SRM VALLIAMMAI ENGINEERING COLLEGE

(An Autonomous Institution)

SRM Nagar, Kattankulathur, Chengalpattu Dt.-603203, Tamil Nadu.

DEPARTMENT OF

ELECTRONICS AND INSTRUMENTATION ENGINEERING

UNDER GRADUATE

CURRICULA AND SYLLABI

(REGULATIONS 2019)

SRM VALLIAMMAI ENGINEERING COLLEGE

(An Autonomous Institution Affiliated to Anna University, Chennai)

B.E. ELECTRONICS AND INSTRUMENTATION ENGINEERING

REGULATIONS – 2019

CHOICE BASED CREDIT SYSTEM

I TO VIII SEMESTERS CURRICULA & SYLLABI

SEMESTER I

S.No	Course Code	Course Title	Category	Contact Periods	L	T	P	C
THEORY								
1.	1919101	Communicative English	**HS**	**3**	**3**	**0**	**0**	**3**
2.	1918102	Engineering Mathematics - I	**BS**	**4**	**3**	**1**	**0**	**4**
3.	1920103	Engineering Physics	**BS**	**3**	**3**	**0**	**0**	**3**
4.	1921104	Engineering Chemistry	**BS**	**3**	**3**	**0**	**0**	**3**
5.	1901005	Problem solving and Python Programming	**ES**	**3**	**3**	**0**	**0**	**3**
6.	1901008	Basic Civil and Mechanical Engineering	**ES**	**3**	**3**	**0**	**0**	**3**
PRACTICALS								
7.	1901009	Problem solving and Python Programming Laboratory	**ES**	**4**	**0**	**0**	**4**	**2**
8.	1901108	Physics and Chemistry Laboratory	**BS**	**4**	**0**	**0**	**4**	**2**
			TOTAL	**27**	**18**	**1**	**8**	**23**

SEMESTER II

S.No	Course Code	Course Title	Category	Contact Periods	L	T	P	C
THEORY								
1.	1919201	Technical English	**HS**	**3**	**3**	**0**	**0**	**3**
2.	1918202	Engineering Mathematics - II	**BS**	**4**	**3**	**1**	**0**	**4**
3.	1920203	Physics for Electronics Engineering	**BS**	**3**	**3**	**0**	**0**	**3**
4.	1921203	Environmental Science and Engineering	**BS**	**3**	**3**	**0**	**0**	**3**
5.	1901006	Programming in C	**ES**	**3**	**3**	**0**	**0**	**3**
6.	1901007	Engineering Graphics	**ES**	**6**	**2**	**0**	**4**	**4**
PRACTICALS								
7.	1901010	C Programming Laboratory	**ES**	**4**	**0**	**0**	**4**	**2**
8.	1901208	Engineering Practices Laboratory	**ES**	**4**	**0**	**0**	**4**	**2**
9.	1901209	Applied Physics and Environmental Chemistry Laboratory	**BS**	**4**	**0**	**0**	**4**	**2**
		NSS/NCC/YRC/NSO	**PCD**	**1***	**0**	**0**	**0**	**1**
			TOTAL	**35**	**17**	**1**	**16**	**27**

**Conducted after college hours.*

SEMESTER III

S.No.	Course Code	Course Title	Category	Contact Periods	L	T	P	C
THEORY								
1.	1918301	Transforms and Partial Differential Equations	**BS**	**4**	**3**	**1**	**0**	**4**
2.	1907301	Electron Devices and Circuits	**ES**	**3**	**3**	**0**	**0**	**3**
3.	1909307	Applied Fluid Dynamics and Thermodynamics	**PC**	**3**	**3**	**0**	**0**	**3**
4.	1907302	Electrical and Electronic Instruments	**PC**	**3**	**3**	**0**	**0**	**3**
5.	1907001	Transducers Engineering	**PC**	**3**	**3**	**0**	**0**	**3**
6.	1905305	Circuit Theory	**PC**	**3**	**3**	**0**	**0**	**3**
PRACTICALS								
7.	1907304	Measurements and Transducers Laboratory	**PC**	**4**	**0**	**0**	**4**	**2**
8.	1907305	Circuits and Devices Laboratory	**PC**	**4**	**0**	**0**	**4**	**2**
			TOTAL	**27**	**18**	**1**	**8**	**23**

SEMESTER IV

S.No.	Course Code	Course Title	Category	Contact Periods	L	T	P	C
THEORY								
1.	1918401	Numerical Methods	**BS**	**4**	**3**	**1**	**0**	**4**
2.	1907401	Electrical Machines	**ES**	**3**	**3**	**0**	**0**	**3**
3.	1907402	Digital Logic Circuits	**PC**	**3**	**3**	**0**	**0**	**3**
4.	1907403	Linear Integrated Circuits and Applications	**PC**	**3**	**3**	**0**	**0**	**3**
5.	1907404	Industrial Instrumentation - I	**PC**	**3**	**3**	**0**	**0**	**3**
6.	1915001	Professional Ethics	**HS**	**3**	**3**	**0**	**0**	**3**
PRACTICALS								
7.	1907405	Electrical Machines Laboratory	**PC**	**4**	**0**	**0**	**4**	**2**
8.	1907406	Linear and Digital Integrated Circuits Laboratory	**PC**	**4**	**0**	**0**	**4**	**2**
9.	1919001	Communication Skills Laboratory - Project based	**EEC**	**2**	**0**	**0**	**2**	**0**
			TOTAL	**29**	**18**	**1**	**10**	**23**

SEMESTER V

S.No	Course Code	Course Title	Category	Contact Periods	L	T	P	C
THEORY								
1.	1907501	Industrial Instrumentation - II	**PC**	**3**	**3**	**0**	**0**	**3**
2.	1905504	Control Systems	**PC**	**3**	**3**	**0**	**0**	**3**
3	1906004	Communication Engineering	**PC**	**3**	**3**	**0**	**0**	**3**
4.	1905502	Microprocessors and Microcontrollers	**PC**	**3**	**3**	**0**	**0**	**3**
5.	1907502	Discrete Time Systems and Signal Processing	**PC**	**3**	**3**	**0**	**0**	**3**
6.	19XXXXX	Open Elective - I	**OE**	**3**	**3**	**0**	**0**	**3**
PRACTICALS								
7.	1907505	Industrial Instrumentation Laboratory	**PC**	**4**	**0**	**0**	**4**	**2**
8.	1907506	Microprocessors and Microcontrollers Laboratory	**PC**	**4**	**0**	**0**	**4**	**2**
			TOTAL	**26**	**18**	**0**	**8**	**22**

SEMESTER VI

S. No	Course Code	Course Title	Category	Contact Periods	L	T	P	C
THEORY								
1.	1907601	Logic and Distributed Control System	**PC**	**3**	**3**	**0**	**0**	**3**
2.	1904007	Data Structures	**PC**	**3**	**3**	**0**	**0**	**3**
3.	1907602	Process Control	**PC**	**3**	**3**	**0**	**0**	**3**
4.	19XXXXX	Professional Elective - I	**PE**	**3**	**3**	**0**	**0**	**3**
5.	19XXXXX	Professional Elective - II	**PE**	**3**	**3**	**0**	**0**	**3**
PRACTICALS								
7.	1904613	Data Structures Laboratory	**PC**	**4**	**0**	**0**	**4**	**2**
8.	1907609	Process Control Laboratory	**PC**	**4**	**0**	**0**	**4**	**2**
9.	1919002	Professional Communication	**EEC**	**2**	**0**	**0**	**2**	**1**
10.	1907611	Internship	**EEC**	**0**	**0**	**0**	**0**	**-**
11.	1907610	Mini Project	**EEC**	**4**	**0**	**0**	**4**	**2**
			TOTAL	**30**	**15**	**0**	**14**	**22**

SEMESTER VII

S.No	Course Code	Course Title	Category	Contact Periods	L	T	P	C
THEORY								
1.	1907701	Computer control of Processes	**PC**	**3**	**3**	**0**	**0**	**3**
2.	1907702	Industrial data network	**PC**	**3**	**3**	**0**	**0**	**3**
3.	19XXXXX	Professional Elective - III	**PE**	**3**	**3**	**0**	**0**	**3**
4.	19XXXXX	Professional Elective - IV	**PE**	**3**	**3**	**0**	**0**	**3**
5.	19XXXXX	Open Elective - II	**OE**	**3**	**3**	**0**	**0**	**3**
PRACTICALS								
6.	1907709	Industrial Automation Laboratory	**PC**	**4**	**0**	**0**	**4**	**2**
7.	1907710	Instrumentation System Design Laboratory	**PC**	**4**	**0**	**0**	**4**	**2**
8.	1907611	Internship	**EEC**	**0**	**0**	**0**	**0**	**1**
9.	1907711	Project work - Phase I	**EEC**	**4**	**0**	**0**	**4**	**2**
			TOTAL	**27**	**15**	**0**	**12**	**22**

SEMESTER VIII

S.No	Course Code	Course Title	Category	Contact Periods	L	T	P	C
THEORY								
1.	19XXXXX	Professional Elective - V	**PE**	**3**	**3**	**0**	**0**	**3**
2.	19XXXXX	Professional Elective - VI	**PE**	**3**	**3**	**0**	**0**	**3**
PRACTICALS								
3.	1907805	Project Work - Phase II	**EEC**	**12**	**0**	**0**	**12**	**6**
			TOTAL	**18**	**6**	**0**	**12**	**12**

TOTAL NO. OF CREDITS: 174

PROFESSIONAL ELECTIVE – I (VI SEMESTER)

S.No	Course Code	Course Title	Category	Contact Periods	L	T	P	C
THEORY								
1.	1920601	MEMS and Nanoscience	**PE**	**3**	**3**	**0**	**0**	**3**
2.	1905613	Power Electronics and Drives	**PE**	**3**	**3**	**0**	**0**	**3**
3	1907603	System Identification	**PE**	**3**	**3**	**0**	**0**	**3**
4.	1904003	Computer Networks	**PE**	**3**	**3**	**0**	**0**	**3**
5.	1904606	Intellectual Property Rights	**PE**	**3**	**3**	**0**	**0**	**3**

PROFESSIONAL ELECTIVE – II (VI SEMESTER)

S.No	Course Code	Course Title	Category	Contact Periods	L	T	P	C
THEORY								
1.	1907604	Adaptive Control	**PE**	**3**	**3**	**0**	**0**	**3**
2.	1907605	Advanced Instrumentation Systems	**PE**	**3**	**3**	**0**	**0**	**3**
3	1907606	Applied Soft Computing	**PE**	**3**	**3**	**0**	**0**	**3**
4.	1905608	Embedded Systems	**PE**	**3**	**3**	**0**	**0**	**3**
5.	1907607	Analytical Instruments	**PE**	**3**	**3**	**0**	**0**	**3**

PROFESSIONAL ELECTIVE – III (VII SEMESTER)

S.No	Course Code	Course Title	Category	Contact Periods	L	T	P	C
1.	1907703	Biomedical Instrumentation	**PE**	**3**	**3**	**0**	**0**	**3**
2.	1907704	Fibre Optics and Laser Instrumentation	**PE**	**3**	**3**	**0**	**0**	**3**
3.	1906005	VLSI Design	**PE**	**3**	**3**	**0**	**0**	**3**
4.	1906704	Digital Image Processing	**PE**	**3**	**3**	**0**	**0**	**3**
5.	1904014	Artificial Intelligence	**PE**	**3**	**3**	**0**	**0**	**3**

PROFESSIONAL ELECTIVE – IV (VII SEMESTER)

S.No	Course Code	Course Title	Category	Contact Periods	L	T	P	C
1.	1907705	Instrumentation Standards	**PE**	**3**	**3**	**0**	**0**	**3**
2.	1915003	Total Quality Management	**PE**	**3**	**3**	**0**	**0**	**3**
3.	1907706	Non Linear Control	**PE**	**3**	**3**	**0**	**0**	**3**
4.	1920001	Fundamentals of Nanoscience	**PE**	**3**	**3**	**0**	**0**	**3**
5.	1904012	Machine Learning	**PE**	**3**	**3**	**0**	**0**	**3**

PROFESSIONAL ELECTIVE – V (VIII SEMESTER)

S.No	Course Code	Course Title	Category	Contact Periods	L	T	P	C
1.	1907801	Thermal Power Plant Instrumentation	**PE**	**3**	**3**	**0**	**0**	**3**
2.	1906007	Advanced Digital Signal Processing	**PE**	**3**	**3**	**0**	**0**	**3**
3.	1915002	Principles of Management	**PE**	**3**	**3**	**0**	**0**	**3**
4.	1907802	Advanced Process Control	**PE**	**3**	**3**	**0**	**0**	**3**
5.	1907003	Process Modeling and Simulation	**PE**	**3**	**3**	**0**	**0**	**3**

PROFESSIONAL ELECTIVE – VI (VIII SEMESTER)

S.No	Course Code	Course Title	Category	Contact Periods	L	T	P	C
1.	1907803	Instrumentation in Petrochemical Industries	**PE**	**3**	**3**	**0**	**0**	**3**
2.	1915004	Human Rights	**PE**	**3**	**3**	**0**	**0**	**3**
3.	1907002	Robotics and Automation	**PE**	**3**	**3**	**0**	**0**	**3**
4.	1907804	Advanced Control Systems	**PE**	**3**	**3**	**0**	**0**	**3**

OPEN ELECTIVE – I (V SEMESTER)

S.No	COURSE CODE	COURSE TITLE	Course offering Department	Contact Periods	L	T	P	C
1.	1902512	Environment and Agriculture	AGRI	**3**	**3**	**0**	**0**	**3**
2.	1902513	Production Technology of Agricultural Machinery	AGRI	**3**	**3**	**0**	**0**	**3**
3.	1903514	Air Pollution and Control Engineering	CIVIL	**3**	**3**	**0**	**0**	**3**
4.	1903515	Participatory Water Resources Management	CIVIL	**3**	**3**	**0**	**0**	**3**
5.	1904504	Geographic Information System	CSE	**3**	**3**	**0**	**0**	**3**
6.	1904508	Database management systems	CSE	**3**	**3**	**0**	**0**	**3**
7.	1904509	Cloud computing	CSE	**3**	**3**	**0**	**0**	**3**
8.	1905001	Energy Conservation and Management	EEE	**3**	**3**	**0**	**0**	**3**
9.	1905508	Renewable Energy Sources	EEE	**3**	**3**	**0**	**0**	**3**
10.	1905509	SCADA System Management	EEE	**3**	**3**	**0**	**0**	**3**
11.	1906507	Entertaintronics	ECE	**3**	**3**	**0**	**0**	**3**
12.	1906505	Photonic Networks	ECE	**3**	**3**	**0**	**0**	**3**
13.	1906506	Telecommunication Network Management	ECE	**3**	**3**	**0**	**0**	**3**
14.	1908001	3D Printing and Design	IT	**3**	**3**	**0**	**0**	**3**
15.	1908002	Scripting Languages	IT	**3**	**3**	**0**	**0**	**3**
16.	1909510	Product Design and Development	MECH	**3**	**3**	**0**	**0**	**3**
17.	1909511	Vibration and Noise Control	MECH	**3**	**3**	**0**	**0**	**3**
18.	1909512	Industrial Safety Engineering	MECH	**3**	**3**	**0**	**0**	**3**
19.	1910504	Principles of Food Preservation	MEDICAL ELECTRONICS	**3**	**3**	**0**	**0**	**3**
20.	1920501	Nanotechnology	PHYSICS	**3**	**3**	**0**	**0**	**3**
21.	1920502	Microscopy	PHYSICS	**3**	**3**	**0**	**0**	**3**
22.	1921501	Advanced Engineering Chemistry	CHEMISTRY	**3**	**3**	**0**	**0**	**3**
23.	1921502	Industrial Nanotechnology	CHEMISTRY	**3**	**3**	**0**	**0**	**3**

OPEN ELECTIVE – II (VII SEMESTER)

S.No	COURSE CODE	COURSE TITLE	Course offering Department	Contact Periods	L	T	P	C
1.	1903706	Green Building Design	CIVIL	**3**	**3**	**0**	**0**	**3**
2.	1903716	Environmental and social impact assessment	CIVIL	**3**	**3**	**0**	**0**	**3**
3.	1904703	Tamil Computing	CSE	**3**	**3**	**0**	**0**	**3**
4.	1904010	Object Oriented Programming	CSE	**3**	**3**	**0**	**0**	**3**
5.	1904712	Software Engineering	CSE	**3**	**3**	**0**	**0**	**3**
6.	1905712	Renewable Energy systems	EEE	**3**	**3**	**0**	**0**	**3**
7.	1905713	Electric Vehicles and Power Management	EEE	**3**	**3**	**0**	**0**	**3**
8.	1906705	Acoustics	ECE	**3**	**3**	**0**	**0**	**3**
9.	1906706	Visual Communication	ECE	**3**	**3**	**0**	**0**	**3**
10.	1906707	MEMS and NEMS	ECE	**3**	**3**	**0**	**0**	**3**
11.	1908003	Software Quality Management	IT	**3**	**3**	**0**	**0**	**3**
12.	1908004	C # and . Net Programming	IT	**3**	**3**	**0**	**0**	**3**
13.	1908005	Virtual Reality	IT	**3**	**3**	**0**	**0**	**3**
14.	1909718	Robotics	MECH	**3**	**3**	**0**	**0**	**3**
15.	1909719	Testing of Materials	MECH	**3**	**3**	**0**	**0**	**3**
16.	1909720	Design of Electric Vehicles	MECH	**3**	**3**	**0**	**0**	**3**
17.	1910703	Clinical Trials	MEDICAL ELECTRONICS	**3**	**3**	**0**	**0**	**3**
18.	1910704	Regulatory requirements in pharmaceutical Industries	MEDICAL ELECTRONICS	**3**	**3**	**0**	**0**	**3**
19.	1910705	Microbiology	MEDICAL ELECTRONICS	**3**	**3**	**0**	**0**	**3**
20.	1920701	Analytical Methods and Instrumentation	PHYSICS	**3**	**3**	**0**	**0**	**3**
21.	1920702	Medical Physics	PHYSICS	**3**	**3**	**0**	**0**	**3**
22.	1920703	Electronic Materials	PHYSICS	**3**	**3**	**0**	**0**	**3**
23.	1921701	Waste Water Treatment	CHEMISTRY	**3**	**3**	**0**	**0**	**3**

SUMMARY

S.No	SUBJECT AREA	CREDIT AS PER SEMESTER								CREDITS TOTAL	PERCENTAGE
		I	II	III	IV	V	VI	VII	VIII		
1.	**HS**	3	3	-	3		-	-	-	9	5.17
2.	**BS**	12	12	4	4	-	-	-	-	32	18.39
3.	**ES**	8	11	3	3	-	-	-	-	25	14.36
4.	**PC**	-	-	16	13	19	13	10	-	71	40.80
5.	**PE**	-	-	-	-	-	6	6	6	18	10.34
6.	**OE**	-	-	-	-	3	-	3	-	6	3.45
7.	**EEC**	-	-	-	0	-	3	3	6	12	6.90
8.	**PCD**	-	1	-	-	-	-	-	-	01	0.57
	TOTAL	23	27	23	23	22	22	22	12	174	100
	Non credit /mandatory	**-**	**-**	**-**	✓	**-**	**-**	**-**	**-**	**-**	**-**

SEMESTER I

1919101	COMMUNICATIVE ENGLISH	L T P C
		3 0 0 3

COURSE OBJECTIVES:

- To develop the basic reading and writing skills of first year engineering and technology students.
- To help learners develop their listening skills, which will, enable them listen to lectures and understand.
- Comprehend content - asking questions; seeking clarifications.
- To help learners develop their speaking skills and speak fluently in real contexts.
- To help learners develop vocabulary of a general kind by developing their reading skills

UNIT-I: SHARING INFORMATION 9

Reading– short comprehension passages, practice in skimming-scanning and predicting **Writing**– Blog/film review/quora/Twitter/Facebook– developing hints. **Listening**– short texts- short formal and informal conversations. **Speaking-** introducing oneself– exchanging personal information- **Language development**– Wh- Questions- asking and answering-yes or no questions- parts of speech. **Vocabulary development-**– prefixes- suffixes – word formation- articles.-make sentences of your own.

UNIT-II: GENERAL READING AND FREEWRITING 9

Reading – Story with questions and answers- **Writing** – paragraph writing- topic sentence- main ideas- free writing, short narrative descriptions using some suggested vocabulary and structures –**Listening**– Listening to a speech – answering questions. **Speaking – Presentation** with PPT - **Language development** – prepositions, conjunctions **Vocabulary development-** guessing meanings of words in context – synonyms inferring meaning from passages.

UNIT- III: GRAMMAR AND LANGUAGE DEVELOPMENT 9

Reading– short texts and longer passages (close reading) **Writing-** understanding text structure- use of reference words and discourse markers-coherence-jumbled sentences **Listening** –listening to stories to answer questions. **Speaking**– asking about routine actions and expressing opinions. **Language development**– degrees of comparison- pronouns- correction of errors- **Vocabulary development –** single word substitutes- adverbs.

UNIT- IV: READING AND LANGUAGE DEVELOPMENT 9

Reading- Picture comprehension - Maps **Writing**– letter writing, informal or personal letters- congratulating/ thanking/requesting help e-mails-forward a mail to Staff on given topic- **Listening**– listen to different sounds and differentiate the sounds with different words. **Speaking-** speaking about oneself- speaking about one's friend- **Language development-** Tenses- **Vocabulary development**– synonyms-antonyms- phrasal verbs.

UNIT- V: EXTENDED WRITING 9

Reading- longer texts- close reading –**Writing**– brainstorming -writing short essays **–** developing an outline- identifying main and subordinate ideas- dialogue writing-**Listening** – listening to talks- conversations- **Speaking –** participating in conversations- short group conversations-**Language development**-modal verbs- **Vocabulary development**-collocations- fixed and semi-fixed expressions.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

- Read articles of a general kind in magazines and newspapers
- Participate effectively in informal conversations; introduce themselves and their friends and express opinions in English.
- Comprehend conversations and short talks delivered in English
- Write short essays of a general kind and personal letters and emails in English
- Speak fluently and express opinions clearly.

TEXT BOOKS:

1. Board of Editor,'Using English' a Course book for Undergraduate Engineers andTechnologists. Orient Black Swan Limited, Hyderabad: 2015
2. Richards, C. Jack.' Interchange Students' Book-2 ' New Delhi: CUP, 2015.

REFERENCE BOOKS:

1. Bailey, Stephen. Academic Writing: A practical guide for students. New York: Rutledge,2011.
2. Means,L. Thomas and Elaine Langlois. English & Communication For Colleges.CengageLearning ,USA: 2007
3. Redston, Chris &Gillies Cunningham Face2Face (Pre-intermediate Student's Book& Workbook)Cambridge University Press, New Delhi: 2005

4. Comfort, Jeremy, et al. Speaking Effectively: Developing Speaking Skills for Business English.Cambridge University Press, Cambridge: Reprint 2011
5. Dutt P. Kiranmai and RajeevanGeeta. Basic Communication Skills, Foundation Books: 2013.

CO-PO and CO-PSO MAPPING:

CO	PO												PSO			
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**	**4**
CO1	3	3	2	3	3	-	-	-	-	3	-	1	2	2	1	2
CO2	3	2	3	2	2	-	2	-	-	3	-	1	1	1	1	1
CO3	3	3	-	2	-	-	-	-	-	3	-	1	1	2	2	2
CO4	3	3	-	-	-	-	3	-	-	3	-	1	1	1	1	1
CO5	3	3	3	2	3	3	2	-	-	3	-	1	2	1	1	2

1918102 ENGINEERING MATHEMATICS - I L T P C

3 1 0 4

COURSE OBJECTIVES:

- To understand and apply matrix techniques for engineering applications.
- To familiarize the student with basic calculus and traditions of traditional calculus.
- To solve the problems in single and multivariable calculus and plays an important role in science, economics, engineering.
- To acquaint the student with mathematical tools needed in evaluating integrals.
- To familiarize the student with multiple integrals and their usage in find the area and volume of two and three dimensional objects.

UNIT-I: MATRICES 9L+3T

System of Equations – consistency and inconsistency - Eigen values and Eigen vectors of a real matrix - Characteristic equation - Properties of Eigen values and Eigen vectors - Statement and Applications of Cayley-Hamilton Theorem - Reduction of a quadratic form into canonical form by orthogonal transformation.

UNIT II DIFFERENTIAL CALCULUS FOR FUNCTIONS OF ONE VARIABLE 9L+3T

Limit of a function - Continuity – Differentiability - Differentiation rules – Rolle's theorem and Mean Value theorem – Taylor's series- Maxima and Minima of functions of one variable.

UNIT III FUNCTIONS OF SEVERAL VARIABLES 9L+3T

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

UNIT-IV: INTEGRAL CALCULUS FOR FUNCTION OF ONE VARIABLE 9L+3T

Definite and Indefinite integrals - Substitution rule - Techniques of Integration - Integration by parts, Trigonometric integrals, Trigonometric substitutions, Integration by partial fractions – Improper integrals.

UNIT-V: MULTIPLE INTEGRALS 9L+3T

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

TOTAL: 45L +15T PERIODS

COURSE OUTCOMES:

- To apply the idea of reducing complex problems into simple form using matrix technique.
- Basic application of calculus in Engineering problems and to tackle for different geometries.
- This course equips the students to have basic knowledge and understanding of fundamental statistics to analyze and interpret data.
- To apply Integration byparts, Trigonometric integrals, Trigonometric substitutions, Integration bypartial fractions in Engineering Problems.
- Basic application of Double and Triple integrals used in Engineering real life problems

TEXT BOOKS:

1. Grewal. B.S, "Higher Engineering Mathematics", 41st Edition, Khanna Publications, Delhi, 2011.3. Gupta S.C and Kapoor V.K, "Fundamentals of Mathematical Statistics", S.Chand Private Ltd.,11th Edition, 2005.
2. Veerarajan.T, " Engineering Mathematics", McGrawHill Education(India) Private Ltd 2019.
3. Gupta S.C and Kapoor V.K, " Fundamentals of Mathematical Statistics", S.Chand Private Ltd., 11th Edition, 2005.

REFERENCE BOOKS:

1. Kreyszig Erwin, "Advanced Engineering Mathematics", John Wiley and Sons, 10th Edition, New Delhi, 2016 27 2.
2. Ramana B.V, "Higher Engineering Mathematics", Tata McGraw Hill Publishing Company, New Delhi, 2008.

3. James Stewart, “Calculus: Early Transcendentals”, Cengage Learning, 7th Edition, New Delhi, 2015. [For Units I & III- Sections 1.1, 2.2, 2.3, 2.5, 2.7 (Tangents problems only), 2.8, 3.1 to 3.6, 3.11, 4.1, 4.3, 5.1 (Area problems only), 5.2, 5.3, 5.4 (excluding net change theorem), 5.5, 7.1 – 7.4 and 7.8].

CO-PO MAPPING:

CO	PO											
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
CO1	3	2	2	1	-	-	-	-	-	-	-	1
CO2	3	2	2	1	-	-	-		-	-	-	1
CO3	3	2	2	1	-	-	-		-	-	-	1
CO4	3	2	2	1	-	-	-		-	-	-	1
CO5	3	2	2	1	-	-	-		-	-	-	1

1920103 **ENGINEERING PHYSICS** **L T P C**
3 0 0 3

COURSE OBJECTIVES:

- To understand the stress, strain and the concept of Hooke's law for the modulus of elasticity values .
- To facilitate the knowledge about basics of laser, optical fiber sources and transmission techniques.
- To enrich the idea of transfer and measurement of heat and uses of heat exchangers.
- To explore the basics of quantum theory and atomic and subatomic particles.
- To enhance the fundamental knowledge crystal Physics and its applications

UNIT- I PROPERTIES OF MATTER 9

Elasticity – Hooke’s law-Stress-strain diagram and its uses –Poisson ratio-factors affecting elastic modulus and tensile strength – twisting couple - torsion pendulum: theory and experiment (regular body) - bending of beams - bending moment – cantilever: theory and experiment – uniform and non-uniform bending: theory and experiment - I-shaped girders.

UNIT-II LASERS AND FIBER OPTICS 9

Lasers: population of energy levels, Einstein’s A and B coefficients derivation – resonant cavity, optical amplification (qualitative) – Nd-YAG laser-Semiconductor lasers: homojunction and heterojunction – Applications. Fiber optics: principle, numerical aperture and acceptance angle - types of optical fibres (material, refractive index, and mode) – losses associated with optical fibers–Fiber optic communication- fibre optic sensors: pressure and displacement- Endoscope.

UNIT-III THERMAL PHYSICS 9

Transfer of heat energy – thermal conduction, convection and radiation – Newton's law cooling (qualitative) -heat conductions in solids – thermal conductivity - Forbe's and Lee's disc method: theory and experiment - conduction through compound media (series and parallel) – thermal insulation – applications: heat exchangers, refrigerators, ovens and solar water heaters.

UNIT-IV QUANTUM PHYSICS 9

Black body radiation – Planck's theory (derivation)- deduction of Wien's and Rayleigh jeans law – Compton effect: theory and experimental verification – wave particle duality – electron diffraction – concept of wave function and its physical significance – Schrödinger's wave equation – time independent and time dependent equations – particle in a one-dimensional - three dimensional potential box– tunnelling (qualitative) - scanning tunnelling microscope.

UNIT-V CRYSTAL PHYSICS 9

Single crystalline, polycrystalline and amorphous materials – single crystals: unit cell, crystal systems, Bravais lattices, directions and planes in a crystal, Miller indices – inter-planar distances- coordination number and packing factor for SC, BCC, FCC, HCP and diamond structure (qualitative) - crystal imperfections: point defects, line defects – Burger vectors, stacking faults – growth of single crystals: solution and melt growth techniques - Importance of crystal physics.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

Upon completion of this course,

- The students will gain knowledge on the basics of properties of matter and its applications,
- The students will acquire knowledge on the concepts of optical devices and their applications in fibre optics,
- the students will have adequate knowledge on the concepts of thermal properties of material and their applications in heat exchanger and electrical appliances,
- the students will get knowledge on advanced physics concepts of quantum theory and its applications in tunnelling microscopes, and
- the students will understand the basics of crystals, their structures and different crystal growth techniques.

TEXT BOOKS:

1. Bhattacharya, D.K. & Poonam, T. "Engineering Physics". Oxford University Press, 2015.
2. Gaur, R.K. & Gupta, S.L. "Engineering Physics". Dhanpat Rai Publishers, 2012.
3. Pandey, B.K. &Chaturvedi, S. "Engineering Physics". Cengage Learning India, 2012.
4. Brijlal and Subramanyam, "Properties of Matter", S .Chand publishing, 2002.

REFERENCE BOOKS:

1. Halliday, D., Resnick, R. & Walker, J. “Principles of Physics”. Wiley, 2015.
2. Serway, R.A. & Jewett, J.W. “Physics for Scientists and Engineers”. Cengage Learning, 2010.
3. Tipler, P.A. & Mosca, G. “Physics for Scientists and Engineers with Modern Physics’. W.H.Freeman, 2007.
4. Shatendra Sharma & Jyotsna Sharma, “Engineering Physics”. Pearson, 2018.

CO-PO and CO-PSO MAPPING:

CO	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
CO1	3	1	1			1	1	-	-	-	-	1	2	-	-	-
CO2	3	1	1		1	1	1	-	-	-		1	3	-	-	-
CO3	3		1			1		-	-	-	-	1	3	-	-	-
CO4	3	1		1		1	1	-	-	-	-	1	3	1	-	-
CO5	3	1		1			1	-	-	-		1	2	-	-	-

1921104 ENGINEERING CHEMISTRY L T P C
3 0 0 3

COURSE OBJECTIVES

- To make the students acquainted with boiler feed water requirements, related problems and domestic water treatment techniques.
- To understand the basic mechanism of surface phenomenon.
- To acquaint the student with the principles of electrochemical reactions, methods for corrosion prevention and protection of materials.
- To make the student conversant with the basics of polymers, cement and glass.
- To acquaint the students with the basics of nanomaterials, their properties and applications.

UNIT-I: WATER AND ITS TREATMENT 9

Hardness of water – types – expression of hardness – units - Boiler feed water-boiler troubles - scale and sludge, priming and foaming, caustic embrittlement, boiler corrosion. Treatment of boiler feed water – Internal treatment (phosphate, colloidal, sodium aluminate and calgon conditioning). External treatment – Ion exchange process – domestic water treatment (break point chlorination) – Desalination of brackish water – Reverse Osmosis.

UNIT-II: SURFACE CHEMISTRY AND CATALYSIS 9

Adsorption: Types of adsorption – adsorption of gases on solids – adsorption of solute from solutions – adsorption isotherms. Freundlich's adsorption isotherm – Langmuir's adsorption isotherm – Contact theory. Kinetics of surface reactions, unimolecular reactions, Langmuir – applications of adsorption on pollution abatement. Catalysis: Catalyst – types of catalysis – Criteria – Autocatalysis – Catalytic poison and catalytic promoters – Acid base catalysis – Applications (3 way catalytic convertor) – Enzyme catalysis– Michaelis – Menten equation.

UNIT-III: ELECTROCHEMISTRY, CORROSION AND PROTECTIVE COATINGS 9

Electrochemical cell - redox reaction, electrode potential - origin of electrode potential - oxidation potential - reduction potential, measurement and applications - Electrochemical series and its significance - Nernst equation (derivation and problems). Corrosion – causes – factors – types - chemical, electrochemical corrosion (galvanic, differential aeration), corrosion control – material selection and design aspects – Electrochemical protection – sacrificial anode method and impressed current cathodic method. Protective coatings: Metallic coatings – Electroplating of Cu - electroless plating of Ni. Organic coatings: Paints - constituents and function.

UNIT-IV: ENGINEERING MATERIALS 9

Cement: Definition – classification of cement – Portland cement - manufacture and properties - setting and hardening of cement - special cement, water proof, white and sorel cement – properties and uses – Glass: Manufacture, types, properties and uses (laminated, safety and flint glass) - Polymers: Classification - types of polymerization - mechanism - methods of polymerization - Engineering polymers: Nylon-6, Nylon-6,6, Teflon, Kevlar and PEEK - preparation, properties and uses - Plastic and its types - Conducting polymers: Types and applications - Polymers in medicine and surgery (applications).

UNIT-V: NANOCHEMISTRY 9

Basics - distinction between molecules, nanoparticles and bulk materials; size-dependent properties (surface to volume ratio, melting point, optical and electrical). Nanoparticles, Nanocluster, Nanorods, Nanotube (CNT: SWNT and MWNT) and Nanowire, Synthesis - precipitation, thermolysis, hydrothermal, electrodeposition, chemical vapour deposition, laser ablation, sol-gel process and applications.

TOTAL: 45 PERIODS

COURSE OUTCOMES

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

- Gain idea about various methods available for water treatment.
- Explain the materials surface engineering.

- Understand the process of electrochemistry and its application to corrosion.
- Appreciate the nature and novelty of engineering materials.
- Ability to understand the nature and uses of nanomaterials.

TEXT BOOKS:

1. Shikha Agarwal, “Engineering Chemistry”-Fundamentals and Applications, Cambridge University Press, Delhi, 2015.
2. P. C. Jain and Monika Jain, “Engineering Chemistry” Dhanpat Rai Publishing Company (P) LTD, New Delhi, 2015.
3. S. Vairam, P. Kalyani and Suba Ramesh, “Engineering Chemistry”, Wiley India PVT, LTD, New Delhi, 2013.

REFERENCE BOOKS:

1. Friedrich Emich, “Engineering Chemistry”, Scientific International PVT, LTD, New Delhi, 2014.
2. S.S. Dara and S.S. Umare, “A Text Book of Engineering Chemistry”, S. Chand & Company LTD, New Delhi, 2015.
3. B. Sivasankar, “Engineering Chemistry”, Tata McGraw-Hill Publishing Company LTD, 2012.

CO-PO and CO-PSO MAPPING:

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

1901005 PROBLEM SOLVING AND PYTHON PROGRAMMING **L T P C**

(Common to all branches of B.E. / B.Tech. Programmes) **3 0 0 3**

COURSE OBJECTIVES:

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

UNIT I ALGORITHMIC PROBLEM SOLVING, DATA TYPES 9

Algorithms: building blocks of algorithms (statements, control flow, functions), notation (pseudo code, flow chart). Python interpreter and interactive mode; **values and types:** int, float, Boolean, string, and list; variables, operators and expressions, statements, tuple assignment, precedence of operators, comments, Illustrative programs: Algorithm for Arithmetic expression (addition and subtraction).

UNIT II CONTROL FLOW STATEMENTS AND FUNCTIONS 9

Conditionals: Boolean values and operators, conditional (if), alternative (if-else), chained conditional (if-elif-else); **Iteration:** state, while, for, break, continue, pass; functions, function definition and use. **Fruitful functions:** return values, parameters, local and global scope, recursion. Illustrative programs: exchange the values of two variables square root, printing n numbers iteratively

UNIT III LIST& TUPLES 9

Lists: list operations, list slices, list methods, list loop, mutability, list parameters; **Tuples:** tuple assignment, tuple as return value. Comparison of Lists and tuples. Illustrative programs: selection sort, insertion sort, Quick sort.

UNIT IV STRINGS, DICTIONARIES & SET 9

Strings: string slices, immutability, string functions and methods, string module. **Dictionaries:** Operations (create, access, add, remove) and methods. (insert, delete).Set operation (Access, Add, Remove).Comparison of dictionary and set.

UNIT V FILES, MODULES & PACKAGES 9

Files and exception: text files, reading and writing files, format operator; errors and exceptions, handling exceptions, modules, packages; Illustrative programs: word count, copy file.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

- Develop algorithmic solutions to simple computational problems.
- Structure simple Python programs for solving problems.
- Decompose a Python program into functions.
- Represent compound data using Python lists, tuples, Set and dictionaries.
- Read and write data from/to files in Python Programs.

TEXT BOOKS:

1. Reema Thareja, **"Python Programming using Problem solving Approach"** ,Oxford Higher Education,2017
2. Allen B. Downey, **"Think Python: How to Think Like a Computer Scientist"**, 2nd edition, Updated for Python 3, Shroff/O'Reilly Publishers, 2016 (http://greenteapress.com/wp/think-python/)
3. Guido van Rossum and Fred L. Drake Jr, **"An Introduction to Python**" – Revised and updated for Python 3.2, Network Theory Ltd., 2011.

REFERENCE BOOKS:

1. Charles Dierbach, **"Introduction to Computer Science using Python: A Computational Problem-Solving Focus**", Wiley India Edition, 2013.
2. John V Guttag, **"Introduction to Computation and Programming Using Python''**, Revised and expanded Edition, MIT Press , 2013
3. Kenneth A. Lambert, **"Fundamentals of Python: First Programs"**, CENGAGE Learning, 2012.
4. Paul Gries, Jennifer Campbell and Jason Montojo, **"Practical Programming: An Introduction to Computer Science using Python 3"**, Second edition, Pragmatic Programmers,LLC,2013.
5. Robert Sedgewick, Kevin Wayne, Robert Dondero, **"Introduction to Programming in Python: An Inter-disciplinary Approach"**, Pearson India Education Services Pvt. Ltd., 2016.

CO - PO and CO - PSO MAPPING:

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

1901008 BASIC CIVIL AND MECHANICAL ENGINEERING **L T P C**

(Common to CSE, EEE, ECE, EIE, IT & Medical Electronics) **3 0 0 3**

COURSE OBJECTIVES:

- Impart basic knowledge on Civil and Mechanical Engineering.
- Familiarize the materials and measurements used in Civil Engineering.
- To provide the exposure on the fundamental elements of civil engineering structures and construction methods.

- To enable the students to distinguish the components and working principle of power plant units, boilers and IC engines.
- To understand the concepts and working priciple of refrigeration and air conditioning system

A – OVER VIEW

UNIT-I SCOPE OF CIVIL AND MECHANICAL ENGINEERING 7

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.

Overview of Mechanical Engineering: Mechanical Engineering contributions to the welfare of Society –Specialized sub disciplines in Mechanical Engineering - Production, Automobile, Energy Engineering - Interdisciplinary concepts in Civil and Mechanical Engineering.

B – CIVIL ENGINEERING

UNIT-II SURVEYING AND CIVIL ENGINEERING MATERIALS 7

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 BUILDING COMPONENTS AND STRUCTURES 11

Foundations: Types of foundations - Bearing capacity and settlement – Requirement of good foundations.

Civil Engineering Structures: Brickmasonry – stonemasonry – beams – columns – lintels – roofing– flooring – plastering – floor area, carpet area and floor space index - Types of Bridges and Dams – water supply - sources and quality of water - Rain water harvesting - introduction to high way and railway.

C – MECHANICAL ENGINEERING

UNIT-IV INTERNAL COMBUSTION ENGINES AND POWER PLANTS 11

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 – working

principle of Cochran, La-mont, Benson Boilers, Turbines, Reciprocating Pumps (single acting and double acting) and Centrifugal Pumps

UNIT-V REFRIGERATION AND AIR CONDITIONING SYSTEM 9

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

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

- Knowledge of basics in various sub-disciplines of civil and mechanical engineering.
- Use the basics of surveying for calculation of area and volume in basic construction works
- Fundamental elements of civil engineering structures and construction methods.
- Understand the energy sources and working principle of power plants and apply the knowledge of power plants to diagonize and solve the Engineering problem and the working principle of IC Engines
- Understand the function of refrigeration and air conditioning system.

TEXT BOOKS:

1. Shanmugam G and Palanichamy MS, **"Basic Civil and Mechanical Engineering"**, Tata McGraw Hill Publishing Co., New Delhi, 2018.
2. Satheesh Gopi, **"Basic Civil Engineering"**, Pearson publications, 2009.
3. Basant Agrawal and C.M.Agrawal, **"Basic Mechanical Engineering"**, Wiley Publications Pvt Ltd., New Delhi, 2018.

REFERENCE BOOKS:

1. Ramamrutham S., **"Basic Civil Engineering"**, Dhanpat Rai Publishing Co.(P) Ltd, 2015.
2. Rajput R.K., **"Thermal Engineering"**, Laxmi Publications (P) Ltd, 10th Edition, 2018.
3. Kothandaraman C.P., Domkundwar S., Dhanpat Rai, **"Thermal Engineering"**, Publishing Co.(P) Ltd., 6th Edition, 2015.

CO - PO and CO - PSO MAPPING:

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

1901009 PROBLEM SOLVING AND PYTHON PROGRAMMING LABORATORY

L T P C

0 0 4 2

COURSE OBJECTIVES:

- To write, test, and debug simple Python programs.
- To implement Python programs with conditionals and loops.
- Represent compound data using Python lists, tuples, and dictionaries.
- Use functions for structuring Python programs.
- Read and write data from/to files in Python.

LIST OF PROGRAMS

1. Compute the GCD of two numbers.
2. Find the square root of a number (Newton‘s method)
3. Exponentiation (power of a number)
4. Find the maximum of a list of numbers
5. Linear search and Binary search
6. Selection sort, Insertion sort
7. How to create, slice, change, delete and index elements using Tuple.
8. Find First n prime numbers
9. How to create, slice, change, add, delete and index elements using list.
10. Write a program to calculate the length of a string.
11. Write a program to reverse the string
12. How to change, delete, add and remove elements in Dictionary
13. Find the most frequent words in a text read from a file

14. Simulate elliptical orbits in Pygame
15. Simulate bouncing ball using Pygame

PLATFORM NEEDED

Python 3 interpreter for Windows/Linux

TOTAL : 60 PERIODS

COURSE OUTCOMES:

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

- Write, test, and debug simple Python programs.
- Implement Python programs with conditionals and loops.
- Develop Python programs step-wise by defining functions and calling them.
- Use Python lists, tuples, dictionaries for representing compound data.
- Read and write data from/to files in Python.

CO - PO and CO - PSO MAPPING:

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

1901108 **PHYSICS AND CHEMISTRY LABORATORY** **L T P C**

(Common to all branches of B.E. / B.Tech. Programmes) **0 0 4 2**

PHYSICS LABORATORY

COURSE OBJECTIVES:

- To study the behaviour of material under shear stress.
- To learn the basics concept understanding the deformation due to linear stress
- To explore the photons to measure the physical parameters.
- To introduce experiments to test thermal conductivity of bad conductor.
- To study the spectrum of white light.

LIST OF EXPERIMENTS: (Any 5 Experiments)

1. Determination of rigidity modulus – Torsion pendulum.
2. Determination of Young's modulus by non-uniform bending method.
3. (a) Determination of wavelength and particle size using Laser.
   (b) Determination of acceptance angle and numerical aperture in an optical Fiber.
4. Determination of thermal conductivity of a bad conductor – Lee's Disc method.
5. Determination of velocity of sound and compressibility of liquid and Solid – Ultrasonic Interferometer
6. Determination of wavelength of mercury spectrum – spectrometer grating
7. Determination of thickness of a thin wire – Air wedge method

TOTAL: 30 PERIODS

COURSE OUTCOMES:

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

- Measure the rigidity modulus of the material.
- Calculate the deformation due to linear stress and Young's Modulus
- Use laser to measure the physical parameters.
- Calculate the thermal conductivity of bad conductor by lees disc.
- Measure the wavelength of the mercury the spectrum.

REFERENCE BOOKS:

1. Wilson J.D. and Hernaandez Hall C.A. – "Physics Laboratory Experiments", Houghton Mifflin Company, New York, 2005.
2. S. Srinivasan, "A Text Book of Practical Physics", S. Sultan Chand publications. 2005
3. R. Sasikumar, "Practical Physics", PHI Learning Pvt. Ltd, New Delhi, 2011.

CHEMISTRY LABORATORY

COURSE OBJECTIVES:

- To make the student to acquire practical skills in the determination of water quality parameters through volumetric and instrumental analysis.
- To acquaint the students with the determination of molecular weight of a polymer by viscometery.
- To make the student conversant with the corrosion defects experimentally.
- To develop and understand the basic concepts of acidic and basic nature using pH.
- To make the student familiar with the properties and nature of alloys experimentally.

LIST OF EXPERIMENTS: (Any 5 Experiments)

1. Estimation of HCl using Na_2CO_3 as primary standard and determination of alkalinity in water sample.
2. Estimation of copper content of the given solution by iodometry.
3. Determination of strength of given hydrochloric acid using pH meter.
4. Determination of strength of acids in a mixture of acids using conductivity meter.
5. Estimation of iron content of the given solution using potentiometer.
6. Determination of molecular weight of polyvinyl alcohol using Ostwald viscometer.
7. Pseudo first order kinetics-ester hydrolysis.
8. Corrosion experiment-weight loss method.
9. Conductometric titration of strong acid Vs strong base.

TOTAL: 30 PERIODS

COURSE OUTCOMES:

The students should be able to:

- Obtain the hands-on knowledge in the quantitative chemical analysis of water quality related parameters.
- Understand the experimental concepts in the mixture of acids and bases.
- Appreciate the need of iodometry in the estimation of metals.
- Explore the drawbacks of corrosion by weight loss method.
- Design and carry out the scientific experiments related to boiler troubles.

TEXTBOOKS:

1. G.H. Jeffery, J. Bassett, J. Mendham and R.C. Denney, “Vogel’s Textbook of Quantitative Chemical Analysis”, John Wiley & Sons Inc, 2014.

CO - PO and CO - PSO MAPPING: (PHYSICS LABORATORY)

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

CO - PO and CO - PSO MAPPING: (CHEMISTRY LABORATORY)

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

SEMESTER II

1919201 TECHNICAL ENGLISH L T P C

3 0 0 3

COURSE OBJECTIVES:

The Course prepares second semester Engineering and Technology students to:

- 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.
- Develop 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 9

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 – Technical Jargons, homophones – issue- writing instructions – checklists-recommendations-**Vocabulary Development**– technical vocabulary **Language Development** –subject verb agreement – compound words.

UNIT- II: READING AND STUDY SKILLS 9

Listening– Listening to a regional text and translate to English-**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 9

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-** homonyms.

UNIT- IV: REPORT WRITING 9

Listening– Listening to documentaries and making notes. **Speaking** – mechanics of presentations- **Reading** – reading for detailed comprehension- **Writing**– give relevant Idioms in English - job application – cover letter –Résumé preparation(via email and hard copy)- Issue based essays and format of official circulars– **Vocabulary Development**– finding suitable synonyms-paraphrasing-. **Language Development-** clauses- if conditionals.

UNIT- V: GROUP DISCUSSION AND JOB APPLICATIONS 9

Listening– TED/Ink talks; **Speaking** –participating in a group discussion–**Reading**– reading and understanding technical articles **Writing**– Writing reports- minutes of a meeting- Letter Writing- Letter to the Editor – Letter seeking permission for an Industrial visit/ Internship – Business Letters, Introduction letter- seeking orders , thanking for the order given, Complaint letters - **Vocabulary Development- verbal analogies Language Development-** reported speech.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

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

- 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.
- Have the ability to write different letters in the expected format.

TEXT BOOKS:

1. Board of editors. Fluency in English A Course book for Engineering and Technology. Orient Black swan, Hyderabad: 2016
2. Sudharshana.N.P and Saveetha. C. English for Technical Communication. Cambridge University Press: New Delhi, 2016

REFERENCE BOOKS:

1. Raman, Meenakshi and Sharma, Sangeetha- Technical Communication Principles and Practice. Oxford University Press: New Delhi, 2014.Kumar, Suresh. E. Engineering English. Orient Blackswan: Hyderabad,2015
2. Booth-L. Diana, Project Work, Oxford University Press, Oxford: 2014.
3. Grussendorf, Marion, English for Presentations, Oxford University Press, Oxford: 2007
4. Means, L. Thomas and Elaine Langlois, English & Communication For Colleges, 2006.

CO - PO and CO - PSO MAPPING:

CO	PO												PSO			
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**	**4**
CO1	3	2	-	-	-	-	-	-	-	3	-	1	2	2	1	2
CO2	3	2	2	-	-	-	-	-	-	-	-	2	1	1	1	1
CO3	3	-	-	-	-	-	-	-	3	3	-	1	1	2	2	2
CO4	3	2	2	2	-	-	-	-	-	3	-	1	1	1	1	1
CO5	3	2	-	2	-	-	-	-	-	3	2	1	2	1	1	2

1918202 ENGINEERING MATHEMATICS II L T P C

3 1 0 4

COURSE OBJECTIVES:

- This course is designed to cover topics such as Ordinary Differential equation, Vector Calculus, Complex Analysis and Laplace Transform.
- ODE is the powerful tools to solve practical problems in the field of engineering.
- Vector calculus can be widely used for modeling the various laws of physics.
- The various methods of complex analysis helps us to evaluate contour integration.
- Laplace transforms can be used for efficiently solving the problems that occur in various branches of engineering.

UNIT-I: ORDINARY DIFFERENTIAL EQUATIONS 9L+3T

First order linear differential equations- Exact differential equations - Second order linear differential equations with constant coefficients – Method of variation of parameters – Homogenous equation of Euler’s and Legendre’s type.

UNIT-II: VECTOR CALCULUS 9L+3T

Gradient and directional derivative – Divergence and curl – Irrotational and Solenoidal vector fields – Green's, Gauss divergence and Stoke's theorems – Verification and application in evaluating line, surface and volume integrals.

UNIT- III: LAPLACE TRANSFORMS 9L+3T

Existence conditions – Transforms of elementary functions – Transform of unit step function and unit impulse function – Basic properties – Shifting theorems -Transforms of derivatives and integrals – Inverse transforms – Convolution theorem – Transform of periodic functions – Application to solution of linear second order ordinary differential equations with constant coefficients.

UNIT-IV: ANALYTIC FUNCTIONS 9L+3T

.Analytic functions – Necessary and sufficient conditions for analyticity in Cartesian coordinates – Properties – Harmonic conjugates – Construction of analytic function – Conformal mapping – Mapping by functions w = Cz,C+z,1/z. z^2 - Bilinear transformation.

UNIT-V: COMPLEX INTEGRATION 9L+3T

Complex Integration – Cauchy's integral theorem – Cauchy's integral formula – Taylor's and Laurent's series – Singularities – Residues – Residue theorem – Application of residue theorem for evaluation of real integrals – Use of circular contour and semicircular contour.

