMA memory constraints, DMA masks, DMA API, DMA pools, Scatter/Gather mappings

Memory Technology Devices - What are MTD Devices? NAND vs. NOR vs. eMMC, Flash filesystems

Block Drivers - What are Block Drivers? Buffering, Registering a block driver, gendisk structure, Request handling

Power Management - ACPI and APM, System power states, Callback functions

Network Drivers - Network Layers and Data Encapsulation, Datalink Layer, Network Device Drivers, Loading/Unloading, Opening and Closing, net\_device, sk\_buff, Tx/Rx, ioct, NAPI

Overview of ARM support in Kernel

### **Lab work**

1. Write a simple block driver
2. Code walkthrough for an example USB driver
3. Code walkthrough for an example Network driver
4. Write SNULL driver example from LDD3
5. Write DMA driver example from LDD3

**TOTAL: 45 PERIODS**

### **OUTCOMES:**

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

**CO1:** Write device drivers for simple devices used in Linux based embedded systems.

**CO2:** Design and implement simple embedded applications

**CO3:** Demonstrate end-end data flow from device to application

**CO4:** Demonstrate various debugging techniques when the system crashes due to a malfunctioning Kernel or Device Driver

**CO5:** Execute simple device driver development projects.

**TEXT BOOKS:**

1. Linux Device Drivers (LDD), 3rd Edition
2. Linux Kernel Development, 3rd Edition, Robert Love

**REFERENCES:**

1. Linux System Programming, 2nd Edition, Robert Love
2. The Linux Programming Interface, Michael Kerrisk
3. Linux Kernel Documentation

**OBJECTIVES:**

- To explain the fundamentals of data science
- To experiment and implement python libraries for data science
- To apply and implement basic classification algorithms
- To apply clustering and outlier detection approaches.
- To present and interpret data using visualization tools in Python

**UNIT I INTRODUCTION 09**

Data Science: Benefits and uses – facets of data - Data Science Process: Overview – Defining research goals – Retrieving data – data preparation - Exploratory Data analysis – build the model – presenting findings and building applications - Data Mining - Data Warehousing – Basic statistical descriptions of Data

**UNIT II PYTHON LIBRARIES FOR DATA SCIENCE 09**

Launching the IPython Shell - Launching the Jupyter Notebook - IPython Magic Commands - The Basics of NumPy Arrays-Universal Functions – Aggregations – Computation on Arrays – Fancy Indexing – Sorting arrays – Structured data – Data manipulation with Pandas – Data Indexing and Selection – Handling missing data – Hierarchical indexing – Combining datasets – Aggregation and Grouping – String operations – Working with time series – High performance Pandas.

**UNIT III CLASSIFICATION 09**

Basic Concepts – Decision Tree Induction – Bayes Classification Methods – Rule-Based Classification – Model Evaluation and Selection.

Bayesian Belief Networks – Classification by Backpropagation – Support Vector Machines – Associative Classification – K-Nearest-Neighbor Classifiers – Fuzzy Set Approaches - Multiclass Classification - Semi-Supervised Classification.

**UNIT IV CLUSTERING AND OUTLIER DETECTION 09**

Cluster Analysis – Partitioning Methods – Evaluation of Clusters – Probabilistic Model-Based Clustering – Outliers and Outlier Analysis – Outlier Detection Methods – Statistical Approaches – Clustering and Classification-Based Approaches.

**UNIT V DATA VISUALIZATION 09**

Importing Matplotlib – Simple line plots – Simple scatter plots – visualizing errors – density and contour plots – Histograms – legends – colors – subplots – text and annotation – customization – three-dimensional plotting - Geographic Data with Base map - Visualization with Seaborn.

**TOTAL: 45 PERIODS**

**OUTCOMES:**

On successful completion of this Course, the students will be able

**CO1:** Explain the fundamentals of data science

**CO2:** Experiment python libraries for data science

**CO3:** Apply and implement basic classification algorithms

**CO4:** Implement clustering and outlier detection approaches

**CO5:** Present and interpret data using visualization tools in Python

**TEXT BOOKS:**

1. J.M. David Cielen, Arno D. B. Meysman, and Mohamed Ali, "Introducing Data Science", Manning Publications, 2016.
2. Jiawei Han, Micheline Kamber, Jian Pei, "Data Mining: Concepts and Techniques", 3rd Edition, Morgan Kaufmann, 2012
3. Jake Vander Plas, "Python Data Science Handbook: Essential Tools for Working with Data", Kindle Edition, 2017

**REFERENCES:**

1. G. Roger D. Peng, R Programming for Data Science, Lulu.com, 2016.
2. Laura Igual, Santi Seguí, "Introduction to Data Science: A Python Approach to Concepts, Techniques and Applications", 1st Edition, Springer, 2017
3. Peter Bruce, Andrew Bruce, "Practical Statistics for Data Scientists: 50 Essential Concepts", 3rd Edition, O'Reilly, 2017.
4. Avrim Blum, John Hopcroft, Ravi Kannan, "Foundations of Data Science", 1st Edition, Cambridge University Press, 2020.