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ANNA UNIVERSITY, CHENNAI
AFFILIATED INSTITUTIONS
REGULATIONS 2017
B. TECH. PLASTICS TECHNOLOGY
CHOICE BASED CREDIT SYSTEM

1. Program Educational Objectives (PEOs)

Bachelor of plastics technology curriculum is designed to prepare the graduates having attitude and knowledge to

1. Have successful professional technical career in the field of plastics and allied industries such as taking up the challenging positions in plastics material manufacturing industries, compounding industries, processing machinery manufacturing industries by offering specialized elective subjects and industry exposure**.**
2. Acquire a strong knowledge in basic sciences, engineering, mathematics and computational platforms by providing overall knowledge on the manufacturing of plastics materials, their properties, applications, processing, product design, mold design, testing & quality control and recycling through theory as well as practical training.
3. who will engage in lifelong learning or continuous education opportunities in the area of management such as TQM, Industrial costing and management, statistical quality control, professional ethics and environmental science to impart leadership qualities.
4. Meet the manpower requirements of plastics and allied industries in India and overseas.

2. Program Outcomes (POs)

a) Ability to apply knowledge in Humanities, basic sciences, mathematics and engineering.
b) This program would provide well trained professionals for the plastics and allied industries to meet the well trained man power requirements.
c) The graduates will get skilled experience in various aspects of plastics technology viz. plastics materials manufacturing, properties, applications, processing, product design, mold design, testing & quality control, and recycling.
d) The program will help the graduates to take up responsibilities in production, testing, design and marketing in the plastics industries and contribute for the growth of industry.
e) The graduates with the knowledge of plastics technology can become entrepreneurs as they can easily start up processing, compounding, design and marketing units.
f) Ability to understand the ethical and professional responsibilities and make them to work effectively in interdisciplinary groups.
g) Ability to review, comprehend and report the technological development.
h) An ability to identify, formulate and solve engineering problems and to gain knowledge in solving contemporary issues.
i) An ability to use the techniques, skills and modern tools necessary for engineering practice.
j) Recognition of need for and an ability to engage in continuous learning.
k) The broad education necessary to understand the impact of engineering solutions in global, economic, environmental and societal context.
l) Ability to design and realize a processing system to meet desired needs within realistic constraints such as economic, environmental, social, health and safety, manufacturability and sustain ability.
m) Able to work professionally in the area of manufacturing / processing systems.

3. PEOs/POs MAPPING

PEOs / POs	a	b	c	d	e	F	g	h	i	j	k	l	m
1.									✓		✓		
2.	✓		✓		✓		✓			✓			✓
3.			✓	✓		✓		✓			✓	✓	
4.	✓	✓			✓			✓				✓	✓

4. POs MAPPING

Year	Sem.	Course Title	a	b	c	d	e	f	g	h	i	j	k	l	m
I	I	Communicative English	✓	✓	-	-	✓	✓	✓	-	-	✓	-	-	-
		Engineering Mathematics I	✓	✓	-	✓	-	-	✓	-	-	✓	-	✓	-
		Engineering Physics	✓	✓	-	✓	✓	-	✓	-	-	-	-	✓	-
		Engineering Chemistry	✓	✓	✓	-	✓	✓	-	-	-	-	-	-	✓
		Problem Solving and Python Programming	-	✓	✓	✓	-	✓	✓	-	-	-	-	✓	-
		Engineering Graphics	✓	-	✓	✓	✓	-	✓	-	-	✓	-	✓	-
		Physics and Chemistry Laboratory	✓	✓	✓	-	-	-	-	✓	✓	✓	-	-	-
		Problem Solving and Python Programming Laboratory	✓	✓	-	✓	-	-	-	✓	-	✓	✓	-	-
	II	Technical English	✓	✓	-	✓	-	-	✓	-	-	✓	✓	✓	-
		Engineering Mathematics II	✓	-	-	-	-	-	✓	✓	-	-	✓	✓	✓
		Physics of Materials	✓	✓	✓	✓	-	-	-	✓	✓	✓	-	-	✓
		Physical and Organic Chemistry	-	✓	✓	✓	-	✓	-	✓	-	✓	-	-	-
		Basic Electrical and Electronics Engineering	✓	-	✓	✓	-	-	-	-	-	-	✓	✓	✓
		Production Processes	✓	-	✓	-	✓	✓	✓	-	-	-	-	✓	-
		Engineering Practices Laboratory	✓	✓	-	-	✓	✓	-	-	-	-	✓	-	-
		Computer Aided Drafting and Modeling Laboratory	✓	-	✓	✓	✓	-	✓	-	✓	-	-	--	✓
	III	Probability and Statistics	-	✓	✓	✓	-	-	✓	-	✓	-	-	✓	-
		Fundamentals of Polymer Science	✓	✓	-	✓	-	✓	-	-	-	✓	-	✓	✓
		Environmental Science and Engineering	✓	✓	-	-	-	✓	-	-	-	-	✓	✓	-

Year	Sem.	Course Title	a	b	c	d	e	f	g	h	i	j	k	l	m
		Mechanics of Solids	-	-	✓	✓	✓	-	✓	-	-	✓	✓	-	-
		Introduction to Chemical Engineering	✓	-	✓	✓	-	✓	-	-	✓	-	✓	-	✓
		Polymer Physics	✓	✓	-	✓	-	-	✓	-	-	-	✓	✓	✓
		Chemical Engineering Laboratory	-	✓	✓	✓	-	✓	-	✓	✓	-	-	-	✓
		Plastics Identification and Analysis Laboratory	✓	✓	✓	✓	✓	-	✓	-	-	-	✓	-	-
		Interpersonal Skills/Listening and Speaking	-	✓	-	✓	✓	-	✓	-	-	✓	-	✓	-
	IV	Numerical Methods	✓	-	✓	✓	✓	-	-	✓	✓	-	-	✓	-
		Fluid Mechanics and Polymer Rheology	-	-	✓	✓	-	✓	✓	-	✓	-	✓	-	-
		Plastics Materials I	✓	✓	-	-	-	✓	-	✓	-	-	-	✓	✓
		Engineering Thermodynamics	-	-	-	✓	-	-	✓	-	✓	-	-	✓	✓
		Process Instrumentation for Polymer Technologist	✓	✓	-	✓	-	-	✓	✓	-	-	✓	✓	-
		Mould Manufacturing Technology	✓	-	✓	-	✓	-	✓	-	✓	✓	-	✓	✓
		Mould Manufacturing Technology Laboratory	-	✓	-	✓	-	✓	-	✓	-	✓	-	-	-
		Advanced Reading and Writing	✓	-	✓	-	-	-	✓	-	-	✓	-	✓	✓
	V	Additives and Compounding	✓	-	✓	✓	-	-	✓	✓	✓	✓	-	✓	-
		Plastics Testing I	✓	✓	✓	-	✓	✓	✓	✓	✓	✓	✓	✓	-
		Plastics Materials II	✓	-	✓	✓	-	-	✓	✓	-	✓	✓	✓	✓
		Plastics Processing Technology I	-	✓	-	✓	✓	-	-	-	✓	-	✓	✓	✓
		Plastics Processing Laboratory I	✓	✓		✓		✓	✓		✓		✓	✓	
		Polymer Preparation Laboratory	✓	-	✓		✓		✓	✓		✓	✓		
	VI	Plastics Moulds and Dies Design	-	-	✓		✓	✓		-	✓	✓	✓	✓	✓
		CAD/CAM/CAE for Plastics Engineering	-		-	✓	-	✓	✓	✓	-	-		✓	✓
		Plastics Testing II	✓		✓		✓	✓	✓	✓	✓			✓	
		Plastics Processing Technology II	✓	✓	-	✓	✓	-	✓	-	✓	✓	✓	✓	✓
		Rubber Technology	✓	✓	-	✓		✓	✓	-	✓	✓	✓	✓	✓
		Plastics Processing Lab II	✓	✓	✓	-	✓	-		-	-	✓	✓	-	✓

Year	Sem.	Course Title	a	b	c	d	e	f	g	h	i	j	k	l	m
		Plastics Testing Laboratory I	✓	-	✓	-	✓	-	✓	✓	-	✓	✓	-	✓
	VII	Polymer Composites	✓	✓	✓	-	✓	✓	✓	✓	-	✓	-	-	
		Plastics Product Design	✓	-	✓	✓	-		✓	✓	✓	✓		✓	✓
		Advanced Plastics and Speciality Polymers	✓	-			✓		✓			✓	✓		✓
		Plastics Testing Laboratory II	✓	✓	-		✓		✓	-	✓	-	✓	✓	✓
		CAD/CAM/CAE Laboratory	-	✓	-	✓		✓			-	✓	-		✓
		Comprehension	-	✓	✓	-	-	-	✓		-	✓	-	✓	-
	VIII	Project Work	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓

ANNA UNIVERSITY, CHENNAI
AFFILIATED INSTITUTIONS
REGULATIONS 2017
B. TECH. PLASTICS TECHNOLOGY
CHOICE BASED CREDIT SYSTEM
I TO VIII SEMESTERS (FULL TIME) CURRICULA AND SYLLABI

SEMESTER I

S. No.	COURSE CODE	COURSE TITLE	CATE GORY	CONTACT PERIODS	L	T	P	C
THEORY								
1	HS8151	Communicative English	HS	4	4	0	0	4
2	MA8151	Engineering Mathematics I	BS	4	4	0	0	4
3	PH8151	Engineering Physics	BS	3	3	0	0	3
4	CY8151	Engineering Chemistry	BS	3	3	0	0	3
5	GE8151	Problem Solving and Python Programming	ES	3	3	0	0	3
6	GE8152	Engineering Graphics	ES	6	2	0	4	4
PRACTICALS								
7	GE8161	Problem Solving and Python Programming Laboratory	ES	4	0	0	4	2
8	BS8161	Physics and Chemistry Laboratory	BS	4	0	0	4	2
			TOTAL	**31**	**19**	**0**	**12**	**25**

SEMESTER II

S. No.	COURSE CODE	COURSE TITLE	CATE GORY	CONTACT PERIODS	L	T	P	C
THEORY								
1	HS8251	Technical English	HS	4	4	0	0	4
2	MA8251	Engineering Mathematics II	BS	4	4	0	0	4
3	PH8254	Physics of Materials	BS	3	3	0	0	3
4	CY8251	Physical and Organic Chemistry	BS	3	3	0	0	3
5	BE8251	Basic Electrical and Electronics Engineering	ES	3	3	0	0	3
6	PR8251	Production Processes	ES	4	4	0	0	4
PRACTICALS								
7	GE8261	Engineering Practices Laboratory	ES	4	0	0	4	2
8	ME8261	Computer Aided Drafting and Modeling Laboratory	ES	4	0	0	4	2
			TOTAL	**29**	**21**	**0**	**8**	**25**

SEMESTER III

S. No.	COURSE CODE	COURSE TITLE	CATE GORY	CONTACT PERIODS	L	T	P	C
THEORY								
1	MA8391	Probability and Statistics	BS	4	4	0	0	4
2	PT8351	Fundamentals of Polymer Science	PC	3	3	0	0	3
3	GE8291	Environmental Science and Engineering	HS	3	3	0	0	3
4	PT8353	Mechanics of Solids	ES	3	3	0	0	3
5	PT8352	Introduction to Chemical Engineering	ES	3	3	0	0	3
6	PT8354	Polymer Physics	PC	3	3	0	0	3
PRACTICALS								
7	PT8361	Chemical Engineering Laboratory	ES	4	0	0	4	2
8	PL8311	Plastics Identification and Analysis Laboratory	PC	4	0	0	4	2
9	HS8381	Interpersonal Skills/Listening and Speaking	EEC	2	0	0	2	1
			TOTAL	**29**	**19**	**0**	**10**	**24**

SEMESTER IV

S. No.	COURSE CODE	COURSE TITLE	CATE GORY	CONTACT PERIODS	L	T	P	C
THEORY								
1	MA8491	Numerical Methods	BS	4	4	0	0	4
2	PT8451	Fluid Mechanics and Polymer Rheology	PC	3	3	0	0	3
3	PL8451	Plastics Materials I	PC	3	3	0	0	3
4	ME8391	Engineering Thermodynamics	ES	5	3	2	0	4
5	PT8453	Process Instrumentation for Polymer Technologist	ES	3	3	0	0	3
6	PT8452	Mould Manufacturing Technology	PC	3	3	0	0	3
PRACTICALS								
7	PT8461	Mould Manufacturing Technology Laboratory	PC	4	0	0	4	2
8	HS8461	Advanced Reading and Writing	EEC	2	0	0	2	1
			TOTAL	**27**	**19**	**2**	**6**	**23**

SEMESTER V

S. No.	COURSE CODE	COURSE TITLE	CATE GORY	CONTACT HOURS	L	T	P	C
THEORY								
1.	PL8501	Additives and Compounding	PC	3	3	0	0	3
2.	PL8502	Plastics Testing I	PC	3	3	0	0	3
3.	PL8551	Plastics Materials II	PC	3	3	0	0	3
4.	PL8503	Plastics Processing Technology I	PC	4	4	0	0	4
5.		Professional Elective I	PE	3	3	0	0	3
6.		Open Elective I*	OE	3	3	0	0	3
PRACTICAL								
7.	PL8511	Plastics Processing Laboratory I	PC	4	0	0	4	2
8.	PT8561	Polymer Preparation Laboratory	PC	4	0	0	4	2
			TOTAL	**27**	**19**	**0**	**8**	**23**

SEMESTER VI

S. No.	COURSE CODE	COURSE TITLE	CATE GORY	CONTACT HOURS	L	T	P	C
THEORY								
1.	PL8601	Plastics Moulds and Dies Design	PC	3	3	0	0	3
2.	PL8602	CAD/CAM/CAE for Plastics Engineering	PC	3	3	0	0	3
3.	PL8603	Plastics Testing II	PC	3	3	0	0	3
4.	PL8604	Plastics Processing Technology II	PC	3	3	0	0	3
5.	PL8605	Rubber Technology	PC	3	3	0	0	3
6.		Professional Elective II	PE	3	3	0	0	3
7.		Professional Elective III	PE	3	3	0	0	3
PRACTICAL								
8.	PL8611	Plastics Processing Laboratory II	PC	4	0	0	4	2
9.	PL8612	Plastics Testing Laboratory I	PC	4	0	0	4	2
			TOTAL	**29**	**21**	**0**	**8**	**25**

SEMESTER VII

S. No.	COURSE CODE	COURSE TITLE	CATE GORY	CONTACT HOURS	L	T	P	C
THEORY								
1.	PT8751	Polymer Composites	PC	3	3	0	0	3
2.	PL8701	Plastics Product Design	PC	3	3	0	0	3
3.	PL8702	Advanced Plastics and Speciality Polymers	PC	3	3	0	0	3
4.		Professional Elective IV	PE	3	3	0	0	3
5.		Professional Elective V	PE	3	3	0	0	3
6.		Open Elective II*	OE	3	3	0	0	3
PRACTICAL								
7.	PL8711	Plastics Testing Laboratory II	PC	4	0	0	4	2
8.	PL8712	CAD / CAM / CAE Laboratory	PC	4	0	0	4	2
9.	PL8713	Comprehension	EEC	2	0	0	2	1
			TOTAL	**28**	**18**	**0**	**10**	**23**

SEMESTER VIII

S. No.	COURSE CODE	COURSE TITLE	CATE GORY	CONTACT HOURS	L	T	P	C
THEORY								
1	PL8811	Project Work	EEC	20	0	0	20	10
				TOTAL	**0**	**0**	**20**	**10**

TOTAL CREDITS: 178

PROFESSIONAL ELECTIVES

PROFESSIONAL ELECTIVE I, SEMESTER V

S. No.	COURSE CODE	COURSE TITLE	CATE GORY	CONTACT HOURS	L	T	P	C
1.	PT8073	Plastics Packaging Technology	PE	3	3	0	0	3
2.	PT8072	Fiber Technology	PE	3	3	0	0	3
3.	GE8071	Disaster Management	PE	3	3	0	0	3

PROFESSIONAL ELECTIVE II, SEMESTER VI

S. No.	COURSE CODE	COURSE TITLE	CATE GORY	CONTACT HOURS	L	T	P	C
1.	PL8072	Biodegradable Polymers	PE	3	3	0	0	3
2.	PL8075	Polyurethane Technology	PE	3	3	0	0	3
3.	PL8074	Plastics Waste Management and Recycling Techniques	PE	3	3	0	0	3
4.	PT8074	Polymer Nanocomposites	PE	3	3	0	0	3

5.	GE8075	Intellectual Property Rights	PE	3	3	0	0	3

PROFESSIONAL ELECTIVE III, SEMESTER VI

S. No.	COURSE CODE	COURSE TITLE	CATE GORY	CONTACT HOURS	L	T	P	C
1.	PT8651	Polymer Blends and Alloys	PE	3	3	0	0	3
2.	PL8091	Thermoplastic Elastomers	PE	3	3	0	0	3
3.	PL8001	Woven Sacks Technology	PE	3	3	0	0	3
4.	PL8002	Polymers in Fuel cells	PE	3	3	0	0	3
5.	GE8076	Professional Ethics in Engineering	PE	3	3	0	0	3
6.	GE8073	Fundamentals of Nano Science	PE	3	3	0	0	3