TOTAL: 45L +15T PERIODS

COURSE OUTCOMES:

- Apply complex variables in finding Gradient, divergence,curl of a vector point function.
- Evaluation of line, surface and volume integrals using Gauss, Stokes and Green's theorems and their verification.
- Analytic functions, conformal mapping and complex integration are evaluated.
- Laplace transform and inverse transform of simple functions, properties, are studied.
- Apply various techniques in solving Ordinary differential equations with constant coefficients.

TEXT BOOKS:

1. Grewal B.S., "Higher Engineering Mathematics", Khanna Publishers, New Delhi,43rd Edition, 2014.
- Veerarajan. T , " Engineering Mathematics", McGrawHill Education(India) Private Limited 2019.

REFERENCE BOOKS:

1. Bali N., Goyal M. and Watkins C., "Advanced Engineering Mathematics", FirewallMedia (An imprint of Lakshmi Publications Pvt., Ltd.,), New Delhi, 7th Edition, 2009.
2. Jain R.K. and Iyengar S.R.K., "Advanced Engineering Mathematics", Narosa Publications, New Delhi, 3rd Edition, 2007.
3. O'Neil, P.V."Advanced Engineering Mathematics", Cengage Learning India Pvt., Ltd, New Delhi, 2007.

CO - PO MAPPING:

CO	PO											
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
CO1	3	2	2	1	-	-	-	-	-	-	-	1
CO2	3	2	1	-	-	-	-		-	-	-	1
CO3	3	1	2	1	-	-	-		-	-	-	1
CO4	3	2	1	-	-	-	-		-	-	-	1
CO5	3	1	1	1	-	-	-		-	-	-	1

1920203 PHYSICS FOR ELECTRONICS ENGINEERING **L T P C**

(Common to EEE, ECE, EIE & Medical Electronics) **3 0 0 3**

COURSE OBJECTIVES:

- To understand the concept of conductivities in the conducting material .
- To facilitate the knowledge about basics of doping, types of semiconductors.
- To enrich the idea of magnetism and dielectric properties.
- To explore the basics of interaction of photon with materials.
- To enhance the fundamental knowledge of nano materials and its applications.

UNIT-I ELECTRICAL PROPERTIES OF MATERIALS 9

Classical free electron theory - Expression for electrical conductivity and Thermal conductivity - Wiedemann-Franz law - Success and failures – Quantum Free electron theory - Fermi Distribution function – Density of energy states – Energy bands in solids; conductors, semiconductors and insulators.

UNIT-II SEMICONDUCTOR PHYSICS 9

Direct and indirect semiconductors - Intrinsic Semiconductors –Carrier concentration in intrinsic

semiconductors – Extrinsic semiconductors - Carrier concentration in N-type & P-type semiconductors – Carrier transport– Drift and Diffusion transport – Hall effect - Theory and Experiment – Applications.

UNIT-III MAGNETIC AND DIELECTRIC PROPERTIES OF MATERIALS 9

Magnetism in materials – magnetic field and induction - magnetic permeability and susceptibility–classification of magnetic materials - types of magnetic materials - Ferromagnetism: origin and exchange interaction- saturation magnetization and Curie temperature – Energy involved in Domain Theory. Dielectric material: Polarization processes – dielectric loss – internal field – Clausius -Mosotti relation- dielectric breakdown – high-k dielectrics.

UNIT-IV OPTICAL PROPERTIES OF MATERIALS 9

Classification of optical materials – carrier generation and recombination processes - excitons - Absorption emission and scattering of light in metals, insulators and Semiconductors (concepts only) - photo current in a P- N diode – solar cell –photo detectors - LED – Organic LED.

UNIT-V NANOELECTRONIC DEVICES 9

Introduction - Size dependence of Fermi energy– quantum confinement – quantum structures - Density of states in quantum well, quantum wire and quantum dot structures – quantum interference effects – Coulomb blockade effects - Single electron phenomena and Single electron Transistor - quantum dot laser – magnetic semiconductors– spintronics - Carbon nanotubes: Properties and applications.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

- gain knowledge in classical and quantum electron theories and energy band structures,
- acquire knowledge on basics of semiconductor physics and its applications in various devices,
- get knowledge on magnetic and dielectric properties of materials,
- have the necessary understanding on the functioning of optical materials for optoelectronics,
- understand the basics of quantum structures and their applications in spintronics and nano electronics.

TEXT BOOKS:

1. Kasap, S.O., “Principles of Electronic Materials and Devices”, McGraw-Hill Education, 2007.
2. Umesh K Mishra & Jasprit Singh, “Semiconductor Device Physics and Design”, Springer, 2008.
3. Wahab, M.A. “Solid State Physics: Structure and Properties of Materials”. Narosa Publishing House, 2009.
4. Kittel, C., “Introduction to Solid State Physics”, Wiley, 2005.

REFERENCE BOOKS:

1. Garcia, N. & Damask, A. “Physics for Computer Science Students”, Springer-Verlag, 2012.
2. Hanson, G.W. “Fundamentals of Nano electronics”, Pearson Education, 2009.
3. Rogers, B., Adams, J. & Pennathur, S. “Nanotechnology: Understanding Small Systems”, CRC Press, 2014.

CO - PO and CO - PSO MAPPING:

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

1921203 ENVIRONMENTAL SCIENCE AND ENGINEERING L T P C

3 0 0 3

COURSE OBJECTIVES

- To study the nature and facts about environment.
- To finding and implementing scientific, technological, economic and political solutions to environmental problems.
- To study the interrelationship between living organism and environment.
- To appreciate the importance of environment by assessing its impact on the human world; envision the surrounding environment, its functions and its value.

- To study the dynamic processes and understand the features of the earth's interior and surface.
- To study the integrated themes and biodiversity, natural resources, pollution control and waste management.

UNIT-I: ENVIRONMENT, ECOSYSTEMS AND BIODIVERSITY 14

Definition, scope and importance of environment – need for public awareness – concept of an ecosystem – structure and function of an ecosystem – producers, consumers and decomposers – energy flow in the ecosystem – ecological succession – food chains, food webs and ecological pyramids – Introduction, types, characteristic features, structure and function of the grassland ecosystem, aquatic ecosystems (lakes, oceans) – Introduction to biodiversity definition: genetic, species and ecosystem diversity – biogeographical classification of India – value of biodiversity: consumptive use, productive use, social, ethical, aesthetic and option values – India as a mega-diversity nation – hot-spots of biodiversity – threats to biodiversity: habitat loss, poaching of wildlife, man-wildlife conflicts – endangered and endemic species of India – conservation of biodiversity: In-situ and ex-situ conservation of biodiversity. Field study of an ecosystems.

UNIT-II: ENVIRONMENTAL POLLUTION 8

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

UNIT-III: NATURAL RESOURCES 10

Forest resources: Use and over-exploitation, deforestation, soil erosion and desertification, case studies- timber extraction, mining, dams and their effects on forests and tribal people – Water resources: Use and over- utilization of surface and ground water, floods, drought, conflicts over water– Mineral resources: Use and exploitation, environmental effects of extracting and using mineral resources, case studies – Food resources: World food problems, changes caused by agriculture and overgrazing, effects of modern agriculture, fertilizer-pesticide problems, water logging, salinity– role of an individual in conservation of natural resources – Equitable use of resources for sustainable lifestyles. Field study of local area to document environmental assets – river / forest / grassland / hill / mountain.

UNIT-IV: SOCIAL ISSUES AND THE ENVIRONMENT 7

From unsustainable to sustainable development – urban problems related to energy – water conservation, rain water harvesting and watershed management – role of non-governmental organization- environmental ethics: Issues and possible solutions – climate change, global warming, acid rain, ozone layer depletion, nuclear accidents and holocaust, case studies. – wasteland reclamation – consumerism and waste products – environment production act – Air (Prevention and Control of Pollution) Act – Water (Prevention and control of Pollution) Act – Wildlife protection Act – Forest conservation Act – enforcement machinery involved in environmental legislation- central and state pollution control boards- Public awareness.

UNIT-V: HUMAN POPULATION AND THE ENVIRONMENT 6

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

TOTAL : 45 PERIODS

COURSE OUTCOMES

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

- Gain knowledge on ecosystem, environment and biodiversity.
- Understand the process and disadvantages of environmental pollution.
- Analyze the ill effects of over exploitation of natural resources.
- Explain the social issues from unsustainable to sustainable development.
- Outline the need for decrease in population growth and its measures.

TEXT BOOKS:

1. Benny Joseph, ‘Environmental Science and Engineering’, Tata McGraw-Hill, New Delhi, 2006.
2. Gilbert M. Masters, ‘Introduction to Environmental Engineering and Science’, 2nd edition, Pearson Education, 2004.

REFERENCE BOOKS:

1. Dharmendra S. Sengar, "Environmental law", Prentice Hall of India PVT LTD, New Delhi, 2007.

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

CO - PO and CO - PSO MAPPING:

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

1901006 PROGRAMMING IN C L T P C

3 0 0 3

COURSE OBJECTIVES:

- To develop C Programs using basic programming.
- To develop C programs using arrays
- To develop C programs using strings.
- To develop applications in C using functions
- To develop C program using structures and union

UNIT –I BASICS OF C PROGRAMMING 9

Introduction to algorithm: Flowchart-Pseudo code- Introduction to programming paradigms- C programming: Data Types -Keywords-Variables and Constants– Operators and Expressions: Expressions -precedence,-associativity-Input/Output statements-Decision making and looping: Branching statement, Iterative statement - Compilation process.

UNIT –II ARRAYS AND STRINGS 9

Introduction to Arrays: One dimensional array: Assigning an array to another array –Equating an array with another array-Two dimensional Arrays: Declaration-usage of two dimensional array-reading, storing and accessing elements in two dimensional array-memory

representation-String operations: String library functions- list of strings-command line arguments.

UNIT –III FUNCTIONS 9

Introduction to functions: Classification of functions- function definition-function call-function with inputs and outputs-recursive function-library functions-scope of variables.

UNIT –IV STRUCTURES AND UNIONS 9

Introduction to Structures: Array of structures – Nested structure-functions and Structures-Introduction to union-: practical applications of union —typedef and structures-enumerated data type.

UNIT-V STORAGE CLASS AND PREPROCESSOR DIRECTIVE 9

Introduction to storage classes: Types of storage classes- C preprocessor Directives: Types of preprocessor directives-Pragma Directive-conditional directive.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

- Develop simple applications in C using basic constructs.
- Design and implement applications using arrays and strings
- Develop and implement applications in C using functions
- Develop applications in C using structures and unions
- Design applications using preprocessor to stimulate functions

TEXT BOOKS:

1. Anita Goel and Ajay Mittal, —Computer Fundamentals and Programming in C, Dorling Kindersley (India) Pvt. Ltd., Pearson Education in South Asia, 2011.
2. Reema Thareja, —Programming in C, Oxford University Press, Second Edition, 2016.

REFERENCE BOOKS:

1. Paul Deitel and Harvey Deitel, —C How to Program, Seventh edition, Pearson Publication.

CO - PO and CO - PSO MAPPING:

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

1901007 ENGINEERING GRAPHICS L T P C

2 0 4 4

COURSE OBJECTIVES:

The main learning objective of this course is to impart knowledge

- To draw the conics curves and special curves.
- To draw the orthographic projection of lines and plane surfaces.
- To draw the projections and solids and Isometric projection of simple solids.
- To draw projections of Section of Solids and development of surfaces.
- To draw free hand sketching of basic geometrical constructions, multiple views of objects and Perspective Projection of simple solids.

CONCEPTS AND CONVENTIONS (Not for Examination) 1

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

UNIT-I PLANE CURVES AND SPECIAL CURVES 10

Basic Geometrical constructions, Curves used in engineering practices: Conics – Construction of ellipse, parabola and hyperbola by eccentricity method – Construction of cycloid (Rolling Circle rolls on flat surface only). Construction of involutes of square and circle – Drawing of tangents and normal to the above curves.

UNIT-II PROJECTION OF POINTS, LINES AND PLANE SURFACES 16

Orthographic projection- Principles-Principal planes - First angle projection-projection of points at First Quadrant only. Projection of straight lines (only First angle projections) inclined to both the principal planes - Determination of true lengths and true inclinations by rotating line method.

Projection of planes (polygonal and circular surfaces) which inclined to both the principal planes by rotating object method.

UNIT-III PROJECTION OF SOLIDS AND ISOMETRIC PROJECTION 16

Projection of simple solids like prisms, pyramids, cylinder and cone when the axis is Inclined to one of the principal planes by rotating object method. Principles of isometric projection – isometric scale – Isometric projections of simple solids - Prisms, pyramids, cylinders, cones.

UNIT-IV PROJECTION OF SECTIONED SOLIDS AND DEVELOPMENT OF SURFACES 16

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. Development of lateral surfaces of simple and sectioned solids – Prisms, pyramids cylinders and cones.

UNIT-V FREE HAND SKETCHING AND PERSPECTIVE PROJECTIONS 16

Free Hand sketching: Visualization principles –Representation of Three Dimensional objects – Layout of views- Free hand sketching of multiple views from pictorial views of objects. Perspective projection of simple solids-Prisms and pyramids by visual ray method.

TOTAL : 75 PERIODS

COURSE OUTCOMES:

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

- To draw the conics curves and special curves.
- To draw the orthographic projection of lines and plane surfaces.
- To draw the projections and solids and Isometric projection of simple solids.
- To draw projections of Section of Solids and development of surfaces.
- To draw free hand sketching of basic geometrical constructions, multiple views of objects and Perspective Projection of simple solids.

TEXTBOOKS:

1. N.D.BHATT, "Engineering Drawing (Plane and Solid Geometry)", Charotar Publishing House PVT. LTD. 53rd Edition : 2018 (Reprint)
2. Venugopal K. and Prabhu Raja V., “Engineering Graphics”, New Age International (P) Limited, 2019.

REFERENCE BOOKS:

1. T.Jeyapoovan “Engineering Graphics Using Auto CAD”, Vikas Publishing House Pvt. LTD, seventh Edition, 2015.
2. Luzzader, Warren.J. and Duff, John M., “Fundamentals of Engineering Drawing with an introduction to Interactive Computer Graphics for Design and Production, Eastern Economy Edition, Prentice Hall of India Pvt. Ltd, New Delhi, 2005.
3. Shah M.B., and Rana B.C., “Engineering Drawing”, Pearson, 2nd Edition, 2011.
4. Natrajan K.V., “A text book of Engineering Graphics”, Dhanalakshmi Publishers, Chennai, 2009.
5. Basant Agarwal and Agarwal C.M., “Engineering Drawing”, Tata McGraw Hill Publishing Company Limited, New Delhi, 2013.

CO - PO and CO - PSO MAPPING:

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CO 3	2	-	3	-	-	-	-	-	1	3	-	1	2	1	1	1
CO 4	2	-	3	-	-	-	-	-	1	3	-	1	2	1	1	1
CO 5	2	-	3	-	-	-	-	-	1	3	-	1	2	1	1	1

1901010 **C PROGRAMMING LABORATORY** **L T P C**

0 0 4 2

COURSE OBJECTIVES:

- To develop programs in C using basic constructs.
- To develop applications in C using arrays and functions.
- To develop applications in C using Strings and Structures.
- To develop various applications using array concepts
- To develop various application using function concept.

LIST OF EXPERIMENTS

1. Programs using I/O statements and expressions.
2. Programs using decision-making constructs.
3. Write a program to find whether the given year is leap year or Not? (Hint: not every centurion year is a leap. For example 1700, 1800 and 1900 is not a leap year)

4. Write a program to perform the Calculator operations, namely, addition, subtraction, multiplication, division and square of a number.
5. Check whether a given number is Armstrong number or not?
6. Check whether a given number is odd or even?
7. Write a program to perform factorial of a number.
8. Write a C program to find out the average of 4 integers.
9. Show how to display array elements using two dimensional array.
10. Write a C program to perform swapping using function.
11. Display all prime numbers between two intervals using functions.
12. Reverse a sentence using recursion.
13. Write a program in C to get the largest element of an array using the function.
14. Write a C program to concatenate two string.
15. Write a C program to find the length of String.
16. Find the frequency of a character in a string.
17. Write a C program to Store Student Information in Structure and Display it.
18. The annual examination is conducted for 10 students for five subjects. Write a program to read the data and determine the following:
    (a) Total marks obtained by each student.
    (b) The highest marks in each subject and the marks of the student who secured it.
    (c) The student who obtained the highest total marks.

TOTAL : 60 PERIODS

COURSE OUTCOMES:

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

- Develop C programs for simple applications.
- Making use of basic constructs, arrays and strings.
- Develop C programs involving functions,
- Develop program using recursion, pointers, and structures.
- Design applications using sequential and random access file processing.

CO - PO and CO - PSO MAPPING:

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

1901208	ENGINEERING PRACTICES LABORATORY	L	T	P	C
	(Common to all branches of B.E. / B.Tech. Programmes)	0	0	4	2

COURSE OBJECTIVES:

- To provide hands on training for fabrication of components using carpentry, sheet metal andwelding equipment / tools.
- To gain the skills for making fitting joints and assembling air conditioner
- To develop the skills for making simple electrical wiring connections using suitable tools.
- Develop soldering in simple PCB board.
- Togain knowledge about the behavior of electronics components.

GROUP A (CIVIL & MECHANICAL)

I CIVIL ENGINEERING PRACTICE 15

Buildings:

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

Plumbing Works:

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

Carpentry works:

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

II MECHANICAL ENGINEERING PRACTICE 15

Welding:

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

b) Gas welding practice

Basic Machining:

a) Simple Turning and Taper turning

b) Drilling Practice

Sheet Metal Work:

a) Forming & Bending

b) Model making – Trays and funnels.

c) Different type of joints.

Fitting:

a) Preparation of square fitting

b) Preparation of V – fitting models.

Machine assembly practice:

a) Assembly of centrifugal pump

b) Assembly of air conditioner

Demonstration on:

a) Smithy operations, upsetting, swaging, setting down and bending. Example – Exercise – Production of hexagonal headed bolt.

b) Foundry operations like mould preparation for gear and step cone pulley.

GROUP B (ELECTRICAL & ELECTRONICS)

III ELECTRICAL ENGINEERING PRACTICE 15

1. Residential house wiring using Switches, Fuse, Indicator, Lamp and Energy meter.
2. Fluorescent Lamp Wiring.
3. Staircase Wiring.
4. Measurement of Voltage, Current, Power and Power factor in electrical circuit.
5. Measurement of Energy using Analog & Digital Energy meter.
6. Measurement of Earth Resistance.
7. Study of Industrial house wiring.
8. Identification & Study of protective devices: Fuses & Fuse carriers, MCB, ELCB and Isolators with ratings and usage.

IV ELECTRONICS ENGINEERING PRACTICE 15

1. Study of Electronic components and equipments – Resistor, colour coding measurement of AC signal parameter (peak-peak, RMS period, frequency) using CR.
2. Study of logic gates AND, OR, EX-OR and NOT.
3. Generation of Clock Signal.
4. Soldering practice – Components, Devices and Circuits – Using general purpose PCB.
5. Measurement of ripple factor of HWR and FWR.

TOTAL: 60 PERIODS

COURSE OUTCOMES:

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

- Fabricate carpentry components and pipe connections including plumbing works.
- Illustrate on centrifugal pump, Air conditioner, operations of smithy, foundary and fittings
- Carry out basic home electrical works and appliances
- Elaborate on the components, gates, soldering practices.
- Measure the electrical quantities

LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS:

CIVIL

1. Assorted components for plumbing consisting of metallic pipes, plastic pipes, flexible pipes, couplings, unions, elbows, plugs and other fittings. 15 Sets
2. Carpentry vice (fitted to work bench) 15 Nos.
3. Standard woodworking tools 15 Sets
4. Models of industrial trusses, door joints, furniture joints 5 each

MECHANICAL

1. Arc welding transformer with cables and holders 5 Nos.
2. Welding booth with exhaust facility 5 Nos.
3. Welding accessories like welding shield, chipping hammer, wire brush, etc. 5 Sets

4. Oxygen and acetylene gas cylinders, blow pipe and other welding outfit. 2 Nos.
5. Centre lathe 2 Nos.
6. Hearth furnace, anvil and smithy tools 2 Sets
7. Moulding table, foundry tools 2 Sets
8. Power Tool: Angle Grinder 2 Nos.
9. Study-purpose items: centrifugal pump, air-conditioner One each
10. Fitting tools, Hack saw frame, 12' file, hack saw blade 15 Nos.

ELECTRICAL

1. Assorted electrical components for house wiring 15 Sets
2. Fluorescent Lamp 15 Sets
3. Electrical measuring instruments 10 Sets
4. Analog & Digital energy meter 5 Sets
5. Megger 2

ELECTRONICS

1. Soldering guns 10 Nos.
2. Assorted electronic components for making circuits 50 Nos.
3. Small PCBs 10 Nos.
4. Multimeters 10 Nos.
5. Study purpose items: Telephone, FM radio, low-voltage power supply

CO - PO and CO - PSO MAPPING:

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

1901209	APPLIED PHYSICS AND ENVIRONMENTAL CHEMISTRY LABORATORY	L	T	P	C
		0	0	4	2

(Common to all branches of B.E. / B.Tech. Programmes)

(Laboratory classes on alternate weeks for Physics and Environmental Chemistry)

APPLIED PHYSICS LABORATORY

COURSE OBJECTIVES:

- To measure the band gap of given semi conductor.
- To study I-V characteristics of solar cell
- To measure electrical resistivity of metal and alloy
- To calculate the hkl planes
- To measure the paramagnetic susceptibility by Quinke's method.

LIST OF EXPERIMENTS: (Any 5 Experiments)

1. Determination of band gap of a semiconductor.
2. Study of I-V characteristics of solar cell and determination of its efficiency.
3. Determination of electrical resistivity of metal and alloy –Carey foster Bridge.
4. Calculation of lattice cell parameter – X-ray diffraction method.
5. Measurement of susceptibility of paramagnetic solution by Quinke's method.
6. Study of magnetic Hysteresis-B-H curve.
7. Measurement of Temperature using LM35.

TOTAL: 30 PERIODS

DEMO:

1. Crystal growth- Low temperature solution growth.
2. Absorption and transmittance measurement of materials – UV visible spectrum.
3. Attenuation losses in optical Fiber.

COURSE OUTCOMES:

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

- Measure the band gap of semiconductors
- Measure the efficiency of solar cell
- Compare the resistivity of metals and alloys
- Calculate the lattice parameter and interplanar distance.
- Understand the susceptibility values for any paramagnetic substances.

REFERENCE BOOKS:

1. Wilson J.D. and Hernaandez Hall C.A. – **"Physics Laboratory Experiments",** Houghton Mifflin Company, New York, 2005.
2. S. Srinivasan, **"A Text Book of Practical Physics",** S. Sultan Chand publications. 2005.
3. R. Sasikumar, **"Practical Physics",** PHI Learning Pvt. Ltd, New Delhi, 2011.

ENVIRONMENTAL CHEMISTRY LABORATORY

COURSE OBJECTIVES:

- To determine the dissolved oxygen and chloride content in water
- To determine calcium and magnesium present in domestic water
- To estimate iron, sodium and chlorine using various techniques
- To determine the chemical oxygen demand in industrial effluent
- To determine the available chlorine in bleaching powder.

LIST OF EXPERIMENTS: (Any 5 Experiments)

1. Determination of total, temporary & permanent hardness of water by EDTA method.
2. Determination of DO content of water sample by Winkler's method.
3. Determination of chloride content of water sample by argentometric method.
4. Estimation of iron content of the water sample using spectrophotometer
5. Determination of COD value of industrial effluents
6. Estimation of sodium by flame photometry
7. Estimation of available chlorine in bleaching powder

TOTAL: 30 PERIODS

DEMO:

1. Pollution abatement by adsorption techniques
2. Scintillation Process

COURSE OUTCOMES:

The student should be able to:

- Appreciate the basic requirements for potable water.
- Understand the need of dissolved oxygen in water.
- Explore the quantity of bleaching powder to be added in water.
- Analyze the ill effects caused by the industrial effluents.
- Explore new research areas in the treatment of waste water.

TEXT BOOKS:

1. G.H. Jeffery, J. Bassett, J. Mendham and R.C. Denney, “Vogel’s Textbook of Quantitative Chemical Analysis”, John Wiley & Sons Inc, 2014.

CO - PO and CO - PSO MAPPING: (APPLIED PHYSICS LABORATORY)

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

CO - PO and CO - PSO MAPPING: (ENVIRONMENTAL CHEMISTRY LABORATORY)

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

SEMESTER III

1918301 TRANSFORMS AND PARTIAL DIFFERENTIAL EQUATIONS L T P C

3 1 0 4

COURSE OBJECTIVES:

- To introduce Fourier series analysis which is central to many applications in engineering apart from its use in solving boundary value problems.
- To acquaint the student with Fourier transform techniques used in wide variety of situations.
- To introduce the effective mathematical tools for the solutions of partial differential equations.
- Apply PDE in solving one dimensional Wave and Heat flow equations.

- To model several physical problems to develop Z transform techniques for discrete time systems.

UNIT-I: PARTIAL DIFFERENTIAL EQUATIONS 9L+3T

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

UNIT-II: FOURIER SERIES 9L+3T

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

UNIT-III: APPLICATIONS OF PARTIAL DIFFERENTIAL EQUATIONS 9L+3T

Classification of PDE – Solutions of one dimensional wave equation – One dimensional equation of heat conduction – Steady state solution of two dimensional equation of heat conduction in infinite plates(excluding insulated edges).

UNIT-IV: FOURIER TRANSFORMS 9L+3T

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

UNIT-V: Z – TRANSFORMS AND DIFFERENCE EQUATIONS 9L+3T

Z- transforms – Elementary properties – Inverse Z – transform (using partial fraction and residues) – Convolution theorem – Solution of difference equations using Z – transform.

TOTAL: 45L +15T PERIODS

COURSE OUTCOMES:

- Understand the fundamental concept of the concepts of Partial differential Equations.
- Understand the basic concepts of mathematical principles on Fourier & Z- transforms.
- Apply the concept of PDE and Solve Wave equation, and Heat flow equations.
- Understand the concept Fourier series and apply the concept in solving PDE.
- Understand the fundamental concept of the concepts of Solution of difference equations

TEXT BOOKS:

1. Veerarajan. T., "Transforms and Partial Differential Equations", Tata McGraw Hill Education Pvt. Ltd., New Delhi, Second reprint, 2012.
2. Grewal. B.S., "Higher Engineering Mathematics", 42nd Edition, Khanna Publishers, Delhi, 2012.

3. Narayanan.S., Manicavachagom Pillay.T.K and Ramanaiah.G “Advanced Mathematicsfor Engineering Students” Vol. II & III, S.Viswanathan Publishers Pvt. Ltd.1998.

REFERENCE BOOKS:

1. Bali.N.P and Manish Goyal, “A Textbook of Engineering Mathematics”, 7th Edition, Laxmi Publications Pvt Ltd, 2007.
2. Ramana.B.V., “Higher Engineering Mathematics”, Tata McGraw Hill Publishing Company Limited, NewDelhi, 2008.
3. Glyn James, “Advanced Modern Engineering Mathematics”, 3rd Edition, Pearson Education, 2007.
4. Erwin Kreyszig,“Advanced Engineering Mathematics”, 8th Edition, Wiley India, 2007.
5. Ray Wylie. C and Barrett.L.C, “Advanced Engineering Mathematics” Tata McGraw Hill Education Pvt Ltd, Sixth Edition, New Delhi, 2012.
6. P.Sivaramakrishna Das, C.Vijayakumari, Transforms and Partial Differential Equations, Pearson India Education Services Pvt. Ltd, 2019.

CO - PO and CO - PSO MAPPING:

CO	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
CO1	3	3	-	-	1	-	-	-	-	-	-	1	-	-	-	-
CO2	3	3	-	-	1	-	-	-	-	-	-	1	-	-	-	-
CO3	3	3	-	-	1	-	-	-	-	-	-	1	-	-	-	-
CO4	3	3	-	-	1	-	-	-	-	-	-	1	-	-	-	-
CO5	3	3	-	-	1	-	-	-	-	-	-	1	-	-	-	-

1907301 ELECTRON DEVICES AND CIRCUITS L T P C

3 0 0 3

COURSE OBJECTIVES:

The student should be made to:

- Understand the structure of basic electronic devices.
- Be exposed to active and passive circuit elements.
- Familiarize the operation and applications of transistor like BJT and FET.
- Explore the characteristics of amplifier gain and frequency response.
- Learn the required functionality of positive and negative feedback systems.

UNIT-I PN JUNCTION DEVICES 9

PN junction diode –structure, operation and V-I characteristics, diffusion and transition capacitance - Rectifiers – Half Wave and Full Wave Rectifier,– Display devices- LED, Laser diodes, Zener diode characteristics- Zener Reverse characteristics – Zener as regulator.

UNIT-II TRANSISTORS AND THYRISTORS 9

BJT, JFET, MOSFET- structure, operation, characteristics and Biasing UJT, Thyristors and IGBT - Structure and characteristics.

UNIT-III AMPLIFIERS 9

BJT small signal model – Analysis of CE, CB, CC amplifiers- Gain and frequency response – MOSFET small signal model– Analysis of CS and Source follower – Gain and frequency response- High frequency analysis.

UNIT-IV MULTISTAGE AMPLIFIERS AND DIFFERENTIAL AMPLIFIER 9

BIMOS cascade amplifier, Differential amplifier – Common mode and Difference mode analysis – FET input stages – Single tuned amplifiers – Gain and frequency response – Neutralization methods, power amplifiers –Types (Qualitative analysis).

UNIT-V `FEEDBACK AMPLIFIERS AND OSCILLATORS 9

Advantages of negative feedback – voltage / current, series, Shunt feedback –positive feedback – Condition for oscillations, phase shift – Wien bridge, Hartley, Colpitts and Crystal oscillators.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

Upon Completion of the course, the students will be able to:

- Explain the structure and working operation of basic electronic devices.
- Able to identify and differentiate both active and passive elements
- Analyze the characteristics of different electronic devices such as diodes and transistors
- Choose and adapt the required components to construct an amplifier circuit.
- Employ the acquired knowledge in design and analysis of oscillators

TEXT BOOKS:

1. David A. Bell ,"Electronic devices and circuits", Oxford University higher education, 5th edition 2008.
2. Sedra and smith, "Microelectronic circuits",7th Ed., Oxford University Press
3. R.S.Sedha,"A textbook of Electronic circuits ", S.Chand and Company Ltd.4/e , 2007

REFERENCE BOOKS:

1. Balbir Kumar, Shail.B.Jain, "Electronic devices and circuits" PHI learning private limited,2nd edition 2014.
2. Thomas L.Floyd, "Electronic devices" Conventional current version, Pearson prentice hall,10th Edition, 2017.
3. Donald A Neamen, "Electronic Circuit Analysis and Design" Tata McGraw Hill, 3rd Edition,2003.
4. Robert B. Northrop, "Analysis and Application of Analog Electronic Circuits to Biomedical Instrumentation", CRC Press, 2004.

CO - PO and CO - PSO MAPPING:

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

1909307 APPLIED FLUID DYNAMICS AND THERMODYNAMICS

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

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

- To make students understand fluids properties and application of orifice and verturimeter.
- To impact knowledge on the dimensional analyses.
- To understand the working principle of different types of pumps and its applications.

- To understand the thermodynamics laws and basic IC engines functions.
- To understand the properties of steam and application of ranking cycle.

UNIT-I: BASIC CONCEPTS OF FLUID MECHANICS &FLOW OF FLUIDS 9

Introduction – classification - types of fluids – properties - laws of pressure - atmospheric, gauge, absolute pressure, pressure measurement – manometers - mechanical gauges. Head of a liquid - Bernoulli's theorem - orifice and venturimeter.

UNIT-II: DIMENSIONAL ANALYSIS 9

Introduction – dimensions - dimensional analyses - Rayleigh's and Buckingham's method.

UNIT-III: PUMPS AND TURBINES 9

Introduction - types of pumps - reciprocating pump - construction details - co-efficient of discharge – slip - power required - centrifugal pump – classification - working principle - specific speed – turbines – classification – working principle.

UNIT-IV: LAWS OF THERMODYNAMICS AND BASIC IC ENGINE CYCLES 9

Systems, Zeroth law, first law of thermodynamics - concept of internal energy and enthalpy - applications of closed and open systems - second law of thermodynamics. Basic IC engine,2 stroke and 4 stroke engine and gas turbine cycle- Brayton cycle.

UNIT-V: THERMODYNAMICS OF REFRIGERATORS AND HEAT PUMPS 9

Properties of steam - Ranking cycle - Boilers and its accessories - Basic thermodynamics of refrigerators and heat pumps.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

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

- Understand fluids properties and application of orifice and verturimeter.
- Understand the dimensional analyses.
- Understand the working principle of different types of pumps and its applications.
- Apply first and second law of thermodynamics to open and closed systems under steady state and unsteady conditions. Understand the thermodynamics laws and basic IC engines functions.
- Understand the properties of steam and application of ranking cycle.

TEXT BOOKS:

1. Bansal.R.K,'Fluid Mechanics and Hydraulic Machines', Laxmi Publications' (P) Ltd, 2018.

2. Nag, P.K., Engineering Thermodynamics, Tata McGraw-Hill Co. Ltd., 2013.

REFERENCE BOOKS:

1. Shames, I.H., 'Mechanics of fluids', Kogakusha, Tokyo, 2013
2. Reynolds, Thermodynamics, Int. Student Edition, McGraw-Hill Co. Ltd., 1990.
3. Ramalingam. K.K, "Thermodynamics", Sci-Tech Publications, 2009.
4. Yunus A. Çengel, Michael A. Boles, Thermodynamics: An Engineering Approach, McGraw- Hill Higher Education, 2014.

CO - PO and CO - PSO MAPPING:

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

1907302 ELECTRICAL AND ELECTRONIC INSTRUMENTS L T P C

3 0 0 3

COURSE OBJECTIVES:

- To introduce the meters used to measure current & voltage.
- To have an adequate knowledge in the measurement techniques for power and energy, power and energy meters are included.
- To provide knowledge on various types of cathode ray oscilloscopes, their applications and different types of signal analyzers.
- To give knowledge on telemetry, modulation techniques, multiplexing,
- To give exposure to telemetry virtual instrumentation, its applications.

UNIT-I SCIENCE OF MEASUREMENTS 9

Units and standards – Classification of errors in measurement, Odds and uncertainty - propagation of errors – Error analysis - Galvanometers - Moving coil meter, Moving iron meter, Dynamometer and Induction type meters - Measurement of voltage, current, power and Energy in single and three phase circuits - AC and DC current probes.

UNIT-II MEASUREMENT OF RESISTANCE, INDUCTANCE AND CAPACITANCE 9

DC potentiometer - Measurement of low, medium & high resistance: – Ammeter, voltmeter method – Wheatstone bridge – Kelvin's double bridge – Series and shunt type ohmmeter - Instrument Transformer - AC bridges for the measurement of inductance, capacitance: - Maxwell Bridge – Wein's bridge– Schering bridge – Anderson bridge –Hay's bridge.

UNIT-III ELECTRONIC INSTRUMENTS 9

Electronic Voltmeter and their advantages – Types Electronic multimeter and ohmmeter Microprocessor based DMM with auto ranging and self diagnostic features .Cathode ray oscilloscope – Dual trace, dual beam and sampling oscilloscopes–Digital storage oscilloscope.

UNIT-IV SIGNAL GENERATORS & ANALYZERS 9

Wien's bridge and phase shift oscillators – Hartley and crystal oscillators –Square wave and pulse generators – Triangular wave-shape generator -frequency selective and heterodyne wave analyzer – Harmonic distortion analyzer – Spectrum analyzer.

UNIT-V VIRTUAL INSTRUMENTATION & TELEMETRY 9

Virtual instrumentation (VI) – Definition, flexibility – Block diagram and architecture-Software in virtual instrumentation DAQ cards for VI applications-General telemetry system – voltage, current and position telemetry systems-Radio frequency telemetry- modulation Techniques-Frequency and time multiplexing.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

At the end of the course, the student should have the:

- Ability to measure current and voltage, power and calibration of energy meters.
- Ability to measure current and voltage using potentiometric method.
- Ability to understand the resistance measurement, inductance and capacitance.
- Ability to understand various types of cathode ray oscilloscopes their applications
- Ability understand various types of signal Analyzers and their applications.

TEXT BOOKS

1. E.W. Golding & F.C.Widdis, 'Electrical Measurements & Measuring Instruments', A.H.Wheeler& Co, 2001
2. H.S. Kalsi, Electronic Instrumentation, McGraw-Hill Education, New Delhi, 2010
3. A.K. Sawhney, A Course in Electrical & Electronic Measurements & Instrumentation, DhanpatRai and Co, New Delhi, 2010.

REFERENCE BOOKS

1. S.K.Singh, 'Industrial Instrumentation and control', Tata McGraw Hill, 2nd edn., 2002.
2. J.B.Gupta, 'A Course in Electronic and Electrical Measurements and Instrumentation',S.K.Kataria& Sons, Delhi, 2003.
3. Martin U. Reissland, 'Electrical Measurement – Fundamental Concepts and Applications', New Age International (P) Ltd., 2001.
4. R.B. Northrop, Introduction to Instrumentation and Measurements, Taylor & Francis, New Delhi, 2008.
5. M.M.S. Anand, "Electronics Instruments and Instrumentation Technology", Prentice Hall India, NewDelhi, 2009.
6. J.J. Carr, "Elements of Electronic Instrumentation and Measurement", Pearson Education India, New Delhi, 2011.

CO - PO and CO - PSO MAPPING:

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

1907001 TRANSDUCERS ENGINEERING L T P C

3 0 0 3

COURSE OBJECTIVES

- Get to know the methods of measurement, classification of transducers and to analyze error.
- To understand the behavior of transducers under static and dynamic conditions and hence to model the transducer.
- Get exposed to different types of resistive transducers and their application areas.
- To acquire knowledge on capacitive and inductive transducers.
- To gain knowledge on variety of transducers and get introduced to MEMS and Smart transducers.

UNIT-I SCIENCE OF MEASUREMENTS AND CLASSIFICATION OF TRANSDUCERS 9

Units and standards – Static calibration – Classification of errors–Error analysis – Statistical methods – Odds and uncertainty – Classification of transducers – Selection of transducers.

UNIT-II CHARACTERISTICS OF TRANSDUCERS 9

Static characteristics: - Accuracy, precision, resolution, sensitivity, linearity. Dynamic characteristics: Mathematical model of transducer, Zero, I and II order transducers, Response to impulse, step, ramp and sinusoidal inputs.

UNIT-III VARIABLE RESISTANCE TRANSDUCERS 9

Principle of operation, construction details, characteristics and applications of potentiometer, strain gauge, resistance thermometer, Thermistor, hot-wire anemometer, piezo-resistive sensor and humidity sensor.

UNIT-IV VARIABLE INDUCTANCE AND VARIABLE CAPACITANCE TRANSDUCERS 9

Inductive transducers: – Principle of operation, construction details, characteristics and applications of LVDT, Induction potentiometer – Variable reluctance transducers – EI pickup- – Principle of operation, construction details, characteristics of capacitive transducers - Capacitor microphone, Proximity sensor.

UNIT-V OTHER TRANSDUCERS 9

Piezoelectric transducer – Hall Effect transducer – Magneto elastic sensor – Digital transducers – Smart transducers - Fiber optic sensors – Thick & Thin Film sensors (Bio sensor & Chemical Sensor) – Nano sensors

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of the course, the student should have the

- Ability to apply the mathematical knowledge and science & engineering fundamentals gained to solve problems pertaining to measurement applications.
- Ability to analyze the problems related to sensors & transducers.
- Ability to select the right sensor/transducer for a given application.
- Ability to determine the static and dynamic characteristics of transducers.
- Ability to understand fiber optic sensor, smart traducers and its applications.

TEXT BOOKS

1. Doebelin E.O. and Manik D.N., “Measurement Systems”, 6th Edition, McGraw-Hill Education Pvt. Ltd., 2011.
2. A.K. Sawhney, A Course in Electrical & Electronic Measurements & Instrumentation, Dhanpat Rai and Co, New Delhi, 2010.

REFERENCE BOOKS

1. Bela G.Liptak, Instrument Engineers' Handbook, Process Measurement and Analysis, 4th Edition, Vol. 1, ISA/CRC Press, 2003.
2. D. Patranabis, Sensors and Transducers, 2nd edition, Prentice Hall of India, 2010. E.A. John P. Bentley, Principles of Measurement Systems, III Edition, Pearson Education,2000.
3. W.Bolton, Engineering Science, Elsevier Newnes, Fifth edition, 2006.
4. Murthy, D.V.S., Transducers and Instrumentation, 2nd Edition, Prentice Hall of India Pvt. Ltd., New Delhi, 2010.
5. S.Ranganathan,”Transducer Engineering”, Allied Publishers Pvt. Ltd. 2003.

CO - PO and CO - PSO MAPPING:

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

1905305 CIRCUIT THEORY

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- To introduce electric circuits and its analysis.
- To impart knowledge on solving circuit equations using network theorems.
- To introduce the phenomenon of resonance in coupled circuits.
- To educate on obtaining the transient response of circuits.
- To introduce Phasor diagrams and analysis of three phase circuits.

UNIT-I BASIC CIRCUITS ANALYSIS 9

Resistive elements – Ohm's Law Resistors in series and parallel circuits – Kirchoffs laws – Mesh current and node voltage - methods of analysis. Tree and Cotree

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

Network reduction: voltage and current division, source transformation – star delta conversion. Thevenins and Norton Theorems – Superposition Theorem – Maximum power transfer theorem – Reciprocity Theorem – Millman's theorem.

UNIT-III TRANSIENT RESPONSE ANALYSIS 9

L and C elements -Transient response of RL, RC and RLC Circuits using Laplace transform for DC input and A.C. sinusoidal input.

UNIT-IV THREE PHASE CIRCUITS 9

A.C. circuits – Average and RMS value - Phasor Diagram – Power, Power Factor and Energy - Analysis of three phase 3-wire and 4-wire circuits with star and delta connected loads, balanced & un balanced – phasor diagram of voltages and currents – power measurement in three phase circuits.

UNIT-V RESONANCE AND COUPLED CIRCUITS 9

Series and parallel resonance – their frequency response – Quality factor and Bandwidth - Self and mutual inductance – Coefficient of coupling – Tuned circuits – Single tuned circuits.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

- Ability to analyse electrical circuits.
- Ability to apply circuit theorems.
- Ability to analyse transients.
- Ability to analyse three phase circuits.
- Ability to analyse frequency response of resonance and coupled circuits.

TEXTBOOKS:

1. William H. Hayt Jr, Jack E. Kemmerly and Steven M. Durbin, "Engineering Circuits Analysis", McGraw Hill publishers, edition, New Delhi, 2013.
2. Sudhakar A and Shyam Mohan SP, "Circuits and Network Analysis and Synthesis", Tata McGraw Hill, 2015.

REFERENCE BOOKS:

1. Chakrabati A, “Circuits Theory (Analysis and Synthesis), Dhanpat Rai & Sons, New Delhi, 2013.
2. Charles K. Alexander, Mathew N.O. Sadiku, “Fundamentals of Electric Circuits”, Second Edition, McGraw Hill, 2013.

CO - PO and CO - PSO MAPPING:

CO	PO												PSO			
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**	**4**
CO1	1	1									3		1		2	
CO2	1		1	2								3	1			
CO3	1		1		2			3					1		2	3
CO4	1	1	1								3	1	1	1		
CO5	1	1			2								1			3

1907304 MEASUREMENTS AND TRANSDUCERS LABORATORY L T P C

0 0 4 2

COURSE OBJECTIVES

- To make the students aware of basic concepts of measurement and operation of different types of transducers.
- To make the students conscious about static and dynamic characteristics of different types of transducer.
- To make the students to analyze step response of RTD
- To the student to measure resistance using bridge circuits
- To make the students to calibrate the electrical instruments

LIST OF EXPERIMENTS

1. Displacement versus output voltage characteristics of a potentiometric transducer.
2. Characteristics of Strain gauge and Load cell.
3. Characteristics of LVDT, Hall Effect transducer and Photoelectric tachometer.
4. Characteristics of LDR, thermistor and thermocouple.
5. Step response characteristic of RTD and thermocouple.
6. Temperature measurements using RTD with three and four leads.

7. Wheatstone and Kelvin's bridge for measurement of resistance.
8. Schering Bridge for capacitance measurement and Anderson Bridge for inductance
9. Measurement Measurement of Angular displacement using resistive and Capacitive transducer.
10. Calibration of Single-phase Energy meter and wattmeter.
11. Calibration of Ammeter and Voltmeter using Shunt type potentiometer.

Minimum of ten experiments to be offered from the list. Additional one or two experiments can be framed beyond the list or curriculum

TOTAL : 60 PERIODS

COURSE OUTCOMES:

- Understand the concepts of measurement, error and uncertainty.
- Understand the static and dynamic characteristics of measuring instruments.
- Gain knowledge about the principle of operation and characteristics of different types of resistance, capacitance and inductance transducers.
- Acquire knowledge of analyzing different stages of signal conditioning units.
- Ability to work as a member of a team while carrying out experiments.

LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS:

1. Experimental setup for
2. Measurement of Linear displacement using Potentiometer
3. Strain gauge and Load cell characterisation and application
4. LVDT characterisation and application
5. Hall Effect characterisation and application
6. Measurement of Angular displacement
7. Thermistor characterisation and application
8. Various types of Thermocouple and RTD characterisation and application
9. Measurement of power and energy
10. Sufficient number of power supply, Galvanometer, Bread board, Multimeter, resistors, Decade Capacitance box, Decade resistance box, Decade Inductance box, CRO.

CO - PO and CO - PSO MAPPING:

CO	PO												PSO			
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**	**4**
CO1	3		2		2								3			
CO2					3										2	
CO3					1	2									2	
CO4					1								1	1		
CO5					1	2						2				1

1907305 CIRCUITS AND DEVICES LABORATORY L T P C

0 0 4 2

COURSE OBJECTIVES

- To simulate various electric circuits using Pspice/ Matlab/e-Sim / Scilab.
- To gain practical experience on electric circuits and verification of theorems.
- To facilitate the students to study the characteristics of various semiconductor devices.
- To be exposed to the characteristics of basic electronic devices.
- To provide practical knowledge on the analysis of regulators, amplifiers and oscillators

LIST OF EXPERIMENTS FOR CIRCUITS LAB

1. Simulation and experimental solving of electrical circuit problems using Kirchhoff's voltage and current laws.
2. Simulation and experimental solving of electrical circuit problems using Thevenin's theorem.
3. Simulation and experimental solving of electrical circuit problems using Norton's theorem.
4. Simulation and experimental solving of electrical circuit problems using Superposition theorem.
5. Simulation and experimental verification of Maximum Power transfer Theorem.
6. Simulation and Experimental validation of R-C electric circuit transience.
7. Simulation and Experimental validation of frequency response of RLC electric circuit.
8. Design and Simulation of series resonance circuit.

Minimum of five experiments to be offered from the list. Additional one or two experiments can be framed beyond the list or curriculum

LIST OF EXPERIMENTS FOR DEVICES LAB

1. Simulation and experimental Characteristion of Semiconductor diode and Zener diode.
2. Simulation and experimental Characteristion of a NPN Transistor under common emitter configurations.
3. Simulation and experimental Characterisation of FET and JFET(Draw the equivalent circuit)
4. Simulation and experimental Characterisation of RC and LC phase shift oscillators.
5. Simulation and experimental Characterisation of Monostable and Astable multivibrators.
6. Simulation of Single Phase half-wave and full wave rectifiers with inductive and capacitive filters.
7. Characteristics of SCR and application as a controlled rectifier.

Minimum of five experiments to be offered from the list. Additional one or two experiments can be framed beyond the list or curriculum.

TOTAL : 60 PERIODS

COURSE OUTCOMES

- Ability to analyse electrical circuits
- Ability to apply circuit theorems
- Ability to analyse transients.
- Gain knowledge on the proper usage of various electronic equipment and simulation tools for design and analysis of electronic circuits.
- Get hands-on experience in studying the characteristics of semiconductor devices.
- Ability to analyze various electronic circuits such as voltage regulators, transistor amplifiers and oscillators

LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS:

FOR CIRCUITS LAB:

SL.No	Name of the Equipment / Components
1.	Regulated Power Supply (0-15 V) -10 Nos Function Generator (1 MHz) - 10 Nos. Oscilloscope (20 MHz) - 10 Nos Digital Storage Oscilloscope (20 MHz) – 1 No.

2.	AC/DC - Voltmeters (10 Nos.), Ammeters (10 Nos.) and Multi-meters (10 Nos.) Single Phase Wattmeter – 3 Nos.
3.	Decade Resistance Box, Decade Inductance Box, Decade Capacitance Box Each - 6 Nos. Circuit Connection Boards - 10 Nos

FOR DEVICES LAB:

SL.No	Name of the Equipment / Components
1.	Circuit Simulation Software (5 Users) (Pspice / Matlab /other Equivalent software Package) with PC.
2.	Sufficient number of power supply, Galvanometer, Bread board, Multimeter, resistors, Decade Capacitance box, Decade resistance box, Decade Inductance box, CRO.
3.	Semiconductor devices like Diode, Zener Diode, NPN Transistors, JFET, and UJT.

CO - PO and CO - PSO MAPPING:

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

SEMESTER IV

1918401 NUMERICAL METHODS L T P C

3 1 0 4

COURSE OBJECTIVES:

- To introduce the basic concepts of solving algebraic and transcendental equations.
- To introduce the numerical techniques of interpolation in various intervals in real life.
- To acquaint the student with understanding of numerical techniques of differentiation and integration which plays an important role in engineering

- To understand the knowledge of various techniques and methods of solving various types of ordinary differential equations.
- To give knowledge about numerical solving one dimensional wave and heat equations.

UNIT-I: SOLUTION OF EQUATIONS AND EIGENVALUE PROBLEMS 9L+3T

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 , Inverse of a matrix by Jordan Method –Iterative method of Gauss Seidel –Dominant Eigenvalue of a matrix by Power method.

UNIT-II: INTERPOLATION AND APPROXIMATION 9L+3T

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

UNIT-III: NUMERICAL DIFFERENTIATION AND INTEGRATION 9L+3T

Approximation of derivatives using interpolation polynomials - Numerical integration using Trapezoidal, Simpson's 1/3 rule – Romberg's Method – Evaluation of double integrals by Trapezoidal and Simpson's 1/3 rules.

UNIT-IV: INITIAL VALUE PROBLEMS FOR ORDINARYDIFFERENTIAL EQUATIONS 9L+3T

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 Adams - Bash forth predictor corrector methods for solving first order equations.

UNIT-V: BOUNDARY VALUE PROBLEMS IN ORDINARY AND PARTIAL DIFFERENTIAL EQUATIONS 9L+3T

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: 45L+15T PERIODS

COURSE OUTCOMES:

- Understand the basic concepts and techniques of solving algebraic and transcendental equations and numerical techniques of interpolation and error approximations.
- Apply the numerical techniques of differentiation and integration for engineering problems.
- Understand the knowledge of various techniques and methods for solving first and second order ordinary differential equations.
- Solve the partial and ordinary differential equations with initial and boundary conditions by using certain techniques with engineering applications.
- Understand the basic concepts of solving Finite difference techniques for the solution of two dimensional Laplace's and Poisson's equations on rectangular domain.

TEXT BOOKS:

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

REFERENCEBOOKS:

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

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CO1	3	3	3	-	-	-	-	-	-	-	-	1	-	-	-	-
CO2	3	3	3	-	-	-	-	-	-	-	-	1	-	-	-	-
CO3	3	3	3	-	-	-	-	-	-	-	-	1	-	-	-	-
CO4	3	3	3	-	-	-	-	-	-	-	-	1	-	-	-	-
CO5	3	3	3	-	-	-	-	-	-	-	-	1	-	-	-	-

1907401 ELECTRICAL MACHINES L T P C

3 0 0 3

COURSE OBJECTIVES

- To introduce the principles of operations of DC machines as motor and generator
- To introduce the principles of operations of Transformers
- To introduce the principles of operations of Induction machines
- To introduce the principles of operations of Synchronous machines
- To introduce other special machines

UNIT-I D.C. MACHINES 9

D.C. Machines: – Principle of operation and construction of motor and generator – EMF and torque equation – Various excitation schemes – Characteristics of Motor and Generator – Starting, Speed control and braking of D.C. Motor.