PROFESSIONAL ELECTIVE IV, SEMESTER VII

S. No.	COURSE CODE	COURSE TITLE	CATE GORY	CONTACT HOURS	L	T	P	C
1.	PL8073	Biomedical Plastics	PE	3	3	0	0	3
2.	PL8003	Advanced Mould and Die Manufacturing Techniques	PE	3	3	0	0	3
3.	PT8075	Polymers for Energy Storage Applications	PE	3	3	0	0	3
4.	PT8071	Conducting Polymers	PE	3	3	0	0	3
5.	GE8074	Human Rights	PE	3	3	0	0	3

PROFESSIONAL ELECTIVE V, SEMESTER VII

S. No.	COURSE CODE	COURSE TITLE	CATE GORY	CONTACT HOURS	L	T	P	C
1.	PL8004	Additive Manufacturing in Plastics Products	PE	3	3	0	0	3
2.	PL8071	Advanced Plastics Processing	PE	3	3	0	0	3
3.	PL8005	Electrical devices	PE	3	3	0	0	3
4.	PL8006	Adhesives and Surface Coatings	PE	3	3	0	0	3
5.	GE8077	Total Quality Management	PE	3	3	0	0	3

SUBJECT AREAWISE DETAILS

HUMANITIES AND SOCIAL SCIENCE (HS)

S. No.	COURSE CODE	COURSE TITLE	CATE GORY	CONTACT PERIODS	L	T	P	C
1	HS8151	Communicative English	HS	4	4	0	0	4
2	HS8251	Technical English	HS	4	4	0	0	4
3	GE8291	Environmental Science and Engineering	HS	3	3	0	0	3

BASIC SCIENCES (BS)

S. No.	COURSE CODE	COURSE TITLE	CATE GORY	CONTACT PERIODS	L	T	P	C
1	MA8151	Engineering Mathematics I	BS	4	4	0	0	4
2	PH8151	Engineering Physics	BS	3	3	0	0	3
3	CY8151	Engineering Chemistry	BS	3	3	0	0	3
4	BS8161	Physics and Chemistry Laboratory	BS	4	0	0	4	2
5	MA8251	Engineering Mathematics II	BS	4	4	0	0	4
6	PH8254	Physics of Materials	BS	3	3	0	0	3
7	CY8251	Physical and Organic Chemistry	BS	3	3	0	0	3
8	MA8391	Probability and Statistics	BS	4	4	0	0	4
9	MA8491	Numerical Methods	BS	4	4	0	0	4

ENGINEERING SCIENCES (ES)

S. No.	COURSE CODE	COURSE TITLE	CATE GORY	CONTACT PERIODS	L	T	P	C
1	GE8151	Problem Solving and Python Programming	ES	3	3	0	0	3
2	GE8152	Engineering Graphics	ES	5	3	2	0	4
3	GE8161	Problem Solving and Python Programming Laboratory	ES	4	0	0	4	2
4	BE8251	Basic Electrical and Electronics Engineering	ES	3	3	0	0	3
5	PR8251	Production Processes	ES	4	4	0	0	4
6	GE8261	Engineering Practices Laboratory	ES	4	0	0	4	2
7	ME8261	Computer Aided Drafting and Modeling Laboratory	ES	4	0	0	4	2
8	PT8353	Mechanics of Solids	ES	3	3	0	0	3
9	PT8352	Introduction to Chemical Engineering	ES	3	3	0	0	3
10	PT8361	Chemical Engineering Laboratory	ES	4	0	0	4	2
11	ME8391	Engineering Thermodynamics	ES	5	3	2	0	4
12	PT8453	Process Instrumentation for Polymer Technologist	ES	3	0	0	0	3

PROFESSIONAL CORE (PC)

S. No.	COURSE CODE	COURSE TITLE	CATE GORY	CONTACT PERIODS	L	T	P	C
1.	PT8351	Fundamentals of Polymer Science	PC	3	3	0	0	3
2.	PT8354	Polymer Physics	PC	3	3	0	0	3

3.	PL8311	Plastics Identification and Analysis Laboratory	PC	4	0	0	4	2
4.	PT8451	Fluid Mechanics and polymer Rheology	PC	3	3	0	0	3
5.	PL8451	Plastics Materials I	PC	3	3	0	0	3
6.	PT8452	Mould Manufacturing Technology	PC	3	3	0	0	3
7.	PT8461	Mould Manufacturing Technology Laboratory	PC	4	0	0	4	2
8.	PL8501	Additives and Computing	PC	3	3	0	0	3
9.	PL8502	Plastics testing I	PC	3	3	0	0	3
10.	PL8551	Plastics Materials II	PC	3	3	0	0	3
11.	PL8503	Plastics Processing Technology I	PC	4	4	0	0	4
12.	PT8561	Polymer Preparation Laboratory	PC	4	0	0	4	2
13.	PL8511	Plastics Processing Laboratory I	PC	4	0	0	4	2
14.	PL8601	Plastics Moulds and Dies Design	PC	3	3	0	0	3
15.	PL8602	CAD/CAM/CAE for Plastics Engineering	PC	3	3	0	0	3
16.	PL8603	Plastics Testing II	PC	3	3	0	0	3
17.	PL8604	Plastics Processing Technology II	PC	3	3	0	0	3
18.	PL8605	Rubber Technology	PC	3	3	0	0	3
19.	PL8611	Plastics Processing Laboratory II	PC	4	0	0	4	2
20.	PL8612	Plastics Testing Laboratory I	PC	4	0	0	4	2
21.	PT8751	Polymer Composites	PC	3	3	0	0	3
22.	PL8701	Plastics Product Design	PC	3	3	0	0	3
23.	PL8702	Advanced Plastics and Speciality Polymers	PC	3	3	0	0	3
24.	PL8711	Plastics Testing Laboratory II	PC	4	0	0	4	2
25.	PL8712	CAD/CAM/CAE Laboratory	PC	4	0	0	4	2

EMPLOYABILITY ENHANCEMENT COURSES (EEC)

S. No.	COURSE CODE	COURSE TITLE	CATE GORY	CONTACT PERIODS	L	T	P	C
1	HS8381	Interpersonal Skills/Listening and Speaking	EEC	2	0	0	2	1
2	HS8461	Advanced Reading and Writing	EEC	2	0	0	2	1
3	PL8713	Comprehension	EEC	2	0	0	2	1
4	PL8811	Project Work	EEC	20	0	0	20	10

SUMMARY

B.TECH. PLASTICS TECHNOLOGY									
S. No.	SUBJECT AREA	CREDITS PER SEMESTER							TOTAL CREDITS
		I	II	III	IV	V	VI	VII	VIII	
1	HS	4	4	3	-	-	-	-	-	11
2	BS	12	10	4	4	-	-	-	-	30
3	ES	9	11	8	7	-	-	-	-	35
4	PC	-	-	8	11	17	19	13	-	68
5	EEC	-	-	1	1	-	-	1	10	13
6	PE	-	-	-	-	3	6	6	-	15
7	OE	-	-	-	-	3	-	3	-	6
	TOTAL	25	25	24	23	23	25	23	10	178

HS8151 **COMMUNICATIVE ENGLISH** **L T P C**
4 0 0 4

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 comprehend them by 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 RELATED TO ONESELF/FAMILY& FRIENDS 12

Reading- short comprehension passages, practice in skimming-scanning and predicting- **Writing**- completing sentences - 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- articles.- count/ uncount nouns.

UNIT II GENERAL READING AND FREE WRITING 12

Reading - comprehension-pre-reading-post reading- comprehension questions (multiple choice questions and /or short questions/ open-ended questions)-inductive reading- short narratives and descriptions from newspapers including dialogues and conversations (also used as short Listening texts)- register- **Writing** – paragraph writing- topic sentence- main ideas- free writing, short narrative descriptions using some suggested vocabulary and structures –**Listening**- telephonic conversations. **Speaking –** sharing information of a personal kind—greeting – taking leave- **Language development** – prepositions, conjunctions **Vocabulary development-** guessing meanings of words in context.

UNIT III GRAMMAR AND LANGUAGE DEVELOPMENT 12

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 longer texts and filling up the table- product description- narratives from different sources. **Speaking**- asking about routine actions and expressing opinions. **Language development**- degrees of comparison- pronouns- direct vs indirect questions- **Vocabulary development –** single word substitutes- adverbs.