UNIT-II TRANSFORMERS 9

Principle, Construction and Types of Transformer - EMF equation – Equivalent Circuit- Phasor diagrams - Regulation and efficiency of a transformer-Introduction to three phase transformer Connection, Auto transformer.

UNIT-III SYNCHRONOUS MACHINES 9

Principle of Operation, types - EMF Equation and Phasor diagrams - Synchronous motor- Types of Excitation-Starting Methods , Torque equation- V Curves, inverted V curves.

UNIT-IV THREE PHASE INDUCTION MOTORS 9

Construction – Production of rotating magnetic field- Principle of operation, Torque-slip characteristics - Starting methods and Speed control of induction motors.

UNIT-V SINGLE PHASE INDUCTION MOTORS AND SPECIAL MACHINES 9

Types of single phase induction motors –Double field revolving theory- Capacitor start motors – Shaded pole motor – Repulsion type motor – Universal motor – Hysteresis motor - Switched reluctance motor – Brushless D.C motor.

TOTAL: 45 PERIODS

COURSE OUTCOMES

At the end of the course, the student should have the:

- Ability to acquire knowledge to solve problems associated with DC and AC Machines.
- Ability to test and control different machines based on the familiarity of basic concepts and working principle.
- Ability to choose appropriate machines for a given application while carrying out projects.
- Ability to apply the knowledge gained to choose appropriate machines for specific application useful for the society.
- Ability to know about the latest developments related to machines and to learn their concepts even after the completion of the course.

TEXT BOOKS

1. Fitzgerald A.E, Kingsley C., Umans, S. and Umans S.D., “Electric Machinery”, McGraw- Hill, 2002.
2. Theraja, B.L., “A TEXT BOOKS of Electrical Technology”, Vol.II, S.C Chand and Co., New Delhi, 2007.

REFERENCE BOOKS

1. Abhijit Chakrabarti and Sudipta Debnath, “Electrical Machines”, McGraw- Hill Education, 2015.
2. Deshpande M. V., “Electrical Machines” PHI Learning Pvt. Ltd., New Delhi, 2011
3. B.S.Guru and H.R.Hiziroglu, “Electric Machinery and Transformer’, Oxford university Press 2007
4. Del Toro, V., “Electrical Engineering Fundamentals”, Prentice Hall of India, New Delhi, 1995.
5. Nagrath I. J and Kothari D. P. ‘Electric Machines’, Fourth Edition, McGraw Hill Education, 2010.
6. C.A.Gross, “Electric Machines”, CRC Press 2010.
7. NPTEL Video Lecture series on “Electrical Machines I” and “Electrical Machines II” by Dr. Krishna Vasudevan, IIT Madras.

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CO1	3	3										1	2	1		
CO2	3	3	2	2								1	3	3		
CO3	3	3	1	2								1	2	2		
CO4	3	3	1	2								1	2	2		
CO5	3	3	1	2								1	2	2		

1907402 DIGITAL LOGIC CIRCUITS L T P C

3 0 0 3

COURSE OBJECTIVES:

- To study various number systems and simplify the logical expressions using Boolean functions
- To study combinational circuits
- To design various synchronous and asynchronous circuits.
- To introduce asynchronous sequential circuits and PLDs
- To introduce digital simulation for development of application oriented logic circuits.

UNIT-I NUMBER SYSTEMS AND DIGITAL LOGIC FAMILIES 9

Review of number systems, binary codes, error detection and correction codes (Parity and Hamming code) - Digital Logic Families -comparison of RTL, DTL, TTL, ECL, MOS and E2CMOS families -operation, characteristics of digital logic family.

UNIT-II COMBINATIONAL CIRCUITS 9

Combinational logic - representation of logic functions-SOP and POS forms, K-map representations - minimization using K maps - simplification and implementation of combinational logic – multiplexers and de multiplexers - code converters, adders, subtractors, Encoders and Decoders.

UNIT-III SYNCHRONOUS SEQUENTIAL CIRCUITS 9

Sequential logic- SR, JK, D and T flip flops - level triggering and edge triggering - counters - asynchronous and synchronous type - Modulo counters - Cascadded counters - Shift registers - design of synchronous sequential circuits – Moore and Melay models- Counters, state diagram; state reduction; state assignment.

UNIT-IV ASYNCHRONOUS SEQUENTIAL CIRCUITS AND PROGRAMMABILITY LOGIC DEVICES 9

Asynchronous sequential logic circuits-Transition tability, flow tability-race conditions, hazards &errors in digital circuits; analysis of asynchronous sequential logic circuits-introduction to Programmability Logic Devices: PROM – PLA –PAL, GAL ,and its implementation, CPLD-FPGA.

UNIT-V VHDL 9

RTL Design – combinational logic – Sequential circuit – VHDL design of state machines-Operators – Introduction to Packages – Subprograms – Test bench. (Simulation /Tutorial Examples: adders, counters, flip flops, Multiplexers & De multiplexers).

TOTAL : 45 PERIODS

COURSE OUTCOMES:

- Ability to design combinational and sequential Circuits.
- Ability to simulate using software package.
- Ability to study various number systems and simplify the logical expressions using Boolean functions
- Ability to design various synchronous and asynchronous circuits.
- Ability to introduce asynchronous sequential circuits and PLDs
- Ability to introduce digital simulation for development of application oriented logic circuits.

TEXT BOOKS:

1. James W. Bignel, Digital Electronics, Cengage learning, 5th Edition, 2007.
2. M. Morris Mano, ‘Digital Design with an introduction to the VHDL’, Pearson Education, 2013.
3. Comer “Digital Logic & State Machine Design, Oxford, 2012.

REFERENCE BOOKS

1. Mandal, “Digital Electronics Principles & Application, McGraw Hill Edu, 2013.
2. William Keitz, Digital Electronics-A Practical Approach with VHDL, Pearson, 2013.
3. Thomas L.Floyd, ‘Digital Fundamentals’, 11th edition, Pearson Education, 2015.
4. Charles H.Roth, Jr, Lizy Lizy Kurian John, ‘Digital System Design using VHDL, Cengage, 2013.

5. D.P.Kothari,J.S.Dhillon, 'Digital circuits and Design',Pearson Education, 2016.
6. Volnei A.Pedromi,"Digital electronics and design with VHDL" Elsevier Morgan Kaufmann Publishers.

CO - PO and CO - PSO MAPPING:

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CO 1			3											2		
CO 2					3						1				3	
CO 3	2												3			
CO 4			2			2								1		
CO 5			2											1		
CO 6					2						1	2				2

1907403 LINEAR INTEGRATED CIRCUITS AND APPLICATIONS L T P C

3 0 0 3

COURSE OBJECTIVES:

To impart knowledge on the following topics

- analyze the characteristics of Op-Amp
- Signal analysis using Op-amp based circuits.
- Applications of Op-amp.
- Functional blocks and the applications of special ICs like Timers, PLL circuits, regulator Circuits.
- IC fabrication procedure.

UNIT-I IC FABRICATION 9

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.

UNIT-II CHARACTERISTICS OF OPAMP 9

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, summer, differentiator and integrator-V/I & I/V converters.

UNIT-III APPLICATIONS OF OPAMP 9

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

UNIT-IV SPECIAL ICs 9

Functional block, characteristics of 555 Timer and its PWM application - IC-566 voltage controlled oscillator IC; 565-phase locked loop IC, AD633 Analog multiplier ICs.

UNIT-V APPLICATION ICs 9

IC voltage regulators –LM78XX, LM79XX; Fixed voltage regulators its application as Linear power supply - LM317, 723 Variable voltage regulators, switching regulator- SMPS - LM 380 power amplifier- ICL 8038 function generator IC.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

- Ability to analyze the characteristics of Op-Amp
- To understand the importance of Signal analysis using Op-amp based circuits.
- To understand the Functional blocks and the applications of special ICs like Timers, PLL circuits, regulator Circuits.
- To understand and acquire knowledge on the Applications of Op-amp
- Ability to acquire knowledge in IC fabrication procedure

TEXT BOOKS:

1. David A. Bell, ‘Op-amp & Linear ICs’, Oxford, 2013.
2. D. Roy Choudhary, Sheil B. Jani, ‘Linear Integrated Circuits’, II edition, New Age, 2003.
3. Ramakant A.Gayakward, ‘Op-amps and Linear Integrated Circuits’, IV edition, Pearson Education, 2003 / PHI. 2000.

REFERENCE BOOKS

1. Fiore,”Opamps & Linear Integrated Circuits Concepts & applications”, Cengage, 2010.
2. Floyd ,Buchla,”Fundamentals of Analog Circuits, Pearson, 2013.
3. Jacob Millman, Christos C.Halkias, ‘Integrated Electronics - Analog and Digital circuits system’, McGraw Hill, 2003.
4. Robert F.Coughlin, Fredrick F. Driscoll, ‘Op-amp and Linear ICs’, Pearson, 6th edition,2012.

5. Sergio Franco, ‘Design with Operational Amplifiers and Analog Integrated Circuits’, Mc Graw Hill, 2016.
6. Muhammad H. Rashid,’ Microelectronic Circuits Analysis and Design’ Cengage Learning, 2011.

CO - PO and CO - PSO MAPPING:

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CO 1	3	2	3	1	1								3	2		
CO 2					3				1		1	1		2	1	
CO 3					2				1		1	1		2	1	
CO 4	2	2														2
CO 5	2	2											1	2		

1907404 INDUSTRIAL INSTRUMENTATION - I L T P C

3 0 0 3

COURSE OBJECTIVES:

- To educate the measurement techniques of force, torque and speed.
- To understand the measurement techniques of acceleration, vibration and density
- To introduce the measurement of viscosity, humidity and moisture.
- To impart the knowledge of temperature measurement techniques.
- To learn the pressure measurement techniques.

UNIT-I MEASUREMENT OF FORCE, TORQUE AND SPEED 9

Different types of load cells: Hydraulic, Pneumatic, Strain gauge, Magneto-elastic and Piezoelectric load cells - Different methods of torque measurement: Strain gauge, Relative angular twist. Speed measurement: Capacitive tacho, Drag cup type tacho, D.C and A.C tacho generators - Stroboscope.

UNIT-II MEASUREMENT OF ACCELERATION, VIBRATION AND DENSITY 9

Accelerometers: LVDT, Piezoelectric, Strain gauge and Variable reluctance type accelerometers - Mechanical type vibration instruments - Seismic instruments as accelerometer – Vibration sensor - Calibration of vibration pickups - Units of density and specific gravity – Baume scale and API scale – Densitometers: Pressure type densitometers, Float type densitometers, Ultrasonic densitometer and gas densitometer.

UNIT-III MEASUREMENT OF VISCOSITY, HUMIDITY AND MOISTURE 9

Viscosity: Saybolt viscometer - Rotameter type and Torque type viscometers – Consistency Meters – Humidity: Dry and wet bulb psychrometers – Resistive and capacitive type hygrometers – Dew cell – Commercial type dew meter. Moisture: Different methods of moisture measurements –Thermal, Conductivity and Capacitive sensors, Microwave, IR and NMR sensors, Application of moisture measurement - Moisture measurement in solids.

UNIT-IV TEMPERATURE MEASUREMENT 9

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 – IC sensors – Thermocouples: Laws of thermocouple, Fabrication of industrial thermocouples, Reference junctions compensation, Signal conditioning for thermocouple, Commercial circuits for cold junction compensation, Response of thermocouple, Special techniques for measuring high temperature using thermocouple – Radiation fundamentals - Radiation methods of temperature measurement – Total radiation pyrometers – Optical pyrometers – Two color radiation pyrometers – Fiber optic sensor for temperature measurement – Thermograph, Temperature switches and thermostats – Temperature sensor selection, Installation and Calibration.

UNIT-V PRESSURE MEASUREMENT 9

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, lionization gauges, Cold cathode type and hot cathode type – Pressure gauge selection, installation and calibration using dead weight tester.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

At the end of the course, the student will have the:

- Ability to reproduce the construction of instruments used for measurement of force, torque, speed, acceleration, vibration, density, viscosity, humidity, moisture, temperature and pressure.
- Ability to understand the working of instruments used for measurement of force, torque, speed, acceleration, vibration, density, viscosity, humidity, moisture, temperature and pressure.

- Ability to select instruments according to the application.
- Ability to perform calibration of instruments and gain knowledge about different calibration techniques.
- Ability to design signal conditioning circuits and compensation schemes for measuring instruments.

TEXT BOOKS:

1. Doebelin, E.O. and Manik, D.N., “Measurement systems Application and Design”, 6th McGraw-Hill Education Pvt. Ltd, 2011.
2. Jones, B.E., “Instrument Technology”, Vol.2, Butterworth-Heinemann, International Edition, 2003.
3. A.K. Sawhney, “A Course in Mechanical Measurements and Instrumentation”, Dhanpat Rai & Co. (P) Limited, 2001.

REFERENCE BOOKS:

1. Liptak, B.G., “Instrumentation Engineers Handbook (Measurement)”, CRC Press, 2005.
2. Patranabis, D., “Principles of Industrial Instrumentation”, 3rd Edition, McGraw-Hill Education, 2017.
3. Eckman D.P., “Industrial Instrumentation”, Wiley Eastern Limited, 1990.
4. Singh,S.K., “Industrial Instrumentation and Control”, Tata Mc-Graw-Hill Education Pvt. Ltd., New Delhi, 2009.
5. Alok Barua, “Lecture Notes on Industrial Instrumentation”, NPTEL, E-Learning Course, IIT Kharagpur.
6. Jayashankar, V., “Lecture Notes on Industrial Instrumentation”, NPTEL, E-Learning Course, IIT Madras.
7. A.K. Sawhney, “A Course in Electronic Measurements and Instrumentation”, Dhanpat Rai & Co. (P) Limited, 2015.

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CO 2	3	1	2	3									3	3	1	1
CO 3				2	1	1	1	1				2	1		2	3
CO 4	3	3	3	3	2	2	2						3		2	3
CO 5	3	3	3										3			2

1915001 PROFESSIONAL ETHICS L T P C

3 0 0 3

COURSE OBJECTIVES:

- To introduce and educate the students on the concept of Human Values.
- To enable the students to have awareness on Engineering Ethics theories and models.
- To make students understand the code of ethics and fundamental principles in social experiments in engineering.
- To educate on safety and risk aspects in engineering and to appreciate the rights of others.
- To create awareness about international issues related to ethics.

UNIT – I: HUMAN VALUES 9

Moral 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 – Introduction to Yoga and Meditation for professional excellence and stress management - Simple Living and High Thinking, Science and Spirituality.

UNIT – II: ENGINEERING ETHICS 9

Senses of 'Engineering Ethics' – Variety of moral issues – Types of inquiry – Moral dilemmas – Moral Autonomy – Kohlberg's theory – Gilligan's theory – Consensus and Controversy – Models of Professional roles – Theories about right action – Self-interest – Customs and Religion – Uses of Ethical Theories.

UNIT – III: ENGINEERING AS SOCIAL EXPERIMENTATION 9

Engineering as Experimentation – Engineers as responsible Experimenters - Engineer's Responsibilities to Economically Deprived People and Environment, Corruption – Codes of Ethics- Fundamental Principles – A Balanced Outlook on Law – Challenger Case Study

UNIT – IV: SAFETY, RESPONSIBILITIES AND RIGHTS 9

Safety and Risk – Assessment of Safety and Risk – Risk Benefit Analysis and Reducing Risk – Government Regulator's approach to risks - The Three Mile Island, Chernobyl & Bhopal Case Studies, Greenery Effects - Collegiality and Loyalty - Respect for Authority – Collective Bargaining – Confidentiality – Conflicts of Interest – Unethical Behaviour at Work Place – Reporting Unethical Behaviour- Professional Rights – Employee Rights – Intellectual Property Rights (IPR).

UNIT – V: INTERNATIONAL ISSUES **9**

Multinational corporations - Business ethics - Environmental ethics - Internet ethics - Role in Technological Development - Weapons development-engineers as managers - Consulting Engineers - Engineers as expert witnesses and advisors - Honesty - leadership - Sample code of conduct ethics - ASME, ASCE, IEEE, Institution of Engineers (India),Indian Institute of Materials Management Institution of electronics and telecommunication engineers (IETE), India – Corporate Social Responsibility, Indian and Western Culture – Cyber Crime.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

- Students should be able to understand human values and apply ethics in societal issues.
- Students will be able to get understanding on senses of engineering ethics.
- Student will have an understanding of engineer's responsibility to society and code of ethics
- Students will understand risk and safety issues related to engineering.
- Students will be able to advocate on applying ethical principles in international context.

TEXT BOOKS:

1. World Community Service Centre, "Value Education", Vethathiri publications, Erode, 2011.
2. R. Subramanian, 'Professional Ethics' Oxford University Press, 2nd Edition 2017
3. R. S. Nagarazan, ' A Textbook on Professional Ethics and Human Values' New Age International Publishers, 2015
4. Sekhar, R.C., Ethical Choices in Business Response Books, New Delhi, Sage Publications,1997

REFERENCE BOOKS:

1. Langford, Duncan (EDT): Internet Ethics, London, Macmillan Press Ltd., 2000.
2. Erwann, M. David, Michele S. Shauf, Computers, Ethics and Society, Oxford University Press,2003
3. Alan Kitson and Robert Campbell:" The Ethical Organisation", Red Globe Press, 2008.
4. Govindarajan M, Natarajan S, Senthil Kumar V. S, "Professional Ethics and Human Values", Prentice Hall of India, New Delhi, 2013.
5. Mike Martin and Roland Schinzinger, "Ethics in Engineering", McGraw Hill, New York, 3rd edition (2017).

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CO 3						3	3	2						2		
CO 4						2	3									1
CO 5								1								

1907405 ELECTRICAL MACHINES LABORATORY L T P C

0 0 4 2

COURSE OBJECTIVES:

- To expose the students to the operation of D.C. machines.
- To expose the students to the operation of transformers.
- To expose the students to the operation of generators.
- To impart knowledge about open circuit and load characteristics.
- To expose the students to the operation of induction motors.

LIST OF EXPERIMENTS:

1. Open circuit characteristics of D.C. shunt generator.
2. Load characteristics of D.C. shunt generator.
3. Load test on D.C. shunt motor.
4. Load test on D.C. series motor.
5. Swinburne's test
6. Speed control of D.C. shunt motor.
7. Load test on single phase transformer
8. Open circuit and short circuit tests on single phase transformer(Determination of equivalent circuit parameters).
9. Load test on single phase induction motor.
10. No load and blocked rotor tests on three phase induction motor (Determination of equivalent circuit parameters)
11. Load test on Three phase induction motor.
12. Study of Starters

TOTAL: 60 PERIODS

COURSE OUTCOMES:

- Ability to understand and analyze DC Generator.
- Ability to understand and analyze DC Motor.
- Ability to understand and analyze Transformers.
- Ability to understand the performance characteristics.
- Ability to understand the importance of Induction machines.

LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS:

1. DC Shunt Motor with Loading Arrangement – 3 nos
2. Single Phase Transformer – 4 nos
3. DC Series Motor with Loading Arrangement – 1 No.
4. Three Phase Induction Motor with Loading Arrangement – 2 nos
5. Single Phase Induction Motor with Loading Arrangement – 1 No.
6. DC Shunt Motor Coupled With DC Compound Generator – 2 nos
7. DC Shunt Motor Coupled With DC Shunt Generator – 1 No.
8. Tachometer -Digital/Analog – 8 nos
9. Single Phase Auto Transformer – 2 nos
10. Three Phase Auto Transformer – 1 No.
11. Single Phase Resistive Loading Bank – 2 nos
12. Three Phase Resistive Loading Bank. – 2 nos
13. SPST switch – 2 nos

CO - PO and CO - PSO MAPPING:

CO	PO												PSO			
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**	**4**
CO1	3	3		1								1	2	2		
CO2	3	3		1								1	2	2		
CO3	3	3	2	2								2	3	3		
CO4	3	3										1	2	2		
CO5	3	3										1	2	2		

1907406 LINEAR AND DIGITAL INTEGRATED CIRCUITS LABORATORY L T P C

0 0 4 2

COURSE OBJECTIVES:

- To learn design, testing and characterizing ofvarious combinational logic circuits.
- To learn design, testing and characterizing of applications like Mux, Demux, Encoder and Decoder circuits.
- To learn design, testing and characterizing of Synchronous and Asynchronous digital circuits.
- To learn design, testing and characterizing of circuit behavior with analog ICs.
- To study about working of 566 IC and LM 317 IC

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 of 3-bit modulo counters as synchronous and Asynchronous types using FF IC's and specific counter IC.
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.

TOTAL: 60 PERIODS

COURSE OUTCOMES:

At the end of the course, the student should have the :

- Ability to understand and implement Boolean Functions.
- Ability to understand the importance of code conversion
- Ability to Design and implement 4-bit shift registers
- Ability to acquire knowledge on Application of Op-Amp
- Ability to Design and implement counters using specific counter IC.

LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS: (3 per Batch)

SL.No	Name of the equipments / Components	Quantity Required	Remarks
1	Dual ,(0-30V) variability Power Supply	10	-
2	CRO	9	30MHz
3	Digital Multimeter	10	Digital
4	Function Generator	8	1 MHz
5	IC Tester (Analog)	2	
6	Bread board	10	
7	Computer (PSPICE installed)	1	

Consumabilitys (sufficient quantity)

1 IC 741/ IC NE555/566/565
2 Digital IC types
3 LED
4 LM317
5 LM723
6 ICSG3524 / SG3525
7 Transistor – 2N3391
8 Diodes, IN4001,BY126
9 Zener diodes
10 Potentiometer
11 Step-down transformer 230V/12-0-12V
12 Capacitor
13 Resistors 1/4 Watt Assorted
14 Single Strand Wire

CO - PO and CO - PSO MAPPING:

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

1919001 Communication Skills laboratory – Project based **L T P C**

0 0 2 0

COURSE OBJECTIVES:

The Course will enable learners to:

- Equip students with the English language skills required for the successful undertaking of academic studies with primary emphasis on academic speaking and listening skills.
- Provide guidance and practice in basic general and classroom conversation and to engage in specific academic speaking activities and make effective presentations.
- Improve general and academic listening skills and technical writing skills.
- Strengthen the reading skills of students of engineering.
- Provide more opportunities to develop their project and proposal writing skills.

UNIT- I Informal Communication – An Introduction **6**

Listening - Listening as a key skill- its importance- **Speaking** - give personal information - ask for personal information - express ability - enquire about ability – rephrase for clarification or emphasis - Improving pronunciation – Articulation of speaking –vowel sounds. **Reading** – Strategies for effective reading- Read and recognize different text types in a newspaper - **Writing**-Plan before writing- Develop a paragraph: topic sentence, supporting sentences, concluding sentence.

UNIT- II Mechanics of Basic Communication **6**

Listening - Listen to a process information- **Speaking** - asking for details formal/informal – give views, opinions and justification of a news- consonant sounds –diphthongs -.**Reading**- Read for vocabulary through scientific invention summarise the same into a paragraph- . **Writing**- compare and contrast ideas using adjectives from multiple sources stating reasons and examples to support ideas. Write a paragraph with reasons and examples- Write a rejoint to a newspaper expressing opinions on particular news.

UNIT- III Nuances of LSRW **6**

Listening - Lexical chunking for accuracy and fluency- factors that influence fluency- listen for and follow the gist- listen for detail **Speaking** - deliver a five-minute informal talk - invite and offer - accept - decline - take leave - word stress – stress rules-ability to recognize RP sound- . **Reading**– Skimming / Scanning a text to apply both the concepts – to search – to analyze.**Writing**–Use of dictionary and usage of synonyms- editing and proof reading.

UNIT- IV Technical Communication – Basic Presentation Skills 6

Listening - Being an active listener: giving verbal and non-verbal feedback- listening to a podcast of a native speaker and reciprocating **Speaking** - participating in a group discussion - conversational speech listening to and participating in conversations - persuade.– Sentence stress – intonations types-features of connected speech **Reading**– Genre and Organization of Ideas- note taking and summarizing **Writing–**Email writing- Job application- Blog writing.

UNIT- V Communication Skills for Formal Occasion 6

Listening Listening to documentaries and make notes (TED talks) **Speaking** -Power point presentation - strategies for presentations and interactive communication - group/pair presentations –use stress and intonation to convey meaning and nuances of meaning clearly- **Reading**– Technical passages for comprehension- understanding how the text positions the reader- **Writing**– Statement of Purpose - analyse the situation in a picture / photo and write a suitable description with a proper title

TOTAL : 30 PERIODS

The lab course is offered as an **Employability Enhancement Course**

The Course will have an Internal End semester exam includes a **project work**. The Students need to have **75% attendance** for the completion of the course.

COURSE OUTCOMES:

At the end of the course Learners will be able to:

- Read and evaluate texts critically
- Make effective presentations
- Participate confidently and appropriately in conversations both formal and informal
- Write winning job applications.
- Display critical thinking in various professional contexts.

REFERENCE BOOKS:

1. Gramer F.Margot and Colin S.Ward ‘Reading and Writing’ (Level 3) Oxford University Press: Oxford, 2011.
2. Debra Daise, CharlNorloff, and Paul ‘Reading and Writing’ (Level 4) Oxford University Press: Oxford, 2011

3. Brooks, Margret. ‘Skills for Success. Listening and Speaking.’ (Level 4)Oxford University Press, Oxford: 2011.
4. Richards,C. Jack. & David Bholke. ‘Speak Now’(Level 3.) Oxford University Press, Oxford: 2010
5. Davis,Jason and Rhonda LIss. ‘Effective Academic Writing’ (Level 3) Oxford University Press: Oxford, 2006
6. E.Suresh Kumar. ‘Enriching Speaking and Writing Skills. Second Edition. Orient Black swan: Hyderabad, 2012
7. Petelin, Roslyn and Marsh Durham. ‘The Professional Writing Guide: Knowing Well and Knowing Why’. Business & Professional Publishing: Australia, 2004.
8. Bhatnagar, Nitin and Mamta Bhatnagar. ‘Communicative English for Engineers and Professionals’. Pearson: New Delhi, 2010.
9. Hughes, Glyn and Josephine Moate. Practical English Classroom. Oxford University Press: Oxford, 2014.
10. Vargo, Mari. Speak Now (Level 4). Oxford University Press: Oxford, 2013.
11. Richards C. Jack. Person to Person (Starter). Oxford University Press: Oxford, 2006.
12. Ladousse, Gillian Porter. Role Play. Oxford University Press: Oxford, 2014
13. IELTS, TOFEL testing series
14. Jack c. Richards. Tactics for Listening: Developing. Oxford University Press: Oxford,.2004
15. New Oxford Dictionary for writers and editors: The essential A-Z Guide to the Written Word 2005.

CO - PO and CO - PSO MAPPING:

CO	PO												PSO			
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**	**4**
CO1	3	3	2	3	3	-	-	-	-	3	-	1	2	2	1	2
CO2	3	2	3	2	2	-	2	-	-	3	-	1	2	1	1	2
CO3	3	3	-	2	-	-	-	-	-	3	-	1	1	1	1	1
CO4	3	3	-	-	-	-	3	-	-	2	-	1	1	1	1	1
CO5	3	2	2	-	-	-	-	-	-	3	-	1	2	1	1	2

SEMESTER V

1907501 INDUSTRIAL INSTRUMENTATION - II L T P C

3 0 0 3

COURSE OBJECTIVES:

- To educate about variable head type flow meters.
- To impart knowledge on quantity meters, air flow meters and mass flow meters.
- To introduce the concepts on electrical type flow meters, open channel flow measurement and solid flow measurement.
- To impart knowledge on level measurement techniques.
- To introduce the working and calibration of transmitters.

UNIT-I VARIABLE HEAD TYPE FLOWMETERS 9

Expression for flow rate through restriction(compressible and incompressible flow) –Orifice plate: different types of orifice plates – Cd variation – pressure tappings – Venturi tube – Flow nozzle – Dall tube – Pitot tube: combined pitot tube, averaging pitot tube – Installation and applications of head flow meters.

UNIT-II QUANTITY METERS, AREA FLOW METERS AND MASS FLOW METERS 9

Positive displacement flow meters: Nutating disc, Reciprocating piston and Oval gear flow meters – Inferential meter – Turbine flow meter – Variable Area flow meter: Rotameter – theory, characteristics, installation and applications – Mass flow meter :– Angular momentum – Thermal, Coriolis type mass flow meters – Calibration of flow meters: – Dynamic weighing method.

UNIT-III ELECTRICAL TYPE FLOW METERS 9

Principle and constructional details of Electromagnetic flow meter – Ultrasonic flow meters – Laser Doppler anemometer – Vortex shedding flow meter – Target flow meter – Guidelines for selection of flow meter – Open channel flow measurement – Solid flow rate measurement.

UNIT-IV LEVEL MEASUREMENT 9

Level measurement: Float gauges - Displacer type – D/P methods -Bubbler system-Load cell – Electrical types – Conductivity sensors – Capacitive sensors – Nucleonic gauge - Ultrasonic gauge – Boiler drum level measurement :– Differential pressure method and Hydrastep method - Solid level measurement.

UNIT-V TRANSMITTERS 9

Pneumatic transmitter: Operation - Electronic transmitter: Study of 2 wire and 4 wire transmitters – Operation of Electronics and Smart transmitters – Principle of operation of flow, level, temperature and pressure transmitters – Installation and Calibration of smart and conventional transmitters.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

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

- Understand the construction, installation and working of different variable head type flow meters.
- Understand the construction, working and calibration of different quantity flow meters, variable area flow meters, mass flow meters, electrical type flow meters, open channel flow measurement and solid flow meters.
- Analyse errors in measurement, working and calibration of different type of transmitters.
- Choose appropriate flow meters or level sensor for an application.
- Draw conclusion on choosing best measurement technique based on cost, accuracy and applications involved.

TEXT BOOKS:

1. Doebelin, E.O. and Manik, D.N., “Measurement systems Application and Design”, 6th McGraw-Hill Education Pvt. Ltd, 2011.
2. Patranabis, D., “Principles of Industrial Instrumentation”, 3rd Edition, McGraw-Hill Education, 2017
3. A.K. Sawhney, “A Course in Mechanical Measurements and Instrumentation”, Dhanpat Rai & Co. (P) Limited, 2001.

REFERENCE BOOKS:

1. Liptak, B.G., Instrumentation Engineers Handbook (Measurement), CRC Press, 2005.
2. Singh,S.K., Industrial Instrumentation and Control, Tata McGraw Hill Education Pvt. Ltd., New Delhi, 2009.
3. Jain, R.K., Mechanical and Industrial Measurements, Khanna Publishers, Delhi, 1999.
4. Jayashankar, V., “Lecture Notes on Industrial Instrumentation”, NPTEL, E-Learning Course, IIT Madras.

CO - PO and CO - PSO MAPPING:

CO	PO												PSO			
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**	**4**
CO 1	3	2	1	1									3	2	2	1
CO 2			2		1		1						2	1	2	1
CO 3	3	2	1	1									2	-	2	1
CO 4	3	2	1	1		1	1	1			1	1	2	-	2	2
CO 5	3	2	1	1		1	1	1					2	1	2	1

1905504 CONTROL SYSTEMS L T P C

3 0 0 3

COURSE OBJECTIVES:

- Transfer function models for analysis physical systems and introduce the control system components.
- Knowledge in the time response of systems and steady state error analysis.
- Basic knowledge in obtaining the open loop and closed–loop frequency responses of systems.
- Stability analysis and design of compensators.
- State variable representation of physical systems.

UNIT-I SYSTEMS AND REPRESENTATION 9

Basic elements in control systems: – Open and closed loop systems – Electrical analogy of mechanical and thermal systems – Transfer function, Synchros, – AC and DC servomotors – Block diagram reduction techniques – Signal flow graphs.

UNIT-II TIME RESPONSE 9

Time response: – Time domain specifications – Types of test input – I and II order system response – Error coefficients – Generalized error series – Steady state error – Root locus construction- Effects of P, PI, PID modes of feedback control –Time response analysis.

UNIT-III FREQUENCY RESPONSE 9

Frequency response: – Bode plot – Polar plot, Nichols Chart – Determination of closed loop response from open loop response - Correlation between frequency domain and time domain specifications.

UNIT-IV STABILITY AND COMPENSATOR DESIGN 9

Characteristics equation – Routh Hurwitz criterion – Nyquist stability criterion- Lag, lead, lag-lead network, Performance criteria – Effect of Lag, lead and lag-lead compensation on frequency response-Design of Lag, lead and lag- lead compensator using bode plots.

UNIT-V STATE VARIABLE ANALYSIS 9

Concept of state variables – State models for linear and time invariant Systems – Solution of state and output equation in controllable canonical form – Concepts of controllability and observability.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

- Ability to develop various representations of system based on the knowledge of Mathematics, Science and Engineering fundamentals.
- Ability to do time domain and frequency domain analysis of various models of linear system.
- Ability to interpret characteristics of the system to develop mathematical model.
- Ability to understand and design appropriate compensator for the given specifications.
- Ability to design State variable representation of physical systems.

TEXTBOOKS:

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

REFERENCE BOOKS:

1. Katsuhiko Ogata, “Modern Control Engineering”, Pearson, 2015.
2. Richard C.Dorf and Bishop, R.H., “Modern Control Systems”, Pearson Education,Twelth Edition,2011.
3. John J.D., Azzo Constantine, H. and Houpis Sttuart, N Sheldon, “Linear Control System Analysis and Design with MATLAB”, CRC Taylor& Francis Reprint 2009.
4. Rames C.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.

CO - PO and CO - PSO MAPPING:

CO	PO												PSO			
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**	**4**
CO1	2	1				2	1			1			3			
CO2	1			1	1							2	1			
CO3		2	3							2				3		2
CO4			2				2				1				1	
CO5		1		2	1			1						2		

1906004 COMMUNICATION ENGINEERING L T P C

3 0 0 3

COURSE OBJECTIVES:

The student should be made:

- To understand analog communication techniques.
- To be aware of Pulse modulation techniques.
- To study the various digital modulation techniques.
- To explore the principles behind information theory and coding.
- To gain knowledge on various digital communication techniques.

UNIT - I: ANALOG COMMUNICATION 9

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 9

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 9

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 9

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 9

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

TOTAL : 45 PERIODS

COURSE OUTCOMES:

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

- Apply analog communication techniques.
- Examine the various digital communication techniques.
- Use data and pulse communication techniques.
- Analyze Source and Error control coding.
- Utilize spread spectrum and multiple access communication.

TEXT BOOKS:

1. H Taub, D L Schilling, G Saha, “Principles of Communication Systems” 3/e, TMH 2007.
2. S. Haykin “Digital Communications” John Wiley 2005.

REFERENCE BOOKS:

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.

CO - PO and CO - PSO MAPPING:

CO	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
CO1	3	2	3	3	-	3	-	-	-	-	-	2	2	-	-	-
CO2	3	3	3	3	-	3	-	-	-	-	-	3	2	-	-	-
CO3	3	2	3	3	-	2	-	-	-	-	-	3	1	-	-	-
CO4	3	2	3	3	-	3	-	-	-	-	-	2	1	-	-	-
CO5	2	3	3	2	-	3	-	-	-	-	-	3	1	-	-	-

1905502 MICROPROCESSORS AND MICROCONTROLLERS L T P C

3 0 0 3

COURSE OBJECTIVES:

To impart knowledge on the following Topics

- Architecture of µP8085 & µC 8051
- Architecture of µP8086
- Addressing modes & instruction set of 8085 & 8051.
- Need & use of Interrupt structure 8085 & 8051.
- Simple applications development with programming 8085 & 8051

UNIT-I 8085 PROCESSOR 9

Hardware Architecture, pinouts – Functional Building Blocks of Processor – Memory organization – I/O ports and data transfer concepts– Timing Diagram – Interrupts – 8086 Processor (Architecture only).

UNIT-II PROGRAMMING OF 8085 PROCESSOR 9

Instruction -format and addressing modes – Assembly language format – Data transfer, data manipulation& control instructions – Programming: Loop structure with counting & Indexing – Look up tability - Subroutine instructions - stack.

UNIT-III 8051 MICRO CONTROLLER 9

Hardware Architecture, pinouts – Functional Building Blocks of Processor – Memory organization – I/O ports and data transfer concepts– Timing Diagram – Interrupts- Data Transfer, Manipulation, Control Algorithms& I/O instructions, Comparison to Programming concepts with 8085.

UNIT-IV PERIPHERAL INTERFACING 9

Study on need, Architecture, configuration and interfacing, with ICs: 8255, 8259, 8254, 8279, - A/D and D/A converters &Interfacing with 8085& 8051.

UNIT-V MICRO CONTROLLER PROGRAMMING & APPLICATIONS 9

Simple programming exercises- key board and display interface –Control of servo motor-stepper motor control- Application to automation systems.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

- Ability to acquire knowledge in Addressing modes & instruction set of 8085 & 8051.
- Ability to need & use of Interrupt structure 8085 & 8051.
- Ability to understand the importance of Interfacing.
- Ability to explain the architecture of Microprocessor and Microcontroller and it's applications.
- Ability to write the assembly language programme.

TEXTBOOKS:

1. Sunil Mathur &Jeebananda Panda, "Microprocessor and Microcontrollers", PHI Learning Pvt. Ltd, 2016.
2. R.S. Gaonkar, 'Microprocessor Architecture Programming and Application', with 8085, Wiley Eastern Ltd., New Delhi, 2013.
3. Muhammad Ali Mazidi & Janice Gilli Mazidi, R.D.Kinely 'The 8051 Micro Controller and Embedded Systems', PHI Pearson Education, 5th Indian reprint, 2003.

REFERENCE BOOKS:

1. Krishna Kant, "Microprocessor and Microcontrollers", Eastern Company Edition, Prentice Hall of India, New Delhi, 2007.
2. B.RAM," Computer Fundamentals Architecture and Organization" New age International Private Limited, Fifth edition, 2017.
3. Soumitra Kumar Mandal, Microprocessor & Microcontroller Architecture, Programming & Interfacing using 8085,8086,8051,McGraw Hill Edu,2013.
4. Ajay V.Deshmukh, 'Microcontroller Theory &Applications', McGraw Hill Edu,2016
5. Douglas V.Hall, 'Microprocessor and Interfacing', McGraw Hill Edu,2016.

CO - PO and CO - PSO MAPPING:

CO	PO												PSO			
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**	**4**
CO1	3	3	3	2	2				2				3			
CO2	3	2	2	1	1		2		1		2			2		
CO3	3	2	1	1	3				3		2	2				3
CO4	1	2	2	3	3						3	1	3			2
CO5	1	2	1	2	3						1	2				3

1907502 DISCRETE TIME SYSTEMS AND SIGNAL PROCESSING L T P C

3 0 0 3

COURSE OBJECTIVES:

- To educate on signals, systems & their mathematical representation.
- To impart knowledge on analysis of signals and discrete Time Systems.
- To make the students familiar with computation of transforms and its application in discrete time signal processing.
- To introduce the concept and importance of Digital signal processors.
- To provide knowledge on analog and digital filters and make them to design and realize the filters.

UNIT-I CLASSIFICATION AND ANALYSIS OF SIGNALS 9

Classification of signals: continuous and discrete- continuous and discrete: Energy and power, Deterministic and Random, Periodic and Aperiodic; Mathematical representation of signals; Fourier series and Fourier transform of continuous time signal, Spectral density- sampling techniques, quantization, quantization error, Nyquist rate, aliasing effect.

UNIT-II CLASSIFICATION OF SYSTEMS AND DIGITAL SIGNAL PROCESSOR 9

Classification of systems: Continuous and discrete; Discrete- linear, causal, stability, dynamic, recursive, time variance;Introduction – DSP Architecture – Features

UNIT-III Z- TRANSFORMS AND 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 – Discrete Time Fourier transform , magnitude and phase representation.

UNIT-IV 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-V DESIGN OF ANALOG AND 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.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

- Understand the representation of continuous and discrete time signals.
- Analyze continuous time signals, discrete time signals and discrete time systems.
- Apply Fourier transform / Z-transform techniques and perform its computation for analyzing discrete time systems.
- Understand the significance of digital signal processor DSP application.
- Understand the types of filters and perform their design for digital implementation and also can efficiently realize it.

TEXT BOOKS:

1. J.G. Proakis and D.G. Manolakis, 'Digital Signal Processing Principles, Algorithms and Applications', Pearson Education, New Delhi, PHI. 2003.
2. S.K. Mitra, 'Digital Signal Processing – A Computer Based Approach', McGraw Hill Edu, 2013.
3. Lonnie C.Ludeman ,"Fundamentals of Digital Signal Processing", Wiley, 2013.

REFERENCE BOOKS:

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", CengageLearning, 2014.
3. B.P.Lathi, 'Principles of Signal Processing and Linear Systems', Oxford University Press, 2010
4. Taan S. ElAli, 'Discrete Systems and Digital Signal Processing with Mat Lab', CRC Press, 2009.
5. SenM.kuo, woonseng…s.gan, "Digital Signal Processors, Architecture, Implementations & Applications, Pearson, 2013
6. DimitrisG.Manolakis, Vinay K. Ingle, applied Digital Signal Processing, Cambridge, 2012
7. B.Venkataramani, M. Bhaskar, "Digital Signal Processors, Architecture, Programming and Applications", Tata McGraw Hill, New Delhi, 2003.

CO - PO and CO - PSO MAPPING:

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

1907505 INDUSTRIAL INSTRUMENTATION LABORATORY L T P C

0 0 4 2

COURSE 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 understand the working of basic biomedical instruments.
- To identify, formulate, and analyze problems regarding sensors and transmitters.

LIST OF EXPERIMENTS:

1. Measurement of speed, torque and vibration
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 and fibre optics system.
5. Measurement of flow using
    a. Discharge coefficient of orifice plate
    b. Calibration of Rotameter.
6. Design and Testing of Electromagnetic Flow meters.
7. Measurement of temperature using IR thermometer and IC sensor
8. Measurement of Absorbance and Transmittance of Test solutions using UV-Spectrometer.
9. Measurement of Conductivity, Moisture and Viscosity of test solutions.
10. Standardization and measurement of pH values of different solutions.
11. Measurement and analysis of ECG and pulse rate.

Minimum of ten experiments to be offered from the list.

Additional one or two experiments can be framed beyond the list or curriculum.

TOTAL: 60 PERIODS

COURSE COURSE OUTCOMES :

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

- Ability to experimentally measure industrial process parameters such as flow, level, temperature, pressure and viscosity.
- Ability to measure and analyze pH, conductivity, UV absorbance and transmittance.
- Ability to measure and analyze physiological parameters such as BP, ECG and pulse rate.
- Ability to apply proper calibration method for measuring systems.
- Ability to do mathematical calculations regarding choosing equipment and identifying errors.

LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS:

1. Orifice plate - 1
2. Dead weight tester with pressure gauge - 1
3. Torque trainer - 1
4. Saybolt Viscometer - 1
5. Vacuum gauge - 1
6. DP transmitter - 1
7. UV – Visible spectrophotometer - 1
8. pH meter - 1
9. Conductivity meter - 1
10. ECG trainer - 1
11. Pulse rate trainer - 1
12. tacho meter - 1

CO - PO and CO - PSO MAPPING:

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

1907506 MICROPROCESSORS AND MICROCONTROLLERS LABORATORY

L T P C

0 0 4 2

COURSE OBJECTIVES:

- To provide training on programming of microprocessors
- To provide training on programming of microcontrollers
- To provide training on interfacing peripherals with microprocessors.
- To provide training on interfacing peripherals with microcontrollers
- To provide training on interfacing I/O devices with arduino / raspberry pi development boards.

LIST OF EXPERIMENTS

8-bit Microprocessor

1. Simple arithmetic operations: addition / subtraction / multiplication / division.
2. Programming with control instructions:
    a. Ascending / Descending order, Maximum / Minimum of numbers.
    b. Programs using Rotate instructions.
    c. Hex / ASCII / BCD code conversions.
3. Interface Experiments: with 8085
    a. A/D Interfacing & D/A Interfacing.
4. Traffic light controller.
5. I/O Port / Serial communication
6. Read a key, interface display

8-bit Microcontroller

7. Demonstration of basic instructions with 8051 Micro controller execution, including:
    (i) Conditional jumps & looping
    (ii) Calling subroutines.
9. Programming I/O Port and timer of 8051
    (i) study on interface with A/D & D/A
    (ii) Study on interface with DC & AC motors
10. Application hardware development using embedded processors.
11. Interfacing of LEDs and sensor with arduino / raspberry pi modules.

TOTAL: 60 PERIODS

COURSE OUTCOMES:

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

- Understand programming logics for code conversion and arithmetic operations.
- Perform interfacing of A/D and D/A converters and also speed control of DC and AC motor
- Understand the basics of serial communication with microprocessors and microcontrollers.
- Perform LED and sensor interfacing with development board
- Understand and apply computing platform and software for engineering problems.

LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS:

Sl.No.	Description of Equipment	Quantity required
1	8085 Microprocessor Trainer with Power Supply	15
2	8051 Micro Controller Trainer Kit with power supply	15
3	8255 Interface boards	5
4	8251 Interface boards	5
5	8259 Interface boards	5
6	8279 Keyboard / Display Interface boards	5
7	8254 timer/ counters	5
8	ADC and DAC cards	5
9	AC & DC motor with Controllers	5
10	Traffic Light Control Systems	5
11	Arduino / Rasberry pi development board	2
12	Sensor (Temperature/ Humidity)	2

CO - PO and CO - PSO MAPPING:

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

SEMESTER VI

1907601 LOGIC AND DISTRIBUTED CONTROL SYSTEM L T P C

3 0 0 3

COURSE OBJECTIVES:

- To give an overview of the automation technologies such as PLCs, SCADA and DCS used in industries
- To impart knowledge on architectural, implementation and interfacing details for PLCs, SCADA and DCS.
- To provide a fundamental understanding of the different languages used for PLC Programming
- To provide insight into some of the advanced principles those are evolving for present and future automation.
- To impart basic knowledge about recent developments in Industrial automation.

UNIT-I PLC & SCADA 9

PLC: Evolutions of PLCs – Programmable Controllers – Architecture, I/O modules – selection criteria for PLC. Comparative study of Industrial PLCs. SCADA: basic architecture of SCADA- Remote terminal units- Master station - Communication architectures.

UNIT-II BASICS OF PLC PROGRAMMING (LADDER) 9

Basics of PLC programming – Ladder Logic – Relay type instructions – Timer/C ounter instructions – Program control instructions – Data manipulation and math instructions – Programming Examples. Simulation of Ladder Logic Programs

UNIT-III PLC PROGRAMMING (OTHER LANGUAGES) 9

Functional block programming - Sequential function chart – Instruction list – Structured text programming – PLC controlled sequential Process Examples.

UNIT-IV DISTRIBUTED CONTROL SYSTEM 9

DCS: Evolution & types – Hardware architecture – Field control station – Interfacing of conventional and smart field devices (HART and FF enabled) with DCS Controller – Communication modules – Operator and Engineering Human interface stations – Study of any one DCS available in market. General purpose computer in DCS.

UNIT-V ADVANCED TOPICS IN AUTOMATION 9

Introduction to Networked Control systems – Plant wide control – Internet of things – Cloud based Automation – OLE for Process Control – Safety PLC – Case studies: PLC - SCADA - DCS.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

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

- Understand all the important components such as PLC, SCADA, DCS, I/O modules and field devices of an industrial automation system.
- Develop PLC program in different languages for industrial sequential applications.
- Select and use most appropriate automation technologies for a given application.
- Gain knowledge on the recent developments in industrial automation.
- Ability to understand emerging technologies.

TEXT BOOKS:

1. F.D. Petruzella, Programmable Logic Controllers, Tata Mc-Graw Hill, Fourth edition, 2014.
2. Michael P. Lukas, Distributed Control Systems: Their Evaluation and Design, Van Nostrand Reinhold Co.,2016.
3. D. Popovic and V.P.Bhatkar,' Distributed computer control for industrial Automation' Marcel Dekker,Inc., Newyork ,1990.

REFERENCE BOOKS:

1. Clarke, G., Reynders, D. andWright, E., "Practical Modern SCADA Protocols: DNP3,4. 60870.5 and Related Systems", Newnes, 1st Edition, 2004.
2. Hughes, T.A., "Programmable Logic Controllers: Resources for Measurements and Control Series", 3rd Edition, ISA Press, 2004.
3. McMillan, G.K., "Process/Industrial Instrument and Controls Handbook", 5thEdition, McGraw- Hill handbook, New York, 1999.
4. NPTEL Notes on, "Programmable Logic Control System" by Department of Electrical Engg., IIT Kharagpur.
5. John W. Webb, Ronald A.Ries, "programmable logic controllers: Principle and application " 5th Edition.

CO - PO and CO - PSO MAPPING:

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

1904007 DATA STRUCTURES L T P C

3 0 0 3

COURSE OBJECTIVES:

- To understand Linear Data structures programs.
- To understand Nonlinear Data structures program
- To have an idea about implementing search techniques.
- To have a better understanding in sorting techniques.
- To understand the various Indexing algorithms.

UNIT-I LINEARDATASTRUCTURES - LIST 9

Introduction to structure-Abstract Data Types (ADTs) - List ADT - array-based implementation - linked list implementation - singly linked lists- circularly linked lists - applications of lists – Polynomial Manipulation.

UNIT-II LINEARDATASTRUCTURES - STACKS, QUEUES 9

Stack ADT – Operations – Applications – Evaluating arithmetic expressions- Conversion of Infix to postfix expression – Queue ADT – Operations – Circular Queue – Priority Queue – deQueue –applications of queues.

UNIT-III NON LINEAR DATA STRUCTURES TREES- GRAPHS 9

.Binary Trees – Binary tree representation and traversals – Application of trees: – Graph and its representations – Graph Traversals – Connected components.

UNIT-IV SORTING 9

Selection sort-Insertion sort – Merge sort – Quick sort – Heap sort – Bubble sort- Shell sort – Radix sort.

UNIT-V SEARCHING AND INDEXING 8

Linear Search–Binary Search-Hash tables–Overflow handling– Hash Index – B-Tree Indexing.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

- To learn about Linear Data structures
- Ability to describe stack queue and linked list operation
- Ability to analyze algorithms
- To understand about the tree concepts.
- Ability to summarize searching and sorting techniques.

TEXT BOOKS:

1. Ellis Horowitz and Sartaj Sahni,Fundamentals of Data Structures, Galgotia Book Source, Gurgaon,1976.
2. Gregory L. Heilman, Data Structures, Algorithms and Object Oriented Programming, Tata Mcgraw-Hill, New Delhi,2002.

REFERENCE BOOKS:

1. Jean-Paul Tremblay and Paul G. Sorenson, An Introduction to Data Structures with Applications, Second Edition, Tata McGraw-Hill, New Delhi,1991.
2. Alfred V. Aho, John E. Hopcroft and Jeffry D. Ullman, Data Structures and Algorithms, Pearson Education, New Delhi,2006.

CO - PO and CO - PSO MAPPING:

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

1907602 PROCESS CONTROL L T P C

3 0 0 3

COURSE OBJECTIVES:

- To introduce technical terms and nomenclature associated with Process Control domain.
- To familiarize the students with characteristics, selection, sizing of control valves.
- To provide an overview of the features associated with Industrial type PID controller.
- To make the students understand the various PID tuning methods.
- To elaborate different types of control schemes such as cascade control, feed forward control and Model Based control schemes.

UNIT-I PROCESS MODELLING AND DYNAMICS 9

Need for process control – Mathematical Modeling of Processes: Level, Flow, Pressure and Thermal processes – Continuous and batch processes – Self regulation – Servo and regulatory operations – Lumped and Distributed parameter models – Heat exchanger – CSTR – Linearization of nonlinear systems.