UNIT IV READING AND LANGUAGE DEVELOPMENT 12

Reading- comprehension-reading longer texts- reading different types of texts- magazines **Writing**- letter writing, informal or personal letters-e-mails-conventions of personal email- **Listening**- listening to dialogues or conversations and completing exercises based on them. **Speaking-** speaking about oneself- speaking about one's friend- **Language development-** Tenses- simple present-simple past- present continuous and past continuous- **Vocabulary development**- synonyms-antonyms- phrasal verbs

UNIT V EXTENDED WRITING 12

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- present/ past perfect tense - **Vocabulary development**-collocations- fixed and semi-fixed expressions

TOTAL : 60 PERIODS

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.

TEXT BOOKS:

1. Board of Editors. **Using English** A Coursebook for Undergarduate Engineers and Technologists**.** Orient BlackSwan Limited, Hyderabad: 2015**.**
2. Richards, C. Jack. **Interchange Students' Book-2** New Delhi: CUP, 2015.

REFERENCES:

1. Bailey, Stephen. **Academic Writing: A practical guide for students**. New York: Rutledge,2011.
2. Comfort, Jeremy, et al. **Speaking Effectively : Developing Speaking Skillsfor BusinessEnglish.** Cambridge University Press, Cambridge: Reprint 2011.
3. Dutt P. Kiranmai and RajeevanGeeta. **Basic Communication Skills,** Foundation Books: 2013.
4. Means,L. Thomas and Elaine Langlois. **English & Communication For Colleges.** CengageLearning ,USA: 2007.
5. Redston, Chris &Gillies Cunningham **Face2Face** (Pre-intermediate Student's Book& Workbook) Cambridge University Press, New Delhi: 2005.

MA8151 ENGINEERING MATHEMATICS I L T P C
4 0 0 4

OBJECTIVES :

- The goal of this course is to achieve conceptual understanding and to retain the best traditions of traditional calculus. The syllabus is designed to provide the basic tools of calculus mainly for the purpose of modelling the engineering problems mathematically and obtaining solutions. This is a foundation course which mainly deals with topics such as single variable and multivariable calculus and plays an important role in the understanding of science, engineering, economics and computer science, among other disciplines.

UNIT I DIFFERENTIAL CALCULUS 12

Representation of functions - Limit of a function - Continuity - Derivatives - Differentiation rules - Maxima and Minima of functions of one variable.

UNIT II FUNCTIONS OF SEVERAL VARIABLES 12

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

UNIT III INTEGRAL CALCULUS **12**

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

UNIT IV MULTIPLE INTEGRALS **12**

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

UNIT V DIFFERENTIAL EQUATIONS **12**

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

TOTAL : 60 PERIODS

OUTCOMES :

After completing this course, students should demonstrate competency in the following skills:

- Use both the limit definition and rules of differentiation to differentiate functions.
- Apply differentiation to solve maxima and minima problems.
- Evaluate integrals both by using Riemann sums and by using the Fundamental Theorem of Calculus.
- Apply integration to compute multiple integrals, area, volume, integrals in polar coordinates, in addition to change of order and change of variables.
- Evaluate integrals using techniques of integration, such as substitution, partial fractions and integration by parts.
- Determine convergence/divergence of improper integrals and evaluate convergent improper integrals.
- Apply various techniques in solving differential equations.

TEXT BOOKS :

1. Grewal B.S., "Higher Engineering Mathematics", Khanna Publishers, New Delhi, 43rd Edition, 2014.
2. 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].

REFERENCES :

1. Anton, H, Bivens, I and Davis, S, "Calculus", Wiley, 10th Edition, 2016.
2. Jain R.K. and Iyengar S.R.K., "Advanced Engineering Mathematics", Narosa Publications, New Delhi, 3rd Edition, 2007.
3. Narayanan, S. and Manicavachagom Pillai, T. K., "Calculus" Volume I and II, S. Viswanathan Publishers Pvt. Ltd., Chennai, 2007.
4. Srimantha Pal and Bhunia, S.C, "Engineering Mathematics" Oxford University Press, 2015
5. Weir, M.D and Joel Hass, "Thomas Calculus", 12th Edition, Pearson India, 2016.

PH8151	ENGINEERING PHYSICS	L	T	P	C
		3	0	0	3

OBJECTIVES:

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

UNIT I PROPERTIES OF MATTER **9**

Elasticity – Stress-strain diagram and its uses - factors affecting elastic modulus and tensile strength – torsional stress and deformations – twisting couple - torsion pendulum: theory and experiment - bending of beams - bending moment – cantilever: theory and experiment – uniform and non-uniform bending: theory and experiment - I-shaped girders - stress due to bending in beams.

UNIT II WAVES AND FIBER OPTICS **9**

Oscillatory motion – forced and damped oscillations: differential equation and its solution – plane progressive waves – wave equation. Lasers : population of energy levels, Einstein's A and B coefficients derivation – resonant cavity, optical amplification (qualitative) – Semiconductor lasers: homojunction and heterojunction – Fiber optics: principle, numerical aperture and acceptance angle - types of optical fibres (material, refractive index, mode) – losses associated with optical fibers - fibre optic sensors: pressure and displacement.

UNIT III THERMAL PHYSICS **9**

Transfer of heat energy – thermal expansion of solids and liquids – expansion joints - bimetallic strips - thermal conduction, convection and radiation – 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) – 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 rigid 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 structures - crystal imperfections: point defects, line defects – Burger vectors, stacking faults – role of imperfections in plastic deformation - growth of single crystals: solution and melt growth techniques.

TOTAL : 45 PERIODS

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 waves and optical devices and their applications in fibre optics,
- the students will have adequate knowledge on the concepts of thermal properties of materials and their applications in expansion joints and heat exchangers,
- the students will get knowledge on advanced physics concepts of quantum theory and its

applications in tunneling 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.

REFERENCES:

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.

CY8151 ENGINEERING CHEMISTRY L T P C
3 0 0 3

OBJECTIVES:

- To make the students conversant with boiler feed water requirements, related problems and water treatment techniques.
- To develop an understanding of the basic concepts of phase rule and its applications to single and two component systems and appreciate the purpose and significance of alloys.
- Preparation, properties and applications of engineering materials.
- Types of fuels, calorific value calculations, manufacture of solid, liquid and gaseous fuels.
- Principles and generation of energy in batteries, nuclear reactors, solar cells, wind mills and fuel cells.

UNIT I WATER AND ITS TREATMENT 9

Hardness of water – types – expression of hardness – units – estimation of hardness of water by EDTA – numerical problems – boiler troubles (scale and sludge) – treatment of boiler feed water – Internal treatment (phosphate, colloidal, sodium aluminate and calgon conditioning) external treatment – Ion exchange process, zeolite process – 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 poisoning and catalytic promoters - acid base catalysis – applications (catalytic convertor) – enzyme catalysis– Michaelis – Menten equation.

UNIT III ALLOYS AND PHASE RULE 9

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. 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.

UNIT IV FUELS AND COMBUSTION 9

Fuels: Introduction - classification of fuels - coal - analysis of coal (proximate and ultimate) - carbonization - manufacture of metallurgical coke (Otto Hoffmann method) - petroleum - manufacture of synthetic petrol (Bergius process) - knocking - octane number - diesel oil - cetane number - natural gas - compressed natural gas (CNG) - liquefied petroleum gases (LPG) - power alcohol and biodiesel. Combustion of fuels: Introduction - calorific value - higher and lower calorific values- theoretical calculation of calorific value - ignition temperature - spontaneous ignition temperature - explosive range - flue gas analysis (ORSAT Method).

UNIT V ENERGY SOURCES AND STORAGE DEVICES 9

Nuclear fission - controlled nuclear fission - nuclear fusion - differences between nuclear fission and fusion - nuclear chain reactions - nuclear energy - light water nuclear power plant - breeder reactor - solar energy conversion - solar cells - wind energy. Batteries, fuel cells and supercapacitors: Types of batteries – primary battery (dry cell) secondary battery (lead acid battery, lithium-ion-battery) fuel cells – H_2-O_2 fuel cell.

TOTAL: 45 PERIODS

OUTCOMES:

- The knowledge gained on engineering materials, fuels, energy sources and water treatment techniques will facilitate better understanding of engineering processes and applications for further learning.

TEXT BOOKS:

1. S. S. Dara and S. S. Umare, “A Textbook of Engineering Chemistry”, S. Chand & Company LTD, New Delhi, 2015
2. P. C. Jain and Monika Jain, “Engineering Chemistry” 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.

REFERENCES:

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

GE8151 PROBLEM SOLVING AND PYTHON PROGRAMMING L T P C
3 0 0 3

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 9

Algorithms, building blocks of algorithms (statements, state, control flow, functions), notation (pseudo code, flow chart, programming language), algorithmic problem solving, simple strategies for developing algorithms (iteration, recursion). Illustrative problems: find minimum in a list, insert a card in a list of sorted cards, guess an integer number in a range, Towers of Hanoi.

UNIT II DATA, EXPRESSIONS, STATEMENTS 9

Python interpreter and interactive mode; values and types: int, float, boolean, string, and list; variables, expressions, statements, tuple assignment, precedence of operators, comments; modules and functions, function definition and use, flow of execution, parameters and arguments; Illustrative programs: exchange the values of two variables, circulate the values of n variables, distance between two points.

UNIT III CONTROL FLOW, FUNCTIONS 9

Conditionals: Boolean values and operators, conditional (if), alternative (if-else), chained conditional (if-elif-else); Iteration: state, while, for, break, continue, pass; Fruitful functions: return values, parameters, local and global scope, function composition, recursion; Strings: string slices, immutability, string functions and methods, string module; Lists as arrays. Illustrative programs: square root, gcd, exponentiation, sum an array of numbers, linear search, binary search.

UNIT IV LISTS, TUPLES, DICTIONARIES 9

Lists: list operations, list slices, list methods, list loop, mutability, aliasing, cloning lists, list parameters; Tuples: tuple assignment, tuple as return value; Dictionaries: operations and methods; advanced list processing - list comprehension; Illustrative programs: selection sort, insertion sort, mergesort, histogram.

UNIT V FILES, MODULES, PACKAGES 9

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

OUTCOMES:

Upon completion of the course, students will be able to

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

TOTAL : 45 PERIODS

TEXT BOOKS:

1. 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/)
2. Guido van Rossum and Fred L. Drake Jr, "An Introduction to Python – Revised and updated for Python 3.2, Network Theory Ltd., 2011.

REFERENCES:

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.
6. Timothy A. Budd, “Exploring Python”, Mc-Graw Hill Education (India) Private Ltd.,, 2015.

GE8152 ENGINEERING GRAPHICS L T P C
2 0 4 4

OBJECTIVES:

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

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 FREEHAND SKETCHING 7+12

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

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

UNIT II PROJECTION OF POINTS, LINES AND PLANE SURFACE 6+12

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

UNIT III PROJECTION OF SOLIDS 5+12

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

UNIT IV PROJECTION OF SECTIONED SOLIDS AND DEVELOPMENT OF SURFACES **5+12**

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 ISOMETRIC AND PERSPECTIVE PROJECTIONS **6+12**

Principles of isometric projection – isometric scale –Isometric projections of simple solids and truncated solids - Prisms, pyramids, cylinders, cones- combination of two solid objects in simple vertical positions - Perspective projection of simple solids-Prisms, pyramids and cylinders by visual ray method .

TOTAL: 90 PERIODS

OUTCOMES:

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

- familiarize with the fundamentals and standards of Engineering graphics
- perform freehand sketching of basic geometrical constructions and multiple views of objects.
- project orthographic projections of lines and plane surfaces.
- draw projections and solids and development of surfaces.
- visualize and to project isometric and perspective sections of simple solids.

TEXT BOOK:

1. Natrajan K.V., “A text book of Engineering Graphics”, Dhanalakshmi Publishers, Chennai, 2009.
2. Venugopal K. and Prabhu Raja V., “Engineering Graphics”, New Age International (P) Limited, 2008.

REFERENCES:

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

Publication of Bureau of Indian Standards:

1. IS 10711 – 2001: Technical products Documentation – Size and lay out of drawing sheets.
2. IS 9609 (Parts 0 & 1) – 2001: Technical products Documentation – Lettering.
3. IS 10714 (Part 20) – 2001 & SP 46 – 2003: Lines for technical drawings.
4. IS 11669 – 1986 & SP 46 – 2003: Dimensioning of Technical Drawings.
5. IS 15021 (Parts 1 to 4) – 2001: Technical drawings – Projection Methods.

Special points applicable to University Examinations on Engineering Graphics:

1. There will be five questions, each of either or type covering all units of the syllabus.
2. All questions will carry equal marks of 20 each making a total of 100.
3. The answer paper shall consist of drawing sheets of A3 size only. The students will be permitted to use appropriate scale to fit solution within A3 size.

The examination will be conducted in appropriate sessions on the same day

GE8161 PROBLEM SOLVING AND PYTHON PROGRAMMING LABORATORY L T P C 0 0 4 2

OBJECTIVES:

- To write, test, and debug simple Python programs.
- To implement Python programs with conditionals and loops.
- Use functions for structuring Python programs.
- Represent compound data using Python lists, tuples, dictionaries.
- 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. Merge sort
8. First n prime numbers
9. Multiply matrices
10. Programs that take command line arguments (word count)
11. Find the most frequent words in a text read from a file
12. Simulate elliptical orbits in Pygame
13. Simulate bouncing ball using Pygame

PLATFORM NEEDED

Python 3 interpreter for Windows/Linux

OUTCOMES:

Upon completion of the course, students 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.

TOTAL :60 PERIODS

BS8161	PHYSICS AND CHEMISTRY LABORATORY	L	T	P	C
	(Common to all branches of B.E. / B.Tech Programmes)	0	0	4	2

OBJECTIVES:

- To introduce different experiments to test basic understanding of physics concepts applied in optics, thermal physics, properties of matter and liquids.

LIST OF EXPERIMENTS: PHYSICS LABORATORY (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 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 – Ultrasonic interferometer
6. Determination of wavelength of mercury spectrum – spectrometer grating
7. Determination of band gap of a semiconductor
8. Determination of thickness of a thin wire – Air wedge method

TOTAL: 30 PERIODS

OUTCOMES:

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

- apply principles of elasticity, optics and thermal properties for engineering applications.

CHEMISTRY LABORATORY: (Any seven experiments to be conducted)

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.

1. Estimation of HCl using Na_2CO_3 as primary standard and Determination of alkalinity in water sample.
2. Determination of total, temporary & permanent hardness of water by EDTA method.
3. Determination of DO content of water sample by Winkler's method.
4. Determination of chloride content of water sample by argentometric method.
5. Estimation of copper content of the given solution by Iodometry.
6. Determination of strength of given hydrochloric acid using pH meter.
7. Determination of strength of acids in a mixture of acids using conductivity meter.
8. Estimation of iron content of the given solution using potentiometer.
9. Estimation of iron content of the water sample using spectrophotometer (1, 10-Phenanthroline / thiocyanate method).
10. Estimation of sodium and potassium present in water using flame photometer.
11. Determination of molecular weight of polyvinyl alcohol using Ostwald viscometer.

12. Pseudo first order kinetics-ester hydrolysis.
13. Corrosion experiment-weight loss method.
14. Determination of CMC.
15. Phase change in a solid.
16. Conductometric titration of strong acid vs strong base.

OUTCOMES:

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

TOTAL: 30 PERIODS

TEXTBOOKS:

1. Vogel's Textbook of Quantitative Chemical Analysis (8^{TH} edition, 2014)

HS8251 TECHNICAL ENGLISH L T P C
4 0 0 4

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 specialisation.

UNIT I INTRODUCTION TECHNICAL ENGLISH 12

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- newsapapers- **Writing**- purpose statements – extended definitions – issue- writing instructions – checklists-recommendations-**Vocabulary Development**- technical vocabulary **Language Development** –subject verb agreement - compound words.

UNIT II READING AND STUDY SKILLS 12

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

UNIT III TECHNICAL WRITING AND GRAMMAR 12

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

UNIT IV REPORT WRITING **12**

Listening- Listening to documentaries and making notes. **Speaking** – mechanics of presentations- **Reading** – reading for detailed comprehension- **Writing**- email etiquette- job application – cover letter –Résumé preparation(via email and hard copy)- analytical essays and issue based essays--**Vocabulary Development**- finding suitable synonyms-paraphrasing-. **Language Development-** clauses- if conditionals.

UNIT V GROUP DISCUSSION AND JOB APPLICATIONS **12**

Listening- TED/Ink talks; **Speaking** –participating in a group discussion -**Reading**– reading and understanding technical articles **Writing**– Writing reports- minutes of a meeting- accident and survey-**Vocabulary Development- verbal analogies Language Development-** reported speech .

TOTAL :60 PERIODS

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 specialisation successfully.
- Speak appropriately and effectively in varied formal and informal contexts.
- Write reports and winning job applications.

TEXT BOOKS:

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

REFERENCES

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

Students can be asked to read Tagore, Chetan Bhagat and for supplementary reading.

MA8251 ENGINEERING MATHEMATICS II **L T P C**
4 0 0 4

OBJECTIVES :

- This course is designed to cover topics such as Matrix Algebra, Vector Calculus, Complex Analysis and Laplace Transform. Matrix Algebra is one of the powerful tools to handle practical problems arising in the field of engineering. Vector calculus can be widely used for modelling the various laws of physics. The various methods of complex analysis and Laplace transforms can be used for efficiently solving the problems that occur in various branches of engineering disciplines.