UNIT-II FINAL CONTROL ELEMENTS 9

Actuators: Pneumatic and electric actuators – Control Valve Terminology - Characteristic of Control Valves: Inherent and Installed characteristics - Valve Positioner – Modeling of a Pneumatically Actuated Control Valve – Control Valve Sizing: ISA S 75.01 standard flow equations for sizing Control Valves – Cavitation and flashing – Control Valve selection

UNIT-III CONTROL ACTIONS 9

Characteristic of ON-OFF, Proportional, Single speed floating, Integral and Derivative controllers– P+I, P+D and P+I+D control modes – Practical forms of PID Controller – PID Implementation Issues: Bumpless, Auto/manual Mode transfer, Anti-reset windup Techniques – Direct/reverse action.

UNIT-IV PID CONTROLLER TUNING 9

PID Controller Design Specifications: Criteria based on Time Response and Criteria based Frequency Response - PID Controller Tuning: Z-N and Cohen-Coon methods, Continuous cycling method and Damped oscillation method, optimization methods, Auto tuning – Cascade control – Feed-forward control

UNIT-V MODEL BASED CONTROL SCHEMES 9

Smith Predictor Control Scheme - Internal Model Controller – IMC PID controller –- Three

element Boiler drum level control - Introduction to Multi-loop Control Schemes – Control Schemes for CSTR, and Heat Exchanger - P&ID diagram.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. Seborg, D.E., Edgar, T.F. and Melli champ, 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.

REFERENCE BOOKS:

1. Coughanowr, D.R., “Process Systems Analysis and Control”, McGraw - Hill International Edition, 2004.
2. Curtis D. Johnson, “Process Control Instrumentation Technology”, 8th Edition, Pearson, 2006.
3. Considine, D.M., Process Instruments and Controls Handbook, Second Edition, McGraw,1 999.
4. Bela.G.Liptak., “Process Control and Optimization”, Instrument Engineers’ Handbook., volume 2, CRC Press and ISA, 2005.
5. Ramesh C. Panda., T.Thyagarajan., “An Introduction to Process Modelling Identification and Control for Engineers” Narosa Publishing house Pvt. Ltd, 2017.

COURSE OUTCOMES:

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

- Understand technical terms and nomenclature associated with Process control domain.
- Build models using first principles approach as well as analyze models.
- Design, tune and implement PID Controllers to achieve desired performance for various processes
- Analyze Systems and design & implement control Schemes for various Processes.
- Identify, formulate and solve problems in the Process Control Domain.

CO - PO and CO - PSO MAPPING:

CO	PO												PSO			
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**	**4**
CO 1	2	3	2	2	2	2							1	1	3	
CO 2	2	1	3	1	2	2							3	-	3	3
CO 3	1	3	1	1	1	3							1	1	-	1
CO 4	2	2	2	2	2	2							1	2	2	-
CO 5				2	3	2							2	2	2	2

1904613 DATA STRUCTURES LABORATORY L T P C

0 0 4 2

COURSE OBJECTIVES

- To implement linear and non-linear data structures
- To understand the different operations of search trees
- To implement graph traversal algorithms
- To get familiarized to sorting and searching algorithms
- To understand hashing and collision techniques

LIST OF EXPERIMENTS

1. Array implementation of List ADT
2. Array implementation of Stack and Queue ADTs
3. Linked list implementation of List, Stack and Queue ADTs
4. Applications of List, Stack and Queue ADTs
5. Implementation of Binary Trees and operations of Binary Trees
6. Implementation of Binary Search Trees
7. Implementation of AVL Trees
8. Implementation of Heaps using Priority Queues.
9. Graph representation and Traversal algorithms
10. Implementation of searching and sorting algorithms
11. Implementation of Hashing – collision techniques

TOTAL : 60 PERIODS

COURSE OUTCOMES

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

- Write functions to implement linear and non-linear data structure operations

- Suggest appropriate linear / non-linear data structure operations for solving a given problem
- Appropriately use the linear / non-linear data structure operations for a given problem
- Apply efficient search method to solve the problems.
- Analyze the different sorting algorithms.

CO - PO and CO - PSO MAPPING:

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

1907609 PROCESS CONTROL LABORATORY L T P C

0 0 4 2

COURSE OBJECTIVES:

- To experimentally verify the process control concepts on the selected process control loops.
- To experimentally verify the characteristics of On/OFF and PID controller.
- To impart theoretical and practical skills in process identification and PID controller tuning.
- To make the students aware of drives and MIMO system.
- To make the students aware of basic and advanced control schemes.

SIMULATION BASED EXPERIMENTS

1. Dynamic Characteristics of First & Second Order System with and without transportation lag.
2. Tuning of PID Controller for mathematically described processes
3. PID Enhancements (Cascade and Feed-forward Control Schemes)
4. PID Implementation Issues.
5. Study of Multi-input Multi-output system
6. Study of AC and DC drives.

HARDWARE BASED EXPERIMENTS

1. Characteristics of Pneumatically Actuated Control Valve (with and without Positioner).
2. Study and control of flow process using Compact Flow Control Unit.
3. Control of Level and Pressure using Process Control Training Plant.
4. Implementation of ON/OFF Controller for the Temperature Process.
5. Implementation of Interacting and non-interacting system.
6. Dynamic characteristics of P+I+D controller.

Minimum of ten experiments to be offered from the list. Additional one or two experiments can be framed beyond the list or curriculum

COURSE OUTCOMES :

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

- Understand and analyze process control engineering problems.
- Build dynamic models using input – output data of a process
- Work with real time control loops (flow/level/temperature/pressure)
- Make use of simulation tools such as MATLAB/LABVIEW/ASPEN for design and analysis.
- Learn and implement simple adaptive and model based control schemes.

TOTAL: 60 PERIODS

LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS:

1. Flow process station with all accessories
2. Analog / Digital PID controller
3. Control valve setup (with position for varying ΔP across the valve)
4. Flow meter
5. Level process station with all accessories
6. Temperature process station with all accessories
7. Pressure process station with all accessories
8. Personal computer-15 nos
9. MATLAB software
10. Two tank system with following accessories.

CO - PO and CO - PSO MAPPING:

CO	PO												PSO			
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**	**4**
CO 1	2	3	2	2	3	3	2		2				3	2	1	-
CO 2	2	3	2	2	3	3	2		2				3	1	3	2
CO 3	2	3	3	2	3	2	3						3	1	3	2
CO 4	3	3	3	3	3	2	2						3	3	3	2
CO 5	3	3	2	2	3	3				2			3	3	3	2

1919002 PROFESSIONAL COMMUNICATION L T P C
0 0 2 1

COURSE OBJECTIVES

The course aims to

- Enhance the Employability and Career Skills of students.
- Orient the students towards grooming as a professional.
- To learn how to speak in Group discussions
- Make them employable Graduates and help them attend interviews successfully.
- Develop their confidence and help them express views clearly.

UNIT- I General English for competitive Exams 6

English for competitive exams —General awareness of Current Affairs – multiple choice – Cloze – Vocabulary Structure.

UNIT- II Mechanics of Interpersonal Communication 6

Introduction to soft skills - Interpersonal communication - Introducing oneself to the audience — answering questions – writing a message – memo –mail – asking for comments – giving information – agreeing to requests – apologizing – Complaining – Business proposal – short report – summarizing.

UNIT- III Basics of Group Discussion 6

Introduction to Group Discussion— participating in group discussions –-– questioning and clarifying –GD strategies –monologues – dialogues – discussions.

UNIT- IV Fundamentals of Interview Skills 6

Interview etiquette –Portfolio development- attending job interviews–FAQs related to job interviews- Interview types –expressing opinions – present circumstances - past experiences – future plans.

UNIT- V Specific skills for Career advancement 6

Recognizing differences between groups and teams - networking professionally- respecting social protocols- understanding career management- developing a long- term career plan- making career changes. – organizing a larger unit of discourse – expressing and justifying opinions – negotiating – collaborating – disagreeing – speculating – decision taking.

TOTAL : 30 PERIODS

The lab course is offered as an **Employability Enhancement Course**

The course is offered as a **one credit** paper with an End Semester Examination.

COURSE OUTCOMES:

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

- Make effective presentations
- Participate confidently in Group Discussions
- Attend job interviews and interacting in different situations.
- Write business reports, proposals and related correspondence.
- Develop adequate Soft Skills required for the workplace

REFERENCE BOOKS:

1. Butterfield, Jeff Soft Skills for Everyone. Cengage Learning: New Delhi, 2015
2. Interact English Lab Manual for Undergraduate Students, Orient Blackswan: Hyderabad, 2016.
3. E.Suresh Kumar Communication for Professional Success. Orient Blackswan: Hyderabad, 2015
4. Raman, Meenakshi and Sangeeta Sharma. Professional Communication. Oxford University Press: Oxford, 2014
5. S. Hariharan. Soft Skills. MJP Publishers: Chennai, 2010.
6. Successful Presentations: DVD and Student's Book. A video series teaching business communication skills for adult professionals by John Huges and Andrew Mallett- OUP 2012.
7. Goodheart-Willcox, "Professional Communication", First Edition , 2017. Online test book

8. Training in Interpersonal Skills: Tips for Managing People at Work, Pearson Education, India, 6 edition, 2015
9. English for success in Competitive exams. Philip Sunil Solomon – OUP 2009.

CO - PO and CO - PSO MAPPING:

CO	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
CO1	3	3	2	3	3	-	-	-	-	3	-	1	2	2	1	2
CO2	3	2	2	2	2	-	3	-	-	2	-	1	2	2	1	2
CO3	3	2	-	3	-	-	-	-	-	3	-	1	2	2	-	-
CO4	3	3	-	-	-	-	3	-	-	3	-	1	2	2	1	1
CO5	3	2	3	-	-	-	-	-	-	3	-	1	1	1	1	1

1907611 INTERNSHIP L T P C

0 0 0 0

COURSE OBJECTIVES:

- To explore career interests while applying knowledge and skills learned in the classroom in a work setting.
- To learn and provides an opportunity to build professional networks.

The students should undergo Industrial training for a period as specified in the Curriculum during summer / winter vacation. In this case the training has to be undergone either 2 or 4 weeks period.

The students may undergo Internship at Research organization / University (after due approval from the Head of the Institution) for a period prescribed in the curriculum during summer / winter vacation, in lieu of Industrial training.

COURSE OUTCOMES:

The internship will provide students with the opportunity to

- Gain practical experience within the business environment.
- Acquire knowledge of the industry in which the internship is done.
- Apply knowledge and skills learned in the classroom in a work setting.
- Develop a greater understanding about career options while more clearly defining personal career goals.
- Experience the activities and functions of business professionals.
- Identify areas for future knowledge and skill development.

1907610	MINI PROJECT	L	T	P	C
		0	0	4	2

COURSE OBJECTIVES:

- Make students able to demonstrate the ability to collaborate with others as they work on intellectual projects.
- Provide a platform to the students to implement their technical skills on a given/selected task.
- To get the Knowledge for the assembling of electronics circuit with components on PCB (Printed Circuit Board) of circuit design.
- Design and development of Small electronic project based on hardware and software for electronics systems.
- Design solutions for real life problems using engineering knowledge.

The students in a group of 5 to 6 works on a topic approved by the head of the department and prepare a comprehensive mini project report after completing the work to the satisfaction. The progress of the project is evaluated based on a minimum of two reviews. The review committee may be constituted by the Head of the Department. A mini project report is required at the end of the semester. The mini project work is evaluated based on oral presentation and the mini project report jointly by external and internal examiners constituted by the Head of the Department.

TOTAL : 60 PERIODS

COURSE OUTCOMES:

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

- Students will be able to practice acquired knowledge within the chosen area of technology for project development.
- Identify, discuss and justify the technical aspects of the chosen project with a comprehensive and systematic approach.
- Reproduce, improve and refine technical aspects for engineering projects.
- Work as an individual or in a team in development of technical projects.
- Communicate and report effectively project related activities and findings.

CO - PO and CO - PSO MAPPING:

CO	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
CO1	3	3	2	2	3							3	3	3	2	
CO2	2	3	2	2	3		2					3	3	3	2	
CO3	3	3	2	2	3		2					3	3	3	2	
CO4									3	3	2	2			1	1
CO5										3	2	1				1

SEMESTER VII

1907701 COMPUTER CONTROL OF PROCESSES L T P C

3 0 0 3

COURSE OBJECTIVES

- To represent the linear time invariant System in discrete State Space form.
- To analyze the controllability, observability and stability of a Discrete time System.
- To estimate model parameters from input/output measurements.
- To Design Digital Controllers.
- To Design Multi-loop and Multivariable Controllers for multivariable system.

UNIT-IDISCRETE STATE-VARIABLE TECHNIQUE 9

State equation of discrete data system with sample and hold – State transition equation – Methods of computing the state transition matrix – Decomposition of discrete data transfer functions – State diagrams of discrete data systems – System with zero-order hold – Controllability and observability of linear time invariant discrete data system–Stability tests of discrete -data system.

UNIT-II SYSTEM IDENTIFICATION 9

Identification of Non Parametric Input-Output Models:-Transient analysis–Frequency analysis–Correlation analysis– Spectral analysis – Identification of Parametric Input- Output Models:- Least Squares Method – Recursive Least Square Method.

UNIT-III DIGITAL CONTROLLER DESIGN 9

Review of z-transform – Modified of z-transform – Pulse transfer function – Digital PID controller– Dead-beat controller and Dahlin's controller – IMC - Smith Predictor.

UNIT-IV MULTI-LOOP REGULATORY CONTROL 9

Multi-loop Control - Introduction – Process Interaction – Pairing of Inputs and Outputs –The Relative Gain Array (RGA) – Properties and Application of RGA - Multi-loop PID Controller – Biggest Log Modulus Tuning Method – De-coupler.

UNIT-V MULTIVARIABLE REGULATORY CONTROL 9

Introduction to Multivariable control –Multivariable PID Controller – Multivariable Dynamic Matrix Controller – Fuzzy Logic Controller – Case Studies:- Distillation Column, CSTR and Four-tank system.

TOTAL : 45 PERIODS

COURSE OUTCOMES

- Ability to analyze the discrete time systems
- Ability to build models from input-output data
- Ability to design a digital controller
- Ability to design multi-loop controller and multivariable controller for multi-variable systems.
- Ability to design multivariable controller for multi-variable systems.

TEXT BOOKS:

1. Stephanopoulos, G., “Chemical Process Control -An Introduction to Theory and Practice”, Prentice Hall of India, 2005.
2. SigurdSkogestad, Ian Postlethwaite, “Multivariable Feedback Control: Analysis and Design”, John Wiley and Sons, 2005.

REFERENCE BOOKS:

1. Gopal, M., “Digital Control and State Variable Methods”, Tata Mc Graw Hill, 2003.
2. Dale E. Seborg, Duncan A. Mellichamp, Thomas F. Edgar, “Process Dynamics and Control”, Wiley John and Sons, 3rd Edition, 2010.
3. P. Albertos and A. Sala, “Multivariable Control Systems An Engineering Approach”, Springer Verlag, 2006.
4. Bequette, B.W., “Process Control Modeling, Design and Simulation”, Prentice Hall of India, 2008.
5. Thomas E. Marlin, Process Control – Designing Processes and Control systems for Dynamic Performance, Mc-Graw-Hill,2000.

CO - PO and CO - PSO MAPPING:

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

1907702 INDUSTRIAL DATA NETWORKS L T P C

3 0 0 3

COURSE 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 9

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 9

Bridges - Routers - Gateways - Standard ETHERNET and ARCNET configuration special Requirement for networks used for control - RS 232, RS 485 configuration Actuator Sensor (AS) – Interface, Device net.

UNIT-III HART AND FIELD BUS 9

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 9

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 9

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

TOTAL: 45 PERIODS

COURSE OUTCOMES:

Students will have the

- Ability to define basic concepts of data communication and its importance.
- Ability to explain the various internetworking devices involved in industrial networks
- Ability to explain the various serial communication used in process industries.
- Ability to illustrate, compare & explain the working of HART and Field bus used in Process digital communication.
- Ability to summarize the operation of MODBUS, PROFIBUS protocol & its applications.
- Ability to explain and adopt 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' Newness Publication, Elsevier First Edition, 2004
2. William Buchanan, Computer Buses, CRC Press, 2000.
3. Behrouz Forouzan, Data Communications & Networking, 3RD edition, Tata McGraw Hill, 2006.

REFERENCE BOOKS

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.

CO - PO and CO - PSO MAPPING:

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CO 1	3	2			1	2		2		3		2	3	2		2
CO 2	3	2	2		2			1	1	3	1	2	3	2	1	
CO 3	3	2	2		2	1		1		3	2	1	2		2	2
CO 4	3	2	2		2	1		1		2	1	1	3	2	2	
CO 5	2	2	1	1	2	1	1			2			3	2		
CO 6	2	2	1	1	2	2	1	2		2	1	2	3	2		2

1907709 INDUSTRIAL AUTOMATION LABORATORY L T P C

0 0 4 2

COURSE OBJECTIVES:

To impart practical skills in

- Programming of PLC and DCS.
- Sensor data acquisition, data processing and visualization
- Interfacing the various field devices with PLC
- Design and Implementation of advanced control schemes.
- Interfacing Pilot plant with Distributed Control System.

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

COURSE OUTCOMES:

- Ability to understand and Programming of PLC, SCADA and DCS
- Ability to working with industrial automation system
- Be able to design and implement control schemes in PLC & DCS
- Ability to interface field devices with PLC & DCS.
- Ability to understand the advanced control schems.

CO - PO and CO - PSO MAPPING:

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

1907710 INSTRUMENTATION SYSTEM DESIGN LABORATORY **L T P C**

0 0 4 2

COURSE OBJECTIVES:

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

LIST OF EXPERIMENTS:

1. Design of Instrumentation amplifier.
2. Design of active filters – LPF, HPF and BPF
3. Design of regulated power supply and design of V/I and I/V converters.
4. Design of linearizing circuits and cold–junction compensation circuit for thermocouples.
5. Design of signal conditioning circuit for strain gauge and RTD.
6. Design of orifice plate and rotameter.
7. Design of Control valve (sizing and flow-lift characteristics)
8. Design of PID controller (using operational amplifier and microprocessor)
9. Design of a multi-channel data acquisition system

10. Design of multi range DP transmitter
11. Piping and Instrumentation Diagram – case study.
12. 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).

Minimum of ten experiments to be offered from the list. Additional one or two experiments can be framed beyond the list or curriculum

TOTAL: 60 PERIODS

COURSE OUTCOMES:

- Ability to understand design of signal conditioning circuits and instrumentation systems.
- Ability to design controller, control valve and transmitter.
- Be able to design and draw the piping diagram for industrial application projects.
- Be able to design the multi-channel data acquisition system and transmitter.
- understand the use and application of instrument/component data sheets, manuals, manufacture's catalogues in consultation with handbooks, reference books etc.

CO - PO and CO - PSO MAPPING:

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

1907611 INTERNSHIP L T P C

0 0 0 1

COURSE OBJECTIVES:

- To explore career interests while applying knowledge and skills learned in the classroom in a work setting.
- To learn and provides an opportunity to build professional networks.

The students should undergo Industrial training for a period as specified in the Curriculum during summer / winter vacation. In this case the training has to be undergone either 2 or 4 weeks period.

The students may undergo Internship at Research organization / University (after due approval from the Head of the Institution) for a period prescribed in the curriculum during summer / winter vacation, in lieu of Industrial training.

COURSE OUTCOMES:

The internship will provide students with the opportunity to

- Gain practical experience within the business environment.
- Acquire knowledge of the industry in which the internship is done.
- Apply knowledge and skills learned in the classroom in a work setting.
- Develop a greater understanding about career options while more clearly defining personal career goals.
- Experience the activities and functions of business professionals.
- Identify areas for future knowledge and skill development.

1907711	PROJECT WORK – PHASE I	L T P C
		0 0 4 2

COURSE OBJECTIVES:

- To enable students to use all concepts for creating a solution for a problem
- To develop the ability to solve a specific problem right from its identification and literature review till the successful solution of the same.
- To develop their own innovative prototype of ideas
- To improve the team building, communication and management skills of the students.
- To train the students in preparing project reports and to face reviews and viva voce examination.

The students in a group of 3 to 4 works on a topic approved by the head of the department under the guidance of a faculty member and prepares a comprehensive project report after completing the work to the satisfaction of the supervisor. The progress of the project is evaluated based on a minimum of three reviews. The review committee may be constituted by the Head of the Department. A project report is required at the end of the semester. The project work is evaluated based on oral presentation and the project report jointly by external and internal examiners constituted by the Head of the Department.

TOTAL: 60 PERIODS

COURSE OUTCOMES:

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

- Identify the problem by applying acquired knowledge.
- Analyze and categorize executable project modules after considering risks.
- Choose efficient tools for designing project modules.
- Combine all the modules through effective team work after efficient testing
- Elaborate the completed task and compile the project report.

CO - PO and CO - PSO MAPPING:

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

SEMESTER VIII

1907805 PROJECT WORK - PHASE II **L T P C**

0 0 12 6

COURSE OBJECTIVES:

- To enable students to use all concepts for creating a solution for a problem
- To develop the ability to solve a specific problem right from its identification and literature review till the successful solution of the same.
- To develop their own innovative prototype of ideas
- To improve the team building, communication and management skills of the students.
- To train the students in preparing project reports and to face reviews and viva voce examination.

The students in a group of 3 to 4 works on a topic approved by the head of the department under the guidance of a faculty member and prepares a comprehensive project report after completing the work to the satisfaction of the supervisor. The progress of the project is evaluated based on a minimum of three reviews. The review committee may be constituted by

the Head of the Department. A project report is required at the end of the semester. The project work is evaluated based on oral presentation and the project report jointly by external and internal examiners constituted by the Head of the Department.

TOTAL: 180 PERIODS

COURSE OUTCOMES:

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

- Identify the problem by applying acquired knowledge.
- Analyze and categorize executable project modules after considering risks.
- Choose efficient tools for designing project modules.
- Combine all the modules through effective team work after efficient testing
- Elaborate the completed task and compile the project report.

CO - PO and CO - PSO MAPPING:

CO	PO											
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
CO1	3	3		1			1	2	3			
CO2		3	2	3		3	1		3	3		2
CO3			3	3	3			3	3	3	1	2
CO4							3	3	3	3	2	3
CO5									3	3		3

PROFESSIONAL ELECTIVE – I

(VI SEMESTER)

1920601 MEMS AND NANO SCIENCE **L T P C**

3 0 0 3

COURSE OBJECTIVES

- To provide wide knowledge of semiconductors and solid mechanics to fabricate MEMS devices
- To educate on the rudiments of Micro fabrication techniques
- To educate on applications of MEMS
- To provide wide information dealing with nano material and its necessity
- To analyze methods involving preparation of nano scale devices.

UNIT-I OVERVIEW OF MEMS AND MICROSYSTEMS 9

Introduction to MEMS and Microsystems, Need for Miniaturization, MEMS and Microsystem products: Micro gears - Micro turbines – Micromotors - Micro optical devices. Microsystems and Microelectronics, Application of Microsystems in Automotive Industries: Safety - Engine and power trains - Comfort and convenience, Micro actuation: Actuation using thermal forces -actuation using shape memory alloys - Actuation using piezoelectric effect - Actuation using Electrostatic forces.

UNIT-II MICROSYSTEM FABRICATION PROCESS 9

Photolithography, Ion Implantation, Diffusion, Oxidation: Thermal oxidation-Oxidation by color, Chemical Vapour Depostion, Physical Vapour Deposition: Sputtering, Etching: Chemical-Plasma, Micromaching: Bulk Micromachining - Surface Micromachining.

UNIT-III POLYMERS AND OPTICAL MEMS 9

Polymers in MEMS : Polimide - SU-8 - Liquid Crystal Polymer (LCP) – PDMS – PMMA – Parylene – Fluorocarbon, Optical MEMS : Lenses and Mirrors – Actuators for Active OpticalMEMS, Assembly of 3D MEMS – Foundry process.

UNIT-IV INTRODUCTION TO NANOSCALE ENGINEERING 9

General Principle of Nano Fabrication, Nano products, Applications of Nano products, Quantum physics, Fluid flow in submicrometers and nanoscales : Rarefied Gas – Knudsen and matchnumbers – Modleing of micro and nanoscale gas flow, Heat Conduction at Nanoscale,Challenges in Nanoscale Engineering, New materials for NEMS.

UNIT-V PATTERNING AND PREPARATION METHODS 9

Bottom up Synthesis – Top down Approach : Precipitation, Mechanical Milling, Colloidal routes, Self assembly, Vapour phase deposition, Evaporation, Molecular Beam Epitaxy, Atomic LayerEpitaxy, MOMBE, Patterning : Introduction to optical/UV electron beam and X-ray Lithography systems and processes. Clean rooms: specifications and design, air and water purity, requirements for particular processes.

TOTAL :45 PERIODS

COURSE OUTCOMES

- Ability to understand the operation of micro devices, micro systems and their applications.
- Ability to design the micro devices, micro systems using the MEMS fabrication process.

- Ability to understand the operation of nao devices, nano systems and their applications.
- Ability to have knowledge on lithographic techniques and using clean room facility.
- Ability to design nano devices, nano systems using the preparation methods.

TEXT BOOKS:

1. Tai Ran Hsu “MEMS and Microsystems Design : Manufacture and Nano Scale Engineering”, John Wiely& Sons, INC., 2nd Edition, 2008.
2. A.S. Edelstein and R.C. Cammearata, eds., Nanomaterials: Synthesis, Properties and Applications,
3. (Institute of Physics Publishing, Bristol and Philadelphia, 1996).

REFERENCE BOOKS:

1. Chang Liu, ‘Foundations of MEMS’, Pearson Education Inc., 2012.
2. Mohamed Gad-el-Hak, editor, “ The MEMS Handbook”, CRC press Baco Raton, 2001.
3. NadimMaluf,“ An Introduction to Micro Electro Mechanical System Design”, ArtechHouse, 2000..
4. G Timp (Editor), Nanotechnology, AIP press/Springer, 1999.
5. N John Dinardo, Nanoscale charecterisation of surfaces & Interfaces, Second edition, Weinheim Cambridge, Wiley-VCH, 2000.

CO - PO and CO - PSO MAPPING:

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

1905613 POWER ELECTRONICS AND DRIVES

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- Comprehensive introduction to various power electronic devices, their structure, operating principle and characteristics.
- Give exposure to various topologies, working principle and analysis of controlled

rectifiers and ac controllers.

- Detailed knowledge on Classifications, structure, operating principle of dc choppers.
- Introduction to different types of Inverters, their principle of operation and waveform control.
- Overview on dc and ac drives and their control using power electronic circuits.

UNIT-I POWER SEMICONDUCTOR DEVICES AND CHARACTERISTICS 9

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 9

Single phase – Three phases – 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 9

Step up and Step down Chopper – Chopper classification - quadrant of operation – Switching mode Regulators – Buck, Boost, Buck-Boost, and Cuk Regulators.

UNIT-IV INVERTERS 9

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 9

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

COURSE OUTCOMES:

- Ability to explain various devices and their structure, operating characteristics in the field of electronics.
- Ability to get exposure to various topologies, working principle and analysis of controlled rectifiers and ac controllers.

- Ability to gain knowledge on Classifications, structure, operating principle of dc choppers.
- Ability to gain knowledge about different types of Inverters , their principle of operation and waveform control.
- Ability to get exposure on dc and ac drives and their control using power electronic circuits.

TEXT BOOKS:

1. Rashid, M.H., “Power Electronics – Circuits, Devices and Applications”, PHI, 3rd Edition, 2009.
2. Mohan, Udeland and Robbins., “Power Electronics”, John Wiley and Sons, New York, 1995.

REFERENCE BOOKS:

1. Singh, M.D., and Khanchandani, K.B., “Power Electronics”, 2ndEdition., 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” by Dr.B.G. Fernandes, IIT Bombay.

CO - PO and CO - PSO MAPPING:

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

1907603 SYSTEM IDENTIFICATION L T P C

3 0 0 3

COURSE OBJECTIVES:

- To understand the mathematical modelling of systems.
- To observe systems by their behaviour using Parametric Identification methods using online and offline Data’s

- To observe systems by their behaviour using Nonparametric Identification Methods using Online and Offline Data's
- To estimate and validate the data's using parametric and recursive estimation methods.
- To perform case studies on electromechanical and process control systems.

UNIT-I NONPARAMETRIC IDENTIFICATION 9

Transient and frequency analysis methods, impulse and step response methods, correlation method, spectral analysis.

UNIT-II PARAMETRIC INDENTIFICATION 9

Steps in identification process, determining model structure and dimension, Linear and nonlinear model structures (ARX, ARMAX, Box-Jenkins, FIR, Output Error models), Input signals: commonly used signals, spectral properties, and persistent excitation, Residual analysis for determining adequacy of the estimated models.

UNIT-III PARAMETRIC ESTIMATION 9

Linear regression, least square estimation, statistical analysis of LS methods, Minimizing prediction error- identifiability, bias, Least squares, relation between minimizing the prediction error and eMLE, MAP, Convergence and consistency, asymptotic distribution of parameter estimates, Instrumental Variable Method.

UNIT-IV RECURSIVE ESTIMATION 9

Forgetting Factor method, Kalman Filter interpretation Identification in practice: Aliasing due to sampling, closed loop data, model order estimation, robustness considerations, model validation.

UNIT-V CASE STUDIES 9

Electro Mechanical Systems, Process Control Systems using Matlab / Equivalent System Identification Toolbox.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

- Understand and explain about different model structures, parameterization, identifiability, structure determination and order estimation
- Perform parameter estimation using different identification techniques
- Identify plants online using recursive estimation methods

- Set up an experiment, identify a nominal model, assess the accuracy and precision of this model.
- Select appropriate design choices to arrive at a validated model.

TEXT BOOKS:

1. Torsten Soderstrom, Petre Stoica, System Identification, Prentice Hall International (UK) Ltd. 1989.

REFERENCE BOOKS:

1. Jung, L. System Identification: Theory for the User, 2nd Edition, Prentice-Hall, 1999, ISBN 0-13-656695-2.
2. Karel J. Keesman, System Identification, An introduction, Springer, 2011.
3. Zhu, Y. Multivariable System Identification for Process Control, Pergamon, 2001.
4. Landan ID, “System Identification and Control Design,” Prentice Hall
5. ArunK. Tangirala, Principles of System Identification: Theory and Practice, CRC Press, 2014.

CO - PO and CO - PSO MAPPING:

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CO 1	3	3	3	3									3	3	3	3
CO 2	3	3	2	2	2								3	2	3	3
CO 3	3	3	2	2	2								3	2	3	3
CO 4	3	3	2	2	3								3	2	3	3
CO 5	2	2	3	3	3		2						2	1	2	2

1904003 COMPUTER NETWORKS L T P C

3 0 0 3

COURSE OBJECTIVES:

- To understand the protocol layering and physical level communication.
- To analyze the performance of a network.
- To understand the various components required to build different networks.
- To learn the functions of network layer and the various routing protocols.
- To familiarize the functions and protocols of the Transport layer.

UNIT-I INTRODUCTION AND PHYSICAL LAYER 9

Networks – Network Types – TCP/IP Protocol suite – OSI Model – Physical Layer: Performance – Transmission media – Switching – Circuit-switched Networks – Packet Switching.

UNIT-II DATA-LINK LAYER & MEDIA ACCESS 9

Introduction – DLC Services – Data-Link Layer Protocols – HDLC – PPP - Media Access Control - Wired LANs: Ethernet - Wireless LANs – Introduction – IEEE 802.11, Bluetooth – Connecting Devices.

UNIT-III NETWORK LAYER 9

Network Layer Services – Packet switching – IPV4 Addresses – Forwarding of IP Packets - Network Layer Protocols: IP, ICMP v4 – Unicast Routing Algorithms – Protocols – Multicasting Basics – IPV6 Addressing – IPV6 Protocol.

UNIT-IV TRANSPORT LAYER 9

Introduction – Transport Layer Protocols – Services – Port Numbers – User Datagram Protocol – Transmission Control Protocol – SCTP.

UNIT-V APPLICATION LAYER 9

WWW and HTTP – FTP – Email –Telnet –SSH – DNS – SNMP.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

- Understand the basic layers and its functions in computer networks.
- Evaluate the performance of a network.
- Understand the basics of how data flows from one node to another.
- Analyze and design routing algorithms.
- Understand the working of various application layer protocols

TEXT BOOKS:

1. Behrouz A. Forouzan, Data Communications and Networking, Fifth Edition TMH, 2013.

REFERENCE BOOKS:

1. Larry L. Peterson, Bruce S. Davie, “Computer Networks: A Systems Approach”, Fifth Edition, Morgan Kaufmann Publishers Inc., 2012.

2. William Stallings, “Data and Computer Communications”, Tenth Edition, Pearson Education, 2013.
3. Nader F. Mir, “Computer and Communication Networks”, Second Edition, Prentice Hall, 2014.

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	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
CO 1	3	2			3								2	3		
CO 2	2				3									2	3	
CO 3		3			2						3		2			
CO 4			2		3		3							3	2	
CO 5	3		2								2		2		3	

1904606 INTELLECTUAL PROPERTY RIGHTS L T P C

3 0 0 3

COURSE OBJECTIVE:

- To acquaint the students with basics of intellectual property rights with special reference to Indian Laws and its practices.
- To provide an overview of the statutory, procedural, and case law underlining these processes and their interplay with litigation.
- To provide an detailed idea about Agreements and Registration.
- To provide a superior environment to students for commercialization of intellectual property.
- To encourage and protect innovation in the form of intellectual property rights.

UNIT-I INTRODUCTION 9

Introduction to IPRs, Basic concepts and need for Intellectual Property - Patents, Copy rights, Geographical Indications, IPR in India and Abroad – Genesis and Development – the way from WTO to WIPO –TRIPS, Nature of Intellectual Property, Industrial Property, technological Research, Inventions and Innovations – Important examples of IPR.

UNIT-II REGISTRATION OF IPRs 9

Meaning and practical aspects of registration of Copy Rights, Trademarks, Patents, Geographical Indications, Trade Secrets and Industrial Design registration in India and Abroad

UNIT-III AGREEMENTS AND LEGISLATIONS 9

International Treaties and Conventions on IPRs, TRIPS Agreement, PCT Agreement, Patent Act ofIndia, Patent Amendment Act, Design Act, Trademark Act, Geographical Indication Act.

UNIT-IV DIGITAL PRODUCTS AND LAW 9

Digital Innovations and Developments as Knowledge Assets – IP Laws, Cyber Law and Digital Content Protection – Unfair Competition – Meaning and Relationship between Unfair Competition andIP Laws – Case Studies.

UNIT-V ENFORCEMENT OF IPRs 9

Infringement of IPRs, Enforcement Measures, Emerging issues – Case Studies.

TOTAL: 45 PERIODS

COURSE OUTCOME:

- Skill to understand the concept of intellectual property rights.
- Develops procedural knowledge to Legal System and solving the problem relating to Intellectual property rights.
- Skill to pursue the professional programs in Company Secretary ship, Law. Business (MBA), International Affairs, Public Administration and Other fields.
- Employability as the Compliance Officer, Public Relation Officer and Liaison Officer.
- Establishment of Legal Consultancy and service provider.

TEXT BOOKS

1. V. Scople Vinod, Managing Intellectual Property, Prentice Hall of India pvt Ltd, 2012
2. S. V. Satakar, “Intellectual Property Rights and Copy Rights, Ess Ess Publications, New Delhi, 2002

REFERENCE BOOKS:

1. Deborah E. Bouchoux, “Intellectual Property: The Law of Trademarks, Copyrights, Patents and Trade Secrets”, Cengage Learning, Third Edition, 2012.
2. PrabuddhaGanguli,”Intellectual Property Rights: Unleashing the Knowledge Economy”,McGraw Hill Education, 2011.
3. Edited by Derek Bosworth and Elizabeth Webster, The Management of Intellectual Property,Edward Elgar Publishing Ltd., 2013.

CO - PO and CO - PSO MAPPING:

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

PROFESSIONAL ELECTIVE - II
(VI SEMESTER)

1907604 ADAPTIVE CONTROL L T P C

3 0 0 3

COURSE OBJECTIVES:

- To study the definition of adaptive control and methods of adaptation.
- To study the parameter identification of systems.
- To study the self-tuning of PID controllers based on parameter identification.
- To study the model reference adaptive control.
- To study the practical application through case studies.

UNIT-I INTRODUCTION 9

Introduction to adaptive control – Effects of process variations –Adaptive control schemes – Adaptive control problem – Non-parametric identification – Step response method – Impulse response method – Frequency response method.

UNIT-II PARAMETRIC IDENTIFICATION 9

Linear in parameter models - ARX – ARMAX – ARIMAX – Least square estimation – Recursive least square estimation – Extended least square estimation – Maximum likelihood estimation – Introduction to non-linear systems identification - Pseudo random binary sequence.

UNIT-III SELF-TUNING REGULATOR 9

Deterministic in-direct self-tuning regulators – Deterministic direct self-tuning regulators – Introduction to stochastic self-tuning regulators – Stochastic indirect self-tuning regulator.

UNIT-IV MODEL REFERENCE ADAPTIVE CONTROLLER 9

The MIT rule – Lyapunov theory – Design of model reference adaptive controller using MIT rule and Lyapunov theory – Relation between model reference adaptive controller and self-tuning regulator.

UNIT-V TUNING OF CONTROLLERS AND CASE STUDIES 9

Design of gain scheduling controller - Auto-tuning of PID regulator – Stability analysis of adaptive controllers – Application of adaptive control in chemical reactor, distillation column and variable area tank system.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

- Understand the effect of parameter variation and principle of adaptive control schemes.
- Distinguish different parametric identification methods.
- Understand Deterministic and Stochastic Self Tuning Regulators.
- Design model reference adaptive controller
- Design gain scheduling controller and apply adaptive control schemes for industrial processes.

TEXT BOOKS:

1. Karl J. Astrom& Bjorn Wittenmark, ‘Adaptive Control’, Pearson Education (Singapore), Second Edition, 2003.
2. Shankar Sastry and Marc Bodson, ‘Adaptive Control: Stability, Convergence, and Robustness’ , Prentice-Hall, 2011.
3. I. D. Landau, R. Lozano, and M. M’Saad, ‘Adaptive Control’, NY:Springer\Verlag, 1998.

REFERENCE BOOKS:

1. Chalam, ‘Adaptive Control Systems: Techniques and Applications’, CRC Press, 1987.
2. Landau, I.D., Lozano, R., M'Saad, M., Karimi, A, ‘Adaptive Control Algorithms, Analysis and Applications’, 2nd edition, Springer, 2011
3. T. C.H.A. Hsia, ‘System Identification’, Lexington books, 1974.
4. Stephanopoulis G. ‘Chemical Process Control’, Prentice Hall of India, New Delhi, 1990.
5. Miroslav Krstic, IoannisKanellakopoulos, Petar V. Kokotovic, ‘Nonlinear and Adaptive Control Design’, 1st Edition, Wiley, 1995.
6. Gang Tao, ’Adaptive Control Design and Analysis’, Wiley-IEEE Press, 2003,
7. Kumpati S. Narendra, Anuradha M. Annaswamy, ‘Stable Adaptive Control Systems’, Prentice Hall,1989.

CO - PO and CO - PSO MAPPING:

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

1907605 ADVANCED INSTRUMENTATION SYSTEMS LT P C

3 0 0 3

COURSE OBJECTIVES:

- To make the students review the instruments used for measurement of basic process parameters like level, flow, pressure and temperature.
- To explore the various types of analyzers used in industrial applications.
- To make the students to understand the requirement of safety instrumented system, standards and risk analysis techniques
- To make students familiarize with Instrumentation standards such as BS1042, ISA 75, ISA 84and ISA 88.
- To make students familiarize with Instrumentation Symbols, Abbreviations and Identification for Instruments, Process Flow diagrams, Instrument Loop diagrams and Piping and Instrumentation Diagrams.

UNIT-I MEASUREMENT OF PROCESS PARAMETERS 9

Review the various Measurement techniques of temperature, pressure, flow and level – application -selection of sensors– calibration methods.

UNIT-II INSTRUMENTS FOR ANALYSIS 9

Ion selective electrodes, Gas & Liquid Chromatography - Oxygen analyzers for gas and liquid – CO,CO2, NO and SO Analyzers- Hydrocarbon and HS Analyzers – Dust Analyzers, smoke Analyzers, Toxic gas Analyzers and radiation monitoring.

UNIT-III SAFETY INSTRUMENTATION 9

Introduction to Safety Instrumented Systems – Hazards and Risk – Process Hazards Analysis (PHA)– Safety Life Cycle – Control and Safety Systems - Safety Instrumented Function - Safety Integrity Level (SIL) – Selection, Verification and Validation.

UNIT-IV INSTRUMENTATION STANDARDS 9

Instrumentation Standards - significance of codes and standards – overview of various types - Introduction of various Instrumentation standards – review, interpretation and significance of specific standards - examples of usage of standards on specific applications.

UNIT-V DOCUMENTATION IN PROCESS INDUSTRIES 9

Block Diagram of a Typical Process – Instrumentation Symbols, Abbreviations and Identification for Instruments: - Mechanical Equipment, Electrical Equipment, Instruments and Automation Systems -Process Flow Diagram (PFD) – Piping and Instrumentation Diagram (P&ID) -Instrument Lists and Specification – Logic Diagrams – Instrument Loop Diagrams - Instrument Hookup Diagrams –Location Plans for Instruments - Cable Routing Diagrams – Typical Control / Rack Rooms Layout –Vendors Documents and Drawings

TOTAL: 45 PERIODS

TEXT BOOKS:

1. B.G.Liptak, “Instrumentation Engineers Handbook (Process Measurement & Analysis)”,Fourth Edition, Chilton Book Co, CRC Press, 2005.

REFERENCE BOOKS:

1. SwapanBasu, “Plant Hazard analysis and Safety Instrumentation systems” Academic Press, 2016.
2. Al.Sutko,Jerry.D.Faulk, “Industrial Instrumentation”, Delmar publishers, 1996.
3. Paul Gruhn, P.E., CFSE and Harry Cheddie, P.E., “Safety Instrumented Systems: Design, Analysis, and Justification”, 2nd Edition, ISA 2006.
4. Safety - ANSI/ISA84.00.01-2004, Part 1: Framework, Definitions, System Hardware and Software Requirements; ANSI/ISA84.00.01-2004, Part 2: Functional Safety: Safety Instrumented Systems for the Process Industry Sector; ANSI/ISA84.00.01-2004, Part 3: Guidance for the Determination of the Required Safety Integrity Levels-Informative.
5. Standards - ANSI/ISA-75.01.01 -2002 (60534-2-1 Mod): Flow Equations for Sizing control Valves;ISA84 Process Safety Standards and User Resources, Second Edition, ISA, 2011; ISA88 Batch Standards and User Resources, 4th Edition, ISA, 2011.

6. Documentation Standards - ANSI/ISA5.4-1991 - Instrument Loop Diagrams; ANSI/ISA5.06.01-2007 - Functional Requirements Documentation for Control Software Applications; ANSI/ISA20-1981 - Specification Forms for Process Measurement and Control Instruments, Primary Elements, and Control Valves.

COURSE OUTCOMES:

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

- Understand the instrumentation behind flow, level, temperature and pressure measurement
- Explain about the various types of analyzers used in typical industries.
- Understand the role of Safety instrumented system in the industry.
- Explain Standards for applying Instrumentation in Hazards Locations.
- Design, develop, and interpret the documents used to define instruments and control Systems for a typical project, including P&IDs, loop diagrams, logic diagrams, installation details, and location plans.

CO - PO and CO - PSO MAPPING:

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

1907606 APPLIED SOFT COMPUTING **L T P C**

3 0 0 3

COURSE OBJECTIVES:

- To expose the students to the concepts of feed forward neural networks.
- To provide adequate knowledge about feedback neural networks
- To provide adequate knowledge about fuzzy and neuro-fuuzy systems
- To provide comprehensive knowledge of fuzzy logic control to real time systems.
- To provide adequate knowledge of genetic algorithms and its application to economic dispatch and unit commitment problems.

UNIT-I ARCHITECTURES – ANN 9

Introduction – Biological neuron – Artificial neuron – Neuron model – Supervised and unsupervised learning- Single layer – Multi layer feed forward network – Learning algorithm- Back propagation network.

UNIT-II NEURAL NETWORKS FOR CONTROL 9

Feedback networks – Discrete time Hopfield networks – Transient response of continuous time system – Applications of artificial neural network - Process identification – Neuro controller for inverted pendulum.

UNIT-III FUZZY SYSTEMS 9

Classical sets – Fuzzy sets – Fuzzy relations – Fuzzification – Defuzzification – Fuzzy rules - Membership function – Knowledge base – Decision-making logic – Introduction to neuro fuzzy system- Adaptive fuzzy system.

UNIT-IV APPLICATION OF FUZZY LOGIC SYSTEMS 9

Fuzzy logic control: Home heating system - liquid level control - aircraft landing- inverted pendulum –fuzzy PID control, Fuzzy based motor control.

UNIT-V GENETIC ALGORITHMS 9

Basic concept of Genetic algorithm and detail algorithmic steps-adjustment of free Parameters- Solution of typical control problems using genetic algorithm- Concept on some other search techniques like tabu search and ant colony search techniques for solving optimization problems.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

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

- Understand and apply basic science, circuit theory, Electro-magnetic field theory, control theory and apply them to electrical engineering problems.
- Understand and apply computing platform and software for engineering problems.
- Explore knowledge on genetic algorithms and its application to economic dispatch and unit commitment problems.
- Understand about fuzzy and neuro-fuzzy systems.
- Understand fuzzy logic control to real time systems.

TEXT BOOKS:

1. Laurance Fausett, Englewood Cliffs, N.J., 'Fundamentals of Neural Networks', Pearson Education,1992.
2. Timothy J. Ross, 'Fuzzy Logic with Engineering Applications', Tata McGraw Hill, 3rd Edition ,2010.
3. S.N.Sivanandam and S.N.Deepa, Principles of Soft computing, Wiley India Edition, 2nd Edition, 2013.

REFERENCE BOOKS:

1. Simon Haykin, 'Neural Networks', Pearson Education, 2003.
2. John Yen & Reza Langari, 'Fuzzy Logic – Intelligence Control & Information', Pearson Education,New Delhi, 2003.
3. M.Gen and R,Cheng, Genetic algorithms and optimization, Wiley Series in Engineering Design and Automation, 2000.
4. Hagan, Demuth, Beale, " Neural Network Design", Cengage Learning, 2012.
5. N.P.Padhy, " Artificial Intelligence and Intelligent Systems", Oxford, 2013.
6. William S.Levine, "Control System Advanced Methods," The Control Handbook CRC Press 2011.

CO - PO and CO - PSO MAPPING:

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CO 1	3	-	2	2	3					2		2	2	2	1	3
CO 2	2	1	2	2	3	2				2		2	3	2	2	3
CO 3	3	2	1	2	2	2						2	3	3	3	3
CO 4	3	2	2		3								3	3	3	3
CO 5	3	1	2	2	3							2	3	1	2	3

1905608 EMBEDDED SYSTEMS

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

To impart knowledge on the following Topics

- Building Blocks of Embedded System
- Various Embedded Development Strategies
- Bus Communication in processors, Input/output interfacing.

- Various processor scheduling algorithms.
- Basics of Real time operating system and example tutorials to discuss on one real time operating system tool.

UNIT-I INTRODUCTION TO EMBEDDED SYSTEMS 9

Introduction to Embedded Systems –Structural units in Embedded processor , selection of processor & memory devices- DMA – Memory management methods- Timer and Counting devices, Watchdog Timer, Real Time Clock, In circuit emulator, Target Hardware Debugging.

UNIT-II EMBEDDED NETWORKING 9

Embedded Networking: Introduction, I/O Device Ports & Buses– Serial Bus communication protocols RS232 standard – RS422 – RS 485 - CAN Bus -Serial Peripheral Interface (SPI) – Inter Integrated Circuits (I2C) –need for device drivers. USB, Bluetooth, Zigbee.

UNIT-III EMBEDDED FIRMWARE DEVELOPMENT ENVIRONMENT 9

Embedded Product Development Life Cycle- COURSE OBJECTIVES, different phases of EDLC, Modelling of EDLC; issues in Hardware-software Co-design, Data Flow Graph, state machine model, Sequential Program Model, concurrent Model, object oriented Model.

UNIT-IV RTOS BASED EMBEDDED SYSTEM DESIGN 9

Introduction to basic concepts of RTOS- Task, process & threads, interrupt routines in RTOS, Multiprocessing and Multitasking, Preemptive and non-preemptive scheduling, Task communication shared memory, message passing-, Inter process Communication – synchronization between processes-semaphores, Mailbox, pipes, priority inversion, priority inheritance.

UNIT-V EMBEDDED SYSTEM APPLICATION AND DEVELOPMENT 9

Case Study of Washing Machine- Automotive Application- Smart card System Application-ATM machine –Digital camera.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

- Ability to understand and analyze embedded systems.
- Ability to operate various Embedded Development Strategies
- Ability to study about the bus Communication in processors.
- Ability to acquire knowledge on various processor scheduling algorithms.
- Ability to understand basics of Real time operating system.

TEXTBOOKS:

1. Peckol, “Embedded system Design”, John Wiley & Sons,2019.
2. Lyla B Das,” Embedded Systems-An Integrated Approach”, Pearson, 2013
3. Shibu. K.V, “Introduction to Embedded Systems”, 2e, Mc graw Hill, 2017.

REFERENCE BOOKS:

1. Raj Kamal, ‘Embedded System-Architecture, Programming, Design’, Mc Graw Hill, 2013.
2. C.R.Sarma, “Embedded Systems Engineering”, University Press (India) Pvt. Ltd, 2013.
3. Tammy Noergaard, “Embedded Systems Architecture”, Elsevier, 2006.
4. Han-Way Huang, “Embedded system Design Using C8051”, Cengage Learning, 2009.
5. Rajib Mall “Real-Time systems Theory and Practice” Pearson Education, 2007.

CO - PO and CO - PSO MAPPING:

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CO 1	2	2	3	1	2				2				3			
CO 2	3	3	2	1	1		2		3		2			3		
CO 3	3	2	2	2	2				1		2	2				1
CO 4	3	2	3	1	1						3	3	2			3
CO 5	1		3	2	2						2	2				2

1907607 ANALYTICAL INSTRUMENTS L T P C

3 0 0 3

COURSE 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 9

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 9

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

UNIT-III INDUSTRIAL GAS ANALYZERS AND POLLUTION MONITORING INSTRUMENTS 9

Gas analyzers – Oxygen, NO_2 and H_2S 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 9

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

UNIT-V NUCLEAR MAGNETIC RESONANCE AND MASS SPECTROMETRY 9

NMR: – Basic principles, Continuous and pulsed Fourier NMR spectrometer and Applications - Electron spin Resonance spectroscopy: – Basic principles, Instrumentation and applications. Mass spectrometers: – Sample system – Ionization Methods – Mass analyzer Applications.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

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

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

- Critically evaluate the strengths and limitations of the various instrumental methods.
- Develop critical thinking for interpreting analytical data.
- Understand the working principle, types and applications of NMR and 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, 2006.
3. Robert E. Sherman., “Analytical Instrumentation”, Instruments Society of America, 1996.

REFERENCE BOOKS:

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
5. R.K.Jain, Mechanical and Industrial Measurements, Khanna Publishers, New Delhi, 1999.