UNIT I MATRICES **12**

Eigenvalues and Eigenvectors of a real matrix – Characteristic equation – Properties of Eigenvalues and Eigenvectors – Cayley-Hamilton theorem – Diagonalization of matrices –

Reduction of a quadratic form to canonical form by orthogonal transformation – Nature of quadratic forms.

UNIT II VECTOR CALCULUS 12

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

UNIT III ANALYTIC FUNCTIONS 12

Analytic functions – Necessary and sufficient conditions for analyticity in Cartesian and polar coordinates - Properties – Harmonic conjugates – Construction of analytic function - Conformal mapping – Mapping by functions $w = z + c, cz, \frac{1}{z}, z^2$ - Bilinear transformation.

UNIT IV COMPLEX INTEGRATION 12

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

UNIT V LAPLACE TRANSFORMS 12

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

TOTAL: 60 PERIODS

OUTCOMES :

After successfully completing the course, the student will have a good understanding of the following topics and their applications:

- Eigenvalues and eigenvectors, diagonalization of a matrix, Symmetric matrices, Positive definite matrices and similar matrices.
- Gradient, divergence and curl of a vector point function and related identities.
- Evaluation of line, surface and volume integrals using Gauss, Stokes and Green's theorems and their verification.
- Analytic functions, conformal mapping and complex integration.
- Laplace transform and inverse transform of simple functions, properties, various related theorems and application to differential equations with constant coefficients.

TEXT BOOKS :

1. Grewal B.S., "Higher Engineering Mathematics", Khanna Publishers, New Delhi, 43rd Edition, 2014.
2. Kreyszig Erwin, "Advanced Engineering Mathematics ", John Wiley and Sons, 10th Edition, New Delhi, 2016.

REFERENCES :

1. Bali N., Goyal M. and Watkins C., "Advanced Engineering Mathematics", Firewall Media (An imprint of Lakshmi Publications Pvt., Ltd.,), New Delhi, 7th Edition, 2009.
2. 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.
4. Sastry, S.S, "Engineering Mathematics", Vol. I & II, PHI Learning Pvt. Ltd, 4th Edition, New Delhi, 2014.
5. Wylie, R.C. and Barrett, L.C., "Advanced Engineering Mathematics "Tata McGraw Hill Education Pvt. Ltd, 6th Edition, New Delhi, 2012.

PH8254	PHYSICS OF MATERIALS (Common to courses offered in Faculty of Technology except Fashion Technology)	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To introduce the physics of various materials relevant to different branches of technology

UNIT I PREPARATION OF MATERIALS 9

Phases - phase rule – binary systems – tie line rule – lever rule – phase diagram – invariant reactions - nucleation – homogeneous and heterogeneous nucleation – free energy of formation of a critical nucleus – Thin films – preparation: PVD, CVD method – Nanomaterials Preparation: wet chemical, solvothermal, sol-gel method.

UNIT II CONDUCTING MATERIALS 9

Classical free electron theory - expression for electrical conductivity – thermal conductivity, - Wiedemann-Franz law – electrons in metals: particle in a three-dimensional box- degenerate states – Fermi-Dirac statistics – density of energy states – electron in periodic potential (concept only) – electron effective mass – concept of hole. Superconducting phenomena, properties of superconductors – Meissner effect and isotope effect. Type I and Type II superconductors, High T_c superconductors – Magnetic levitation and SQUIDS.

UNIT III SEMICONDUCTING MATERIALS 9

Elemental Semiconductors - Compound semiconductors - Origin of band gap in solids (qualitative) - carrier concentration in an intrinsic semiconductor (derivation) – Fermi level – variation of Fermi level with temperature – electrical conductivity – band gap determination – carrier concentration in n-type and p-type semiconductors (derivation) – variation of Fermi level with temperature and impurity concentration – Hall effect – determination of Hall coefficient – LED - Solar cells.

UNIT IV DIELECTRIC AND MAGNETIC MATERIALS 9

Dielectric, Paraelectric and ferroelectric materials - Electronic, Ionic, Orientational and space charge polarization – Internal field and deduction of Clausius Mosotti equation – dielectric loss – different types of dielectric breakdown – classification of insulating materials and their applications - Ferroelectric materials - Introduction to magnetic materials - Domain theory of ferromagnetism, Hysteresis, Soft and Hard magnetic materials – Anti-ferromagnetic materials – Ferrites, magnetoresistance materials.

UNIT V NEW MATERIALS AND APPLICATIONS 9

Metallic glasses – Shape memory alloys: Copper, Nickel and Titanium based alloys – graphene and its properties - Ceramics: types and applications – Composites: classification, role of matrix and reinforcement – processing of fibre reinforced plastics and fibre reinforced metals – Biomaterials: hydroxyapatite – PMMA – Silicone - Sensors: Chemical Sensors - Bio-sensors – conducting, semiconducting and photoresponsive polymers.

TOTAL : 45 PERIODS

OUTCOMES:

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

- gain knowledge on phase diagrams and various material processing methods,
- acquire knowledge on basics of conducting materials, superconductors and their applications
- get knowledge on the functioning of semiconducting materials and their applications in LED and solar cells,
- understand the functioning of various dielectric and magnetic materials ,
- have the necessary understanding on various advanced materials.

TEXT BOOKS:

1. Balasubramaniam, R. "Callister's Materials Science and Engineering". Wiley India Pvt. Ltd. 2014.
2. Kasap, S.O. "Principles of Electronic Materials and Devices". McGraw-Hill Education, 2007.
3. Wahab, M.A. "Solid State Physics: Structure and Properties of Materials". Narosa Publishing House, 2009.

REFERENCES

1. Askeland, D. "Materials Science and Engineering". Brooks/Cole, 2010
2. Raghavan, V. "Materials Science and Engineering : A First course". PHI Learning, 2015.
3. Smith, W.F., Hashemi, J. & Prakash. R. "Materials Science and Engineering". Tata Mcgraw Hill Education Pvt. Ltd., 2014.

CY8251 PHYSICAL AND ORGANIC CHEMISTRY L T P C
3 0 0 3

OBJECTIVES:

- To understand the structure and reactivity of organic compounds.
- To study about reaction mechanisms and to study the concepts of chemical kinetics and catalysis

UNIT I REACTION MECHANISMS 9

Free radical substitutions, Electophilic addition, Aromatic Electrophilic substitutions, Nucleophilic additions, condensation reactions, nucleophilic substitutions in aliphatic and aromatic compounds, cyclo additions, Rearrangements-Beckmann, Curtius, Hofmann, cope and oxy-cope, Fries rearrangement reactions.

UNIT II HETROCYCLIC COMPOUNDS IN POLYMER TECHNOLOGY 9

Amines, heterocyclic compounds – furan, thiophene, pyrrole, pyridine, quinoline, isoquinoline, imidazoles, thiazoles preparation , properties and uses of simple monomers likeethylene, propylene, isobutylene, butadiene, styrene, methyl methacrylate , diisocyanates, glycols, polyols, epichlorohydrin, fluoro alkenes, acrylonitrile, vinyl chloride, vinyl acetate.

UNIT III STRUCTURE AND REACTIVITY IN ORGANIC COMPOUNDS 9

Bonding in Organic Compounds- Structure-property relationships - Electronic effects like inductive, mesomeric, electromeric and hyper conjugation effects – Free radicals, carbocations, carbanions,

elementary ideas about stereo chemistry RS-nomenclature and EZ- nomenclature- conformational isomers.

UNIT IV PHASE RULE 9

Phase rule – statements and explanation of the terms involved – condensed phase rule – construction of phase diagram – water system – sulphur system – phase rule for two component alloy systems- thermal analysis – eutectic system - Lead-Silver system – solid solutions – Phase rule for miscible, partially miscible and immiscible liquids.

UNIT V ELECTRO CHEMISTRY AND CORROSION 9

Electro Chemistry – Electrochemical series – Transport numbers and ionic mobility – Redox reaction – Galvanic cells – Electrolysis –Corrosion – chemical and electrochemical corrosions- mechanism of electrochemical and galvanic corrosions- concentration cell corrosion and microbiological corrosions - measurement of corrosion rate.

TOTAL: 45 PERIODS

OUTCOME:

- Obtain knowledge in structure and reactivity of organic compounds.
- Familiarize the reaction mechanism and chemical kinetics.