CO - PO and CO - PSO MAPPING:

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CO 1	3					2							3	2		
CO 2		2	2		1								2			
CO 3					1		2	1					2			
CO 4		3	2				2									1
CO 5				2	1			1							1	1

PROFESSIONAL ELECTIVE – III

(VII SEMESTER)

1907703	**BIOMEDICAL INSTRUMENTATION**	**L T P C**
		3 0 0 3

COURSE OBJECTIVES:

- To Introduce Fundamentals of Biomedical Engineering
- To study the communication mechanics in a biomedical system with few examples
- To study measurement of certain important electrical and non-electrical parameters
- To understand the basic principles in imaging techniques
- To have a basic knowledge in life assisting and therapeutic devices

UNIT-I FUNDAMENTALS OF BIOMEDICAL ENGINEERING 9

Cell and its structure – Resting and Action Potential – Nervous system and its fundamentals - Basic components of a biomedical system- Cardiovascular systems- Respiratory systems – Kidney and blood flow - Biomechanics of bone - Biomechanics of soft tissues -Physiological signals and transducers - Transducers – selection criteria – Piezo electric, ultrasonic transducers - Temperature measurements - Fibre optic temperature sensors.

UNIT-II NON ELECTRICAL PARAMETERS MEASUREMENT AND DIAGNOSTIC PROCEDURES 9

Measurement of blood pressure - Cardiac output - Heart rate - Heart sound - Pulmonary function measurements – spirometer – Photo Plethysmography, Body Plethysmography – Blood Gas analysers, pH of blood –measurement of blood pCO2, pO2, finger-tip oxymeter - ESR, GSR measurements.

UNIT-III ELECTRICAL PARAMETERS ACQUISITION AND ANALYSIS 9

Electrodes – Limb electrodes –floating electrodes – pregelled disposable electrodes - Micro,needle and surface electrodes – Amplifiers, Preamplifiers, differential amplifiers, chopper amplifiers – Isolation amplifier - ECG – EEG – EMG – ERG – Lead systems and recording methods – Typical waveforms - Electrical safety in medical environment, shock hazards – leakage current-Instruments for checking safety parameters of biomedical equipment.

UNIT-IV IMAGING MODALITIES AND ANALYSIS 9

Radio graphic and fluoroscopic techniques – Computer tomography – MRI – Ultrasonography – Endoscopy – Thermography –Different types of biotelemetry systems - Retinal Imaging – Imaging application in Biometric systems.

UNIT-V LIFE ASSISTING, THERAPEUTIC AND ROBOTIC DEVICES 9

Pacemakers – Defibrillators – Ventilators – Nerve and muscle stimulators – Diathermy – Heart – Lung machine – Audio meters – Dialysers – Lithotripsy - ICCU patient monitoring system – Nano Robots - Robotic surgery –Orthopedic prostheses fixation.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

At the end of the course students will have the

- Ability to understand the philosophy of the heart, lung, blood circulation and respiration system.
- Ability to provide latest ideas on devices of non-electrical devices.
- Ability to gain knowledge on various sensing and measurement devices of electrical origin.
- Ability to understand the analysis systems of various organ types.
- Ability to bring out the important and modern methods of imaging techniques and their analysis.
- Ability to explain the medical assistance/techniques, robotic and therapeutic equipments.

TEXT BOOKS:

1. Leslie Cromwell, Fred J.Weibell , Erich A.Pfeiffer , Biomedical Instrumentation and Measurement, 2nd edition by Cromwell, Pearson India, 2015
2. Joseph J.carr and John M. Brown, Introduction to Biomedical Equipment Technology, John Wiley and sons, New York, 4th Edition, 2012.
3. Khandpur R.S, Handbook of Biomedical Instrumentation,, Tata McGraw-Hill, New Delhi, 3rd Edition, 2014.

REFERENCE BOOKS:

1. John G. Webster, Medical Instrumentation Application and Design, John Wiley and sons, New York, 4th edition, 2016.
2. Duane Knudson, Fundamentals of Biomechanics, Springer, 2nd Edition, 2012.

3. Suh, Sang, Gurupur, Varadraj P., Tanik, Murat M., Health Care Systems, Technology and Techniques, Springer, 1st Edition, 2014.
4. Ed. Joseph D. Bronzino, Donald R.Peterson The Biomedical Engineering Hand Book, fourth edition , Boca Raton, CRC Press , 2014.
5. M.Arumugam, 'Bio-Medical Instrumentation', Anuradha Publications, 2017.

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CO 1														1		1
CO 2			2	1		3						3				
CO 3			2	1		3						3	1			2
CO 4																
CO 5		1	2	2		3						1	3	2		2
CO 6						2						1	1	1		2

1907704 FIBRE OPTICS AND LASER INSTRUMENTATION L T P C

3 0 0 3

COURSE OBJECTIVES:

- To impart about the basic concepts of optical fibres and their properties.
- To provide adequate knowledge about the Industrial applications of optical fibres.
- To familiarize about Industrial application of lasers.
- To enhance the students knowledge in Laser fundamentals.
- To illustrate about holography and Medical applications of Lasers.

UNIT-I OPTICAL FIBRES AND THEIR PROPERTIES 9

Construction of optical fiber cable: Guiding mechanism in optical fiber and Basic component of optical fiber communication, –Principles of light propagation through a fibre: Total internal reflection, Acceptance angle (θa), Numerical aperture and Skew mode, –Different types of fibres and their properties: Single and multimode fibers and Step index and graded index fibers,– 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 9

Fibre optic sensors: Types of fiber optics sensor, Intrinsic sensor- Temperature/ Pressure sensor, Extrinsic sensors, Phase Modulated Fibre Optic Sensor and Displacement sensor (Extrinsic Sensor) – Fibre optic instrumentation system: Measurement of attenuation (by cut back method), Optical domain reflect meters, Fiber Scattering loss Measurement, Fiber Absorption Measurement, Fiber dispersion measurements, End reflection method and Near field scanning techniques – 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 9

Fundamental characteristics of lasers – Level Lasers: Two-Level Laser, Three Level Laser, Quasi Three and four level lasers – Properties of laser: Monochromaticity, Coherence, Divergence and Directionality and Brightness –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 9

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 instrumentation for material processing, Powder Feeder, Laser Heating, Laser Welding, Laser Melting, Conduction Limited Melting and Key Hole Melting – 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 9

Holography: Basic Principle, Holography vs. photography, 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 tumors of vocal cards, brain surgery, plastic surgery, gynaecology and oncology.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

- Understand the principle, transmission, dispersion and attenuation characteristics of optical fibers
- 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.
- Understand laser theory and laser generation system.
- Apply laser theory for the selection of lasers for a specific Industrial application.
- Illustrate about holography and medical application of lasers.

TEXT BOOKS:

1. J.M. Senior, 'Optical Fibre Communication – Principles and Practice', 3rd Edition, 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, 2nd Edition, 2011.

REFERENCE BOOKS:

1. G. Keiser, 'Optical Fibre Communication', McGraw Hill, 1995.
2. M. Arumugam, 'Optical Fibre Communication and Sensors', Anuradha Agencies, 2002.
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. Keiser, G., "Optical Fiber Communication", McGraw-Hill, 3rd Edition, 2000.

CO - PO and CO - PSO MAPPING:

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

1906005	VLSI DESIGN	L T P C
		3 0 0 3

COURSE OBJECTIVES:

The student should be made:

- To understand the fundamentals of CMOS circuits and its characteristics.
- To learn the design and realization of combinational digital circuits.
- To design and realize the sequential digital circuits.
- To Examine the Architectural choices and performance tradeoffs involved in designing and realizing the circuits in CMOS technology.
- To explore the different FPGA architectures and testability of VLSI circuits.

UNIT – I: INTRODUCTION TO MOS TRANSISTOR 9

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

UNIT – II: COMBINATIONAL MOS LOGIC CIRCUITS 9

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

UNIT – III: SEQUENTIAL CIRCUIT DESIGN 9

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

UNIT – IV: DESIGN OF ARITHMETIC BUILDING BLOCKS AND SUBSYSTEM 9

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

UNIT – V: IMPLEMENTATION STRATEGIES AND TESTING 9

FPGA Building Block Architectures, FPGA Interconnect Routing Procedures. ASIC design flow,

Need for Testing, Design for Testability: Ad Hoc Testing, Scan Design, BIST, IDDQ Testing, Design for Manufacturability, Boundary Scan.

TOTAL :45 PERIODS

COURSE OUTCOMES:

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

- Realize the concepts of digital building blocks using MOS transistor.
- Design combinational MOS circuits and power strategies.
- Construct the Sequential Circuits and Timing systems.
- Develop arithmetic building blocks and memory subsystems.
- Apply and implement FPGA, ASIC design flow and testing.

TEXT BOOKS:

1. Neil H.E. Weste, David Money Harris “CMOS VLSI Design: A Circuits and Systems Perspective”, 4th Edition, Pearson, 2017 (UNIT I,II,V)
2. Jan M. Rabaey,AnanthaChandrakasan, Borivoje. Nikolic,”Digital Integrated Circuits:A Design perspective”, Second Edition , Pearson , 2016.(UNIT III,IV)

REFERENCE BOOKS:

1. M.J. Smith, “Application Specific Integrated Circuits”, Addisson Wesley, 1997.
2. Sung-Mo kang, Yusuf leblebici, Chulwoo Kim, “CMOS Digital Integrated Circuits:Analysis& Design”,4th edition McGraw Hill Education,2013.
3. Wayne Wolf, “Modern VLSI Design: System On Chip”, Pearson Education, 2007.
4. R.Jacob Baker, Harry W.LI., David E.Boyee, “CMOS Circuit Design, Layout and Simulation”, Prentice Hall of India 2005.

CO - PO and CO - PSO MAPPING:

CO	PO												PSO			
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CO 1	3	2	-	-	-	-	-	-	-	-	-	2	2	-	-	-
CO 2	3	3	3	2	-	-	-	2	-	-	-	2	3	-	-	-
CO 3	3	3	3	2	-	-	-	-	-	-	-	2	3	-	-	-
CO 4	3	3	3	2	3	1	2	2	-	-	-	2	3	2	1	-
CO 5	3	2	2	1	3	1	2	2	-	-	-	2	2	2	1	-

1906704	DIGITAL IMAGE PROCESSING	L T P C
		3 0 0 3

COURSE OBJECTIVES:

The student should be made:

- To understand the digital image fundamentals.
- To get exposed to simple image enhancement techniques in Spatial and Frequency domain.
- To learn concepts of degradation function and restoration techniques.
- To study the image segmentation and representation techniques.
- To familiarize with image compression and recognition methods.

UNIT – I: DIGITAL IMAGE FUNDAMENTALS 9

Steps in Digital Image Processing – Components – Elements of Visual Perception – Types of Images: Monochrome and Color model, Chromatic diagram, Image Sensing and Acquisition – Image Sampling and Quantization – Relationships between pixels - Color image fundamentals - RGB, HSI models

UNIT – II: IMAGE ENHANCEMENT 9

Spatial Domain: Gray level transformations – Histogram processing – Basics of Spatial Filtering–Smoothing and Sharpening Spatial Filtering, Frequency Domain: Introduction to Fourier Transform– Smoothing and Sharpening frequency domain filters – Ideal, Butterworth and Gaussian filters, Homomorphic filtering, Color image enhancement.

UNIT – III: IMAGE RESTORATION 9

Image Restoration - Degradation model, Properties, Noise models – Mean Filters – Order Statistics – Adaptive filters – Band reject Filters – Band pass Filters – Notch Filters – Optimum Notch Filtering – Inverse Filtering – Wiener filtering

UNIT – IV: IMAGE SEGMENTATION 9

Edge detection, Edge linking via Hough transform – Thresholding - Region based segmentation – Region growing – Region splitting and merging – Morphological processing- Erosion and Dilation, Segmentation by morphological watersheds – Basic concepts of Dam construction, Watershed segmentation algorithm.

UNIT – V: IMAGE COMPRESSION AND RECOGNITION 9

Need for data compression, Huffman, Run Length Encoding, Shift codes, Arithmetic coding,

JPEG standard, MPEG. Boundary representation, Boundary description, Fourier Descriptor, Regional Descriptors – Topological feature, Texture - Patterns and Pattern classes - Recognition based on matching.

TOTAL :45 PERIODS

COURSE OUTCOMES:

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

- Explain the basics and fundamentals of digital image processing, such as digitization, sampling, quantization, and 2D-transforms.
- Apply various techniques of smoothing, sharpening and enhancement on images.
- Analysethe restoration concepts and filtering techniques.
- Explore the basics of segmentation, features extraction.
- Enumerate the compression and recognition methods.

TEXT BOOKS:

1. Rafael C. Gonzalez, Richard E. Woods, “Digital Image Processing”, Pearson, Third Edition, 2010.
2. Anil K. Jain, “Fundamentals of Digital Image Processing”, Pearson, 2002.

REFERENCE BOOKS:

1. Kenneth R. Castleman, “Digital Image Processing”, Pearson, 2006.
2. Rafael C. Gonzalez, Richard E. Woods, Steven Eddins, “Digital Image Processing using MATLAB”, Pearson Education, Inc., 2011.
3. D,E. Dudgeon and RM. Mersereau, “Multidimensional Digital Signal Processing”, Prentice Hall Professional Technical Reference, 1990.
4. William K. Pratt, “Digital Image Processing”, John Wiley, New York, 2002
5. MilanSonkaetal “Image processing, analysis and machine vision”, Brookes/Cole, Vikas Publishing House, 2nd edition, 1999.

CO - PO and CO - PSO MAPPING:

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CO1	3	2	-	-	-	-	-	-	-	-	-	2	2	-	-	-
CO2	3	2	2	3	-	-	-	-	-	-	-	2	2	2	-	-
CO3	3	2	2	2	-	-	-	-	-	-	-	2	2	2	-	-
CO4	3	3	2	2	-	-	-	-	-	-	-	2	3	3	-	-
CO5	3	3	-	-	-	-	-	-	-	-	-	2	2	-	-	-

1904014 ARTIFICIAL INTELLIGENCE L T P C

3 0 0 3

COURSE OBJECTIVES:

The student should be made to:

- Understand the pattern recognition system and its types.
- Be familiar with the statistical and syntactic approach
- Understand the different knowledge representation schemes for AI problems.
- Explore different search strategies for a problem.
- To understand about expert systems.

UNIT-I INTRODUCTION TO LEARNING PROCESS 9

Error Correction Learning, Memory Based Learning, Hebbian Learning, Competitive, Boltzmann Learning, Credit Assignment Problem, Memory, Adaption, Statistical Nature of the Learning Process.

UNIT-II STATISTICAL PATTERN RECOGNITION 9

Parametric estimation and supervised learning, Maximum likelihood estimation, Bayesian parameter estimation, Non-parametric approaches – Parzen window, k-NN estimation, Unsupervised Learning – Clustering Concepts.

UNIT-III SYNTACTIC PATTERN RECOGNITION 9

Grammar Based Approaches, Elements of Formal Grammars, Parsing Concepts – Parsing Algorithm, Transition Networks in Parsing, Higher Dimensional Grammars, Stochastic Grammars, Graphical Approaches – Graph Isomorphism, Attributed Graphs.

UNIT-IV SELF-ORGANIZATION MAPS (SOM) 9

Two Basic Feature Mapping Models, Self-Organization Map, SOM Algorithm, Properties of Feature Map, Computer Simulations, Learning Vector Quantization, Adaptive Patter Classification

UNIT- V EXPERT SYSTEMS 9

Components of Expert Systems, Production rules, Backwards vs Forward reasoning, Statistical reasoning, Meta level knowledge, Introspection, Knowledge engineering case studies, Heuristic search of state space, DFS, BFS, UCS, choice of a search algorithm, Admissibility theorems,

search performance metrics, AI programming environments. AI oriented language and architecture.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

- Describe the different Types of Pattern Recognition.
- Implement statistical and syntactic approach of pattern recognition.
- Apply heuristic concepts to develop intelligent system.
- To understand about Self Organizing Maps(SOM)
- To understand about the Heuristic search of state space.

TEXT BOOKS:

2. Robert Schalkoff, Pattern Recognition: Statistical Structural and Neural Approaches, Wiley – India, 2009
3. Artificial Intelligence: A new synthesis, Nils J Nilsson, Morgan Kaufmann Publishers.

REFERENCE BOOKS:

1. R.O.Duda, P.E.Hart and D.G.Stork, Pattern Classification, John Wiley, 2001.
2. Artificial Intelligence, 2nd ed., Rich, Tata McGraw Hill.
3. Artificial Intelligence, R.B. Mishra, PHI, India, 2010.

CO - PO and CO - PSO MAPPING:

CO	PO												PSO			
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CO 1		1				3							2			
CO 2			2											3		
CO 3	3			2									1			
CO 4		2			3									2		
CO 5	2		2										3			2

PROFESSIONAL ELECTIVE – IV

(VII SEMESTER)

		L	T	P	C
1907705	**INSTRUMENTATION STANDARDS**	**3**	**0**	**0**	**3**

COURSE OBJECTIVES

- To impart basic knowledge on Instrumentation standards.
- To introduce various standard organizations national and international wise.
- To provide knowledge on ISA Standards towards Control valve and Actuators.
- To provide knowledge on ISA Standards towards Nuclear power plants.
- To give exposure to ISA Standards towards Documentation of Measurement and Control

UNIT-I STANDARDS ORGANIZATION 9

Standards: Introduction International and National Standards organization: IEC, ISO, NIST, IEEE, ISA, API, BIS, DIN, JISC and ANSI.API: Process Measurement and Instrumentation (APIRP551): recommended practice for installation of the instruments – flow, level, temperature, pressure - Process Instrument and Control (API RP554): performance requirements and considerations for the selection, specification, installation and testing of process instrumentation and control systems.

UNIT-II ISA STANDARDS 9

Documentation of Measurement and Control, Instruments and System (ISA 5): 5.1, 5.2, 5.3, 5.4, 5.5, 5.6, 5.7 - General Requirements for Electrical Equipment in Hazardous Location (ISA 12): 12.2, 12.4, 12.24, 12.29 – Instrument Specification Forms (ISA20): – Measurement Transducers (ISA37).

UNIT-III ISA STANDARDS - CONTROL VALVE AND ACTUATOR 9

Control Valve Standards (ISA75): 75.01, 75.04, 75.05, 75.7, 75.11, 75.13, 75.14, 75.23, 75.24, and 75.26. Valve Actuator (ISA 96): 96.01, 96.02, 96.03, 96.04.

UNIT-IV ISA STANDARDS - FOSSIL AND NUCLEAR POWER PLANTS 9

Fossil Power Plant Standards (ISA 77): 77.14, 77.22, 77.30, 77.41, 77.42, 77.44, 77.60, 77.70. Nuclear Power Plant Standards (ISA67): 67.01, 67.02, 67.03, 67.04, 67.06.

UNIT-V BS, ISO, IEC, & ANSI 9

Measurement of Fluid Flow by means of Orifice Plates (ISO 5167/ BSI042) IEC 61131-3 – Programmable Controller – Programming Languages – Specification for Industrial Platinum Resistance Thermometer Sensors (BSI904) – International Thermocouple Reference Tables (BS4937) – Temperature Measurement Thermocouple (ANSIC96.1)

TOTAL: 45 PERIODS

COURSE OUTCOMES

At the end of the course, the student should have the:

- Ability to understand the role of standards organization.
- Ability to implement different standards related to installation and control system, programming, documentation, equipment in hazardous area and instrument specificationforms.
- Ability to implement standards related to power plant and nuclear power plant.
- Ability to select different standards related to Actuators, Control Valve, orifice sizing, RTD and thermocouples.
- Ability to compare and select standards related to Process industries.

TEXT BOOKS:

1. API Recommended Practice 551, “Process Measurement Instrumentation”, American Petroleum Institute, Washington, D.C., 1st Edition, May 1993.
2. API Recommended Practice 554, “Process Instrumentation and Control – 3 parts”, American Petroleum Institute, Washington, D.C., 1st Edition, October 2008.
3. ISA standard 5, “Documentation of Measurement and Control Instruments and Systems”, ISA, North Carolina, USA.
4. ISA standard 12, “Electrical Equipment for Hazardous Locations”, ISA, North Carolina, USA.
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. BS EN 60584-1, “Thermocouples - EMF specifications and tolerances”, British Standard, 2013.

CO - PO and CO - PSO MAPPING:

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

1915003 TOTAL QUALITY MANAGEMENT L T P C

3 0 0 3

COURSE OBJECTIVES:

- To understand the need and evolution of quality concepts, contribution of quality gurus.
- To understand the TQM Principles and Models.
- To learn and apply the traditional tools and techniques of TQM.
- To educate students to apply the modern tools and techniques in TQM.
- To understand and apply QMS and EMS in any organization.

UNIT – I: INTRODUCTION 9

Introduction - Definition of quality - Need for quality - Evolution of quality - Dimensions of product and service quality - Definition of TQM - Basic concepts of TQM – Principles of TQM - TQM Framework- Barriers to TQM – Benefits of TQM – Cost of Quality.

UNIT – II: TQM PRINCIPLES 9

Leadership--The Deming Philosophy, Quality council, Quality statements and Strategic planning- Hoshin Planning - Customer Satisfaction –Customer Perception of Quality, Feedback, Customer complaints, Service Quality, Kano Model and Customer retention – Employee involvement – Motivation, Empowerment, Team and Teamwork, Recognition & Reward - Continuous process improvement –Juran Trilogy, PDSA cycle, 5S and Kaizen - Supplier partnership – Partnering, Sourcing, Supplier selection, Supplier Rating and Relationship development

UNIT – III: TQM TOOLS &TECHNIQUES I 9

The seven traditional tools of quality – New management tools – Six-sigma Process Capability– Bench marking – Reasons to bench mark, Bench marking process, Criticisms of Bench Marking – FMEA –FMEA Documentation, Stages.

UNIT – IV: TQM TOOLS & TECHNIQUES II 9

Quality Circles – Quality Function Deployment (QFD) – House of Quality – QFD Process, Benefits – Total Productive Maintenance – Concepts, Benefits – Business Process Reengineering – Concepts, Process and Applications – Business Process Improvement.

UNIT – V: QUALITY MANAGEMENT SYSTEM 9

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 – National and International Awards.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

- Students would understand the basic concepts, contribution of quality guru's and TQM framework.
- Students would become acquainted with TQM Principles.
- Student would be able to apply the tools and techniques of quality management.
- Students will be able to apply Quality philosophy in business processes with an understanding on customer requirements.
- Students can apply QMS and EMS in any organisation.

TEXT BOOK:

1. Dale 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, 2013.

REFERENCE BOOKS:

1. James R. Evans and William M. Lindsay, "The Management and Control of Quality", 8th Edition, First Indian Edition, Cengage Learning, 2012.
2. Janakiraman. B and Gopal.R.K., "Total Quality Management - Text and Cases", Prentice Hall (India) Pvt. Ltd., 2006.

3. Suganthi.L and Anand Samuel, "Total Quality Management", Prentice Hall (India) Pvt. Ltd.,7th Print 2011.
4. Itay Abuhav, ISO 9001: 2015 - A Complete Guide to Quality Management Systems, CRC Press; 1st edition(2017)
5. ISO 9001-2015 standard

CO - PO and CO - PSO MAPPING:

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

1907706 NON LINEAR CONTROL L T P C

3 0 0 3

COURSE OBJECTIVES:

- To understand the nature of non-linear systems and to analyse the stability of such systems
- To develop suitable models of non-linear systems and to develop suitable controllers for such Systems
- To develop suitable controllers for such Systems
- To understand the chaotic and bifurcation behaviour of non-linear systems
- To linearize the non-linear systems.

UNIT-I NON-LINEAR SYSTEMS 9

Types of Non-Linearity – Typical Examples – Properties of nonlinear systems – Nonlinear differential equations – Numerical solutions to nonlinear differential equations – Equilibrium points – free and forced responses – Input and output multiplicities.

UNIT-II STABILITY OF NON-LINEAR SYSTEMS 9

BIBO and Asymptotic stability – Phase plane analysis (analytical and graphical methods) – LyapunovStability Criteria – Krasovskil's method – Lure's and Variable Gradient Method – Popov's stability criterion Stability Analysis by Describingfunction method.

UNIT-III MODELLING AND CONTROL OF NON-LINEAR SYSTEMS 9

Models for Nonlinear systems - Hammerstein and Wiener models - Input signal design for Identification – On-line parameter estimation for nonlinear systems – Nonlinear PID controller – Gainscheduling control – case studies

UNIT-IV CHAOS AND BIFURCATION BEHAVIOR 9

Introduction to Chaos - The Lorenz Equations – Test for chaos - Bifurcation Behaviour of ordinary differential equations - Types of Bifurcations - Limit Cycle Behaviour and Hopf Bifurcation.

UNIT-V LINEARIZATION 9

Methods of linearization – Taylor's series expansion – Jacobean method - state model for systems –Role of Eigen values and Eigenvectors – State transition matrix and its properties – Controllability andobservability – Stabilizability and Detectability

TOTAL: 45 PERIODS

COURSE OUTCOMES:

- The ability to understand the characteristics of various types of nonlinearities present in physical systems.
- The ability to carry out the stability analysis of non-linear systems.
- The ability to analyze the linearization technique.
- The ability to carry out the analysis and design of control systems.
- To analyze the simulation for various nonlinear control technique.

TEXT BOOKS:

1. Hangos, K.M., Bokor, J., and Szederkrnyi, G., "Analysis and control of Non-linear Process Systems".
2. Gopal, M., "Digital Control and State Variable Methods: Conventional and Intelligent Control Systems", Fourth Edition, Tata McGraw-Hill, 2012.

REFERENCE BOOKS:

1. Shankar Sastry, "Nonlinear Systems: Analysis, Stability, and Control", Springer New York, 2013.
2. Bequette, B.W., "Process Control: Modeling, Design and Simulation", Prentice Hall Internationalseries in Physical and Chemical Engineering Sciences, 2003.

3. Steven E. LeBlanc, and Donald R. Coughanowr, “Process Systems Analysis and Control”, 3rdEdition, Chemical Engineering series, McGraw-Hill Higher Education, 2009.
4. Thompson, J. M.T., and Stewart, H. B.,” Nonlinear Dynamics and Chaos”, John Wiley & Sons, 2002.
5. William S. Levine, “The Control Systems Handbook”, Second Edition: Control System Advanced Methods, 2nd Edition, CRC Press, 2010.
6. NPTEL Lecture on “Non-linear system Analysis” by Prof. Laxmidhar Behera, IIT Kanpur.

CO - PO and CO - PSO MAPPING:

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CO 1	3	3	3	3	3								3	3	3	2
CO 2	3	3	3	3	3								3	3	3	2
CO 3	3	3	3	3	3								3	3	3	2
CO 4	3	3	3	3	3								3	3	3	2
CO 5	3	3	3	3	3								3	3	3	2

1920001 FUNDAMENTALS OF NANOSCIENCE L T P C

3 0 0 3

COURSE OBJECTIVES:

- To learn about basis of nanomaterials and their properties.
- To learn the general preparation techniques of nanomaterials.
- To make the students learn the different synthesis techniques of nanomaterials.
- To explore various characterization techniques.
- To elucidate the different applications of nanomaterials.

UNIT-I INTRODUCTION 9

Nano scale Science and Technology- Implications for Physics, Chemistry, Biology and Engineering-Classifications of nano structured materials- nano particles- quantum dots, nano wires-ultra-thin films multilayered materials. Length Scales involved and effect on properties: Mechanical, Electronic, Optical, Magnetic and Thermal properties. Introduction to properties and motivation for study (qualitative only).

UNIT-II GENERAL METHODS OF PREPARATION 9

Bottom-up Synthesis-Top-down Approach: Co-Precipitation, Ultra sonication, Mechanical

Milling, Colloidal routes, Self-assembly, Vapour phase deposition, MOCVD, Sputtering, Evaporation, Molecular Beam Epitaxy, Atomic Layer Epitaxy, MOMBE.

UNIT III NANOMATERIALS 9

Nano forms of Carbon - Buckminster fullerene- grapheme and carbon nanotube, Single wall carbon Nanotubes (SWCNT) and Multi wall carbon nanotubes (MWCNT)- methods of synthesis(arc-growth, laser ablation, CVD routes, Plasma CVD), structure-property Relationships applications- Nano metal oxides-ZnO, TiO2,MgO, ZrO2, NiO, nanoalumina, CaO, AgTiO2, Ferrites, Nanoclays functionalization and applications-Quantum wires, Quantum dots-preparation, properties and applications.

UNIT-IV CHARACTERIZATION TECHNIQUES 9

X-ray diffraction technique, Scanning Electron Microscopy - environmental techniques, Transmission Electron Microscopy including high-resolution imaging, Surface Analysis techniques- AFM, SPM, STM, SNOM, ESCA, SIMS-Nan indentation.

UNIT-V APPLICATIONS 9

NanoInfoTech: Information storage- nanocomputer, molecular switch, super chip, nanocrystal, Nanobiotechlogy: nanoprobes in medical diagnostics and biotechnology, Nano medicines, Targetted drug delivery, Bioimaging - Micro Electro Mechanical Systems (MEMS), Nano Electro Mechanical Systems (NEMS)- Nanosensors, nano crystalline silver for bacterial inhibition, Nanoparticles for sun barrier products - In Photostat, printing, solar cell, battery.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

- Will familiarize about the science of nanomaterials.
- Will demonstrate the preparation of nanomaterials.
- Will get knowledge on different materials and their synthesize technique.
- Will develop knowledge in characteristic nanomaterials.
- Will learn where and how to apply the various properties of nanomaterials.

TEXT BOOKS:

1. A.S. Edelstein and R.C. Cammearata, eds., “Nanomaterial’s: Synthesis, Properties and Applications”, Institute of Physics Publishing, Bristol and Philadelphia, 1996.
2. N John Dinardo, “Nanoscale Characterisation of surfaces & Interfaces”, 2nd edition, Weinheim Cambridge, Wiley-VCH, 2000.

REFERENCE BOOKS:

1. G Timp, “Nanotechnology”, AIP press/Springer, 1999.
2. Akhlesh Lakhtakia,“The Hand Book of Nano Technology, Manometer Structure, Theory, Modeling and Simulations”. Prentice-Hall of India (P) Ltd, New Delhi, 2007.

CO - PO and CO - PSO MAPPING:

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CO 2	2	-	3	3	3	-	-	-	-	-	-	1	2	-	-	-
CO 3	2	-	3	3	3	-	-	-	-	-	-	1	2	-	-	-
CO 4	2	-	3	3	3	1	1	-	-	-	-	1	2	-	-	-
CO 5	3	-	3	3	3	1	1	-	-	-	-	1	2	1	-	-

1904012 MACHINE LEARNING L T P C

3 0 0 3

COURSE OBJECTIVES:

- To introduce various types of machine learning and its basics functions.
- To provide an insight to different supervised learning techniques, merits and demerits.
- To enable the students to understand Graphical models and their applicability to real world problems.
- To study the various probability based learning techniques.
- To study and evaluate dimensionality reduction for the given data.

UNIT –I INTRODUCTION 9

Machine learning: What and why? - Examples of Machine Learning Applications - Types Of Machine Learning Supervised Learning - Machine Learning Process- The Curse of Dimensionality, Overfitting - Training, Testing, and Validation Sets-The Confusion Matrix & Basic Statistics-Bias-Variance Tradeoff

UNIT-II NEURONS, NEURAL NETWORKS, AND LINEAR DISCRIMINANTS 9

Hebb’s Rule - Neural Networks - The Perceptron - Linear Separability & Linear Regression. The Multi-layer Perceptron: Biases, Algorithm - Local minima and Stochastic gradient Descent

Examples Of Using The MLP : Regression Problem & Classification Example - Deriving Back-Propagation

UNIT – III DIMENSIONALITY REDUCTION AND EVOLUTIONARY MODELS 9

Linear Discriminant Analysis (LDA) - PRINCIPAL COMPONENTS ANALYSIS (PCA), Factor Analysis - Independent Components Analysis - **PROBABILISTIC MODEL -** Gaussian Mixture Models : EM Algorithm - Nearest Neighbour Methods - Support Vector Machines

UNIT-IV LEARNING 9

Evolutionary Learning **-** The Genetic Algorithms (GA)- Reinforcement Learning -Decision Trees - CLASSIFICATION AND REGRESSION TREES (CART) - Ensemble Learning : Boosting, Bagging, Random Forests - Unsupervised Learning : K-Means – Algorithm - Vector Quantization

UNIT-V GRAPHICAL MODELS 9

Bayesian Networks - Markov Random Fields - Hidden Markov Models (HMMS) - Markov Chain Monte Carlo (MCMC) Methods - Deep Belief Networks (DBN)

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

- Distinguish between, supervised, unsupervised and semi-supervised learning
- Apply the appropriate machine learning strategy for any given problem
- Suggest supervised, unsupervised or semi-supervised learning algorithms for any given problem
- Design systems that uses the appropriate graph models of machine learning
- Modify existing machine learning algorithms to improve classification efficiency

TEXT BOOKS:

1. Stephen Marsland, ―Machine Learning – An Algorithmic Perspective‖, Second Edition, Chapman and Hall/CRC Machine Learning and Pattern Recognition Series, 2014.

REFERENCE BOOKS:

1. EthemAlpaydin, ―Introduction to Machine Learning 3e (Adaptive Computation and Machine Learning Series)‖, Third Edition, MIT Press, 2014.
2. Tom M. Mitchell, ―Machine Learning‖, McGraw-Hill Education (India) Private Limited, 2017.

CO - PO and CO - PSO MAPPING:

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

PROFESSIONAL ELECTIVE – V

(VIII SEMESTER)

1907801 THERMAL POWER PLANT INSTRUMENTATION LT P C

3 0 0 3

COURSE OBJECTIVES

- To make the students familiarize about various power generation methods.
- To identify various parameters in thermal power plant
- To impart knowledge about different types of control loops in furnace control.
- To impart knowledge about different types of control loops in boilercontrol.
- To familiarize the student with the methods of monitoring different parameters like speed, vibration of turbines and their control.

UNIT-I POWER GENERATION METHODS 9

Brief survey of methods of power generation: hydro, thermal, nuclear, solar and wind power – importance of instrumentation in power generation – thermal power plants: building blocks, details of boiler processes P&I diagram of boiler – cogeneration.

UNIT-II MEASUREMENTS IN POWER PLANTS 9

Electrical measurements: current, voltage, power, frequency, power factor – non electrical parameters: flow of feed water, fuel, air, steam pressure and steam temperature – smoke density measurement – Flue gas oxygen analyzer – pollution monitoring instruments.

UNIT-III FURNACE CONTROL 9

Coal handling: Pulverizers - Furnace Draught: natural draught, forced draught, induced draught,power requirements for draught systems - Combustion control: Fuel/Air ratio,

combustion efficiency,excess air, parallel and cross limited combustion control- soot-blowing operation.

UNIT-IV BOILER CONTROL 9

Boiler metal temperature measurement, pressure measuring devices – Boiler feed water processing and control - drum level measurement methods - steam temperature control: main steam and reheat steam temperature control, superheater control, deaerator control – distributed control system in power plants – interlocks in boiler operation.

UNIT -V TURBINE CONTROL 9

Speed measurement, rotor and casing movement- vibration - shell temperature monitoring and control - steam pressure control - lubricant oil temperature - cooling system.

TOTAL : 45 PERIODS

COURSE OUTCOME:

- Understanding various power generation process.
- Identify important parameter to be monitored and controlled in thermal power plant.
- Knowledge about various building blocks and instruments involved in furnace control.
- Knowledge about various building blocks and instruments involved in boiler control.
- Knowledge about various methods of monitoring different parameters in turbine and their control.

TEXT BOOKS

1. Sam G. Dukelow, The control of Boilers, instrument Society of America, 1991.
2. Modern Power Station Practice, Vol.6, Instrumentation, Controls and Testing, Pergamon Press, Oxford, 1971.

REFERENCE BOOKS

1. Krishnaswamy KM, Bala P, Bala MP, “Power Plant Instrumentation,” Prentice Hall, 2013
2. Elonka.S.M.and Kohal A.L., Standard Boiler Operations, McGraw-Hill, New Delhi, 1994.
3. Jain R.K., Mechanical and industrial Measurements, Khanna Publishers, New Delhi, 2008

CO - PO and CO - PSO MAPPING:

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CO 2		3											2			
CO 3					3										3	
CO 4		3			3										3	
CO 5															2	1

1906007 ADVANCED DIGITAL SIGNAL PROCESSING L T P C

3 0 0 3

COURSE OBJECTIVES:

The student should be made:

- To understand the concepts of stationary and non-stationary random signals and analysis & characterization of discrete-time random processes.
- To examine the significance of estimation of power spectral density of random processes.
- To introduce the principles of optimum filters such as Wiener and Kalman filters.
- To learn the principles of adaptive filters and their applications to communication engineering.
- To know the concepts of multi-resolution analysis.

UNIT –I: DISCRETE-TIME RANDOM PROCESSES 9

Random variables - Ensemble averages a review, Randomprocesses - Ensemble averages, Autocorrelation and autocovariance matrices, Ergodic random process, White noise, Power spectrum, Filtering random processes, spectral factorization, Special types of random processes - AR, MA, ARMA.

UNIT –II: SPECTRUM ESTIMATION 9

Bias and consistency, Non-parametric methods - Periodogram, modified-Periodogram - Performance analysis.Bartlett's method, Welch's method, Blackman-Tukey method.Performance comparison.Parametric methods - Autoregressive (AR) spectrum estimation - Autocorrelation method, Prony's method-Shank’s method, Solution using Levinson Durbin recursion.

UNIT – III: OPTIMUM FILTERS **9**

Wiener filters - FIR Wiener filter - Discrete Wiener Hopf equation, Applications - filtering, Linear prediction, Noise cancellation. IIR Wiener filter - Causal and non-causal filters. Recursive estimators - Discrete Kalman filter.

UNIT –IV: ADAPTIVE FILTERS **9**

Principles and properties of adaptive filters - FIR adaptive filters.Adaptive algorithms - Steepest descent algorithm, The LMS algorithm – Convergence. Applications of adaptive filtering - Noise cancellation, Channel equalization.

UNIT–V: MULTIRESOLUTION ANALYSIS **9**

Short-time Fourier transform - Heisenberg uncertainty principle- Principles of multi-resolution analysis – Speech Signal-Sub-band coding, Continuous and discrete wavelet transform - Properties. Applications of wavelet transform - Noise reduction, Image compression.

TOTAL :45 PERIODS

COURSE OUTCOMES:

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

- Understand the concepts of special random processes in practical applications.
- Choose appropriate spectrum estimation techniques for a given random process.
- Apply optimum filters appropriately for a given communication application.
- Analyze appropriate adaptive algorithm for processing non-stationary signals.
- Investigate wavelet transforms for signal and image processing based applications.

TEXT BOOKS:

1. Monson H. Hayes, "Statistical digital signal processing and modeling", John Wiley and Sons Inc. New York, Indian reprint 2008.
2. P. P. Vaidyanathan, "Multirate systems and filter banks", Prentice Hall Inc. 1993.

REFERENCE BOOKS:

1. John G. Proakis&DimitrisG.Manolakis, “Digital Signal Processing-Principles, Algorithms & Applications”, Fourth Edition, Pearson Education / Prentice Hall, 2007.
2. Sophoncles J. Orfanidis, "Optimum signal processing", McGraw Hill, 2000.
3. Simon Haykin, “Adaptive Filter Theory”, Prentice Hall, Englehood Cliffs, NJ1986.
4. Sanjit K. Mitra, “Digital Signal Processing - A Computer Based Approach”, Tata McGraw Hill, 2007.
5. Andreas Antoniou, “Digital Signal Processing”, Tata McGraw Hill, 2006.

CO - PO and CO - PSO MAPPING:

CO	PO												PSO			
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CO1	3	3	1	2	-	1	-	-	1	-	-	3	3	1	3	-
CO2	3	3	2	2	-	1	-	-	1	-	-	3	3	1	3	-
CO3	3	3	2	2	-	1	-	-	1	-	-	2	3	1	3	-
CO4	3	3	2	1	-	3	-	-	1	-	-	1	3	2	3	-
CO5	3	3	3	3	-	3	-	-	1	-	-	2	3	2	3	-

1915002 PRINCIPLES OF MANAGEMENT LT P C

3 0 0 3

COURSE OBJECTIVES:

- To study the principles of management, functions and its application an organization.
- To educate the students on the concept of planning and decision making.
- To understand the dynamics of human relations in organisations.
- To learn about motivation, communication and leadership aspects.
- To study the process controlling and the various techniques involved in controlling.

UNIT – I: INTRODUCTION TO MANAGEMENT AND ORGANIZATIONS 9

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

UNIT – II: PLANNING 9

Nature and purpose of planning – planning process – types of planning – objectives – setting objectives – policies – Planning premises – Strategic Management –types of strategies – Planning Tools and Techniques – Decision making steps and process.

UNIT – III: ORGANISING 9

Nature and purpose – Formal and informal organization – organization chart – organization structure – types – Line and staff authority – departmentalization – delegation of authority – centralization and decentralization – Job Design - Human Resource Management – HR

Planning, Talent Acquisition, Training and Development, Performance Management, Career planning and management.

UNIT – IV: DIRECTING 9

Motivation – motivation theories – motivational techniques – job satisfaction – job enrichment – leadership – types and theories of leadership – communication – process of communication – barrier in communication – effective communication – communication and IT.

UNIT – V: CONTROLLING 9

System and process of controlling – budgetary and non-budgetary control techniques – use of computers and IT in Management control – Quality control and Inventory Control - Productivity problems and management – control and performance – direct and preventive control – Maintenance control and purchase control– reporting.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

- Students will be able to have a clear understanding of managerial functions.
- Students would have knowledge to apply planning techniques and decision making.
- Understand concept of Human Resource Management.
- Students would be able to understand motivation, leadership and communication principles.
- Students would be able to apply control techniques in the organization.

TEXTBOOKS:

1 Stephen P. Robbins & Mary Coulter, “Management”, 14th Edition, Pearson, 2017

2 JAF Stoner, Freeman R.E and Daniel R Gilbert “Management”, 6th Edition, Pearson, 2004.

REFERENCE BOOKS:

1. Stephen A. Robbins & David A. Decenzo & Mary Coulter, “Fundamentals of Management” 10th Edition, Pearson Education, 2016.
2. Robert Kreitner & Mamata Mohapatra, “Management”, Biztantra, 2008.
3. Harold Koontz & Heinz Weihrich “Essentials of management” Tata Mc Graw Hill, 2006.
4. Tripathy PC & Reddy PN, “Principles of Management”, Tata McGraw Hill, 6th edition 2017.

CO - PO and CO - PSO MAPPING:

CO	PO												PSO			
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CO 1		1							1		2					1
CO 2		2												1		1
CO 3									2							
CO 4									1	2						
CO 5			1		1		1				1		2		2	

1907802 ADVANCED PROCESS CONTROL L T P C

3 0 0 3

COURSE 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 9

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 9

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 9

Fractional-order Calculus and Its Computations – Frequency and Time Domain Analysis of Fractional- Order 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 9

Introduction – Norms for Signals – Robust Stability – Robust Performance – Small Gain Theorem – Optimal H2 Controller Design - H-Infinity Controller Design –– Effects of Weighting Functions in Infinity Control.

UNIT- V FAULT DIAGNOSIS AND FAULT-TOLERANT CONTROL 9

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

COURSE OUTCOMES

- Apply knowledge of mathematics, science, and engineering to build and analyze models for time-varying systems and non-linear systems.
- Ability to design and implement adaptive controllers such as gain-scheduled adaptive controller, Model-reference adaptive controller and Self-tuning controller
- Ability to Identify, formulate, and solve optimal controller
- Ability to Analyze Fractional-order systems, Fractional-order- controller and Design controller for fractional order systems
- Ability to design and implement H2 and H-infinity Controllers
- Ability to use the FDI Techniques, such as Principal component Analysis, state observer to detect and diagnose faults in sensors and actuators.

REFERENCE BOOKS

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.

CO - PO and CO - PSO MAPPING:

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

1907003 PROCESS MODELING AND SIMULATION L T P C

3 0 0 3

COURSE OBJECTIVE:

- To give an overview of various methods of process modeling, different computational techniques for simulation.
- To analyze the simulation for steady state lumped system.
- To analyze the simulation for unsteady state lumped system.
- To analyze the simulation for steady state distributed system.
- To analyze the simulation for unsteady state distributed system.

UNIT-I INTRODUCTION 9

Introduction to modeling and simulation, classification of mathematical models, conservation equations and auxiliary relations.

UNIT-II STEADY STATE LUMPED SYSTEMS 9

Degree of freedom analysis, single and network of process units, systems yielding linear and nonlinear algebraic equations, flow sheeting – sequential modular and equation oriented

approach, tearing, partitioning and precedence ordering, solution of linear and non-linear algebraic equations.

UNIT-III UNSTEADY STATE LUMPED SYSTEMS 9

Analysis of liquid level tank, gravity flow tank, jacketed stirred tank heater, reactors, flash anddistillation column, solution of ODE initial value problems, matrix differential equations, simulation of closed loop systems.

UNIT-IV STEADY STATE DISTRIBUTED SYSTEM 9

Analysis of compressible flow, heat exchanger, packed columns, plug flow reactor, solution of ODE boundary value problems.

UNIT -V UNSTEADY STATE DISTRIBUTED SYSTEM & OTHER MODELLING APPROACHES 9

Analysis laminar flow in pipe, sedimentation, boundary layer flow, conduction, heat exchanger, heat transfer in packed bed, diffusion, packed bed adsorption, plug flow reactor. Empirical modeling, parameter estimation, population balance and stochastic modeling.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

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

- Explain the development of process models based on Conservation principles and Process data.
- Understand the characteristics of state lumped systems.
- The ability to understand the characteristics of state distributed lumped systems.
- The ability to carry out the analysis and design empirical modeling of systems.
- Computational techniques to solve the process models.

TEXT BOOKS:

1. Ramirez, W.; " Computational Methods in Process Simulation ", 2nd Edn., Butterworths Publishers, New York, 2000.
2. Luyben, W.L., " Process Modelling Simulation and Control ",2nd Edn, McGraw-Hill Book Co.,1990

REFERENCE BOOKS:

1. Felder, R. M. and Rousseau, R. W., " Elementary Principles of Chemical Processes ", John Wiley, 2000.

2. Franks, R. G. E., " Mathematical Modelling in Chemical Engineering ", John Wiley, 1967.
3. Amiya K. Jana,"Process Simulation and Control Using ASPEN", 2nd Edn,PHI Learning Ltd (2012).
4. Amiya K. Jana,"ChemicalProcess Modelling and Computer Simulation" 2nd Edn,PHI Learning Ltd,(2012).

CO - PO and CO - PSO MAPPING:

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	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
CO 1	3	3	3	3	3								3	3	3	2
CO 2	3	3	3	3	3								3	3	3	2
CO 3	3	3	3	3	3								3	3	3	2
CO 4	3	3	3	3	3								3	3	3	2
CO 5	3	3	3	3	3								3	3	3	2

PROFESSIONAL ELECTIVE – VI
(VIII SEMESTER)

1907803 INSTRUMENTATION IN PETROCHEMICAL INDUSTRIES L T P C
3 0 0 3

COURSE OBJECTIVES

- To introduce the students the method of oil recovery and the steps involved in oil gas production process.
- To make the students understand the process behaviour of some of the important unit operations in petrochemical industry through mathematical model.
- To familiarize the students to apply knowledge to select the appropriate control strategy for the selective process.
- To provide information about the most important derivatives obtained from petroleum products.
- To help the students in understanding selection and maintenance of instruments in petrochemical industry.

UNIT-I OIL EXTRACTION AND OIL GAS PRODUCTION 9

Techniques used for oil discovery – Oil recovery methods – oil rig system - Overview of oil gas production – oil gas separation – Gas treatment and compression – Control and safety systems- scrubber – coalesce.

UNIT-II IMPORTANT UNIT OPERATIONS IN REFINERY 9

Distillation Column – Thermal cracking – Catalytic Cracking – Catalytic reforming – mathematical Modeling and selection of appropriate control strategy – Alkylation – Isomerization- polymerization.

UNIT-III DERIVATIVES FROM PETROLEUM 9

Derivatives from methane – Methanol Production – Acetylene production - Derivatives from acetylene —Derivatives from ethylene – Derivatives from propylene.

UNIT-IV IMPORTANT PETROLEUM PRODUCTS & MEASUREMENTS 9

BTX from Reformate – Styrene – Ethylene oxide/Ethylene glycol – polyethylene – Polypropylene – PVC & VCM production. Parameters to be measured in refinery and petrochemical industry – Selection and maintenance of measuring instruments.

UNIT-V SAFETY IN INSTRUMENTATION SYSTEMS 9

Hazardous zone classification – Electrical and Intrinsic safety – Explosion suppression and Deluge systems – Flame, fire and smoke detectors – leak detectors – Guidelines and standards – General SIS Design Configurations – Hazard and Risk Assessment – Failure modes – Operation and Maintenance.

TOTAL: 45 PERIODS

COURSE OUTCOMES

- Gain knowledge on oil gas production process and important unit operations in a refinery
- Having gained the process knowledge, ability to develop and analyze mathematical model of selective processes.
- Able to develop, analyze and select appropriate control strategy for selective unit operations in a refinery.
- Gain knowledge on the most important chemical derivatives obtained from petroleum
- Products.
- Understand safety instrumentation followed in process industries.

TEXT BOOKS:

1. Waddams, A.L., “Chemicals from Petroleum”, Wiley, 1973. (Digitized in 2007).
2. Balchen, J.G., and Mumme K.I., “Process Control Structures and Applications”, Von Nostrand Reinhold Company, New York, 1988.

REFERENCE BOOKS:

1. Liptak, B.G., “Instrumentation in Process Industries”, Chilton Book Company, 2005. (Digitized in 2008.)
2. Austin, G.T. and Shreeves, A.G.T., “Chemical Process industries”, McGraw-Hill, 2012.
3. HavardDevold, “Oil and Gas Production Handbook”, ABB, 2006.
4. Paul Gruhn and Harry Cheddie, “Safety Instrumented Systems: Design, Analysis, and Justification”, 2nd Edition, ISA Press, 2006.

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CO 1	3	2				2	2	1					3			
CO 2	2				2	2	2	1					2	1		
CO 3						2		2	1	1						
CO 4							2		1	1	1	1	2	1		

1915004 HUMAN RIGHTS L T P C

3 0 0 3

COURSE OBJECTIVE:

- To sensitize the Engineering students to various aspects of Human Rights.
- To educate on the evolution of human rights movement.
- To create awareness and understanding on the international deliberations towards human rights.
- To educate on constitutional rights and provisions related to human rights in India.
- Create awareness on support organisations in Human Rights in India.

UNIT – I: INTRODUCTION 9

Human Rights - Meaning, Origin and Development. Notion and classification of Rights – Natural, Moral and Legal Rights. Civil, Political Rights, Economic, Social and Cultural Rights, Collective and Solidarity Rights.

UNIT – II: EVOLUTION OF HUMAN RIGHTS MOVEMENT 9

Evolution of the concept of Human Rights Magana carta – Geneva Convention1864. Universal Declaration of Human Rights, 1948. Theories of Human Rights – Feminist Perspectives of Human Rights.

UNIT – III: INTERNATIONAL PRESPECTIVES 9

Theories and Perspectives of UN Laws – UN Agencies to monitor and compliance – UN Commission of Human Rights (UNCHR), UN Children Fund (UNICEF), UN Commission for Refugee (UNHCR), UN Education, scientific and cultural Organisation (UNESCO).

UNIT – IV: HUMAN RIGHTS IN INDIA 9

Human Rights in India – Constitutional Provisions / Guarantees. – Fundamental rights, Directive Principles of State, Policies, Fundamental Duties, Relationship between them, International Human Rights and the Indian Constitution – Human Rights violation in Private and Public Domain.

UNIT – V: HUMAN RIGHTS SUPPORT ORGANISATION 9

Human Rights of Disadvantaged People – Women, Children, Displaced persons and Disabled persons, including Aged and HIV Infected People. Implementation of Human Rights – National and State Human Rights Commission – Judiciary – Role of NGO's, Media, Educational Institutions, Social Movements.

TOTAL: 45 PERIODS

COURSE OUTCOME:

- Engineering students will acquire the basic knowledge of human rights.
- Students will have an understanding on the evolution of human rights movement.
- Students will be able to show an understanding on UN laws and agencies related to human rights.
- Students will be able to advocate on constitutional provisions related to human rights in India.
- Students will have understanding on the various organisations involved in support of human rights in India.

REFERENCE BOOKS:

1. Kapoor S.K., "Human Rights under International law and Indian Laws", Central Law Agency, Allahabad, 7th edition 2014.
2. Chandra U., "Human Rights", Allahabad Law Agency, Allahabad, 2014.
3. Upendra Baxi, 'The Future of Human Rights', Oxford University Press, NewDelhi, 3rd edition 2012.

CO - PO and CO - PSO MAPPING:

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CO 1						1	1									
CO 2								1								
CO 3						1	1							1		
CO 4							1									1
CO 5								1								

1907002 ROBOTICS AND AUTOMATION L T P C

3 0 0 3

COURSE OBJECTIVES

- To impart knowledge on the basic concepts associated with the design, functioning, applications and social aspects of robots
- To provide the concept of electrical drive systems and sensors used in robotics for various applications
- To make the students learn about analyzing robot kinematics, dynamics through different methodologies and study various design aspects of robot arm manipulator and end-effector
- To educate about various motion planning techniques and the associated control architecture
- To make the students explore the implications of AI and other trending concepts of robotics

UNIT-I FOUNDATION FOR BEGINNERS 9

Introduction -- brief history, definition, anatomy, types, classification, specification and need based applications; role and need of robots for the immediate problems of the society, future of mankind and automation-ethical issues; industrial scenario local and global, case studies on mobile robot research platform and industrial serial arm manipulator.

UNIT-II BUILDING BLOCKS OF A ROBOT 9

Types of electric motors – DC Servo, Stepper; specification, drives for motors - speed & direction control and circuitry, Selection criterion for actuators, direct drives, non-traditional actuators; Sensors for localization, navigation, obstacle avoidance and path planning in known and unknown environments – optical, inertial, thermal, chemical, biosensor, other common sensors; Case study on choice of sensors and actuators for maze solving robot and self driving cars.

UNIT-III KINEMATICS, DYNAMICS AND DESIGN OF ROBOTS & END-EFFECTORS 9

Robot kinematics - Geometric approach for 2R, 3R manipulators, homogenous transformation using D-H representation, kinematics of WMR, Lagrangian formulation for 2R robot dynamics; Mechanical design aspects of a 2R manipulator, WMR; End-effector - common types and design case study

UNIT-IV NAVIGATION, PATH PLANNING AND CONTROL ARCHITECTURE 9

Mapping & Navigation – SLAM, Path planning for serial manipulators; types of control architectures - Cartesian control, Force control and hybrid position/force control, Behaviour based control, application of Neural network, fuzzy logic, optimization algorithms for navigation problems, programming methodologies of a robot.

UNIT-V AI AND OTHER RESEARCH TRENDS IN ROBOTICS 9

Application of Machine learning - AI, Expert systems; Tele-robotics and Virtual Reality, Micro & Nano robots, Unmanned vehicles, Cognitive robotics, Evolutionary robotics, Humanoids.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

- Explain the concepts of industrial robots in terms of classification, specifications and coordinate systems, along with the need and application of robots & automation
- Examine different sensors and actuators for applications like maze solving and self driving cars.
- Design a 2R robot & an end-effector and solve the kinematics and dynamics of motion for robots.
- Explain navigation and path planning techniques along with the control architectures adopted for robot motion planning.
- Describe the impact and progress in AI and other research trends in the field of robotics

TEXT BOOKS:

1. Saeed. B. Niku, “Introduction to Robotics, Analysis, system, Applications”, Pearson educations, 2002.
2. Roland Siegwart, Illah Reza Nourbakhsh, “Introduction to Autonomous Mobile Robots”, MIT Press, 2011.

REFERENCE BOOKS:

1. Richard David Klafter, Thomas A. Chmielewski, Michael Negin, “Robotic engineering: an integrated approach”, Prentice Hall, 1989
2. Craig, J. J., “Introduction to Robotics: Mechanics and Control”, 2nd Edition, Addison-Wesley, 1989.
3. K.S. Fu, R.C. Gonzalez and C.S.G. Lee, “Robotics: Control, Sensing, Vision and Intelligence”, McGraw-Hill, 1987.
4. Wesley E Snyder R, “Industrial Robots, Computer Interfacing and Control”, Prentice Hall International Edition, 1988.
5. Robin Murphy, “Introduction to AI Robotics”, MIT Press, 2000
6. Ronald C. Arkin, “Behaviour-based Robotics”, MIT Press, 1998
7. N. P. Padhy, “Artificial Intelligence and Intelligent Systems”, Oxford University Press, 2005
8. Stefano Nolfi, Dario Floreano, “Evolutionary Robotics – The Biology, Intelligence and Technology of Self–Organizing Machines” (Intelligent Robotics and Autonomous Agents series), MIT Press, 2004

CO - PO and CO - PSO MAPPING:

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

1907804 ADVANCED CONTROL SYSTEMS L T P C

3 0 0 3

COURSE OBJECTIVES

The student should be made to:

- Gain knowledge on the methods of plotting Nyquist chart for multivariable system.
- Develop state space models.
- Design state feedback control schemes and state observers.
- Learn the different types of non-linearity’s and phase plane analysis.
- Understand the different methods of determining the stability of non-linear systems.

UNIT-I FREQUENCY DOMAIN DESCRIPTIONS 9

Properties of transfer functions - poles and zeros of transfer function matrices – singular value analysis – Multivariable Nyquist plots.

UNIT-II STATE SPACE APPROACH 9

Review of state model for systems – State transition matrix and its properties – free and forced responses – controllability and observability – Kalman decomposition – minimal realization –balanced realization.

UNIT-III STATE FEEDBACK CONTROL AND STATE ESTIMATOR 9

State Feedback – Output Feedback – Pole placement technique – Full order and Reduced Order Observers – Deadbeat Observers – Dead beat Control

UNIT-IV NON-LINEAR SYSTEMS 9

Types of Non-Linearity – Typical Examples – Phase plane analysis (analytical and graphical Methods) – Limit cycles – Equivalent Linearization – Describing Function Analysis, Derivation of Describing Functions for different non-linear elements.

UNIT- V STABILITY OF NON-LINEAR SYSTEMS 9

Stability concepts – Equilibrium points – BIBO and Asymptotic stability – Stability Analysis by DF method – Lyapunov Stability Criteria – Krasovskil's method – Variable Gradient Method – Popov's Stability Criterion.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

- Able to design state feedback controller and state observer.
- Able to understand and analyse linear and nonlinear systems using phase plane method and describing function method.
- Able to understand and design optimal controller.
- Able to understand optimal estimator including Kalman Filter.
- Ability to apply advanced control strategies to practical engineering problems

TEXT BOOKS:

1. K.Ogata, "Modern Control Engineering", PHI, 5th Edition, 2010.

REFERENCE BOOKS:

1. C.T. Chen, "Linear System Theory and Design", Prentice Hall, 3rd Edition, 2003

2. M.Gopal, “Modern Control System Theory”, Wiley Eastern Limited, 2nd edition, 1996.
3. W. L. Luyben, “Process Modeling, Simulation and Control for Chemical Engineers”, 2 nd edition, McGraw Hill, 1990.
4. D.P.Atherton, “Stability of nonlinear systems”, Prentice Hall, 1986.

CO - PO and CO - PSO MAPPING:

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CO1	1				2	1	2						1			
CO2		1	3		1						1	2			2	
CO3	1					1		1					3			1
CO4		2		2						2				1		
CO5	2		1		3						3				1	2

OPEN ELECTIVE - I
(V SEMESTER)

1902512 ENVIRONMENT AND AGRICULTURE L T P C

3 0 0 3

COURSE OBJECTIVES:

- To emphasize on the importance of environment and agriculture on changing global scenario and the emerging issues connected to it.
- To understand the ecological context of agriculture and its concerns.
- To study the context of climate change and emerging global issues.
- To gain knowledge on water balance.
- To understand the importance of virtual water.

UNIT-I: ENVIRONMENTAL CONCERNS 9

Environmental basis for agriculture and food – Land use and landscape changes – Water quality issues – Changing social structure and economic focus – Globalization and its impacts – Agro ecosystems.

UNIT-II: ENVIRONMENTAL IMPACTS 9

Irrigation development and watersheds – mechanized agriculture and soil cover impacts – Erosion and problems of deposition in irrigation systems – Agricultural drainage and downstream impacts – Agriculture versus urban impacts.

UNIT- III: CLIMATE CHANGE 9

Global warming and changing environment – Ecosystem changes – Changing blue-green-grey water cycles – Water scarcity and water shortages – Desertification.

UNIT-IV: ECOLOGICAL DIVERSITY AND AGRICULTURE 9

Ecological diversity, wild life and agriculture – GM crops and their impacts on the environment – Insets and agriculture – Pollination crisis – Ecological farming principles – Forest fragmentation and agriculture – Agricultural biotechnology concerns.

UNIT-V: EMERGING ISSUES 9

Global environmental governance – alternate culture systems – Mega farms and vertical farms – Virtual water trade and its impacts on local environment – Agricultural environment policies and its impacts – Sustainable agriculture.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

- Students may be able to know how the environment and agriculture are related and the changes in the environmental due to agriculture.
- Students will be able to gather idea on about how the mechanization helps and impacts of soil erosion due to agricultural activities.
- Students will have a wide knowledge of changing environment due to global warming and climate change and its impact on water.
- Students are exposed to the ecological diversity in agriculture and different technologies used in farming activities.
- Students are able to understand the global governance system and agricultural policies involved in the sustainable agricultural systems.

TEXT BOOKS:

1. M.Lakshmi Narasaiah, Environment and Agriculture, Discovery Pub. House, 2006.
2. Arvind Kumar, Environment and Agriculture, ABH Publications, New Delhi, 2005

REFERENCE BOOKS:

1. T.C. Byerly, Environment and Agriculture, United States Dept. of Agriculture, Economic Research Service, 2006.
2. Robert D. Havener, Steven A. Breth, Environment and agriculture: rethinking development issues for the 21st century: proceedings of a symposium, Winrock International Institute for Agricultural Development, 1994.

3. Environment and agriculture: environmental problems affecting agriculture in the Asia and Pacific region; World Food Day Symposium, Bangkok, Thailand. 1989.

CO - PO and CO - PSO MAPPING:

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

1902513 PRODUCTION TECHNOLOGY OF AGRICULTURAL MACHINERY **L T P C**

3 0 0 3

COURSE OBJECTIVES:

- To understand the mechanical properties of engineering materials and their classifications
- To understand the basic principles of lathe and the corresponding machines.
- To gain knowledge on various welding techniques available.
- To understand the importance of advanced manufacturing process.
- To emphasize on the importance of accuracy on machine operation.

UNIT- I: ENGINEERING MATERIALS **9**

Engineering materials - their classification - Mechanical properties of materials, strength, elasticity, plasticity, stiffness, malleability, ductility, brittleness, toughness, hardness, resilience, machinability, formability, weldability. Steels and cast irons: Carbon steels, their classification based on percentage of carbon as low, mild, medium & high carbon steel, their properties & applications. Wrought iron, cast iron. Alloy steels: Stainless steel, tool steel.

UNIT- II: MACHINING **9**

Basic principles of lathe - machine and operations performed on it. Basic description of machines and operations of Shaper-Planner, Drilling, Milling & Grinding.

UNIT- III: WELDING **9**

Introduction, classification of welding processes. Gas welding, types of flames and their

applications. Electric Arc welding. Resistance welding, Soldering & Brazing processes and their uses.

UNIT-IV: ADVANCED MANUFACTURING PROCESS 9

Abrasive flow machining - abrasive jet machining - water jet machining - Electro Discharge Machining (EDM) - Wire cut EDM - Electro Chemical Machining (ECM) - Ultrasonic Machining / Drilling (USM / USD) - Electron Beam Machining (EBM) - Laser Beam Machining (LBM).

UNIT- V: CNC MACHINE 9

Numerical control (NC) machine tools - CNC: types, constitutional details, special features - design considerations of CNC machines for improving machining accuracy - structural members - slide ways - linear bearings - ball screws - spindle drives and feed drives. Part programming fundamentals - manual programming.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

Upon completion of this course,

- Students can able to apply the different manufacturing process and use this in industry for component production.
- Students will be able to understand the working principle of lathe and various operations done on it.
- Students will be able to gather idea on welding and soldering process.
- Students will gain wide knowledge on various advance manufacturing process.
- Students will gain knowledge in CNC machine and improving the machining accuracy.

TEXTBOOKS:

1. “Manufacturing Engineering and Technology”, Kalpakjian and Schmid, Pearson, 2010.
2. Hajra Choudry, “Elements of workshop technology - Vol II”, Media promoters, 2002.

REFERENCE BOOKS:

1. Gupta. K.N., and Kaushik, J.P., 1998, Workshop Technology Vol I and II, New Heights, Daryaganj, New Delhi.
2. Arthur. D., et. al. 1998, General Engineering Workshop Practice, Asia Publishing House, Bombay.
3. Chapman W.A.J., Workshop Technology, 1992, Part I, II, III, E.L.B.S. and Edward Amold Publishers Ltd, London.

CO - PO and CO - PSO MAPPING:

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CO1	3	-	2	1	1	3	-	2	-	-	-	2	1	-	2	2
CO2	2	2	-	-	1	2	-	-	2	-	1	-	2	2	-	3
CO3	3	2	-	2	2	-	-	2	-	-	-	-	1	-	3	2
CO4	2	-	2	3	3	-	2	-	2	1	1	2	2	3	-	2
CO5	-	2	-	2	3	-	2	-	3	1	-	-	-	2	2	3

1903514 AIR POLLUTION AND CONTROL ENGINEERING L T P C

3 0 0 3

COURSE OBJECTIVE:

- To impart knowledge on the principle and design of control of Indoor/ particulate/ gaseous air pollutant and its emerging trends.
- To gain knowledge of characteristics of air pollution and noise pollution.
- To create awareness among the sources and effects of air pollution.
- To gain knowledge on air pollution control equipments.
- To develop a knowledge on air quality standards.

UNIT- I: INTRODUCTION 9

Structure and composition of Atmosphere – Definition, Scope and Scales of Air Pollution – Sources and classification of air pollutants and their effect on human health, vegetation, animals, property, aesthetic value and visibility- Ambient Air Quality and Emission standards – Ambient and stack sampling and Analysis of Particulate and Gaseous Pollutants.

UNIT- II: METEOROLOGY 9

Effects of meteorology on Air Pollution - Fundamentals, Atmospheric stability, Inversion, Wind profiles and stack plume patterns- Atmospheric Diffusion Theories – Dispersion models, Plume rise.

UNIT- III: CONTROL OF PARTICULATE CONTAMINANTS 9

Factors affecting Selection of Control Equipment – Gas Particle Interaction – Working principle,

Design and performance equations of Gravity Separators, Centrifugal separators Fabric filters, Particulate Scrubbers, Electrostatic Precipitators – Operational Considerations.

UNIT- IV: CONTROL OF GASEOUS CONTAMINANTS 9

Factors affecting Selection of Control Equipment – Working principle, Design and performance equations of absorption, Adsorption, condensation, Incineration, Bio scrubbers, Bio filters – Process control and Monitoring - Operational Considerations.

UNIT- V: INDOOR AIR QUALITY MANAGEMENT 9

Air quality standards - Sources, types and control of indoor air pollutants, sick building syndrome and Building related illness - Town planning regulations of industries-Sources and Effects of Noise Pollution – Measurement – Standards –Control and Preventive measures.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

The students completing the course will have

- An understanding of the nature and characteristics of air pollutants, noise pollution and basic concepts of air quality management.
- Ability to identify, formulate and solve air and noise pollution problems.
- Ability to design stacks and particulate air pollution control devices to meet applicable standards.
- Ability to select control equipments.
- Ability to control effects of noise pollution and indoor air pollution.

TEXTBOOKS:

1. Lawrence K. Wang, Norman C. Pareira, Yung Tse Hung, "Air Pollution Control Engineering", Tokyo, springer science , science media LLC,2004.
2. Noel de Nevers, "Air Pollution Control Engineering", Waveland press,Inc 2017.
3. Anjaneyulu. Y, "Air Pollution and Control Technologies", Allied Publishers (P) Ltd., India 2002.

REFERENCE BOOKS:

1. David H.F. Liu, Bela G. Liptak, "Air Pollution", Lweis Publishers, 2000.
2. Arthur C. Stern, "Air Pollution (Vol.I – Vol.VIII)", Academic Press, 2006.
3. Wayne T.Davis, "Air Pollution Engineering Manual", John Wiley & Sons, Inc, 2000.
4. M.N Rao and HVN Rao, "Air Pollution", Tata Mcgraw Hill Publishing Company limited,2007.

CO - PO and CO - PSO MAPPING:

CO	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
CO1	3					3							2			
CO2		3	1											3		
CO3			2				2	2								
CO4				3	3											1
CO5					3				2	1	2	2			3	

1903515 PARTICIPATORY WATER RESOURCES MANAGEMENT L T P C

3 0 0 3

COURSE OBJECTIVE:

- To gain an insight on local and global perceptions and approaches on participatory water resource management
- To know the role of farmers in socio economic issues and challenges.
- To bring the knowledge of water conservation.
- To gain knowledge on issues of water management.
- To develop knowledge on global challenges and solutions.

UNIT- I: FUNDAMENTALS: SOCIOLOGY AND PARTICIPATORY APPROACH 9

Sociology – Basic concepts – Perspectives- Social Stratification – Irrigation as a Socio technical Process - Participatory concepts– Needs for participatory -Objectives of participatory approach.

UNIT- II: UNDERSTANDING FARMERS PARTICIPATION 9

Farmers participation - Need and Benefits - Comparisons of cost and benefit -Sustained system performance - Kinds of participation - Context of participation, factors in the environment - WUA - Constraints in organizing FA - Role of Community Organizer – socio economic - Case Studies.

UNIT- III: ISSUES IN WATER MANAGEMENT 9

Multiple use of water – Issues in Inter-sectoral Water Allocation - domestic, irrigation, industrial sectors - Modernization techniques and its challenges – Command Area Development - Water delivery systems – Advantages and disadvantages.

UNIT-IV: PARTICIPATORY WATER CONSERVATION 9

Global Challenges -Social – Economic – Environmental - Solutions –Political - Water Marketing –Water Rights -Consumer education – Success Stories Case Studies.

UNIT- V: PARTICIPATORY WATERSHED DEVELOPMENT 9

Concept and significance of watershed - Basic factors influencing watershed development – Principles of watershed management - Definition of watershed management – Identification of problems - Watershed approach in Government programmes –- People's participation – Entry point activities - Evaluation of watershed management measures.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

The students will be able to

- Gain knowledge on various processes involved in participatory water resource management.
- Understand farmer's participation in water resources management.
- Aware of the issues related to water conservation and watershed Development.
- Get knowledge in participatory water conservation.
- Understand concept, principle and approach of watershed management.

TEXT BOOKS:

1. Sivasubramaniyan, K. "Water Management", SIMRES Publication, Chennai, 2011.
2. Uphoff.N, "Improving International Irrigation management with Farmer Participation – Getting the process Right – Studies in water Policy and
3. Management", No.11, West view press, Boulder, CO, 1986.
4. Tideman E.M., "Watershed Management", Omega Scientific Publishers, New Delhi, 1996.

REFERENCE BOOKS:

1. Chambers Robert, "Managing canal irrigation", Cambridge University Press, 1989.

CO - PO and CO - PSO MAPPING:

CO	PO												PSO			
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**	**4**
CO1	3		2	1	1	3		2				2	1		2	2
CO2	2	2			1	2			2		1		2	2		3
CO3	3	2		2	2			2					1		3	2
CO4	2		2	3	3		2		2	1	1	2	2	3		2
CO5		2		2	3		2		3	1				2	2	3

1904504 GEOGRAPHIC INFORMATION SYSTEM L T P C

3 0 0 3

COURSE OBJECTIVES:

- To introduce the fundamentals and components of Geographic Information System.
- To provide details of spatial data structures and input, management and output processes.
- To provide details about raster input data structures.
- To be familiar with network topologies.
- To Analyze data analytics and various applications of GIS.

UNIT - I: FUNDAMENTALS OF GIS 9

Introduction to GIS - Basic spatial concepts - Coordinate Systems - GIS and Information Systems – Definitions – History of GIS - Components of a GIS – Hardware, Software, Data, People, Methods – Proprietary and open source Software - geographical data types - Spatial, Attribute data- types of attributes – scales/ levels of measurements.

UNIT – II: SPATIAL DATA MODELS 9

Database Structures – Relational, Object Oriented – ER diagram - spatial data models – Raster Data Structures – Raster Data Compression - Vector Data Structures - Raster vs Vector ModelsTIN and GRID data models - OGC standards - Data Quality.

UNIT - III: DATA INPUT AND TOPOLOGY 9

Scanner - Raster Data Input – Raster Data File Formats – Vector Data Input –Digitiser – Topology - Adjacency, connectivity and containment – Topological Consistency rules – Attribute Data linking – ODBC – GPS - Concept GPS based mapping.

UNIT - IV: DATA ANALYSIS 9

Vector Data Analysis tools - Data Analysis tools - Network Analysis - Digital Education models - 3D data collection and utilisation.

UNIT - V: APPLICATIONS 9

GIS Applicant - Natural Resource Management - Engineering - Navigation - Vehicle tracking and fleet management - Marketing and Business applications - Case studies.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

This course equips the student to

- Have basic idea about the fundamentals of GIS.
- Understand the types of data models.
- Get knowledge about data input and topology.
- Gain knowledge on data quality and standards.
- Understand data management functions and data output.

TEXT BOOKS:

1. Kang - Tsung Chang, Introduction to Geographic Information Systems, McGraw Hill Publishing, 2nd Edition, 2011.

2. Ian Heywood, Sarah Cornelius, Steve Carver, Srinivasa Raju, “An Introduction Geographical Information Systems, Pearson Education, 2nd Edition, 2007.

REFERENCES:

1. Lo.C.P., Albert K.W. Yeung, Concepts and Techniques of Geographic Information Systems, Prentice-Hall India Publishers, 2006.

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CO 1	3	1			2		3						1	2		
CO 2	1				3	1	2								2	
CO 3							2			3		1		1		
CO 4							1				3					
CO 5							1					2	2			

1904508 DATABASE MANAGEMENT SYSTEM LT P C

3 0 0 3

COURSE OBJECTIVES

- To learn the fundamentals of data models and to represent a database system using ER diagrams.
- To study SQL and relational database design.
- To understand the fundamental concepts of transaction processing- concurrency control techniques recovery procedures
- To have an introductory knowledge about Query Processing.
- To analyze the different DB storage like XML,ODMG etc. in distributed environment

UNIT-I INTRODUCTION TO DATABASE 9

Purpose of Database System – Views of data – Data Models – Database System Architecture – Introduction to relational databases – Relational Model – Keys – Entity-Relationship model – E-R Diagrams – Enhanced-ER Model – ER-to-Relational Mapping.

UNIT-II RELATIONAL DATABASE 9

Relational Model – Keys – Relational Algebra – SQL fundamentals – Advanced SQL features – Embedded SQL– Dynamic SQL.

UNIT-III DATABASE DESIGN 9

Functional Dependencies – Non-loss Decomposition -First, Second, Third Normal Forms, Dependency Preservation – Boyce Codd Normal Form – Multi-valued Dependencies and Fourth Normal Form – Join Dependencies and Fifth Normal Form.

UNIT-IV TRANSACTION PROCESSING AND CONCURRENCY CONTROL 9

Transaction Concepts – ACID Properties – Schedules – Serializability – Concurrency Control – Need for Concurrency – Locking Protocols – Two Phase Locking – Deadlock – Transaction Recovery - Save Points – Isolation Levels – SQL Facilities for Concurrency and Recovery.

UNIT-V MPLEMENTATION TECHNIQUES 9

RAID – File Organization – Organization of Records in Files – Indexing and Hashing – Ordered Indices – B+ tree Index Files – B tree Index Files – Static Hashing – Dynamic Hashing – Query Processing Overview – Query optimization using Heuristics and Cost Estimation.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

- Classify the modern and futuristic database applications based on size and complexity
- Map ER model to Relational model to perform database design effectively
- Write queries using normalization criteria and optimize queries.
- Compare and contrast various indexing strategies in different database systems
- Appraise how advanced databases differ from traditional databases.

TEXT BOOKSS:

1. Abraham Silberschatz, Henry F. Korth, S. Sudharshan, “Database System Concepts”, Sixth Edition, Tata McGraw Hill, 2011
2. RamezElmasri, Shamkant B. Navathe, “Fundamentals of Database Systems”, Sixth Edition , Pearson, 2011.

REFERENCE BOOKS:

1. C.J.Date, A.Kannan, S.Swamynathan, “An Introduction to Database Systems”, Eighth Edition, Pearson Education, 2006.
2. Raghu Ramakrishnan, —Database Management Systems‖, Fourth Edition, McGraw-Hill College Publications, 2015.
3. G.K.Gupta, "Database Management Systems‖, Tata McGraw Hill, 2011.

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CO 3	2	1		2	3									2		
CO 4			2			1			2		1				2	
CO 5		3							2							1

1904509 **CLOUD COMPUTING** **L T P C**

3 0 0 3

COURSE OBJECTIVES:

- To understand the concept of cloud computing.
- To appreciate the evolution of cloud from the existing technologies.
- To have knowledge on the various issues in cloud computing.
- To be familiar with the lead players in cloud.
- To appreciate the emergence of cloud as the next generation computing paradigm.

UNIT I INTRODUCTION 9

Introduction to Cloud Computing – Definition of Cloud – Evolution of Cloud Computing – Underlying Principles of Parallel and Distributed Computing – Cloud Characteristics.

UNIT II CLOUD ENABLING TECHNOLOGIES 9

Service Oriented Architecture – REST and Systems of Systems – Web Services – Publish Subscribe Model – Basics of Virtualization – Types of Virtualization – Implementation Levels of Virtualization – Virtualization Structures – Tools and Mechanisms – Virtualization of CPU – Memory – I/O Devices.

UNIT III CLOUD ARCHITECTURE, SERVICES AND STORAGE 9

Layered Cloud Architecture Design – NIST Cloud Computing Reference Architecture – Public,Private and Hybrid Clouds - laaS – PaaS – SaaS – Architectural Design Challenges – Cloud Storage – Storage-as-a-Service – Advantages of Cloud Storage – Cloud Storage Providers – S3.

UN IT IV RESOURCE MANAGEMENT AND SECURITY IN CLOUD 9

Inter Cloud Resource Management – Resource Provisioning and Resource Provisioning Methods – Global Exchange of Cloud Resources – Security Overview – Cloud Security Challenges – Software-as-a-Service Security – Security Governance – Virtual Machine Security – IAM –Security Standards.

UNIT V CLOUD TECHNOLOGIES AND ADVANCEMENTS 9

Hadoop – Map Reduce –Google App Engine – Programming Environment for Google App Engine –– Amazon Web services-Open Stack – Federation in the Cloud.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

On Completion of the course, the students should be able to:

- Articulate the main concepts, key technologies, strengths and limitations of cloud computing.
- Learn the key and enabling technologies that help in the development of cloud.
- Develop the ability to understand and use the architecture of compute and storage cloud, service and delivery models.
- Explain the core issues of cloud computing such as resource management and security.
- Be able to install and use current cloud technologies.

TEXT BOOKS:

1 Kai Hwang, Geoffrey C. Fox, Jack G. Dongarra, "Distributed and Cloud Computing, From

2 Parallel Processing to the Internet of Things", Morgan Kaufmann Publishers, 2012.

3 2. Rittinghouse, John W., and James F. Ransome, —Cloud Computing: Implementation, Management and Security, CRC Press, 2017.

REFERENCE BOOKS:

1. Rajkumar Buyya, Christian Vecchiola, S. ThamaraiSelvi, —Mastering Cloud Computing, Tata Mcgraw Hill, 2013.
2. Toby Velte, Anthony Velte, Robert Elsenpeter, "Cloud Computing - A Practical Approach, Tata Mcgraw Hill, 2009.
3. George Reese, "Cloud Application Architectures: Building Applications and Infrastructure in the Cloud: Transactional Systems for EC2 and Beyond (Theory in Practice), O'Reilly, 2009.

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CO 3	2		3												3	
CO 4			3	2									2			
CO 5				3	3										3	

1905001	ENERGY CONSERVATIONAN AND MANAGEMENT	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

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

- Understand and analyse the energy data of industries.
- Carry out energy accounting and balancing.
- Conduct energy audit and suggest methodologies for energy savings.
- Utilise the available resources in optimal ways
- Understand and analyse of Energy Economics.

UNIT-I: INTRODUCTION 9

Energy-Power–Past & Present scenario of World; National Energy consumption Data–Environmental aspects associated with energy utilization– Energy Auditing: Need, Types, Methodology and Barriers.Role of Energy Managers. Instruments for energy auditing.

UNIT-II: ELECTRICAL SYSTEMS 9

Components of EB billing–HT and LT supply, Transformers, Cable Sizing, Concept of Capacitors, Power Factor Improvement, Harmonics, Electric Motors – Motor Efficiency Computation, Energy Efficient Motors, Illumination–Lux, Lumens,Types of lighting, Efficacy, LED Lighting and scope of Encon in Illumination.

UNIT-III: THERMAL SYSTEMS 9

Stoichiometry, Boilers, Furnaces and Thermic Fluid Heaters–Efficiency computation and encon measures. Steam: Distribution & U sage: Steam Traps, Condensate Recovery, Flash Steam Utilization,Insulators & Refractories.

UNIT-IV: ENERGY CONSERVATIONIN MAJOR UTILITIES 9

Pumps, Fans, Blowers, Compressed Air Systems, Refrigeration and Air Conditioning Systems– CoolingTowers–D.G.sets.

UNIT-V: ECONOMICS 9

Energy Economics– Discount Rate, Payback Period, Internal Rate of Return, Net Present Value, Life Cycle Costing–ESCO concept.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

- Can able to analyse the energy data.
- Can carryout energy accounting and balancing.
- Can suggest methodologies for energy savings.
- Can carry out Energy Conservation in Major Utilities.
- Can suggest methodologies for Energy Economics.

TEXTBOOKS:

1. Energy ManagerTraining Manual (4Volumes) available at www.energymanagertraining.com, a website administered by Bureau of Energy Efficiency (BEE),a statutory body under Ministry of Power,Government of India, 2004

REFERENCES:

1. Witte. L.C., P.S. Schmidt, D.R. Brown, “Industrial Energy Management and Utilisation” Hemisphere Publ, Washington, 1988.
2. Callaghn, P.W. “Design and Management for Energy Conservation”, Pergamon Press, Oxford,1981.
3. Dryden.I.G.C., “The Efficient Use of Energy”Butterworths, London, 1982.
4. Turner.W.C., “Energy Management Hand book”,Wiley,NewYork, 1982.
5. Murphy.W.R.andG. McKAY, “Energy Management”,Butterworths, London1987.

CO - PO and CO - PSO MAPPING:

CO	PO											
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
CO1	1	1		1		3				2		
CO2			2		1				2			1
CO3		1		3		2						
CO4	3					3		2			2	
CO5		2		3	2		1	2				2

1905508	RENEWABLE ENERGY SOURCES	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To get exposure on solar radiation and its environmental impact to power.
- To know about the various collectors used for storing solar energy.
- To know about the various applications in solar energy.
- To learn about the wind energy and biomass and its economic aspects.
- To know about geothermal energy with other energy sources.

UNIT-I: PRINCIPLES OFSOLAR RADIATION 10

Role and potential of new and renewable source, the solar energy option, Environmental impact of solar power, physics of the sun, the solar constant, extraterrestrial and terrestrial solar radiation, solar radiation on titled surface, instruments for measuring solar radiation and sun shine, solar radiation data.

UNIT-II: SOLAR ENERGY COLLECTION 8

Flat plate and concentrating collectors, classification of concentrating collectors, orientation and thermal analysis, advanced collectors.

UNIT-III: SOLAR ENERGY STORAGE AND APPLICATIONS 8

Different methods, Sensible, latent heat and stratified storage, solar ponds. Solar Applications- solar heating/cooling technique, solar distillation and drying, photovoltaic energy conversion.

UNIT-IV: WIND ENERGY 10

Sources and potentials, horizontal and vertical axis windmills, performance characteristics, Betz criteria BIO-MASS: Principles of Bio-Conversion, Anaerobic/aerobic digestion, types of Bio-gas digesters, gas yield, combustion characteristics of bio-gas, utilization for cooking, I.C.Engine operation and economic aspects.

UNIT-V: GEOTHERMAL ENERGY 9

Resources, types of wells, methods of harnessing the energy, potential in India. OCEAN ENERGY: OTEC, Principles utilization, setting of OTEC plants, thermodynamic cycles. Tidal and wave energy: Potential and conversion techniques, mini-hydel power plants, and their

economics. DIRECT ENERGY CONVERSION: Need for DEC, Carnot cycle, limitations, principles of DEC-Magneto Hydro Dynamic power generation.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

- Understanding the physics of solar radiation.
- Ability to classify the solar energy collectors and methodologies of storing solar energy.
- Knowledge in applying solar energy in a useful way.
- Knowledge in wind energy and biomass with its economic aspects.
- Knowledge in capturing and applying other forms of energy sources like wind, biogas and geothermal energies.

TEXTBOOKS:

1. Rai G.D., “Non-Conventional Energy Sources”, Khanna Publishers, 2011.
2. Twidell & Wier, “Renewable Energy Resources”, CRC Press (Taylor & Francis), 2011.

REFERENCE BOOKS:

1. Tiwari and Ghosal, “Renewable energy resources”, Narosa Publishing House, 2007.
2. Ramesh R & Kumar K.U, “Renewable Energy Technologies”, Narosa Publishing House, 2004.
3. Mittal K M, “Non-Conventional Energy Systems”, Wheeler Publishing Co. Ltd, New Delhi, 2003.

CO - PO and CO - PSO MAPPING:

CO	PO											
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
CO1	1					2	2	1	1			2
CO2	1				2	1	3	1				1
CO3	1					2	3	1	2			2
CO4	2				3	2	3	2			1	2
CO5	2					1	2	2	1		2	1

1905509	SCADA SYSTEM MANAGEMENT	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To provide knowledge about the SCADA system and its architecture
- To provide knowledge about SCADA system components
- To provide knowledge about SCADA communication protocols
- To provide knowledge about SCADA monitoring and control in power system
- To provide knowledge about SCADA applications in power system

UNIT I INTRODUCTION 9

Evolution of SCADA, SCADA definitions, SCADA Functional requirements and Components, SCADA Hierarchical concept, SCADA architecture, General features, SCADA Applications, Benefits

UNIT II SCADA SYSTEM COMPONENTS 9

Remote Terminal Unit (RTU), Interface units, Human- Machine Interface Units (HMI), Display Monitors/Data Logger Systems, Intelligent Electronic Devices (IED), Communication Network, SCADA Server, SCADA Control systems and Control panels

UNIT III COMMUNICATION 9

SCADA Communication requirements, Communication protocols: Past, Present and Future, Structure of a SCADA Communications Protocol, Comparison of various communication protocols, IEC61850 based communication architecture, Communication media like Fiber optic, PLCC etc. Interface provisions and communication extensions, synchronization with NCC, DCC.

UNIT IV MONITORING AND CONTROL 9

Online monitoring the event and alarm system, trends and reports, Blocking list, Event disturbance recording. Control function: Station control, bay control, breaker control and disconnector control.

UNIT V APPLICATIONS IN POWER SYSTEM 9

Applications in Generation, Transmission and Distribution sector, Substation SCADA system Functional description, System specification, System selection such as Substation configuration, IEC61850 ring configuration, SAS cubicle concepts, gateway interoperability

list, signal naming concept. System Installation, Testing and Commissioning.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

- This course gives knowledge about SCADA SYSTEM and its architecture
- This course gives knowledge about various system components of SCADA system
- This course gives knowledge about various communication protocols of SCADA system
- This course gives knowledge about SCADA monitoring and control in power system
- This course gives knowledge about SCADA system applications

TEXTBOOKS:

1. Stuart A. Boyer: SCADA-Supervisory Control and Data Acquisition, Instrument Society of America Publications,USA,2004

2. Gordon Clarke, Deon Reynders: Practical Modern SCADA Protocols: DNP3, 60870.5 and Related Systems, Newnes Publications, Oxford, UK,2004

3 William T. Shaw, Cybersecurity for SCADA systems, PennWell Books, 2006

REFERENCE BOOKS:

1. David Bailey, Edwin Wright, Practical SCADA for industry, Newnes, 2003

2. Michael Wiebe, A guide to utility automation: AMR, SCADA, and IT systems for electric Power, PennWell 1999

3. Dieter K. Hammer, Lonnie R. Welch, Dieter K. Hammer, “Engineering of Distributed Control Systems”, Nova Science Publishers, USA, 1st Edition, 2001

CO - PO and CO - PSO MAPPING:

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CO1	1		2		3	2		2	1			3
CO2	3			2	3	1						
CO3	2			3	3	2	1			3		1
CO4		2		3	3	2			1		2	
CO5					3	1						1

1906507 **ENTERTAINTRONICS** **L T P C**

3 0 0 3

COURSE OBJECTIVES:

The student should be made:

- To understand the basics of display devices.
- To enhance the student knowledge in Audio broadcasting systems.
- To enable the student to learn about Television systems.
- To develop the student knowledge in Interactive Gaming Applications.
- To apply the knowledge of Consumer Electronic Applications.

UNIT - I: DISPLAY DEVICES **9**

Introduction – Underlying technologies of displays -Types of Electronic displays – Segment displays –Two dimensional displays: Liquid Crystal display, Light emitting diode display – Three dimensional displays: Laser display, Holographic display – Applications.

UNIT - II: AUDIO BROADCASTING SYSTEMS **9**

Loud Speakers: construction, working principles and applications of crystal, condenser and dynamic loudspeakers – Tweeters, Squawkers & Woofers - Public address system - Requirements of Public Addressing system -Microphones: construction, working principles and applications of Carbon, Moving coil and Crystal microphones. Headphones: Principle of operation of crystal and dynamic and Bluetooth based headphones.

UNIT - III: TELEVISION SYSTEMS **9**

Basics of Television: Television standards, frequency bands, Scanning method, interlacing and synchronization, bandwidth, Advanced TV systems: LCD, LED, HDTV,3DTV, Smart TV. Color concepts, concepts of luminance, Hue and Saturation, Color TV (PAL Systems). Cable TV concepts, Closed Circuit Television.

UNIT - IV: INTERACTIVE GAMING APPLICATIONS **9**

Fundamental of game design - Gaming scenarios – Interfaces- Multi player interactive gaming – Programming concepts – educational games – Privacy and security in games – Introduction to Android games and its development – Online games.

UNIT - V: CONSUMER ELECTRONIC APPLICATIONS **9**

Principle of operation of digital clocks, electronic calculator, cellular phones- smart

phonesmicrowave ovens, washing machines, air conditioners, ATMs and set-top-boxes – Compact Ultrafast Fiber lasers for Consumer electronics – Virtual reality applications, Alexa.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

The student should be able to:

- Understand the basic applications of display devices.
- Analyze the operation of Audio devices and its applications.
- Know the basic TV Standards and the basics of Television.
- Design the Gaming scenarios and knowing programming concepts.
- Apply the knowledge on the applications of Consumer electronics.

TEXT BOOKS:

1. Shoichi Matsumoto, “Electronic display devices”, Wiley, 1990.
2. Ajay Sharma, “Audio video and TV Engineering-Consumer Electronics”, Dhanpat Rai and co, 2003.
3. R.G. Gupta, “Audio and Video systems”, Tata Mc Graw Hill Publishing Co.Ltd, 2010.

REFERENCE BOOKS:

1. R. Gulati, “Monochrome and Color Television”, New Age International (P) Ltd, New Delhi, 2014.
2. S P Bali, “Consumer Electronics”, Pearson, 2007.

CO - PO and CO - PSO MAPPING:

CO	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
CO1	3	3	2	1	-	-	-	-	-	-	-	-	1	2	-	-
CO2	2	2	2	1	-	-	-	-	-	-	-	-	1	2	-	-
CO3	3	3	2	2	-	-	-	-	-	-	-	-	2	3	-	-
CO4	2	2	1	1	-	-	-	-	-	-	-	-	1	2	-	-
CO5	3	3	2	2	-	-	-	-	-	-	-	-	2	3	-	-

1906505 PHOTONIC NETWORKS L T P C

3 0 0 3

COURSE OBJECTIVES:

The student should be made:

- To enable the students to manifest the components used is the optical system, propagation of signals and their impairments in optical fiber.
- To enable the student to understand the importance of the backbone infrastructure for our present and future communication needs.
- To familiarize the students about the optical network architectures and the protocol stack in use.
- To enable the student to understand the differences in the design of data plane and the control plane and the routing, switching and the resource allocation methods and the network management and protection methods in vogue.
- To expose the student to the advances in networking and switching domains and the future trends.

UNIT - I: OPTICAL SYSTEM COMPONENTS 9

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

UNIT - II: OPTICAL NETWORK ARCHITECTURES 9

Introduction to Optical Networks; Wavelength Division Multiplexing, optical add/drop multiplexer, SONET / SDH, Metropolitan-Area Networks, Layered Architecture; Broadcast and Select Networks – Topologies for Broadcast Networks, Media-Access Control Protocols, Wavelength Routing Architecture.

UNIT - III: WAVELENGTH ROUTING NETWORKS 9

The optical layer, Optical Network Nodes, Routing and wavelength assignment, Traffic Grooming in Optical Networks, Architectural variations- Linear Light wave networks, Logically Routed Networks.

UNIT - IV: PACKET SWITCHING AND ACCESS NETWORKS 9

Photonic Packet Switching – OTDM, Multiplexing and Demultiplexing, Synchronization, Broadcast OTDM networks, Switch-based networks, Contention Resolution Access Networks –

Network Architecture overview, Optical Access Network Architectures and OTDM networks, OTDR.

UNIT - V: NETWORK DESIGN AND MANAGEMENT 9

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

TOTAL : 45 PERIODS

COURSE OUTCOMES:

The student should be able to:

- Elucidate the components in an optical system.
- Use the backbone infrastructure for our present and future communication needs.
- Analyze the architectures and the protocol stack.
- Compare the differences in the design of data plane, control plane, routing, switching, resource allocation methods.
- Annotate the network management and protection methods in vogue.

TEXT BOOKS:

1. Rajiv Ramaswami and Kumar N. Sivarajan, “Optical Networks: A Practical Perspective”, Second Edition, Harcourt Asia Pte Ltd., 2004.
2. Siva Ram Moorthy and Mohan Gurusamy, “WDM Optical Networks: Concept, Design and Algorithms”, 1st Edition, Prentice Hall of India, 2002.

REFERENCE BOOKS:

1. John M. Senior ,“Optical Fiber Communication”,3rd edition, Prentice Hall,2009.
2. Uyless N. Black, “Optical Networks, Third Generation Transport Systems”,1st Edition, Prentice hall of India, 2002.
3. Biswanath Mukherjee, “Optical WDM Networks”, Springer Series, 2006.
4. Govind P. Agrawal, “Fiber Optic Communication Systems”, 3rd Edition, Wiley India (P) Ltd, 2002.
5. Gerd Keiser , “Optical Fiber Communication” , 5th Edition , McGraw Hill Education (India) Pvt. Ltd. , 2013.

CO - PO and CO - PSO MAPPING:

CO	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
CO1	-	-	2	1	-	1	-	-	-	-	2	-	1	-	-	-
CO2	2	-	2	-	1	1	-	-	-	-	-	-	-	-	1	-
CO3	2	2	-	1	-	-	-	-	-	-	-	2	-	1	-	-
CO4	2	2	-	2	1	-	-	-	-	-	-	-	-	-	-	-
CO5	2	2	2	-	-	-	-	-	-	-	-	-	-	-	-	-

1906506 TELECOMMUNICATION NETWORK MANAGEMENT L T P C

3 0 0 3

COURSE OBJECTIVES:

The student should be made:

- To understand the concept of network management standards.
- To design the common management information service element model.
- To analyze the various concept of information modeling.
- To examine the concept of SNMPv1 and SNMPv2 protocol.
- To exhibit the examples of network management.

UNIT - I: BASIC FOUNDATIONS AND NETWORK MANAGEMENT APPLICATIONS 9

Network management standards–Network management model– Organization model– Information model - Abstract syntax notation One (ASN.1) – Encoding structure– Macros – Functional model. Network management applications functional requirements: Configuration management– Fault management–Performance management–Error correlation technology– Security management–Accounting management– Common management–report management– Policy based management – Service level management – Management service– Community definitions– capturing the requirements– simple and formal approaches–semi formal and formal notations.

UNIT - II: COMMON MANAGEMENT INFORMATION SERVICE ELEMENT 9

CMISE model–service definitions–errors–scooping and filtering features– synchronization– functional units– association services– common management information protocol specification.

UNIT - III: INFORMATION MODELING FOR TMN 9

Rationale for information modeling–management information model–object oriented modeling paradigm– structure of management information–managed object class definition–management information base.

UNIT - IV: SIMPLE NETWORK MANAGEMENT PROTOCOL 9

SNMPv1: Managed networks–SNMP models– organization model– Information model–SNMPv1 communication model–functional model. SNMPv2-major changes in SNMPv2–structure of management information, MIB–SNMPv2 protocol– compatibility with SNMPv1. SNMPv3– architecture–applications–MIB- security, SNMP Management: remote monitoring–SMI and MIB– RMON1 and RMON2.

UNIT - V: NETWORK MANAGEMENT EXAMPLES 9

ATM integrated local management interface–ATM MIB–M1– M2–M3–M4–interfaces–ATM digital exchange interface management–digita1 subscriber loop and asymmetric DSL technologies–ADSL configuration management–performance management Network management tools: Network statistics management–network management system–management platform case studies: OPENVIEW–ALMAP.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

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

- Design and analyze of fault management.
- Analyze the common management information protocol specifications.
- Explain the functioning and design of management information model.
- Describe the simple network management protocol.
- Interpret the various types of network management tools with case studies.

TEXT BOOKS:

1. Mani Subramanian, “Network Management: Principles and Practice”, Pearson Education, Second edition, 2010.
2. Lakshmi G Raman, “Fundamentals of Telecommunications Network Management”, Wiley, 1999.

REFERENCE BOOKS:

1. Henry Haojin Wang, “Telecommunication Network Management”, Mc- Graw Hill, 1999.

2. Salah Aidarous & Thomas Plevyak, “Telecommunication Network Management: Technologies and Implementations”, Wiley, 1997.

3. Singh B, “Network Security and Management”, Eastern Economy Edition, 2012.

CO - PO and CO - PSO MAPPING:

CO	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
CO1	3	2	1	1	-	-	-	-	-	-	-	2	2	1	-	-
CO2	3	3	3	1	-	-	2	2	-	-	-	2	1	2	-	-
CO3	3	3	3	2	-	-	-	-	-	-	-	2	1	1	-	-
CO4	3	3	2	3	-		2	2		-	-	2	3	2	-	-
CO5	2	2	1	1	-	2	2	2	2	-	-	2	2	2	-	-

1908001 3D PRINTING AND DESIGN L T P C

3 0 0 3

COURSE OBJECTIVES

- The course is designed to impart knowledge and skills related to 3D printing technologies.
- Selection of material and equipment and develop a product using this technique.
- To understand Industry 4.0 environment.
- To understand CAD and Additive manufacturing
- To understand Additive Equipment.

UNIT I 3D PRINTING AND ADDITIVE MANUFACTURING 9

Introduction, Process, Classification, Advantages, Additive V/s Conventional Manufacturing processes, Applications.

UNIT II CAD AND ADDITIVE MANUFACTURING 9

CAD for Additive Manufacturing-CAD Data formats, Data translation, Data loss, STL format. Additive Manufacturing Techniques - Stereo- Lithography, LOM, FDM, SLS, SLM, Binder Jet technology.

UNIT III PROCESS 9

Process, Process parameter, Process Selection for various applications. Additive Manufacturing Application Domains: Aerospace, Electronics, Health Care, Defence, Automotive, Construction, Food Processing, Machine Tools

UNIT IV MATERIALS 9

Polymers, Metals, Non-Metals, Ceramics, Various forms of raw material- Liquid, Solid, Wire, Powder; Powder Preparation and their desired properties, Polymers and their properties. Support Materials.

UNIT V ADDITIVE MANUFACTURING EQUIPMENT 9

Process Equipment- Design and process parameters-Governing Bonding Mechanism-Common faults and troubleshooting - Process Design- Post Processing: Requirement and Techniques- Product Quality.

TOTAL: 45 PERIODS

COURSE OUTCOMES

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

- Develop CAD models for 3D printing.
- Import and Export CAD data and generate .stl file.
- Select a specific material for the given application.
- Select a 3D printing process for an application.
- Produce a product using 3D Printing or Additive Manufacturing (AM).

TEXT BOOKS

1. Lan Gibson, David W. Rosen and Brent Stucker, “Additive Manufacturing Technologies:Rapid Prototyping to Direct Digital Manufacturing”, Springer, 2010.
2. Andreas Gebhardt, “Understanding Additive Manufacturing: Rapid Prototyping, Rapid Tooling, Rapid Manufacturing”, Hanser Publisher, 2011.

REFERENCES BOOKS

1. Khanna Editorial, “3D Printing and Design”, Khanna Publishing House, Delhi.
   CK Chua, Kah Fai Leong, “3D Printing and Rapid Prototyping- Principles and Applications”, World Scientific, 2017.
2. J.D. Majumdar and I. Manna, “Laser-Assisted Fabrication of Materials”, Springer Series in Material Science, 2013.
3. L. Lu, J. Fuh and Y.S. Wong, “Laser-Induced Materials and Processes for Rapid Prototyping”, Kulwer Academic Press, 2001.
4. Zhiqiang Fan And Frank Liou, “Numerical Modelling of the Additive Manufacturing (AM) Processes of Titanium Alloy”, InTech, 2012.

CO - PO and CO - PSO MAPPING:

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CO1	2	-	2	-	-	-	-	-	-	-	-	-	2	-	-	-
CO2	-	2	3	-	2	-	-	-	-	-	-	-	2	-	-	-
CO3	-	-	2	2	-	-	-	-	-	-	-	-	-	3	-	-
CO4	-	-	-	3	2	-	-	-	-	-	2	-	-	3	-	-
CO5	-	-	2	3	2	-	-	-	-	-	-	-	-	2	-	-

1908002 SCRIPTING LANGUAGES L T P C

3 0 0 3

COURSE OBJECTIVES

- The principles of scripting languages.
- Motivation for and applications of scripting.
- Difference between scripting languages and non- scripting languages.
- Types of scripting languages.
- Scripting languages such as PERL, TCL/TK, python and BASH.
- Creation of programs in the Linux environment.
- Usage of scripting languages in IC design flow.

UNIT I LINUX BASICS 9

Introduction to Linux , File System of the Linux, General usage of Linux kernel & basic commands, Linux users and group, Permissions for file, directory and users, searching a file & directory, zipping and UNZIPPING CONCEPTS.

UNIT II LINUX NETWORKING 9

Introduction to Networking in Linux, Network basics & Tools, File Transfer Protocol in Linux, Network file system, Domain Naming Services, Dynamic hosting configuration Protocol & Network information Services.

UNIT III PERL SCRIPTING 9

Introduction to Perl Scripting, working with simple values, Lists and Hashes, Loops and Decisions, Regular Expressions, Files and Data in Perl Scripting, References &

Subroutines, Running and Debugging Perl, Modules, Object – Oriented Perl.

UNIT IV TCL / TK SCRIPTING 9

Tcl Fundamentals, String and Pattern Matching, Tcl Data Structures, Control Flow Commands, Procedures and Scope, Evel, Working with Unix, Reflection and Debugging, Script Libraries, Tk Fundamentals, Tk by examples, The Pack Geometry Manager, Binding Commands to X Events, Buttons and Menus, Simple Tk Widgets, Entry and List box Widgets Focus, Grabs and Dialogs.

UNIT V PYTHON SCRIPTING 9

Introduction to Python, using the Python Interpreter, More Control Flow Tools, Data Structures, Modules, Input and Output, Errors and Exceptions, Classes, Brief Tour of the Standard Library.