REFERENCES

1. Finar I.L., “Textbook of Organic Chemistry”. ELBS,1996.
2. Glasstone, S., and D. Lewis. “Elements of Physical Chemistry”. Macmillan, 1995.
3. Maron and C.F. Pruton “Physical Chemistry” Macmillan, 1990.
4. Morrison and Boyd, “Organic Chemistry”. Prentice Hall,1992.

BE8251 BASIC ELECTRICAL AND ELECTRONICS ENGINEERING L T P C
3 0 0 3

OBJECTIVES:

- To explain the basic theorems used in Electrical circuits and the different components and function of electrical machines.
- To explain the fundamentals of semiconductor and applications.
- To explain the principles of digital electronics
- To impart knowledge of communication.

UNIT I ELECTRICAL CIRCUITS & MEASURMENTS 9

Fundamental laws of electric circuits– Steady State Solution of DC Circuits – Introduction to AC Circuits –Sinusoidal steady state analysis– Power and Power factor – Single Phase and Three Phase Balanced Circuits. Classification of instruments – Operating Principles of indicating Instruments

UNIT II ELECTRICAL MACHINES 9

Construction, Principle of Operation, Basic Equations and Applications of DC Generators, DC Motors, Single Phase Transformer, single phase induction Motor.

UNIT III SEMICONDUCTOR DEVICES AND APPLICATIONS 9

Introduction - Characteristics of PN Junction Diode – Zener Effect – Zener Diode and its Characteristics – Half wave and Full wave Rectifiers – Voltage Regulation.

Bipolar Junction Transistor – CB, CE, CC Configurations and Characteristics – Elementary Treatment of Small Signal Amplifier.

UNIT IV DIGITAL ELECTRONICS 9

Binary Number System – Boolean Algebra theorems– Digital circuits - Introduction to sequential Circuits– Flip-Flops – Registers and Counters – A/D and D/A Conversion –digital processing architecture.

UNIT V FUNDAMENTALS OF COMMUNICATION ENGINEERING 9

Introduction – Elements of Communication Systems– Modulation and Demodulation: Principles of Amplitude and Frequency Modulations. Digital Communication - Communication Systems: Radio, Antenna, TV, Fax, ISDN, Microwave, Satellite and Optical Fibre (Block Diagram Approach only).

TOTAL: 45 PERIODS

OUTCOMES:

- Ability to identify the electrical components and explain the characteristics of electrical machines.
- Ability to identify electronics components and understand the characteristics

TEXT BOOKS:

1. D P Kothari and I.J Nagarath, ”Electrical Machines “Basic Electrical and Electronics Engineering”, McGraw Hill Education(India) Private Limited, Third Reprint ,2016
2. S.K.Bhattacharya “Basic Electrical and Electronics Engineering”, Pearson India, 2011
3. Sedha R.S., “Applied Electronics”, S. Chand & Co., 2006.

REFERENCES:

1. A.E.Fitzgerald, David E Higginbotham and Arvin Grabel, “Basic Electrical Engineering”, McGraw Hill Education(India) Private Limited, 2009
2. Del Toro, “Electrical Engineering Fundamentals”, Pearson Education, New Delhi, 2007
3. Leonard S Bobrow, “ Foundations of Electrical Engineering”, Oxford University Press, 2013
4. Mahmood Nahvi and Joseph A. Edminister, “Electric Circuits”, Schaum’ Outline Series, McGraw Hill, 2002.
5. Mehta V K, “Principles of Electronics”, S.Chand & Company Ltd, 1994.
6. Nagsarkar T K and Sukhija M S, “Basics of Electrical Engineering”, Oxford press 2005.

PR8251 PRODUCTION PROCESSES L T P C
4 0 0 4

OBJECTIVES:

- To impart the knowledge about the various production technology available
- To expose the student on the principle and applications of the processes
- To make a decision on a relevant technology based on the merits and demerits.

UNIT I CASTING PROCESSES 12

Principles of metal casting: Pattern materials, types and allowance; Study of moulding, sand moulding, tools, moulding materials, description and operation of cupola: special casting processes e.g. die-casting, permanent mould casting, centrifugal casting, investment casting.

UNIT II SMITHY AND FORGING 12

Basic operation – upsetting- flattening- drawing- swaging: tools and appliances-drop forging-press forging.Bench Work and Fitting**-**Fitting, sawing, chipping, thread cutting (die), tapping; Study of hand tools, Marking and marking tools.

UNIT III METAL JOINING 12

Welding principles, classification of welding techniques; Oxyacetylene Gas welding, welding, metal arc, Carbon arc, submerged arc and atomic hydrogen welding, Electric resistance welding - composition, properties and function; Electrodes, Types of joints and edge preparation, Brazing and soldering.

UNIT IV SHEET METAL WORK 12

Common processes, tools and equipments; metals used for sheets, standard specification for sheets, spinning, bending, embossing and coining.

UNIT V UNCONVENTIONAL MACHINING PROCESSES 12

Need for unconventional – Construction, working principle merits, demerits and applications only for AJM, USM, ECM, EDM, EBM, LBM and IBM.

TOTAL: 60 PERIODS

OUTCOMES:

- Has enough knowledge on the various process available to make a part.
- Confident to select the best process to based on cost of time and quantities.
- Can try the processes to use new materials by combining.

TEXT BOOK

1. Kalpakjian S. and SCHMID S., “Manufacturing Engineering and Technology”, Prentice Hall of India”, 5th Edition (2009) , ISBN : 0131489658.
2. Sharma P.C., “A Text book of production Technology: manufacturing processes” S.Chand& Company Limited, 7th Edition (2007).

REFERENCES

1. Hajra Chowdary, Elements of Manufacturing Technology Vol 1 and vol 2
2. Jain R.K., “Engineering Metrology”, Khanna Publishers, 19th Edition, 2005
3. Smid P., “CNC Programming Hand book”, Industrial Press Inc., 2007 Third Edition

GE8261 ENGINEERING PRACTICES LABORATORY L T P C

0 0 4 2

OBJECTIVES:

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

GROUP A (CIVIL & MECHANICAL)

I CIVIL ENGINEERING PRACTICE 13

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 using Power Tools only:

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

II MECHANICAL ENGINEERING PRACTICE 18

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.

Machine assembly practice:

(a) Study of centrifugal pump
(b) Study 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.
(c) Fitting – Exercises – Preparation of square fitting and V – fitting models.

GROUP B (ELECTRICAL & ELECTRONICS)

III ELECTRICAL ENGINEERING PRACTICE 13

1. Residential house wiring using switches, fuse, indicator, lamp and energy meter.
2. Fluorescent lamp wiring.
3. Stair case wiring
4. Measurement of electrical quantities – voltage, current, power & power factor in RLC circuit.
5. Measurement of energy using single phase energy meter.

6. Measurement of resistance to earth of an electrical equipment.

IV ELECTRONICS ENGINEERING PRACTICE 16

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

OUTCOMES:

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

- fabricate carpentry components and pipe connections including plumbing works.
- use welding equipments to join the structures.
- Carry out the basic machining operations
- Make the models using sheet metal works
- Illustrate on centrifugal pump, Air conditioner, operations of smithy, foundary and
- fittings
- Carry out basic home electrical works and appliances
- Measure the electrical quantities
- Elaborate on the components, gates, soldering practices.

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
5. Power Tools: (a) Rotary Hammer	2 Nos
(b) Demolition Hammer	2 Nos
(c) Circular Saw	2 Nos
(d) Planer	2 Nos
(e) Hand Drilling Machine	2 Nos
(f) Jigsaw	2 Nos

MECHANICAL

1. Arc welding transformer with cables and holders	5 Nos.
2. Welding booth with exhaust facility	5 Nos.
3. Welding accessories like welding shield, chipping hammer, wire brush, etc.	5 Sets.
4. Oxygen and acetylene gas cylinders, blow pipe and other welding outfit.	2 Nos.
5. Centre lathe	2 Nos.
6. Hearth furnace, anvil and smithy tools	2 Sets.
7. Moulding table, foundry tools	2 Sets.

8. Power Tool: Angle Grinder 2 Nos
9. Study-purpose items: centrifugal pump, air-conditioner One each.

ELECTRICAL

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

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

ME8261 COMPUTER AIDED DRAFTING AND MODELING LABORATORY L T P C
0 0 4 2

OBJECTIVES:

- To develop skill to use software to create 2D and 3D models.