TOTAL: 45 PERIODS

COURSE OUTCOMES

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

- Ability to create and run scripts using PERL in IC design flow.
- Ability to create and run scripts using TCl in IC design flow
- Ability to create and run scripts using Python in IC design flow
- Ability to use Linux environment and write programs for automation of scripts in VLSI tool design flow.
- Usage of scripting languages in IC design flow.

TEXT BOOKS

1. Python Tutorial by Guido Van Rossum, Fred L. Drake Jr. editor , Release 2.6.4
2. Practical Programming in Tcl and Tk by Brent Welch, Updated for Tcl 7.4 and Tk4.0.
3. Teach Yorself Perl in 21 days by David Till.
4. Red Hat Enterprise Linux 4 : System Administration Guide Copyright, 2005 Red Hat Inc.

REFERENCE BOOKS

1. Learning Python – 2nd Ed., Mark Lutz and David Ascher, 2003, O'Reilly.
2. Perl in 24 Hours – 3rd Ed., Clinton Pierce, 2005, Sams Publishing.
3. Learning Perl – 4th Ed. Randal Schwartz, Tom Phoenix and Brain d foy. 2005.
4. Jython Essentials – Samuele Pedroni and Noel Pappin.2002. O'Reilly.
5. Programming Perl – Larry Wall, Tom Christiansen and John Orwant, 3rd Edition, O'Reilly, 2000. (ISBN 0596000278)

CO - PO and CO - PSO MAPPING:

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CO2	3	2											3			
CO3		2	3		3								3	3		
CO4			3						3					3		
CO5		2				3							3	3		

1909510 PRODUCT DESIGN AND DEVELOPMENT L T P C
3 0 0 3

COURSE OBJECTIVES:

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

- Product design and development
- Apply the concept of prototyping in a real life problem.
- Reduce the waste by using product architecture**.**
- Understand the concepts of industrial design.
- Understand the concepts of DFM

UNIT-I: INTRODUCTION 9

Need for IPPD – Strategic importance of Product development – integration of customer, designer, material supplier and process planner, Competitor and customer – Behaviour analysis. Understanding customer – prompting customer understanding – involve customer in development and managing requirements.

UNIT-II: CONCEPT GENERATION AND SELECTION 9

Task – Structured approaches – clarification – search – externally and internally – explore systematically – reflect on the solutions and processes – concept selection – methodology – benefits.

UNIT-III: PRODUCT ARCHITECTURE 9

Implications – Product change – variety – component standardization – product performance – manufacturability – product development management – establishing the architecture – creation – clustering – geometric layout development – fundamental and incidental interactions

UNIT-IV: INDUSTRIAL DESIGN 9

Need for industrial design – impact – design process – investigation of for industrial design – impact – design process – investigation of customer needs – conceptualization – refinement – management of the industrial design process – technology driven products – user – driven products – assessing the quality of industrial design.

UNIT-V: DESIGN FOR MANUFACTURING AND PRODUCT DEVELOPMENT 9

Definition – Estimation of Manufacturing cost – reducing the component costs and assembly costs – Minimize system complexity – Prototype basics – principles of prototyping – planning for prototypes – Economic Analysis.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

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

- Product design and development
- Apply the concept of prototyping in a real life problem.
- Reduce the waste by using product architecture**.**
- Understand the concepts of industrial design.
- Understand the concepts of DFM

TEXTBOOKS:

1. Kari T.Ulrich and Steven D.Eppinger, ”Product Design and Development”, McGraw-Hill International Edn.2017.

REFERENCE BOOKS:

1. Kemnneth Crow, “Concurrent Engg./Integrated Product Development”, DRM Associates, 26/3,Via Olivera, Palos Verdes, CA 90274(310) 377-569, Workshop Book.
2. Stephen Rosenthal, “Effective Product Design and Development”, Business One Orwin, Homewood, 1992, ISBN 1-55623-603-4.

CO - PO and CO - PSO MAPPING:

CO	PO												PSO			
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**	**4**
CO1	2	1	1	1				1		1		1			1	1
CO2	1	1	1	1	1		1	1		1						1
CO3	1				1	1	1	1	1	1		1			1	1
CO4	1	1	1				1	1		1					1	1
CO5	2	2					1			1			1			

1909511	VIBRATION AND NOISE CONTROL	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

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

- Apply the fundamental concepts of vibration.
- Apply the fundamentals of noise.
- Describe the various sources of noise for automotive applications.
- Determine the natural frequencies and mode shapes of the two degree freedom systems.
- Describe the different types of noise and its control measures

UNIT-I: BASICS OF VIBRATION 9

Introduction, classification of vibration: free and forced vibration, undamped and damped vibration, linear and non linear vibration, response of damped and undamped systems under harmonic force, analysis of single degree and two degree of freedom systems, torsional vibration, determination of natural frequencies

UNIT-II: BASICS OF NOISE 9

Introduction, amplitude, frequency, wavelength and sound pressure level, addition, subtraction and averaging decibel levels, noise dose level, legislation, measurement and analysis of noise, measurement environment, equipment, frequency analysis, tracking analysis, sound quality analysis.

UNIT-III: AUTOMOTIVE NOISE SOURCES 9

Noise Characteristics of engines, engine overall noise levels, assessment of combustion noise, assessment of mechanical noise, engine radiated noise, intake and exhaust noise, engine necessary contributed noise, transmission noise, aerodynamic noise, tire noise, brake noise.

UNIT-IV: CONTROLTECHNIQUES 9

Vibration isolation, tuned absorbers, un-tuned viscous dampers, damping treatments, application dynamic forces generated by IC engines, engine isolation, crank shaft damping, modal analysis of the mass elastic model shock absorbers.

UNIT-V: SOURCE OF NOISE AND CONTROL 9

Methods for control of engine noise, combustion noise, mechanical noise, predictive analysis, palliative treatments and enclosures, automotive noise control principles, sound in enclosures, sound energy absorption, sound transmission through barriers.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

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

- Apply the fundamental concepts of vibration.
- Apply the fundamentals of noise.
- Describe the various sources of noise for automotive applications.
- Determine the natural frequencies and mode shapes of the two degree freedom systems.
- Describe the different types of noise and its control measures

TEXTBOOKS:

1. Singiresu S.Rao, “Mechanical Vibrations”, 6th Edition, Pearson Education, 2016

REFERENCE BOOKS:

1. Balakumar Balachandran and Edward B. Magrab, “Fundamentals of Vibrations”, 1st Editon, Cengage Learning, 2009

2. Benson H. Tongue, “Principles of Vibrations”, 2nd Edition, Oxford University, 2007.

CO - PO and CO - PSO MAPPING:

CO	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
CO1	3	2	2	2			1					1	2	2		
CO2	3	2	2	2			1					1	2	2		
CO3	3	2	2	2			1					1	2	2		
CO4	3	2	2	2			1					1	2	2		
CO5	3	2	2	2			1					1	2	2		

1909512 INDUSTRIAL SAFETY ENGINEERING

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

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

- Identify unsafe conditions and recognize unsafe alerts.
- Interpret the rules and regulations for safety operations.
- Capable of solving problem of accidents.
- Capable of solving the present for criticizing the present for improved safety.
- Collaborate and modify processes / procedures for safety.

UNIT-I: INTRODUCTION 9

Evolution of modern safety concepts – Fire prevention – Mechanical hazards – Boilers, Pressure vessels, Electrical Exposure.

UNIT-II: CHEMICAL HAZARDS 9

Chemical exposure – Toxic materials – Radiation Ionizing and Non-ionizing Radiation - Industrial Hygiene – Industrial Toxicology.

UNIT-III: ENVIRONMENTAL CONTROL 9

Industrial Health Hazards – Environmental Control – Industrial Noise - Noise measuring instruments, Control of Noise, Vibration, - Personal Protection.

UNIT-IV: HAZARD ANALYSIS 9

System Safety Analysis –Techniques – Fault Tree Analysis (FTA), Failure Modes and Effects Analysis (FMEA), HAZOP analysis and Risk Assessment.

UNIT-V: SAFETY REGULATIONS 9

Explosions – Disaster management – catastrophe control, hazard control , Factories Act, Safety regulations Product safety – case studies.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

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

- Identify and prevent chemical, environmental mechanical, fire hazard.
- Collect, analyze and interpret the accidents data based on various safety techniques.
- Apply proper safety techniques on safety engineering and management.
- Able to perform hazard analysis.
- Aid to design the system with environmental consciousness by implementing safety regulation.

TEXTBOOKS:

1. John V.Grimaldi, “Safety Management”, AITB S Publishers, 2003.

REFERENCE BOOKS:

1. David L.Goetsch, “Occupational Safety and Health for Technologists”, Engineers and Managers, Pearson Education Ltd. 5th Edition, 2005.

2. Deshmukh L M, “Industrial Safety Management”, Tata McGraw-Hill Publishing Company Ltd.,2005

3. Safety Manual, “EDEL Engineering Consultancy”, 2000.

CO - PO and CO - PSO MAPPING:

CO	PO												PSO			
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**	**4**
CO1	2	1	2			2	1					1	1	1		
CO2	2	1	2			2	1					1	1	1		
CO3	2	1	2			2	1					1	1	1		
CO4	2	1	2			2	1					1	1	1		
C)5	2	1	2			2	1					1	1	1		

1910504 PRINCIPLES OF FOOD PRESERVATION L T P C

3 0 0 3

COURSE OBJECTIVES:

The student should be made:

- To learn about the shelf life of food products.
- To gain knowledge on the storage of food products.
- To know about the thermal processing methods of food.
- To design different types of Dryers.
- To understand the non-thermal methods of food preservation.

UNIT - I: FOOD PRESERVATION AND ITS IMPORTANCE 9

Introduction to food preservation, Wastage of processed foods; Shelf life of food products; Types of food based on its perishability, Traditional methods of preservation.

UNIT - II: METHODS OF FOOD HANDLING AND STORAGE 9

Nature of harvested crop, plant and animal; storage of raw materials and products using low temperature, refrigerated gas storage of foods, gas packed refrigerated foods, sub atmospheric storage, Gas atmospheric storage of meat, grains, seeds and flour, roots and tubers; freezing of raw and processed foods. Retort pouch packing, Aseptic packaging.

UNIT - III: THERMAL METHODS 9

Newer methods of thermal processing; batch and continuous; In container sterilization-canning; application of infra-red microwaves; ohmic heating; control of water activity; preservation by concentration and dehydration; osmotic methods.

UNIT - IV: DRYING PROCESS FOR TYPICAL FOODS 9

Rate of drying for food products; design parameters of different type of dryers; properties of air-water mixtures. Psychometric chart, freezing and cold storage, freeze concentration, dehydro-freezing, freeze drying, IQF; calculation of refrigeration load, design of freezers and cold storages.

UNIT - V: NON-THERMAL METHODS 9

Super Critical Technology for Preservation - Chemical preservatives, preservation by ionizing radiations, ultrasonics, high pressure, fermentation, curing, pickling, smoking, membrane technology. Hurdle technology.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

The student should be able to:

- Aware of the different methods applied to preserving foods.
- Explain the food handling and storage processes.
- Analyze the thermal processing and osmotic methods.
- Explore the drying process of foods.
- Apply the non-thermal methods for food preservation.

TEXT BOOKS:

1. Karnal, Marcus and D.B. Lund, “Physical Principles of Food Preservation”, Second Edition, Rutledge, 2003.
2. VanGarde, S.J. and Woodburn. M, “Food Preservation and Safety Principles and Practice”, Surbhi Publications, 2001.
3. Sivasankar B, “Food Processing & Preservation”, Prentice Hall of India, 2002.
4. Neelam Khetarpaul, “Food Processing and Preservation”, Daya Publishing House, A division of Astral International (P) Ltd., 2015.

REFERENCE BOOKS:

1. Shafiur M Rahman, “Handbook of Food Preservation”, Second Edition, CRC Press, 2007.
2. Zeuthen Peter, Bogh-Sorensen Leif, “Food Preservation Techniques”, Wood Head Publishing, Cambridge, England, 2005.
3. Ranganna S, “Handbook of Canning and Aseptic Packaging”, Tata McGraw-Hill, 2000.

CO - PO and CO - PSO MAPPING:

CO	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
CO1	2	-	-	3	-	1	1	-	-	-	-	-	2	2	-	2
CO2	2	3	1	2	-	-	-	2	-	-	-	2	2	3	-	3
CO3	3	2	1	2	-	1	1	-	-	-	-	2	1	3	2	-
CO4	3	2	1	2	-	1	1	-	-	-	-	2	1	3	-	-
CO5	3	1	2	-	-	1	1	-	-	-	-	2	-	3	-	1

1920501 NANOTECHNOLOGY L T P C
3 0 0 3

COURSE OBJECTIVES

- Make the students to understand the fundamentals of nanomaterials.
- To acquire the knowledge on different classifications in nano materials.
- To educate the different synthesis techniques.
- To provide information on different fabrication and characterization techniques.
- Make the students to understand and apply the techniques to different systems.

UNIT -I: BASICS OF NANOTECHNOLOGY 9

Introduction –Scientific revolutions –Time and length scale in structures –Definition of a nanosystem –Dimensionality and size dependent phenomena –Surface to volume ratio - Fraction of surface atoms-Properties at nanoscale (optical, mechanical, electronic and magnetic).

UNIT- II: DIFFERENT CLASSES OF NANOMATERIALS 9

Classification based on dimensionality-Quantum Dots, Wells and Wires-Carbon-based nano materials (buckyballs, nanotubes, graphene)–Metal based nano materials (nanogold, nanosilver and metal oxides) –Nanocomposites-Nanopolymers –Nanoglasses –Nano ceramics.

UNIT-III: SYNTHESIS OF NANOMATERIALS 9

Classification of synthesis: Top down and bottom up nanofabrication. Chemical Methods: Solvothermal Synthesis-Photochemical Synthesis –Sonochemical Routes-Chemical Vapor Deposition (CVD) –Metal Oxide -Chemical Vapor Deposition (MOCVD). Physical Methods: Ball Milling –Electrodeposition -Spray Pyrolysis -Flame Pyrolysis - DC/RF Magnetron Sputtering - Molecular Beam Epitaxy (MBE).

UNIT-IV: FABRICATION AND CHARACTERIZATION OF NANOSTRUCTURES 9

Nanofabrication: Photolithography and its limitation-Electron-beam lithography (EBL)-Nanoimprint –Softlithography patterning. Characterization: Environmental Scanning Electron Microscopy (ESEM) High Resolution Transmission Electron Microscope (HRTEM) –Scanning Tunneling Microscope (STM)-Surface enhanced Raman spectroscopy (SERS)-X-ray Photoelectron Spectroscopy (XPS) -Auger electron spectroscopy (AES).

UNIT-V: APPLICATIONS 9

Solar energy conversion and catalysis -Molecular electronics and printed electronics –Nanoelectronics -Polymers with a special architecture -Liquid crystalline systems -optical properties, Applications in displays and other devices -Photonics, Plasmonics-Chemical and biosensors –Nanomedicine and Nanobiotechnology –Nanotoxicology challenges.

TOTAL: 45 PERIODS

COURSE OUTCOMES

- Able to understand the basics of nanoscience.
- Able to differentiate the materials based on their structures.
- Ability to understand the different synthesis techniques of nanomaterials.
- Ability to identify various fabrication techniques and characterization of nanostructures.
- Able to apply them for suitable applications.

TEXT BOOKS:

1. 1.Bhusan, Bharat (Ed), “Springer Handbook of Nanotechnology”, 2nd Edition, 2007.
2. Hari Singh Nalwa, “Nanostructured Materials and Nanotechnology”, Academic Press, 2002.
3. Pradeep T., “A Textbook of Nanoscience and Nanotechnology”, Tata McGraw Hill Education Pvt. Ltd., 2012.

REFERENCE BOOKS:

1. Charles P. Poole Jr., Frank J. Ownes, ‘Introduction to Nanotechnology”, Wiley Interscience, 2003.
2. Dupas C., Houdy P., Lahmani M., “Nanoscience: Nanotechnologies and Nanophysics”,Springer-Verlag Berlin Heidelberg, 2007.
3. Mark Ratner and Daniel Ratner, “Nano Technology”, Pearson Education, New Delhi, 2003.
4. Nabok A., “Organic and Inorganic Nanostructures”, Artech House, 2005.

CO - PO and CO - PSO MAPPING:

CO	PO												PSO			
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**	**4**
CO 1	3	-	3	3	3	1	-	-	-	-	-	1	-	2	-	-
CO 2	2	-	3	3	3	-	-	-	-	-	-	1	-	2	-	-
CO 3	2	-	3	3	3	-	-	-	-	-	-	1	-	2	-	-
CO 4	2	-	3	3	3	1	1	-	-	-	-	1	-	2	-	-
CO 5	3	-	3	3	3	1	1	-	-	-	-	1	-	2	-	-

1920502 MICROSCOPY L T P C

3 0 0 3

COURSE OBJECTIVES

- To introduce the basic principles of optical and electron microscopy.
- To elucidate the different microscopic techniques.
- To explore the knowledge on electron microscopy
- Make the students to learn the sample preparation techniques for the micro structural analysis.
- To investigate on different chemical analysis techniques.

UNIT- I: INTRODUCTION 9

History of Microscopy, Overview of current microscopy techniques. Light as particles and waves, Fundamental of optics: Diffraction and interference in image formation, real and virtual images, Resolution, Depth of field and focus, Magnification, Numerical aperture, Aberration of lenses. Components of Light Microscopy, Compound light microscopy and its variations**.**

UNIT- II: MICROSCOPY 9

Phase contrast microscopy: optical design, theory, image interpretation, Dark-field microscopy: optical design, theory, image interpretation, Polarization Microscopy: Polarized light, optical design, theory, image interpretation, Differential Interference Contrast (DIC): equipment and optics, image interpretation, Modulation contrast microscopy: contrast methods using oblique illumination.

UNIT- III: ELECTRON MICROSCOPY 9

Interaction of electrons with matter, elastic and inelastic scattering, secondary effects, Components of electron microscopy: Electron sources, pumps and holders, lenses, apertures,

and resolution. Scanning Electron and Transmission Electron Microscopy: Principle, construction, applications and limitations.

UNIT- IV: SAMPLE PREPARATION FOR MICROSTRUCTURAL ANALYSIS 9

Optical Microscopy sample preparation: Grinding, polishing and etching, SEM sample preparation: size constrains, TEM sample preparation: Disk preparation, electro polishing, ion milling, lithography, storing specimens.

UNIT-V: CHEMICAL ANALYSIS 9

Surface chemical composition (Principle and applications) - Mass spectroscopy and X-ray emission spectroscopy - Energy Dispersive Spectroscopy- Wave Dispersive Spectroscopy. Electron spectroscopy for chemical analysis (ESCA), X ray Photoelectron Spectroscopy (XPS), Auger Electron Spectroscopy (AES)- Applications.

TOTAL: 45 PERIODS

COURSE OUTCOMES

- Able to understand the physics behind the microscopy.
- Ability to describe the principle, construction and working of light microscopy.
- Ability to describe electron microscopy.
- Ability to understand about the important of sample preparation technique.
- Ability to identify the appropriate spectroscopy technique for chemical analysis.

TEXT BOOKS:

1. Douglas B. Murphy, Fundamentals of light microscopy and electronic imaging, 2001, Wiley- Liss, Inc. USA
2. David B. Williams and C. Barry Carter, Transmission Electron Microscopy-A Textbook for Materials Science, Springer US, 2nd edition, 2009.

REFERENCE BOOKS:

1. Brandon D. G, “Modern Techniques in Metallography”, Von Nostrand Inc. NJ, USA,1986.
2. Whan R E (Ed), ASM Handbook, Volume 10, Materials Characterization“, Ninth Edition, ASM international, USA, 1986.
3. Thomas G., “Transmission electron microscopy of metals”, John Wiley, 1996.

CO - PO and CO - PSO MAPPING:

CO	PO												PSO			
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**	**4**
CO 1	2	2	2	1	1	1	1	-	-	-	1	1	1	2	-	-
CO 2	2	2	2	1	2	-	1	-	-	-	-	1	-	2	-	-
CO 3	3	3	3	-	3	2	-	-	-	-	-	1	1	2	-	
CO 4	3	3	3	1	3	3	-	-	-	-	-	1	-	2	-	
CO 5	3	3	2	2	3	3	-	-	-	-	1	1	1	1		

1921501 ADVANCED ENGINEERING CHEMISTRY L T P C

3 0 0 3

COURSE OBJECTIVES

- To make the students conversant with basics of polymer chemistry.
- Principles and generation of energy in batteries, nuclear reactors, solar cells, wind mills and fuel cells.
- To acquaint the student with concepts of important photophysical and photochemical processes and spectroscopy.
- To make the student acquire sound knowledge of second law of thermodynamics and second law based derivations of importance in engineering applications in all disciplines.
- To develop and understand the basic concepts of phase rule and its applications to single and two component systems and appreciate the purpose and significance of alloys.

UNIT-I: POLYMERS AND SPECIALITY POLYMER 9

Polymers – Types of polymerization – Degree of polymerization – Plastics and types – Mechanism of polymerization (free radical mechanism) properties of polymers - T_g and tacticity – Compounding of plastics – Fabrication of plastics – Blow and extrusion mouldings. Speciality polymers-Conducting polymers: Polyacetylene, polyaniline, synthesis, mechanism of conduction – Applications of conducting polymers. Bio-degradable polymers: Requirements, factors affecting degradation – PLA– preparation, properties –applications.

UNIT-II: ENERGY SOURCES AND STORAGE DEVICES 9

Solar energy conversion – Solar cells: Types – Wind energy. Batteries: Types of batteries –

Primary battery (alkaline battery), secondary battery (lead acid battery, NICAD battery, lithium, lithium-ion & lithium-sulphur battery), fuel cells – H_2-O_2 fuel cell.

UNIT-III: PHOTOCHEMISTRY & ANALYTICAL TECHNIQUES 9

Photochemistry: Laws of photochemistry - Grothuss–Draper law, Stark–Einstein law and Beer-Lambert's Law. Quantum efficiency – determination - Photophysical processes (Jablonski diagram) - photosensitization - Chemiluminescence and bioluminescence. Analytical techniques: IR, UV – principle, Instrumentation and applications. Thermal analysis: TGA & DTA - principle, instrumentation and applications. Chromatography: Basic principles of column & TLC – principles and applications.

UNIT-IV: THERMODYNAMICS 9

Terminology of thermodynamics - Second law: Entropy - entropy change for an ideal gas, reversible and irreversible processes; Entropy of phase transitions; Clausius inequality. Free energy and work function- Helmholtz and Gibbs free energy functions (problems); Criteria of spontaneity; Gibbs-Helmholtz equation (problems); Clausius-Clapeyron equation; Maxwell relations – Van't Hoff isotherm and isochore.

UNIT-V: PHASE RULE AND ALLOYS 9

Phase rule: Introduction, definition of terms with examples, One component system -Water system – Reduced phase rule – Thermal analysis and cooling curves – Two component systems – Lead-silver system – Pattinson process, Zn-Mg System. Alloys: Introduction- Definition- properties of alloys- Significance of alloying, functions and effect of alloying elements- Nichrome and stainless steel (18/8) – heat treatment of steel.

TOTAL: 45 PERIODS

COURSE OUTCOMES

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

- Gain knowledge on polymer chemistry and its developments.
- Understand the process of advanced energy storage devices.
- Analyze the materials using spectroscopic techniques.
- Explain the various state of thermodynamics.
- Outline the nature of alloys by drawing phase rule.

TEXT BOOKS:

1. Shikha Agarwal, “Engineering Chemistry-Fundamentals and Applications”, Cambridge University Press, Delhi, 2016.
2. S. Vairam, P. Kalyani and Suba Ramesh, “Engineering Chemistry”, Wiley India PVT, LTD, New Delhi, 2015.
3. Sivasankar B., “Engineering Chemistry”, Tata McGraw-Hill Publishing Company Ltd., 2012.

REFERENCE BOOKS:

1. P. C. Jain and Monika Jain, “Engineering Chemistry” Dhanpat Rai Publishing Company (P) LTD, New Delhi, 2019.
2. S. S. Dara and S. S. Umare, “A Textbook of Engineering Chemistry”, S. Chand & Company LTD, New Delhi, 2015.
3. B. K. Sharma, “Engineering Chemistry”, Krishna Prakashan Media (P) Ltd, Meerut, 2012.

CO - PO and CO - PSO MAPPING:

CO	PO												PSO			
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**	**4**
CO1	3	2	2	2	2		3				1	3	2	3		2
CO2	1	1	1	2			2				2	3	2	2		1
CO3	1		1	2	2		1					2	3	2		
CO4	1	2	1			1	2		1			2				
CO5	3	2	2	3	1	1	2					2		1		

1921502 INDUSTRIAL NANOTECHNOLOGY L T P C

3 0 0 3

COURSE OBJECTIVES

- To elucidate on advantages of nanotechnology based applications in each industry
- To provide instances of contemporary industrial applications of nanotechnology
- To provide an overview of future technological advancements and increasing role of nanotechnology in each industry
- To provide an awareness on the nanomaterial synthesis for electronic materials
- To make the student conversant with the latest characterization techniques

UNIT-I: NANO ELECTRONICS 9

Micro and Nanoelectromechanical systems – Sensors, Actuators, Data memory –Lighting and Displays – Applications of piezoelectric and ferroelectric materials- Nano for energy systems - Fuel cells and Photo-voltaic cells – Electric double layer capacitors –Nanoparticle coatings for electrical products

UNIT-II: BIONANOTECHNOLOGY 9

Nanoparticles in bone substitutes and dentistry – Implants and Prosthesis – Nanorobotics in Surgery –Nanosensors in Diagnosis– Neuro-electronic Interfaces– Therapeutic applications

UNIT-III: NANOTECHNOLOGY IN CHEMICAL INDUSTRY 9

Nanocatalyts – Smart materials – Heterogenous nanostructures and composites – Nanostructures for Molecular recognition (Quantum dots, Nanorods, Nanotubes) – Molecular Encapsulation and its applications – Nanoporous zeolites – Self-assembled Nanoreactors

UNIT-IV: NANOTECHNOLOGY IN AGRICULTURE AND FOOD TECHNOLOGY 9

Nanotechnology in Agriculture -Precision farming, Smart delivery system – Insecticides using nanotechnology – Potential of nano-fertilizers - Nanotechnology in Food industry

UNIT-V: CHARACTERIZATION TECHNIQUES 9

X-ray Diffraction technique, Scanning Electron Microscopy - environmental techniques, Transmission Electron Microscopy including High-resolution imaging, Surface Analysis techniques-AFM, SPM, STM, SNOM, ESCA, SIMS-Nanoindentation.

TOTAL: 45 PERIODS

COURSE OUTCOMES

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

- Analyze the nanoparticle coatings for electrical products.
- Define various therapeutic applications of bionanotechnology.
- Explain the process of molecular encapsulation and nanoreactors.
- Ability to understand the uses of nanotechnology in food industry.
- Outline the nanofiber production and formulation of gels.

TEXTBOOKS:

1. V.A. Rai and J.A. Bai, Nanotechnology Applications in the Food Industry, CRC Press, 2018.
2. S. Thomas, Y. Grohens and Y.B. Pottathara, Industrial Applications of Nanomaterials, Elsevier Press, 2019.
3. N John Dinardo, Nanoscale Characterization of surfaces & Interfaces, 2nd edition, Weinheim Cambridge, Wiley-VCH, 2000.

REFERENCE BOOKS:

1. Neelina H. Malsch, Biomedical Nanotechnology, CRC Press, 2005.
2. Udo H. Brinker, Jean-Luc Mieusset, Molecular Encapsulation: Organic Reactions in Constrained Systems, Wiley Publishers, 2010.
3. Jennifer Kuzma and Peter VerHage, Nanotechnology in Agriculture and Food Production, Woodrow Wilson International Center, 2006.
4. P. J. Brown and K. Stevens, Nanofibers and Nanotechnology in Textiles, Woodhead Publishing Limited, Cambridge, 2007.
5. Y-W. Mai, Polymer Nano composites, Woodhead Publishing Limited, 2006.
6. W.N. Chang, Nanofibres fabrication, performance and applications, Nova Science Publishers Inc, 2009.

CO - PO and CO - PSO MAPPING:

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CO1	2	2	2		2	1	1		1			2	1	2		2
CO2	1	2	3		1	3	1		1			2	1	2		1
CO3	2	1	2		1	1	1		1			2	1	2		1
CO4	3	2	1		2	1	1		1			2	1	2		
CO5	2	2	1	2	1	1	1		1			2	2	1		2

OPEN ELECTIVE II

(VI SEMESTER)

1903706 GREEN BUILDING DESIGN L T P C

3 0 0 3

COURSE OBJECTIVE:

- To develop buildings which use the natural resources to the minimal at the time of construction as well as operation.
- To ensure minimum negative impact on the environment by the construction and operation of a building.
- To gain knowledge on natural lighting and temperature control.
- To develop a design to further reduce the carbon footprint as well as reduce cost of operation.
- To preserve the external environment to the building location.

UNIT- I: ENVIRONMENTAL IMPLICATIONS OF BUILDINGS 9

Energy use, carbon emissions, water use, waste disposal; Building materials: sources, methods of production and environmental Implications. Embodied Energy in Building Materials: Transportation Energy for Building Materials; Maintenance Energy for Buildings.

UNIT- II: IMPLICATIONS OF BUILDING TECHNOLOGIES EMBODIED ENERGY OF BUILDINGS 9

Framed Construction, Masonry Construction. Resources for Building Materials, Alternative concepts. Recycling of Industrial and Buildings Wastes. Biomass Resources for buildings.

UNIT- III: COMFORTS IN BUILDING 9

Thermal Comfort in Buildings – Issues; Heat Transfer Characteristic of Building Materials and Building Techniques. Incidence of Solar Heat on Buildings – Implications of Geographical Locations.

UNIT- IV: UTILITY OF SOLAR ENERGY IN BUILDINGS 9

Utility of Solar energy in buildings concepts of Solar Passive Cooling and Heating of Buildings. Low Energy Cooling. Case studies of Solar Passive Cooled and Heated Buildings.

UNIT- V: GREEN COMPOSITES FOR BUILDINGS 9

Concepts of Green Composites. Water Utilization in Buildings, Low Energy Approaches to

Water Management. Management of Solid Wastes. Management of Sullage Water and Sewage. Urban Environment and Green Buildings. Green Cover and Built Environment.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

The students completing the course will have ability to

- Describe the concepts of sustainable design and green building techniques including energy efficiency and indoor environmental quality management.
- Create drawings and models of their own personal green building project.
- Reducing waste, pollution and environmental degradation.
- Efficiently using energy, water, and other resources.
- Protecting occupant health and improving employee productivity.

TEXT BOOKS:

1. K.S.Jagadish, B. U. Venkatarama Reddy and K. S. Nanjunda Rao. "Alternative Building Materials and Technologies". New Age International, 2007.
2. "Low Energy Cooling For Sustainable Buildings". John Wiley and Sons Ltd, 2009.
3. Sustainable Building Design Manual. Vol 1 and 2, Teri, New Delhi, 2004.

REFERENCE BOOKS:

1. Osman Attmann, Green Architecture Advanced Technologies and Materials, McGraw Hill, 2010.
2. Jerry Yudelson, Green building Through Integrated Design, McGraw Hill, 2009.
3. Fundamentals of Integrated Design for Sustainable Building by Marian Keeler, Bill Burke.

CO - PO and CO - PSO MAPPING:

CO	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
CO1	3						3						2			
CO2		2														
CO3			2	1	2			1	2	2					1	
CO4						3						2				3
CO5											2	3		3		

1903716 ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT L T P C

3 0 0 3

COURSE OBJECTIVE:

- To impart the knowledge of screening of environmental and social assessment.
- To gain the knowledge of methods for impact assessment.
- To mitigate the environmental and social impacts of developmental projects.
- To develop knowledge on Assessment of Impact on land, water, air, noise and energy, flora and fauna.
- To study on report preparation of EIA.

UNIT- I: INTRODUCTION 9

Impacts of Development on Environment – Rio Principles of Sustainable Development Environmental Impact Assessment (EIA) – Objectives – Historical development – EIA Types – EIA in project cycle –EIA Notification and Legal Framework–Stakeholders and their Role in EIA– Selection & Registration Criteria for EIA Consultants.

UNIT-II: ENVIRONMENTAL ASSESSMENT 9

Screening and Scoping in EIA – Drafting of Terms of Reference, Baseline monitoring, Prediction and Assessment of Impact on land, water, air, noise and energy, flora and fauna - Matrices – Networks – Checklist Methods - Mathematical models for Impact prediction – Analysis of alternatives.

UNIT- III: ENVIRONMENTAL MANAGEMENT PLAN 9

Plan for mitigation of adverse impact on water, air and land, water, energy, flora and fauna – Environmental Monitoring Plan – EIA Report Preparation – Review of EIA Reports – Addressing the issues related to the Project Affected People -Environmental Clearance Post Project Monitoring.

UNIT- IV: SOCIO ECONOMIC ASSESSMENT 9

Baseline monitoring of Socio economic environment – Identification of Project Affected Personal – Rehabilitation and Resettlement Plan- Economic valuation of Environmental impacts – Cost benefit Analysis.

UNIT- V: CASE STUDIES 9

EIA case studies pertaining to Infrastructure Projects – Real Estate Development - Roads and Bridges – Multi-storey Buildings Mass Rapid Transport Systems - Ports and Harbor – Airports -

Dams and Irrigation projects - Power plants – Water supply and drainage projects- Waste water treatment plants, STP – Mining Projects.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

The students completing the course will have ability to

- Carry out scoping and screening of developmental projects for environmental and social assessments.
- To explain different methodologies for environmental impact prediction and assessment.
- Plan environmental impact assessments and environmental management plans.
- Evaluate environmental impact assessment reports.
- Analyse case studies on various projects.

TEXT BOOKS:

1. Canter, R.L, "Environmental impact Assessment", 2nd Edition, McGraw Hill Inc, New Delhi, 1995.
2. Lohani, B., J.W. Evans, H. Ludwig, R.R. Everitt, Richard A. Carpenter, and S.L. Tu, "Environmental Impact Assessment for Developing Countries in Asia", Volume 1 – Overview, Asian Development Bank,1997.
3. Peter Morris, Riki Therivel "Methods of Environmental Impact Assessment", Routledge Publishers, 2009.

REFERENCE BOOKS:

1. Becker H. A., Frank Vanclay, "The International handbook of social impact assessment" conceptual and methodological advances, Edward Elgar Publishing, 2003.
2. Barry Sadler and Mary McCabe, "Environmental Impact Assessment Training Resource Manual", United Nations Environment Programme, 2002.
3. Judith Petts, "Handbook of Environmental Impact Assessment Vol. I and II", Blackwell Science New York, 1998.
4. Ministry of Environment and Forests EIA Notification and Sectoral Guides, Government of India, New Delhi, 2010.

CO - PO and CO - PSO MAPPING:

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

1904703 TAMIL COMPUTING L T P C

3 0 0 3

COURSE OBJECTIVES:

- To understand the Tamil grammar and programming basics for Tamil computing.
- To understand the various types of Tamil Computing applications.
- To make the students understand the use of Tamil computing tools and Resources.
- To strengthen the students' ability to carry out the Computational Linguistics in Tamil computing.
- To understand the concepts of Tamil text processing using open – Tamil python library.

UNIT - I: TAMIL GRAMMAR 9

Alphabets: Classification & Properties - Words: classification and components - Sentences: Structures and word ordering.

UNIT - II: PROGRAMMING BASICS FOR TAMIL COMPUTING 9

History of Tamil Computing - Standards & Fonts - UNICODE - Object Oriented Tamil Computing -Tamil text processing using open-tamil python library.

UNIT - III: COMPUTATIONAL LINGUISTICS 9

Basic linguistics - Phonology – Phonology computing – Tholkappiar's Morphological pattern– lexicography – syntax – semantics – pragmatics, Languages for specific purpose & disconise computing

UNIT - IV: TAMIL COMPUTING TOOLS & RESOURCES 9

POS Tagger - Morphological Analyser - Morphological Generator - Sentence Parser - Named Entity Recognizer - Word Sense Disambiguator - Ontologies – Universal Networking Language & UNL Enconvertor.

UNIT - V: TAMIL COMPUTING APPLICATIONS 9

Machine Translation – Speech : Synthesis & Processing - Information : retrieval & Extraction – Question Answering – Text Summarization – Automatic Indexing – Text Mining – Conceptual Search.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

- Explain classification of Tamil grammar and properties
- Adopt a suitable process for tamil computing tools.
- Analyze the different types of computational linguistics such as phonology, Morphology, lexicography.
- Perform and analyze the Tamil computing applications.
- Analyze and process the Tamil python library.

TEXT BOOKS:

1. The Oxford Handbook of Computational Linguistics, Edited by Ruslan Mitkov, Oxford University Press, 2014.

REFERENCES BOOKS:

1. Translation - Theory and Application, Valarmathi, International Institute of Tamil Studies, First Edition, 2001.
2. Tholkaappiyam - Thodariyal, Shanmugam, International Institute of Tamil Studies, First Edition, 2004.
3. Tholkaappiyam: Phonology & Morphology, Albert, International Institute of Tamil Studies, First Edition, 1985.
4. Natural language processing and computational linguistics, Bhargav Srinivasa-Desikan Packt Publishing, first edition 2018.
5. The Phonology and morphology of tamil chrisdas Prathima, 2016.
6. Pos Tasser R Morphological Analzser Shodhganga inflibnet.ac.in
7. Atamil Programming language ayxiv.org, muthiah Annamalai.

CO - PO and CO - PSO MAPPING:

CO	PO												PSO			
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CO 2					3	3				3				3		
CO 3		3	2			3			2	2					3	
CO 4	3	2				3				2				2		
CO 5	2				3	3				2					3	2

1904010 OBJECT ORIENTED PROGRAMMING L T P C

3 0 0 3

COURSE OBJECTIVES:

- To understand Object Oriented Programming concepts and basic characteristics of Java
- To know the principles of packages, inheritance and interfaces
- To define exceptions and use I/O streams
- To develop a java application with threads and generics classes
- To design and build simple Graphical User Interfaces

UNIT I INTRODUCTION TO OOP AND JAVA FUNDAMENTALS 9

Object Oriented Programming - Abstraction – objects and classes - Encapsulation- Inheritance - Polymorphism- OOP in Java – Characteristics of Java – The Java Environment - Java Source File - Structure – Compilation. Fundamental Programming Structures in Java – Defining classes in Java – constructors, methods -access specifiers - static members -Comments, Data Types, Variables, Operators, Control Flow, Arrays , Packages - JavaDoc comments**.**

UNIT II INHERITANCE AND INTERFACES 9

Inheritance – Super classes- sub classes –Protected members – constructors in sub classes- the Object class – abstract classes and methods- final methods and classes – Interfaces – defining an interface, implementing interface, differences between classes and interfaces and extending interfaces - Strings.

UNIT III EXCEPTION HANDLING AND I/O 9

Exceptions - exception hierarchy - throwing and catching exceptions – built-in exceptions,

creating own exceptions, Stack Trace Elements. Input / Output Basics – Streams – Byte streams and Character streams – Reading and Writing Console – Reading and Writing Files.

UNIT IV MULTITHREADING **9**

Differences between multi-threading and multitasking, thread life cycle, creating threads, synchronizing threads, Inter-thread communication, daemon threads, thread groups.

UNIT V EVENT DRIVEN PROGRAMMING **9**

Graphics programming - Frame – Components - working with 2D shapes - Using color, fonts, and images - Basics of event handling - event handlers - adapter classes - actions - mouse events - AWT event hierarchy.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

1 Develop Java programs using OOP principles
2 Develop Java programs with the concepts inheritance and interfaces
3 Build Java applications using exceptions and I/O streams
4 Develop Java applications with threads and generics classes
5 Develop interactive Java programs using swings.

TEXT BOOKS:

1. Herbert Schildt, ―Java The complete reference‖, 8th Edition, McGraw Hill Education, 2011.
2. Cay S. Horstmann, Gary cornell, ―Core Java Volume –I Fundamentals‖, 9th Edition, Prentice Hall, 2013.

REFERENCE BOOKS:

1. Paul Deitel, Harvey Deitel, ―Java SE 8 for programmers‖, 3rd Edition, Pearson, 2015.
2. Steven Holzner, ―Java 2 Black book‖, Dreamtech press, 2011.
3. Timothy Budd, ―Understanding Object-oriented programming with Java‖, Updated Edition, Pearson Education, 2000.

CO - PO and CO - PSO MAPPING:

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

1904712 SOFTWARE ENGINEERING L T P C

3 0 0 3

COURSE OBJECTIVES:

- To understand the phases in a software development project
- To understand the concepts of requirements analysis and modeling.
- To understand software design methodologies
- To learn various testing methodologies
- To be familiar with issues related to software maintenance

UNIT I SOFTWARE PROCESS 9

Introduction to Software Engineering, scope – software crisis – principles of software engineering- Software process – Life cycle models – Traditional and Agile Models - Team organization.

UNIT II PLANNING AND ESTIMATION 9

Planning and the software process – cost estimation: LOC, FP Based Estimation, COCOMO I & II Models – Duration estimation and tracking – Gantt chart - Software Project Management – plan – risk analysis and management.

UNIT III REQUIREMENTS ANALYSIS AND SPECIFICATION 9

Software Requirements: Functional and Non-Functional, Software Requirements specification– Structured system Analysis – modeling: UML based tools, DFD - Requirement Engineering Process.

UNIT IV SOFTWARE DESIGN AND IMPLEMENTATION 9

Design process – Design principles and guidelines – design techniques – coupling and

cohesion - metrics – tools. Implementation: choice of programming language, programming practices – coding standards – code walkthroughs and inspections.

UNIT V TESTING AND MAINTENANCE 9

Software testing fundamentals- Testing techniques: white box, black box, glass box testing - unit testing – integration testing –system testing – acceptance testing – debugging. Post-delivery maintenance: Types – objectives - metrics - Reverse Engineering.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

- Understand different software life cycle models.
- Perform software requirements analysis
- Apply systematic methodologies for software design and deployment.
- Understand various testing approaches and maintenance related issues.
- Plan project schedule, and estimate project cost and effort required.

TEXT BOOKS:

1. Roger S. Pressman, “Software Engineering – A Practitioner‟ s Approach”, Seventh Edition, Mc Graw-Hill International Edition, 2010.
2. Ian Sommerville, “Software Engineering”, 9th Edition, Pearson Education Asia, 2011.

REFERENCES:

1. Rajib Mall, “Fundamentals of Software Engineering”, Third Edition, PHI Learning PrivateLimited, 2009.
2. Pankaj Jalote, “Software Engineering, A Precise Approach”, Wiley India, 2010.
3. Kelkar S.A., “Software Engineering”, Prentice Hall of India Pvt Ltd, 2007.
4. Stephen R.Schach, “Software Engineering”, Tata McGraw-Hill Publishing CompanyLimited,2007.
5. http://nptel.ac.in/.

CO - PO and CO - PSO MAPPING:

CO	PO												PSO			
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CO 1	2		3	3								2	2			
CO 2	2		3	3		2								2		
CO 3			3	3							3				2	
CO 4		2								2				2		
CO 5		2				3					3				1	

1905712 RENEWABLE ENERGY SYSTEMS L T P C

3 0 0 3

COURSE OBJECTIVES:

- About the stand alone and grid connected renewable energy systems. .
- Design of power converters for renewable energy applications.
- Wind electrical generators.
- Solar energy systems.
- Power converters used for renewable energy systems.

UNIT-I: INTRODUCTION 9

Environmental aspects of electric energy conversion: impacts of renewable energy generation on environment (cost-GHG Emission) - Qualitative study of different renewable energy resources: Solar, wind, ocean, Biomass, Fuel cell, Hydrogen energy systems and hybrid renewable energy systems.

UNIT-II: ELECTRICAL MACHINES FOR RENEWABLE ENERGY CONVERSION 9

Reference theory fundamentals-principle of operation and analysis: IG and PMSG.

UNIT-III: POWER CONVERTERS 9

Solar: Block diagram of solar photo voltaic system -Principle of operation: line commutated converters (inversion-mode) - Boost and buck-boost converters- selection of inverter, battery sizing, array sizing Wind: Three phase AC voltage controllers

UNIT-IV: ANALYSIS OF WIND AND PV SYSTEMS 9

Stand alone operation of fixed and variability speed wind energy conversion systems and solar system-Grid connection Issues -Grid integrated PMSG, SCIG Based WECS, grid Integrated solar system.

UNIT-V: HYBRID RENEWABLE ENERGY SYSTEMS 9

Need for Hybrid Systems- Range and type of Hybrid systems- Case studies of Wind-PV Maximum Power Point Tracking (MPPT).

TOTAL : 45 PERIODS

COURSE OUTCOMES:

- Ability to understand and analyze power system operation, stability, control and protection.
- Ability to handle the engineering aspects of electrical energy generation and utilization.
- Ability to understand the stand alone and grid connected renewable energy systems.
- Ability to design of power converters for renewable energy applications.
- Ability to acquire knowledge on wind electrical generators and solar energy systems.

TEXT BOOKS:

1. S. N. Bhadra, D.Kastha, S.Banerjee, “Wind Electrical Systems”, Oxford University Press, 2005.

2. B.H.Khan Non-conventional Energy sources Tata McGraw-hill Publishing Company New Delhi, 2009.

REFERENCE BOOKS:

1. Rashid .M. H “power electronics Hand book”, Academic press, 2001.

2. Ion Boldea, “Variability speed generators”, Taylor & Francis group, 2006.

3. Rai. G.D, “Non conventional energy sources”, Khanna publishes, 1993.

4. Gray, L. Johnson, “Wind energy system”, prentice hall linc, 1995.

5. Andrzej M. Trzynnadlowski, „Introduction to Modern Power Electronics‟, Second edition, wiley India Pvt. Ltd, 2012.

CO - PO and CO - PSO MAPPING:

CO	PO											
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CO 2	2		2		1		1		2		2	
CO 3	3	2	1		2				2			
CO 4	3	2	2		1		2				2	
CO 5	3	2	1		1				1		2	2

1905713 ELECTRIC VEHICLES AND POWER MANAGEMENT L T P C
3 0 0 3

COURSE OBJECTIVES:

To impart knowledge on the following Topics

- To understand the concept of electrical vehicles and its operations.
- To provide knowledge about Power train components.
- To understand the various Control strategies in AC and DC drives.
- To understand the need for energy storage in hybrid vehicles.
- To provide knowledge about alternative energy storage technologies that can be used in electric vehicles.

UNIT-I: ELECTRIC VEHICLES AND VEHICLE MECHANICS 9

Electric Vehicles (EV), Hybrid Electric Vehicles (HEV), Engine ratings, Comparisons of EV with internal combustion Engine vehicles, Fundamentals of vehicle mechanics – EV Testing.

UNIT-II: ARCHITECTURE OF EV's AND POWER TRAIN COMPONENTS 9

Architecture of EV's and HEV's – Plug-n Hybrid Electric Vehicles (PHEV) - Standards - Power train components and sizing, Gears, Clutches, Transmission and Brakes.

UNIT-III: CONTROL OF DC AND AC DRIVES 9

DC/DC chopper based four quadrant operations of DC drives – Inverter based V/f Operation (motoring and braking) of induction motor drive system – Induction motor and permanent motor-based vector control operation – Switched reluctance motor (SRM) drives.

UNIT-IV: BATTERY ENERGY STORAGE SYSTEM 9

Battery Basics, Different types, Battery Parameters, Battery modeling, Traction Batteries, Energy management system in Electric vehicle – Battery Management Systems.

UNIT-V: ALTERNATIVE ENERGY STORAGE SYSTEMS 9

Fuel cell – Characteristics- Types – hydrogen Storage Systems and Fuel cell EV – Ultra Capacitors

TOTAL : 45 PERIODS

COURSE OUTCOMES:

- Learners will understand the operation of Electric vehicles and Hybrid Electric vehicles.
- Learners will gain knowledge on Power train components.
- Learners can analyze the control strategies in AC and DC drives.
- Learners will gain knowledge on various energy storage technologies for electrical vehicles.
- Learners know about alternative energy storage technologies for electric vehicles.

TEXTBOOKS:

1. Iqbal Hussain, “Electric and Hybrid Vehicles: Design Fundamentals, Second Edition**”** CRC Press, Taylor & Francis Group, Second Edition (2011).
2. Ali Emadi, Mehrdad Ehsani, John M.Miller, “Vehicular Electric Power Systems” , Special Indian Edition, Marcel dekker, Inc 2010.
3. James Larminie and John Loury, “Electric Vehicle Technology – Explained”, John Wiley & Sons Ltd, 2003.

REFERENCE BOOKS:

1. Mehrdad Ehsani, Yimin Gao, Ali Emadi, “Modern Electric, Hybrid Electric and Fuel cell Vehicles” CRC Press, Taylor & Francis Group, Second Edition (2010).
2. Emanuele Crisostomi, Robert Shorten, SonjaStudli & Fabian Wirth “Electric and Plug-in Hybrid Vehicle Networks” Taylor & Francis group 2018.
3. Ronald K Jurgen, “Electric and Hybrid – Electric Vehicles”, SAE, 2002.

CO - PO and CO - PSO MAPPING:

CO	PO											
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
CO 1	3	3	1	2	2	1			1			
CO 2	3	2	2	1		1			2		3	1
CO 3	3	2	1	2	2	2	1		1			
CO 4	3	3	3	2	2	1			2		2	1
CO 5	3	2	1	1	1	2	2		1			2

1906705 **ACOUSTICS** **L T P C**

3 0 0 3

COURSE OBJECTIVES:

The student should be made:

- To learn the origin of sound.
- To understand the knowledge in sound propagation.
- To enhance the concepts in Sound analysis.
- To acquire basic knowledge in Physiological acoustics.
- To enable the student to understand the analysis of acoustics.

UNIT - I: INTRODUCTION **9**

Origin of sound. Objective and subjective sound. Sound vibrations, Amplitude, form, and period. Sound waves and their wavelength and speed. Sound pressure level. Energy parameters of sound. Dynamical range. Sound envelope, Sound frequency, Relation between frequency and period.

UNIT - II: PROPAGATION OF SOUND **9**

Sound propagation. Spherical and plane waves. Change of intensity of a propagating sound wave. Sound reflections, echo, absorption, diffraction, refraction. Relation between pitch and frequency. Pitch standard. Sound spectrum. Types of Public Addressing system. Hi.fi speakers. Microphones: types and its applications.

UNIT - III: SOUND ANALYSIS **9**

Natural scales. Origin of musical scale. Tonal material and modal scale. Pythagorean tuning, Temperaments. Non-equal temperaments. Equal temperaments. Relation of musical scale and kind of music. Sound Pre-Processing and analysis, Audio analysis tools.

UNIT - IV: PHYSIOLOGICAL ACOUSTICS **9**

Physiological and psychological acoustics. Loudness. Loudness level. Fletcher-Munson diagram. Range of hearing. Masking. Compression of sound information, Pitch, timbre, subjective duration. Absolute pitch. Acoustics instruments. Peripheral auditory system.

UNIT - V: ACOUSTICAL ANALYSIS **9**

Sound phenomena in rooms. Direct sound. Early reflections. Reverberation and its formation, Criteria for good acoustics of a room and methods of their realization, Reverberation time. Dependence of reverberation time on room volume and surfaces (area and absorption),

Evaluation of reverberation time. Optimal reverberation times for various types of music and room sizes.

TOTAL PERIODS: 45

COURSE OUTCOMES:

The student should be able to:

- Analyze the basic parameters of sound.
- Understand the effects of propagation.
- Know the basic functions of sound analysis.
- Derive the output using Physiological acoustics.
- Acquire the knowledge on the Applications of acoustics.

TEXT BOOKS:

1. Rossing T. D., Moore R. F., Wheeler P. A.," The Science of Sound", 3rd edition San Francisco: Addison Wesley, 2002.
2. Hall D. E.," Musical Acoustics", 3rd edition Pacific Grove, CA: Brooks/Cole, 2001.
3. Howard D. M., Angus J. A. S.," Acoustics and psychoacoustics", 5th edition New York, London: Routledge, 2017.

REFERENCE BOOKS:

1. Everest F. A., Pohlmann K. C.," Master Handbook of Acoustics", 5th edition New York: McGraw-Hill, 2001.
2. Rossing T. D., ed.," Springer Handbook of Acoustics", 2nd edition Berlin, Heidelberg: SpringerVerlag 2014.
3. Chakrabarti, Pradip Kumar and Chowdhury, Satyabrata, "A Textbook on Waves and Acoustics", New Central book agency, 2010.

CO - PO and CO - PSO MAPPING:

CO	PO												PSO			
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CO2	2	2	-	2	-	2	3	-	-	-	-	-	2	-	-	-
CO3	2	2	2	-	-	2	3	-	-	-	-	-	2	-	-	-
CO4	2	3	2	2	-	2	2	-	-	-	-	-	3	3	-	-
CO5	2	2	1	2	-	2	-	2	-	-	-	-	2	-	-	-

1906706	VISUAL COMMUNICATION	L T P C
		3 0 0 3

COURSE OBJECTIVES:

The student should be made:

- To know about the basics of communication.
- To learn and acquire the art of visual communication.
- To understand and relate the importance of visual communication
- To gain knowledge about the basic of Visual Communication.
- To acquire idea and concepts of various forms of Media

UNIT - I: INTRODUCTION 9

Need for and the Importance of Human and Visual Communication. Communication a expression, skill and process, Understanding Communication: SMRC-Model.

UNIT - II: PROCESS IN COMMUNICATION 9

Communication as a process. Message, Meaning, Connotation, Denotation Culture/Codes etc Levels of communication: Technical, Semantic, and Pragmatic. The semiotic landscape: language and visual communication, narrative representation

UNIT - III: METHODOLOGY 9

Fundamentals of Design: Definition. Approaches to Design, Centrality of Design, Elements/Elements of Design: Line, Shape, Space, Color, Texture. Form Etc. Principles of Design: Symmetry. Rhythm, Contrast, Balance Mass/Scale etc. Design and Designers (Need, role, process, methodologies etc.).

UNIT - IV: DESIGN PROCESS 9

Principles of Visual and other Sensory Perceptions. Color psychology and theory (some aspects) Definition, Optical / Visual Illusions Etc., Various stages of design process- problem identification, search for solution refinement, analysis, decision making, Implementation.

UNIT - V: GRAPHIC DESIGN 9

Basics of Graphic Design. Definition, Elements of GD, Design process-research, a source of concept, the process of developing ideas-verbal, visual, combination & thematic, visual thinking, associative techniques, materials, tools (precision instruments etc.) design execution, and presentation.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

The student should be able to:

- Learn about the history & evolution of Communication.
- Understand the Nature & functions of Visual Communication.
- Acquire knowledge on different types of perception & illusion.
- Get knowledge on semiotics.
- Remember the world of ideation creating.

TEXT BOOKS:

1. Lester, E, “Visual Communications: Images with Messages”, Thomson Learning, 2013.
2. Jonathan Baldwin, “Visual Communication: From Theory to Practice”, AVA publishing, 2006.

REFERENCE BOOKS:

1. Schildgen, T., “Pocket Guide to color with digital applications”, Thomsom Learning, 2000.
2. Palmer, Frederic, “Visual Elements of Art and Design”, Longman, 1990.
3. Carter, “Typographic Design : Form and Communication”, 6/e, John Wiley, 2014.

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

1906707 MEMS AND NEMS L T P C

3 0 0 3

COURSE OBJECTIVES:

The student should be made:

- To introduce the concepts of micro and nano electromechanical devices.
- To know the fabrication process of microsystems.
- To know the design concepts of micro sensors.
- To understand the design of various micro actuators.
- To introduce the concepts of quantum mechanics and nano systems.

UNIT – I: INTRODUCTION TO MEMS AND NEMS 9

Introduction to Design of MEMS and NEMS, Overview of Nano and Microelectromechanical Systems, Applications of Micro and Nanoelectromechanical systems, Materials for MEMS and NEMS: Silicon, silicon compounds, polymers, metals.

UNIT – II: MEMS FABRICATION TECHNOLOGIES 9

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

UNIT – III: MICRO SENSORS 9

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

UNIT – IV: MICRO ACTUATORS 9

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

UNIT – V: NANO DEVICES 9

Atomic Structures and Quantum Mechanics, Shrodinger Equation, ZnO nanorods based NEMS device: Gas sensor.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

After studying this course, the student should be able to,

- Interpret the basics of micro/nano electromechanical systems including their applications and advantages.
- Recognize the use of materials in micro fabrication and describe the fabrication processes including surface micromachining, bulk micromachining and LIGA.
- Analyze the key performance aspects of electromechanical sensors.
- Illustrate the design of micro actuators using various actuations.
- Comprehend the theoretical foundations of quantum mechanics and Nano systems.

TEXT BOOKS:

1. Marc Madou, “Fundamentals of Microfabrication”, CRC press 1997.
2. Stephen D. Senturia, “Micro system Design”, Kluwer Academic Publishers, 2001.

REFERENCES BOOKS:

1. Tai Ran Hsu, “MEMS and Microsystems Design and Manufacture”, Tata McGraw Hill, 2002.
2. Chang Liu, “Foundations of MEMS”, Pearson education India limited, 2006.
3. Sergey Edward Lyshevski, “MEMS and NEMS: Systems, Devices, and Structures”, CRC Press, 2002.

CO - PO and CO - PSO MAPPING:

CO	PO												PSO			
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CO2	3	-	3	3	-	2	1	-	-	2	-	-	3	3	-	-
CO3	3	-	3	3	-	-	1	-	-	2	-	-	3	3	-	-
CO4	3	2	3	3	-	-	-	1	-	2	-	-	3	3	-	-
CO5	3	2	3	3	-	-	-	1	-	2	-	-	3	3	-	-

1908003 SOFTWARE QUALITY MANAGEMENT L T P C

3 0 0 3

COURSE OBJECTIVES

- To have an introduction to software quality
- To understand software quality assurance.
- To understand about quality control and reliability.
- To understand quality management system.
- To understand about Quality Standards.

UNIT I INTRODUCTION TO SOFTWARE QUALITY 9

Software Quality – Hierarchical models of Boehm and McCall – Quality measurement – Metrics measurement and analysis – Gilb’s approach – GQM Model

UNIT II SOFTWARE QUALITY ASSURANCE 9

Quality tasks – SQA plan – Teams – Characteristics – Implementation – Documentation – Reviews and Audits

UNIT III QUALITY CONTROL AND RELIABILITY 9

Tools for Quality – Ishikawa’s basic tools – CASE tools – Defect prevention and removal– Reliability models – Rayleigh model – Reliability growth models for quality Assessment

UNIT IV QUALITY MANAGEMENT SYSTEM 9

Elements of QMS – Rayleigh model framework – Reliability Growth models for QMS – Complexity metrics and models – Customer satisfaction analysis

UNIT V QUALITY STANDARDS 9

Need for standards – ISO 9000 Series – ISO 9000-3 for software development – CMM and CMMI – Six Sigma concepts.

TOTAL: 45 PERIODS

COURSE OUTCOMES

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

- To understand introduction about quality measurement.
- To understand SQA plan.
- To understand about Quality assessment.
- To understand about Customer satisfaction analysis.
- To understand Six Sigma Concepts.

TEXT BOOKS

1. Allan C. Gillies, “Software Quality: Theory and Management”, Thomson Learning, 2003. (UI : Ch 1-4 ; UV : Ch 7-8)
2. Stephen H. Kan, “Metrics and Models in Software Quality Engineering”, Pearson Education (Singapore) Pte Ltd., 2002. (UI : Ch 3-4; UIII : Ch 5-8 ; UIV : Ch 9-11)

REFERENCE BOOKS

1. Norman E. Fenton and Shari Lawrence Pfleeger, “Software Metrics” Thomson, 2003
2. Mordechai Ben – Menachem and Garry S.Marliss, “Software Quality”, Thomson Asia Pte Ltd, 2003.
3. Mary Beth Chrissis, Mike Konrad and Sandy Shrum, “CMMI”, Pearson Education (Singapore) Pte Ltd, 2003.
4. ISO 9000-3 “Notes for the application of the ISO 9001 Standard to software development”.

CO - PO and CO - PSO MAPPING:

CO	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
CO1	2	3	3													
CO2		3											3			
CO3			3										3	3		
CO4	2		3	2										3		
CO5	2	3	3	2									3	3		

1908004 C# and .NET PROGRAMMING L T P C

3 0 0 3

COURSE OBJECTIVES:

- To learn basic programming in C# and the object oriented programming concepts.
- To update and enhance skills in writing Windows applications, ADO.NET and ASP .NET.
- To study the advanced concepts in data connectivity, WPF, WCF and WWF with C# and .NET 4.5.
- To implement mobile applications using .Net compact framework
- To understand the working of base class libraries, their operations and manipulation of data using XML.

UNIT - I: C# LANGUAGE BASICS 9

.Net Architecture – Core C# – Variables – Data Types – Flow control – Objects and Types- Classes and Structs – Inheritance- Generics – Arrays and Tuples – Operators and Casts – Indexers

UNIT - II: C# ADVANCED FEATURES 9

Delegates – Lambdas – Lambda Expressions – Events – Event Publisher – Event Listener – Strings and Regular Expressions – Generics – Collections – Memory Management and Pointers – Errors and Exceptions – Reflection.

UNIT - III: BASE CLASS LIBRARIES AND DATA MANIPULATION 9

Diagnostics -Tasks, Threads and Synchronization – .Net Security – Localization – Manipulating XML- SAX and DOM – Manipulating files and the Registry- Transactions – ADO.NET- Peer-to-Peer Networking – PNRP – Building P2P Applications – Windows Presentation Foundation (WPF).

UNIT - IV: WINDOW BASED APPLICATIONS, WCF AND WWF 9

Window based applications – Core ASP.NET- ASP.NET Web forms -Windows Communication Foundation (WCF)- Introduction to Web Services – .Net Remoting – Windows Service – Windows Workflow Foundation (WWF) – Activities – Workflows

UNIT - V: .NET FRAMEWORK AND COMPACT FRAMEWORK 9

Assemblies – Shared assemblies – Custom Hosting with CLR Objects – Appdomains – Core XAML – Bubbling and Tunneling Events- Reading and Writing XAML – .Net Compact Framework – Compact Edition Data Stores – Errors, Testing and Debugging – Optimizing performance – Packaging and Deployment – Networking and Mobile Devices

TOTAL: 45 PERIODS

COURSE OUTCOMES:

- Write various applications using C# Language in the .NET Framework.
- Develop programs using advanced C# concepts on .NET
- Analyze the base class libraries, operations and manipulation of data using XML.
- Develop distributed applications using .NET Framework.
- Create mobile applications using .NET compact Framework.

TEXT BOOKS:

1. Christian Nagel, Bill Evjen, Jay Glynn, Karli Watson, Morgan Skinner . —Professional C# 2012 and .NET 4.5, Wiley, 2012
2. Harsh Bhasin, —Programming in C#, Oxford University Press, 2014.

REFERENCE BOOKS:

1. Ian Gariffiths, Mathew Adams, Jesse Liberty, —Programming C# 4.0‖, OReilly, Fourth Edition, 2010.
2. Andrew Troelsen, Pro C# 5.0 and the .NET 4.5 Framework, Apress publication, 2012.
3. Andy Wigley, Daniel Moth, Peter Foot, —Mobile Development Handbook, Microsoft Press, 2011.

CO - PO and CO - PSO MAPPING:

CO	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
CO1	2	-	3	-	3	-	-	-	-	-	-	-	3	3	-	-
CO2	3	2	2	-	3	-	-	-	-	-	-	-	3	3	-	-
CO3	3	2	2	-	3	-	-	-	-	-	-	-	3	3	-	-
CO4	2	-	3	-	3	-	-	-	-	-	-	-	3	3	-	-
CO5	-	3	3	3	3	-	-	-	-	-	-	-	3	3	-	-

1908005 VIRTUAL REALITY L T P C

3 0 0 3

COURSE OBJECTIVES:

- To study about basic concepts of Virtual reality.
- To understand Virtual environment.
- To understand geometric modeling.
- To study about Virtual Hardware and Software.
- To develop Virtual Reality applications.

UNIT - I: INTRODUCTION TO VIRTUAL REALITY 9

Virtual Reality & Virtual Environment : Introduction – Computer graphics – Real time computer graphics–Flight Simulation –Virtual environments–requirement – benefits of virtual reality- Historical development of VR : Introduction – Scientific Landmark -3D Computer Graphics :Introduction – The Virtual world space – positioning the virtual observer – the perspective projection – human vision – stereo perspective projection – 3D clipping – Colour theory – Simple 3D modeling- illumination models – Reflection models – Shading algorithms- Radiosity – Hidden Surface Removal – Realism-Stereographic image.

UNIT - II: GEOMETRIC MODELLING 9

Geometric Modeling: Introduction – From 2D to 3D – 3D space curves – 3D boundary representation - Geometrical Transformations: Introduction – Frames of reference – Modeling transformations – Instances –Picking – Flying – Scaling the VE – Collision detection - A Generic VR system: Introduction – The virtual environment – the Computer environment – VR Technology– Model of interaction-VR Systems.

UNIT - III: VIRTUAL ENVIRONMENT 9

Animating the Virtual Environment: Introduction – The dynamics of numbers – Linear and Non-linear interpolation - The animation of objects – linear and non- linear translation - shape & object inbetweening – free from deformation – particle system- Physical Simulation : Introduction – Objects falling in a gravitational field-Rotating wheels – Elastic collisions – projectiles – simple pendulum – springs – Flight dynamics of an aircraft.

UNIT - IV: VR HARDWARES & SOFTWARES 9

Human factors: Introduction – the eye-the ear-the somatic senses-VR Hardware : Introduction – sensor hardware – Head-coupled displays –Acoustic hardware – Integrated VR systems-VR Software: Introduction –Modeling virtual world –Physical simulation- VR toolkits – Introduction to VRML.

UNIT - V: VR APPLICATION 9

Virtual Reality Applications: Introduction – Engineering – Entertainment – Science Training – The Future: Introduction – Virtual environments – modes of interaction.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

Upon completion of the course, students will be able to

- Analyse a system or process to meet given specifications with realistic engineering constraints.
- Design a system for specific real time applications
- Identify problem statements and function as a member of an engineering design team.
- Utilize technical resources
- Propose technical documents and give technical oral presentations related to design mini project results.

TEXT BOOKS:

1. John Vince, “Virtual Reality Systems “, Pearson Education Asia, 2007.\

REFERENCES:

1. Adams, “Visualizations of Virtual Reality”, Tata McGraw Hill, 2000.
2. Grigore C. Burdea, Philippe Coiffet , “Virtual Reality Technology”, Wiley Interscience, 2nd Edition, 2006.
3. William R. Sherman, Alan B. Craig, “Understanding Virtual Reality: Interface, Application, and Design”, Morgan Kaufmann, 2008.
4. www.vresources.org.
5. www.vrac.iastate.edu.
6. www.w3.org/MarkUp/VRML.

CO - PO and CO - PSO MAPPING:

CO	PO												PSO			
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CO2	2	-	-	-	-	-	-	-	-	-	-	-	-	2	-	-
CO3	-	2	3	-	-	-	-	-	-	-	-	-	-	3	-	-
CO4	-	2	2	-	2	-	-	-	-	-	-	-	-	3	-	-
CO5	-	-	-	-	2	-	-	-	-	-	-	-	-	3	-	-

1909718	ROBOTICS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

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

1. Understand the functions of robots and review the need and application of robots in different engineering fields.
2. Exemplify the different types of robot drive systems as well as robot end effectors.
3. Apply the different sensors and image processing techniques in robotics to improve the ability of robots.
4. Develop robotic programs for different tasks and analyze the kinematics motions of robot.
5. Implement robots in various industrial sectors and interpolate the economic analysis of robots.

UNIT-I: FUNDAMENTALS OF ROBOT 9

Robot - Definition - Robot Anatomy - Co ordinate Systems, Work Envelope Types and Classification- Specifications-Pitch, Yaw, Roll, Joint Notations, Speed of Motion, Pay Load-Robot Parts and their Functions-Need for Robots-Different Applications.

UNIT-II: ROBOT DRIVE SYSTEMS AND END EFFECTORS 9

Pneumatic Drives-Hydraulic Drives-Mechanical Drives-Electrical Drives-D.C. Servo Motors, Stepper Motors, A.C. Servo Motors-Salient Features, Applications and Comparison of all these Drives, End Effectors-Grippers-Mechanical Grippers, Pneumatic and Hydraulic- Grippers, Magnetic Grippers, Vacuum Grippers; Two Fingered and Three Fingered Grippers; Internal Grippers and External Grippers; Selection and Design Considerations

UNIT-III: SENSORS AND MACHINE VISION 9

Requirements of a sensor, Principles and Applications of the following types of sensors-Position sensors - Piezo Electric Sensor, LVDT, Resolvers, Optical Encoders, pneumatic Position Sensors, Range Sensors Triangulations Principles, Structured, Lighting Approach, Time of Flight, Range Finders, Laser Range Meters, Touch Sensors ,binary Sensors., Analog Sensors, Wrist Sensors, Compliance Sensors, Slip Sensors, Camera, Frame Grabber, Sensing and Digitizing Image Data-Signal Conversion, Image Storage, Lighting Techniques, Image Processing and Analysis-Data Reduction, Segmentation, Feature Extraction, Object

Recognition, Other Algorithms, Applications-Inspection, Identification, Visual Serving and Navigation.

UNIT-IV: ROBOT KINEMATICS AND ROBOT PROGRAMMING 9

Forward Kinematics, Inverse Kinematics and Difference; Forward Kinematics and Reverse Kinematics of manipulators with Two, Three Degrees of Freedom (in 2 Dimension), Four Degrees of freedom (in 3 Dimension) Jacobians, Velocity and Forces-Manipulator Dynamics, Trajectory Generator, Manipulator Mechanism Design-Derivations and problems. Lead through Programming, Robot programming Languages-VAL Programming-Motion Commands, Sensor Commands, End Effector commands and simple Programs.

UNIT-V: IMPLEMENTATION AND ROBOT ECONOMICS 9

RGV, AGV; Implementation of Robots in Industries -Various Steps; Safety Considerations for Robot Operations - Economic Analysis of Robots.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

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

1. Understand the functions of robots and review the need and application of robots in different engineering fields.
2. Exemplify the different types of robot drive systems as well as robot end effectors.
3. Apply the different sensors and image processing techniques in robotics to improve the ability of robots.
4. Develop robotic programs for different tasks and analyze the kinematics motions of robot.
5. Implement robots in various industrial sectors and interpolate the economic analysis of robots.

TEXTBOOKS:

1. Klafter R.D., Chmielewski T.A and Negin M., “Robotic Engineering - An Integrated Approach”, Prentice Hall, 2003.

2. Groover M.P., “Industrial Robotics -Technology Programming and Applications”, McGraw Hill, 2001.

REFERENCE BOOKS:

1. Craig J.J., “Introduction to Robotics Mechanics and Control”, Pearson Education, 2008.
2. Deb S.R., “Robotics Technology and Flexible Automation” Tata McGraw Hill Book Co., 1994.
3. Koren Y., “Robotics for Engineers", McGraw Hill Book Co., 1992.
4. Fu.K.S.,Gonzalz R.C. and Lee C.S.G., “Robotics Control, Sensing, Vision and Intelligence”,McGraw Hill Book Co., 1987.
5. Rajput R.K., “Robotics and Industrial Automation”, S.Chand and Company, 2008.

CO - PO and CO - PSO MAPPING:

CO	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
CO1	3		1	2									2	2		
CO2	3		2	2								1	2	2		
CO3	3	3	2	2								1	2	2		
CO4	3		2	3								1	2	2		
CO5	3		3	3								1	1	2		

1909719 TESTING OF MATERIALS L T P C

3 0 0 3

COURSE OBJECTIVES:

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

1. Apply the concept of testing to various materials and result analysis.
2. Apply various mechanical testing procedures to different materials.
3. Apply different nondestructive testing procedures to different materials.
4. Apply material characterization testing for analysis.
5. Apply advanced testing techniques for thermal and chemical fields.

UNIT-I: INTRODUCTION TO MATERIALS TESTING 9

Overview of materials, Classification of material testing, Purpose of testing, Selection of material, Development of testing, Testing organizations and its committee, Testing standards, Result Analysis, Advantages of testing

UNIT-II: MECHANICAL TESTING 9

Introduction to mechanical testing, Hardness test (Vickers, Brinell, Rockwell), Tensile test, Impact test (Izod, Charpy) - Principles, Techniques, Methods, Advantages and Limitations, Applications. Bend test, Shear test, Creep and Fatigue test - Principles, Techniques, Methods, Advantages and Limitations, Applications.

UNIT-III: NON DESTRUCTIVE TESTING 9

Visual inspection, Liquid penetrant test, Magnetic particle test, Thermography test – Principles, Techniques, Advantages and Limitations, Applications. Radiographic test, Eddy current test, Ultrasonic test, Acoustic emission- Principles, Techniques, Methods, Advantages and Limitations, Applications.

UNIT-IV: MATERIAL CHARACTERIZATION TESTING 9

Macroscopic and Microscopic observations, Optical and Electron microscopy (SEM and TEM) - Principles, Types, Advantages and Limitations, Applications. Diffraction techniques, Spectroscopic Techniques, Electrical and Magnetic Techniques- Principles, Types, Advantages and Limitations, Applications.

UNIT-V: OTHER TESTING 9

Thermal Testing: Differential scanning calorimetry, Differential thermal analysis. Thermo-mechanical and Dynamic mechanical analysis: Principles, Advantages, Applications. Chemical Testing: X-Ray Fluorescence, Elemental Analysis by Inductively Coupled Plasma-Optical Emission Spectroscopy and Plasma-Mass Spectrometry.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

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

1. Apply the concept of testing to various materials and result analysis.
2. Apply various mechanical testing procedures to different materials.
3. Apply different nondestructive testing procedures to different materials.
4. Apply material characterization testing for analysis.
5. Apply advanced testing techniques for thermal and chemical fields.

TEXTBOOKS:

1. Baldev Raj, T.Jayakumar, M.Thavasimuthu “Practical Non-Destructive Testing”, Narosa Publishing House, 2009.

2. Cullity, B. D., “Elements of X-ray diffraction”, 3rd Edition, Addison-Wesley Company Inc., New York, 2000.

REFERENCE BOOKS:

1. P. Field Foster, “The Mechanical Testing of Metals and Alloys” 7th Edition, Cousens Press, 2007.
2. Metals Handbook: Mechanical testing, (Volume 8) ASM Handbook Committee, 9th Edition, American Society for Metals, 1978.
3. ASM Metals Handbook, “Non-Destructive Evaluation and Quality Control”, American Society of Metals, Metals Park, Ohio, USA.
4. Brandon D.G., “Modern Techniques in Metallography”, Von Nostrand Inc. NJ, USA, 1986.

CO - PO and CO - PSO MAPPING:

CO	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
CO1	2	2	1	1								1	1	1		
CO2	3	2	1	1								1	1	1		
CO3	2	2	1	1								1	1	1		
CO4	3	2	1	1								1	1	1		
CO5	3	2	1	1								1	1	1		

1909720 DESIGN OF ELECTRIC VEHICLES L T P C

3 0 0 3

COURSE OBJECTIVES:

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

1. Understand about electric vehicle technology.
2. Understand the load distribution and stability of vehicles.
3. Analyze the handling characteristics of road vehicles.
4. Analyze the steering, suspension and designing of breaks.
5. Understand hybrid vehicles, power electronics and fuel cell vehicles.

UNIT-I: INTRODUCTION TO ELECTRIC VEHICLES 9

Electric Vehicle – Need - Types – Cost and Emissions – End of life. Electric Vehicle Technology – layouts, cables, components, Controls. Batteries – overview and its types.

Battery plug-in and life. Ultra-capacitor, Charging – Methods and Standards. Alternate charging sources – Wireless & Solar.

UNIT-II: STABILITY OF VEHICLES 9

Load distribution for three wheeler and four wheeler-Stability of vehicle running on slope, banked road and during turn-calculation of Tractive effort, maximum acceleration and reaction forces for different drives.

UNIT-III: HANDLING CHARACTERISTICS OF ROAD VEHICLES 9

Steering geometry-Steady state handling characteristics- Steady state response to steering input-Testing of handling characteristics-Transient response characteristics- Directional stability.

UNIT-IV: STEERING, SUSPENSION AND BRAKE 9

Steering System - Ackerman Principle of Steering - Front End Geometry - Steering Gearbox- Types-Recirculating Ball - Rack and Pinion - Power Steering. Suspension - Front and Rear Forks - Springs for Suspension - Telescopic Suspension - Monoshock Suspension - Hydraulic Shock Absorber - Dampers. Design Consideration – Brake - Drum Brakes - Disc Brakes - ABS

UNIT-V: Power Electronics and Control for Hybrid and Fuel Cell Vehicles 9

Series Hybrid Vehicle Propulsion System, Parallel Hybrid Vehicle Propulsion System, Fuel Cell Vehicles, Power Electronics Requirements, Propulsion Motor Control Strategies, APU Control System in Series Hybrid Vehicles, Fuel Cell for APU Applications.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

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

1. Understand about electric vehicle technology.
2. Understand the load distribution and stability of vehicles.
3. Analyze the handling characteristics of road vehicles.
4. Analyze the steering, suspension and designing of breaks.
5. Understand hybrid vehicles, power electronics and fuel cell vehicles.

TEXTBOOKS:

1. Hybrid Electric Vehicle System Modeling and Control - Wei Liu, General Motors, USA, John Wiley & Sons, Inc., 2017.

2. Rajesh Rajamani, "Vehicle Dynamics and Control", 1st edition, Springer, 2005

REFERENCE BOOKS:

1. Thomas D. Gillespie, "Fundamentals of Vehicle Dynamics", Society of Automotive Engineers Inc, 1992.
2. Dr.Kirpal Singh, 'Automobile Engineering'- Vol. I and II, Standard Publishers, New Delhi, 2011
3. V. Ganesan, 'Internal Combustion Engines', Tata McGraw Hill Book Co, Eighth Reprint, 2010.
4. Ali Emadi, "Handbook of Automotive Power Electronics and Drives", Taylor & Francis Group, First Edition, USA, 2005.

CO - PO and CO - PSO MAPPING:

CO	PO												PSO			
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**	**4**
CO1		2	1	1		1		1			1	2	2	1	2	
CO2	2			1	2				1							
CO3	1		1			1					1			1	1	
CO4		2	2	1			2									
CO5	2	2		1							2		2	1	1	

1910703 CLINICAL TRIALS L T P C

3 0 0 3

COURSE OBJECTIVES:

The student should be made:

1 To highlight the epidemiologic methods, study design, protocol preparation.
2 To learn about the crossover and factorial trial designs.
3 To acquire knowledge in the basic bio-statistical techniques involved in clinical research.
4 To describe the principle involved in ethical, legal and regulatory issues in clinical trials.
5 To explore the reporting of trials.

UNIT – I: ROLE OF CLINICAL TRIALS IN NEW DRUG DEVELOPMENT 9

Drug Discovery, Regulatory guidance and governance, Pharmaceutical manufacturing, Non-clinicalresearch, Clinical trials, Post-marketing surveillance, Ethical conduct during clinical trials.

UNIT – II: FUNDAMENTALS OF TRIAL DESIGN 9

Randomised clinical trials, Uncontrolled trials. Protocol development, Endpoints, Patient selection, Source and control of bias, Randomization, Blinding, Sample size and power.

UNIT – III: ALTERNATE TRIAL DESIGNS 9

Crossover design, Factorial design, Equivalence trials, Bioequivalence trials, Non-inferiority trials, Cluster randomized trials, Multi-center trials.

UNIT – IV: BASICS OF STATISTICAL ANALYSIS 9

Types of data and normal distribution, Significance tests and confidence intervals, Comparison of means, Comparison of proportions, Analysis of survival data, Subgroup analysis, Regression analysis, Missing data.

UNIT – V: REPORTING OF TRIALS 9

Overview of reporting, Trial profile, Presenting baseline data, Use of tables, Figures, Critical appraisal of report, Meta-analysis.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

The student should be able to:

1 Explain key concepts in the design of clinical trials.
2 Describe study designs used in data management for clinical trials.
3 Identify key issues and determine alternate trial designs.
4 Recognize the roles of regulatory affairs in clinical trials.
5 Provide the overview of reporting trials.

TEXT BOOKS:

1. Lawrence M. Friedman, “Fundamentals of Clinical Trials”, Springer Science & Business Media, Fifth Edition, 2015.
2. Stuart J. Pocock, “Clinical Trials: A Practical Approach”, John Wiley & Sons, 2013.

REFERENCE BOOKS:

1. David Machin, Simon Day, Sylvan Green, “Textbook of Clinical Trials”, Second Edition, John Wiley & Sons, 2007.
2. Duolao Wang, Ameet Bakhai, “Clinical trials, A practical guide to design, analysis and reporting”, First Edition, Remedica, 2006.
3. T.A. Durham, J Rick Turner, “Introduction to statistics in pharmaceutical clinical trials”, First Edition, Pharmaceutical Press, 2008.

4. Tom Brody, “Clinical Trials: Study Design, Endpoints and Biomarkers, Drug Safety, and FDA and ICH Guidelines”, Second Edition, Academic Press, 2016.

CO - PO and CO - PSO MAPPING:

CO	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
CO1	3	-	-	-	-	-	-	2	-	-	-	2	-	-	-	-
CO2	3	2	2	-	-	-	-	2	-	-	-	2	2	3	-	-
CO3	3	3	2	2	-	-	-	2	-	-	-	2	2	3	-	-
CO4	3	3	-	-	-	-	2	3	-	-	-	2	2	2	-	-
CO5	3	-	-	-	-	-	-	3	-	-	-	2	2	2	-	-

1910704 REGULATORY REQUIREMENTS IN PHARMACEUTICAL INDUSTRIES **L T P C**

3 0 0 3

COURSE OBJECTIVES:

The student should be made:

1 To acquire knowledge in pharmaceutical industry regulations.
2 To learn about the packaging and labeling of drugs.
3 To understand the patent filling process.
4 To analyze the quality guidelines in drug products.
5 To explore the process of documentation.

UNIT - I: REGULATORY CONCEPTS **9**

Quality assurance – Quality control – Practice of cGMP – Schedule M – USFDA.

UNIT – II: REGULATORY ASPECTS **9**

Pharmaceuticals: Bulk drug manufacture; Personnel, Buildings and Facilities, Process Equipment, Documentation and Records, Materials Management, Production and In-Process Controls, Packaging and Identification Labelling of API‟s and Intermediates, Storage and distribution, Biotechnology derived products; Principles, Personnel, Premises and equipments, Animal quarters and care, production, labelling, Lot processing records and distribution records, Quality assurance and quality control.

UNIT – III: INTELLECTUAL PROPERTY RIGHTS 9

Patent system – Different types of patents – Filing process of application for patent – Infringement of patents – The patent rules 2003 as amended by the patents (amendment) rules 2016.

UNIT – IV: ICH GUIDELINES 9

Quality guidelines – Impurities in new drug substances (Q3A (R2)) – Impurities in newdrug products(Q3B(R2)) – Validation of analytical procedures text and methodology (Q2 (R1)).

UNIT – V: QUALITY AUDIT AND SELF INSPECTIONS 9

SOPs – Documentation – Loan license auditing – Common technical documentation (CTD) – Drug master file (DMF).

TOTAL : 45 PERIODS

COURSE OUTCOMES:

The student should be able to:

1 Explain the pharmaceutical industry manufacturing practices and regulatory aspects of pharmacy products.
2 Describe the process of patenting activities.
3 Assess the different types of patents and filling process.
4 Explore the quality guidelines followed for pharmaceutical products.
5 Enumerate the aspects involved in document preparation for pharmaceutical product registration.

TEXT BOOKS:

1. C. V. Subbrahmanyam & J. Thimmasetty, “Pharmaceutical regulatory affairs”, First Edition, Vallabh Prakashan, New Delhi, 2012.
2. Willig, H., Tuckerman, M.M. and Hitchings, W.S., “Good Manufacturing Practices for Pharmaceuticals”, Fifth Edition, Marcel Dekker Drugs and the Pharmaceutical Sciences, by CRC Press, New York, 2000.
3. N Udupa, Krishnamurthy Bhat, “A Concise Textbook of Drug Regulatory Affairs”, First Edition, Manipal University Press (MUP); 2015.

REFERENCE BOOKS:

1. Ira R. Berry, “The Pharmaceutical Regulatory Process, marcel dekker Series: Drugs and the Pharmaceutical Sciences”, CRC Press, Newyork, 2004.

2. Mindy J. Allport-Settle, “Current Good Manufacturing Practices: Pharmaceutical, Biologics, and Medical Device Regulations and Guidance Documents Concise Reference”, Pharmalogika Inc., USA, 2009.
3. Sharma, P.P., “How to Practice GMPs”, Third Edition, Vandana Publications, 2006.

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CO3	2	2	3	2	-	2	3	3	-	-	-	2	2	-	-	-
CO4	2	-	-	-	-	2	3	3	-	-	-	2	2	-	-	-
CO5	2	-	-	-	-	2	3	3	-	-	-	2	2	-	-	-

1910705 MICROBIOLOGY L T P C

3 0 0 3

COURSE OBJECTIVES:

The student should be made:

1 To understand the principles of Microbiology.
2 To emphasize the structure and biochemical aspects of various microbes.
3 To learn about the Nutritional classification of microorganisms.
4 To gain knowledge on the physical and chemical control of microorganisms.
5 To acquire knowledge about the preservation of food.

UNIT – I: INTRODUCTION TO MICROBIOLOGY 9

Classification and nomenclature of microorganisms, Microscopic examination of microorganisms: Light, Fluorescent, Dark field, Phase contrast, and Electron microscopy.

UNIT – II: MICROBES- STRUCTURE AND REPRODUCTION 9

Structural organization and multiplication of bacteria, Viruses (TMV, Hepatitis B), Algae(cyanophyta, rhodophyta) and Fungi (Neurospora), Life history of actinomycetes (Streptomyces), Yeast (Sacharomyces), Mycoplasma (M. pneumoniae) and Bacteriophages (T4 phage, ʎphage)

UNIT – III: MICROBIAL NUTRITION, GROWTH AND METABOLISM 9

Nutritional classification of microorganisms based on carbon, Energy and electron sources. Definition of growth, Balanced and unbalanced growth, Growth curve and different methods to quantify bacterial growth:(counting chamber, viable count method, counting without equipment),Different media used for bacterial culture (defined, complex, selective, differential, enriched),The mathematics of growth-generation time, Specific growth rate.

UNIT – IV: CONTROL OF MICROORGANISMS 9

Physical and chemical control of microorganisms, Definition of sterilization, Dry and moist heat, Pasteurization, Tyndalization, Radiation, Ultrasonication, Filtration. Disinfections anitization, Antiseptics sterilants and fumigation. Mode of action and resistance to antibiotics, Clinically important microorganisms.

302

UNIT – V: INDUSTRIAL MICROBIOLOGY 9

Microbes involved in preservation (Lactobacillus, bacteriocins), Spoilage of food and food borne pathogens (E.coli, S.aureus, Bacillus, Clostridium). Industrial use of microbes (production of penicillin, alcohol, vitamin B-12); Biogas; Bioremediation (oil spillage leaching of ores by microorganisms, pollution control); Biofertilizers, Biopesticides. Biosensors. Quality assurance – Quality control – Practice of cGMP – Schedule M – USFDA.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

The student should be able to:

1 Explain the fundamentals of Microbiology.
2 Explore the scope of Microbiology.
3 Apply knowledge to solve the problems in microbial infection and their control.
4 Analyze the concept of food preservation.
5 Describe the industrial use of microbes.

TEXT BOOKS:

1. Ananthanarayanan, R. and C.K. Jayaram Paniker, “Textbook of Microbiology”, University Press, Ninth Edition, 2015.
2. Prescott L.M., Harley J.P., Klein DA, “Microbiology”, Eleventh Edition, McGraw -Hill Inc., 2020.

REFERENCE BOOKS:

1. Pelczar, M.J. “Microbiology”, Fifth Edition, Tata McGraw-Hill, 1993.
2. Talaron K, Talaron A, Casita, Pelczar and Reid. Foundations in Microbiology, W.C. Brown Publishers, 1993.
3. Schlegel, H.G. “General Microbiology”, Seventh Edition, Cambridge University Press, 1993.

CO - PO and CO - PSO MAPPING:

CO	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
CO1	3	-	-	-	-	-	-	-	-	-	-	2	2	-	-	-
CO2	3	2	-	-	-	-	-	-	-	-	-	2	2	-	-	-
CO3	3	2	2	2	-	2	1	2	-	-	-	2	2	2	2	-
CO4	3	-	-	2	-	1	2	2	-	-	-	2	2	2	-	-
CO5	3	-	-	-	-	3	2	-	-	-	-	2	2	-	-	-

1920701 ANALYTICAL METHODS AND INSTRUMENTATION L T P C

3 0 0 3

COURSE OBJECTIVES

1. Make the students understand the basics of spectrometry
2. To explore the knowledge on molecular spectroscopy.
3. To introduce the NMR and MASS spectrometry.
4. To elucidate the various separation methods in chromatography.
5. To gain knowledge on potentiometry and surface microscope.

UNIT- I: SPECTROMETRY 9

Properties of electromagnetic radiation- wave properties – components of optical instruments– Sources of radiation – wavelength selectors – sample containers – radiation transducers – Signal process and read outs – signal to noise ratio - sources of noise – Enhancement of signal to noise - types of optical instruments – Applications.

UNIT –II: MOLECULAR SPECTROSCOPY 9

Molecular absorption spectrometry – Measurement of Transmittance and Absorbance – Beer’s law – Instrumentation - Applications -Theory of fluorescence and Phosphorescence –Theory of

Infrared absorption spectrometry – IR instrumentation – Applications – Theory of Raman spectroscopy – Instrumentation – applications.

UNIT- III: NMR AND MASS SPECTROMETRY 9

Theory of NMR – chemical shift- NMR-spectrometers – applications of 1H and 13C NMR-Molecular mass spectra – ion sources.Massspectrometer.Applications of molecular mass - Electron paramagnetic resonance- g values – instrumentation.

UNIT- IV: SEPARATION METHODS 9

General description of chromatography – Band broadening and optimization of column performance-Liquid chromatography – Partition chromatography – Adsorption chromatography – Ion exchange chromatography -size exclusion chromatography- Affinity chromatography-principles of GC and applications – HPLC- Capillary electrophoresis – Applications.

UNIT-V: ELECTRO ANALYSIS AND SURFACE MICROSCOPY 9

Electrochemical cells- Electrode potential cell potentials – potentiometry- reference electrode – ionselective and molecular selective electrodes – Instrument for potentiometric studies – Voltametry – Cyclic and pulse voltametry- Applications of voltametry . Study of surfaces – Scanning probemicroscopes – AFM and STM.

TOTAL: 45 PERIODS

COURSE OUTCOMES

1. Ability to understand the concept of spectrometry
2. Ability to know the operations of various instruments.
3. Able to apply molecular spectroscopy concepts in NMR and MASS spectrometry.
4. Ability to understand surface microscopy and its applications.
5. Ability to acquire knowledge on surface microscopic techniques and voltametric applications.

TEXT BOOKS:

1. Skoog, D.A. F. James Holler, and Stanky, R.Crouch “Instrumental Methods of Analysis”.CengageLearning , 2007.
2. Willard, Hobart, etal., “Instrumental Methods of Analysis”. VIIth Edition, CBS, 1986.
3. Braun, Robert D. “Introduction to Instrumental Analysis”. Pharma Book Syndicate, 1987.
4. Ewing,G.W. “Instrumental Methods of Chemical Analysis”, Vth Edition, McGraw-Hill, 1985

REFERENCE BOOKS:

1. Sharma, B.K. “Instrumental Methods of Chemical Analysis : Analytical Chemistry” GoelPublishing House, 1972.
2. Haven, Mary C., etal., “Laboratory Instrumentation “. IVth Edition, John Wiley, 1995.

CO - PO and CO - PSO MAPPING:

CO	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
CO1	3	-	3	2	2	-	-	3	-	3	2	1	-	2	-	-
CO2	2	2	3	2	2	-	-	2	2	3	2	1	-	2	-	-
CO3	2	2	3	3	3	-	2	2	2	3	3	1	-	2	-	-
CO4	3	2	3	3	3	-	-	3	2	3	3	1	-	2	-	-
CO5	3	-	3	2	2	-	-	3	-	3	2	1	-	2	-	-

1920702 MEDICAL PHYSICS L T P C

3 0 0 3

COURSE OBJECTIVES

1 To study the complete non-ionizing radiations including light and its effect in human body.
2 To understand the principles of ultrasound radiation and its applications inmedicine.
3 To learn about radioactive nuclides.
4 To know the interactions of radiation with matters and how isotopes are produced.
5 To study the harmful effects of radiation and radiation protection regulations.

UNIT-I: NON-IONIZING RADIATION AND ITSMEDICALAPPLICATION 9

Introduction to EM waves - Tissue as a leaky dielectric - Relaxation processes: Debye model, Cole–Cole model- Overview of non-ionizing radiation effects-Low Frequency Effects- Higher frequency effects. Physics of light-Measurement of light and its unit- limits of vision and color vision an overview - Applications of ultraviolet in medicine, Thermography.

UNIT-II: ULTRASOUND IN MEDICINE 9

Ultrasound fundamentals – Generation of ultrasound (Ultrasound Transducer) - Interaction of Ultrasound with matter: Cavitation, Reflection, Transmission- Scanning systems – Artefacts-Ultrasound- Doppler-Double Doppler shift-Clinical Applications- Ultrasonography.

UNIT-III: PRINCIPLES OF RADIOACTIVE NUCLIDESANDDECAY 9

Introduction to Radioisotopes - Radioactive decay : Spontaneous Fission, Isomeric Transition, Alpha Decay, Beta Decay, Positron Decay, Electron Capture- Radioactive decay equations – Half life- Mean Life- Effective half-life - Natural and Artificial radioactivity, - Production of radionuclide – Cyclotron produced Radionuclide - Reactor produced Radionuclide: fission and electron Capture reaction, Target and Its Processing Equation for Production of Radionuclide - Radionuclide Generator-Technetium generator.

UNIT-IV: INTERACTION OF RADIATIONWITH MATTER 9

Interaction of charged particles with matter –Specific ionization, Linear energy transfer, range, Bremsstrahlung, Annihilation - Interaction of X and Gamma radiation with matter: Photoelectric effect, Compton Scattering, Pair production- Attenuation of Gamma Radiation - Interaction of neutron with matter and their clinical significance- Radionuclide used in Medicine and Technology.

UNIT-V: RADIATION EFFECTSAND REGULATIONS 9

Classification of Radiation Damage, Stochastic and Deterministic Effects, Acute Effects of Total Body Irradiation, Long-Term Effects of Radiation, Risk Versus Benefit in Diagnostic Radiology and Nuclear Medicine, Risk of Pregnant Women, Nuclear Regulatory Commission, ALARA Program, Medical Uses of Radioactive Materials, Survey for Contamination and Exposure Rate, Dose Calibrators and Survey Meters, Bioassay, Radioactive Waste Disposal.

TOTAL: 45 PERIODS

COURSE OUTCOMES

1. Analyze the low frequency and high frequency effects of non-ionizing radiation and physics of light.
2. Define various clinical applications based on ultrasoundwave.
3. Explain the process of radioactive nuclide production using differenttechniques
4. Analyze radiation mechanics involved with various physiologicalsystems
5. Outline the detrimental effects of radiation and regulations for radiationsafety.

TEXT BOOKS:

1 B H Brown, R H Smallwood, D C Barber, P V Lawford and D R Hose, Medical Physics and Biomedical Engineering, 2nd Edition, IOP Publishers.2001. (Unit I &II)

2 Gopal B. Saha, Physics and Radiobiology of Nuclear Medicine, 4th Edition, Springer, 2013. (Unit III &IV)

3 R.Hendee and Russell Ritenour “Medical Imaging Physics”, Fourth Edition William, Wiley-Liss, 2002. (Unit V).

REFERENCE BOOKS:

1 S.Webb “ The Physics of Medical Imaging”, Taylor and Francis,1988
2 HyltonB.Meire and Pat Farrant “Basic Ultrasound” John Wiley & Sons,1995
3 John R Cameran , James G Skofronick “Medical Physics” John-Wiley & Sons.1978.

CO - PO and CO - PSO MAPPING:

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CO3	3	1	2	-	-	2	2	-	-	-	-	2	1	2	-	-
CO4	2	1	1	-	1	1	1	-	-	-	-	1	-	2	-	-
CO5	3	2	3	-	2	1	3	-	-	-	-	3	-	3	-	-

1920703 ELECTRONIC MATERIALS L T P C
3 0 0 3

COURSE OBJECTIVES

1. To Understand the various materials and its properties towards electrical and electronics field.
2. To cover the properties of conducting materials.
3. Make the students to understand various semiconducting and magnetic materials and their properties.
4. To give an idea on dielectric and insulating materials.
5. To explore the knowledge on optoelectronic and nano materials.

UNIT- I: INTRODUCTION 7

Structure: atomic structures and bonding, types of bonding, band formation.Defectsandimperfectionsin solids: Point, Line and Planar defects; Interfacial defects and volume defects.Classification of materials based on bonding: conductors, semiconductors and insulators.

UNIT- II: CONDUCTING MATERIALS 9

Introduction, factors affecting the conductivity of materials, classification based on conductivity of materials, temperature dependence of resistivity, Low resistivity materials (graphite, Al, Cu and steel) and its applications, high resistivity materials (manganin, constantan, nichrome, tungsten) and their applications. Superconductors: Meissner effect, classification and applications.

UNIT- III: SEMICONDUCTING AND MAGNETIC MATERIALS 10

Semiconductors: Introduction, types of semiconductors, temperature dependence of semiconductors, compound semiconductors, basic ideas of amorphous and organic semiconductors. Magnetic Materials: classification of magnetic materials, ferromagnetism-B-H curve (Qualitative), hard and soft magnetic materials, magneto materials applications.

UNIT- IV: DIELECTRIC AND INSULATING MATERIALS 9

Dielectric Materials: Introduction, classification, temperature dependence on polarization, properties,dielectric loss, factors influencing dielectric strength and capacitor materials, applications. Insulators: Introduction, thermal and mechanical properties required for insulators, Inorganic materials, organic materials, liquid insulators, gaseous insulators and ageing of insulators, applications.

UNIT –V: OPTOELECTRONIC ANDNANO ELECTRONIC MATERIALS 10

Optoelectronic materials. Introduction, properties, factor affecting optical properties, role of optoelectronic materials in LEDs, LASERs, photo detectors, solar cells. Nano electronic Materials: Introduction, advantage of nanoelectronic devices, materials, fabrication, challenges in Nano electronic materials.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

1. Ability to understand the fundamentals of conducting materials
2. Able to define various applications of semiconducting and magnetic materials
3. Able to explain the concepts of dielectrics and insulating materials
4. Ability to explain various optoelectronic devices and nano electronic materials
5. With the basis, students will be able to have clear concepts on electronic behaviors of materials.

TEXT BOOKS:

1. S.O. Kasap “Principles of Electronic Materials and Devices”, 3rd edition, McGraw-Hill Education (India) Pvt. Ltd., 2007.
2. W D Callister, “Materials Science & Engineering – An Introduction”, Jr., John Willey &Sons,Inc, New York, 7th edition, 2007.

REFERENCE BOOKS:

1. B.G. Streetman and S. Banerjee, Solid State Electronic Devices, 6th edition, PHI Learning, 2009.
2. Eugene A. Irene, Electronic Materials Science, Wiley, 2005
3. Wei Gao, Zhengwei Li, Nigel Sammes, An Introduction to Electronic Materials for Engineers, 2nd Edition, World Scientific Publishing Co. Pvt. Ltd., 2011.

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CO3	3	3	3	-	3	2	-	-	-	-	-	-	3	1	-	-
CO4	2	3	3	1	3	3	-	-	-	-	-	-	3	-	-	-
CO5	2	3	2	1	3	3	-	-	-	-	-	-	3	-	-	-

1921701 WASTE WATER TREATMENT L T P C

3 0 0 3

COURSE OBJECTIVES

1. To make the student conversant with the water treatment methods including adsorption and oxidation process.
2. To provide basic under standings about the requirements of water and its preliminary treatment.
3. To study the dynamic processes and understand the features of corrosion and its effects
4. To develop and understand the waste water treatment process
5. To provide a broad view about the water quality and its standards

UNIT-I: WATER QUALITY AND PRELIMINARY TREATMENT 9

Water Quality-physical-chemical and biological parameters of water-Water quality requirement - potable water standards-Wastewater effluent standards-water quality indices. Water purification systems in natural systems- physical processes-chemical processes and biological processes-Primary, secondary and tertiary treatment-Unit operations-unit processes. Mixing, clarification-sedimentation; Types-aeration and gas transfer-coagulation and flocculation, coagulation processes.

UNIT-II: INDUSTRIAL WATER TREATMENT 9

Filtration-size and shape characteristics of filtering media-sand filters hydraulics of filtration-design considerations-radial, upflow, highrate and multimedia filters, pressure filter. Water softening-lime soda, zeolite and demineralization processes – Boiler troubles-scale, sludge, priming, foaming, caustic embrittlement and boiler corrosion.

UNIT-III: CONVENTIONAL TREATMENT METHODS 9

Taste and odour control-Adsorption-activated carbon treatment-removal of color-iron and manganese removal-aeration, oxidation, ion exchange and other methods-effects of fluorides-fluoridation and defluoridation-desalination-Corrosion prevention and control-factors influencing corrosion-Langelier index-Corrosion control measures.

UNIT-IV: WASTEWATER TREATMENT 9

Wastewater treatment-pre and primary treatment-equalization neutralization-screening and grid removal-sedimentation-oil separation gas stripping of volatile organics-biological oxidation-lagoons and stabilization basins-aerated lagoons-activated sludge process-trickling filtration-anaerobic decomposition-Break point chlorination.

UNIT-V: ADSORPTION AND OXIDATION PROCESSES 9

Chemical process-Adsorption-theory of adsorption-Ion exchange process-chemical oxidation-advanced oxidation process-sludge handling and disposal-Miscellaneous treatment processes.

TOTAL: 45 PERIODS

COURSE OUTCOMES

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

- Gain idea about various methods available for water treatment.
- Appreciate the necessity of water and acquire knowledge of preliminary treatment.
- Interpret the nature of corrosion and its harmful effects.

- Value the various waste water treatment methods.
- Understand about adsorption and oxidation process.

TEXTBOOKS:

1. Metcalf and Eddy, “Wastewater Engineering”, 4th ed., McGraw Hill Higher Edu., 2002.
2. G.L.Karia and R.A. Christian, Waste Water Treatment, Concepts and Design Approach, Prentice Hall, 2013.
3. Joanne E. Drinon and Frank Spellman, Water and Waste Water Treatment, CRC Press, 2012.

REFERENCE BOOKS:

1. S.P. Mahajan, “Pollution control in process industries”, 27th Ed. Tata McGraw Hill Publishing Company Ltd., 2012.
2. M. Lancaster, “Green Chemistry: An Introductory Text”, 2nd edition, RSC publishing, 2010.
3. C.S. Rao, “Environmental Pollution Control Engineering”, New Age International, 2007.
4. M.J. Hammer and M.J. Hammer (Jr.), Water and Waste Water Technology, Pearson, 2011.

CO - PO and CO - PSO MAPPING:

CO	PO												PSO			
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**	**4**
CO1	2	1	2				1		2			1	1	2	1	1
CO2	1	2	2	2			3		1			1	2	2	1	2
CO3	3	1		1	3	1	3					1	1	1		
CO4	2		2	2	1		3					1	2	2	1	2
CO5	3	2			1							1				