LIST OF EXERCISES USING SOFTWARE CAPABLE OF DRAFTING AND MODELING

1. Study of capabilities of software for Drafting and Modeling – Coordinate systems (absolute, relative, polar, etc.) – Creation of simple figures like polygon and general multi-line figures.
2. Drawing of a Title Block with necessary text and projection symbol.
3. Drawing of curves like parabola, spiral, involute using B spline or cubic spine.
4. Drawing of front view and top view of simple solids like prism, pyramid, cylinder, cone, etc, and dimensioning.
5. Drawing front view, top view and side view of objects from the given pictorial views (eg. V-block, Base of a mixie, Simple stool, Objects with hole and curves).
6. Drawing of a plan of residential building (Two bed rooms, kitchen, hall, etc.)
7. Drawing of a simple steel truss.
8. Drawing sectional views of prism, pyramid, cylinder, cone, etc,
9. Drawing isometric projection of simple objects.
10. Creation of 3-D models of simple objects and obtaining 2-D multi-view drawings from 3-D model.

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

OUTCOMES:

- ability to use the software packers for drafting and modeling

- ability to create 2D and 3D models of Engineering Components

TOTAL: 60 PERIODS

LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS:

S. No.	Description of Equipment	Quantity
1.	Pentium IV computer or better hardware, with suitable graphics facility	30 No.
2.	Licensed software for Drafting and Modeling.	30 Licenses
3.	Laser Printer or Plotter to print / plot drawings	2 No.

MA8391 PROBABILITY AND STATISTICS L T P C
4 0 0 4

OBJECTIVE:

- This course aims at providing the required skill to apply the statistical tools in engineering problems.
- To introduce the basic concepts of probability and random variables.
- To introduce the basic concepts of two dimensional random variables.
- To acquaint the knowledge of testing of hypothesis for small and large samples which plays an important role in real life problems.
- To introduce the basic concepts of classifications of design of experiments which plays very important roles in the field of agriculture and statistical quality control.

UNIT I PROBABILITY AND RANDOM VARIABLES 12

Probability – The axioms of probability – Conditional probability – Baye's theorem - Discrete and continuous random variables – Moments – Moment generating functions – Binomial, Poisson, Geometric, Uniform, Exponential and Normal distributions.

UNIT II TWO - DIMENSIONAL RANDOM VARIABLES 12

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

UNIT III TESTING OF HYPOTHESIS 12

Sampling distributions - Estimation of parameters - Statistical hypothesis - Large sample tests based on Normal distribution for single mean and difference of means -Tests based on t, Chi-square and F distributions for mean, variance and proportion - Contingency table (test for independent) - Goodness of fit.

UNIT IV DESIGN OF EXPERIMENTS 12

One way and Two way classifications - Completely randomized design – Randomized block design – Latin square design - 2^2 factorial design.

UNIT V STATISTICAL QUALITY CONTROL 12

Control charts for measurements (X and R charts) – Control charts for attributes (p, c and np charts) – Tolerance limits - Acceptance sampling.

TOTAL: 60 PERIODS

OUTCOMES:

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

- Understand the fundamental knowledge of the concepts of probability and have knowledge of standard distributions which can describe real life phenomenon.
- Understand the basic concepts of one and two dimensional random variables and apply in engineering applications.
- Apply the concept of testing of hypothesis for small and large samples in real life problems.
- Apply the basic concepts of classifications of design of experiments in the field of agriculture and statistical quality control.
- Have the notion of sampling distributions and statistical techniques used in engineering and management problems.

TEXT BOOKS:

1. Johnson, R.A., Miller, I and Freund J., "Miller and Freund's Probability and Statistics for Engineers", Pearson Education, Asia, 8th Edition, 2015.
2. Milton. J. S. and Arnold. J.C., "Introduction to Probability and Statistics", Tata McGraw Hill, 4th Edition, 2007.

REFERENCES:

1. Devore. J.L., "Probability and Statistics for Engineering and the Sciences", Cengage Learning, New Delhi, 8th Edition, 2014.
2. Papoulis, A. and Unnikrishnapillai, S., "Probability, Random Variables and Stochastic Processes", McGraw Hill Education India, 4th Edition, New Delhi, 2010.
3. Ross, S.M., "Introduction to Probability and Statistics for Engineers and Scientists", 3rd Edition, Elsevier, 2004.
4. Spiegel. M.R., Schiller. J. and Srinivasan, R.A., "Schaum's Outline of Theory and Problems of Probability and Statistics", Tata McGraw Hill Edition, 2004.
5. Walpole. R.E., Myers. R.H., Myers. S.L. and Ye. K., "Probability and Statistics for Engineers and Scientists", Pearson Education, Asia, 8th Edition, 2007.

PT8351 FUNDAMENTALS OF POLYMER SCIENCE L T P C
3 0 0 3

OBJECTIVE:

- To enable the students to understand the basic concept of polymer, mechanism and various techniques of polymerization, characterization of polymers by molecular weight, reactions and degradation of polymers.

UNIT I BASIC CONCEPTS OF POLYMER 9

Basic concepts of macromolecules – Monomers - Functionality - Classification and nomenclature of polymers - Types of polymers. Step growth polymerization - Mechanism - Kinetics - Bi-functional systems - Poly functional systems.

UNIT II POLYMERIZATION MECHANISM 9

Addition polymerization Mechanism and kinetics of free radical – Cationic - Anionic Polymerisation - Initiator systems - Chain length and degree of Polymerization – Control of molecular weight - Chain transfer - Inhibition Coordination polymerization- Mechanism – Kinetics - Ring opening polymerization-Atom transfer radical-polymerization. Reversible Addition Fragmentation Termination (RAFT).

UNIT III COPOLYMERIZATION MECHANISM 9

Copolymerization - Mechanism and Kinetics of free radical - Ionic copolymerization -Determination of Monomer reactivity ratios. Polymerization techniques - Bulk polymerization - Solution polymerization - Suspension polymerization - Emulsion polymerization - Interfacial condensation.

UNIT IV POLYMER MOLECULARWEIGHT 9

Molecular weight- Molecular weight averages - Molecular weight distribution - Unidispersity, polydispersity, Degree of polymerization. Molecular weight determination - Basic concepts of end group analysis, colligative properties, osmametry, light scattering, and gel permeation chromatography - Viscosity of polymers solutions.

UNIT V REACTIONS OF POLYMERS 9

Chemical reactions of polymers – Addition and substitution reactions - Hydrolysis – Acidolysis – Aminolysis –— cross linking reactions. Polymer degradation – Mechanical degradation – Oxidative degradation – Hydrolytic degradation – Photo degradation.

TOTAL: 45 PERIODS

OUTCOME:

Upon completion of this course,

- Students will be able to develop the knowledge in the concepts of polymers, their classifications and nomenclature.
- Students will able to evaluate the mechanism and kinetics of free radical cationic and anionic polymerization
- Students will able to appraise the mechanism and kinetics of copolymer free radical the synthesis techniques for polymer.
- Students will able to determine the molecular weight of the polymer and understand the techniques used for determination.
- Students will be aware about degradation mechanism of polymers and chemical reaction of polymers

TEXT BOOKS:

1. F.W. Billmeyer, “Textbook of Polymer Science”, Wiley international publishers, 2008, 3rd Edition.
2. V.R. Gowariker,N.V. Viswanathan, Jayadev Sreedhar, “Polymer Science” – New Age International (P) Ltd, Publishers, 2015, 2nd edition.
3. George Odian, “Principles of polymerisation”, Wiley international publishers, 2004, 4th Edition.

REFERENCES:

1. JM.G. Cowie, “Polymers: Chemistry and Physics of Modern Materials”, Blackie, and London, 1991.
2. R.J. Young and P.Lovell, “Introduction to Polymers”, 2nd Ed., Chapman & Hall, 1991.
3. Premamoy Ghosh, “Polymer Science and Technology of Plastics and Rubbers”, Tata McGraw- Hill, New Delhi, 1990

GE8291 ENVIRONMENTAL SCIENCE AND ENGINEERING L T P C

3 0 0 3

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 (a) forest ecosystem (b) grassland ecosystem (c) desert ecosystem (d) aquatic ecosystems (ponds, streams, lakes, rivers, oceans, estuaries) – Introduction to biodiversity definition: genetic, species and ecosystem diversity – biogeographical classification of India – value of biodiversity: consumptive use, productive use, social, ethical, aesthetic and option values – Biodiversity at global, national and local levels – India as a mega-diversity nation – hot-spots of biodiversity – threats to biodiversity: habitat loss, poaching of wildlife, man-wildlife conflicts – endangered and endemic species of India – conservation of biodiversity: In-situ and ex-situ conservation of biodiversity. Field study of common plants, insects, birds; Field study of simple ecosystems – pond, river, hill slopes, etc.

UNIT II ENVIRONMENTAL POLLUTION 8

Definition – causes, effects and control measures of: (a) Air pollution (b) Water pollution (c) Soil pollution (d) Marine pollution (e) Noise pollution (f) Thermal pollution (g) Nuclear hazards – 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, case studies- timber extraction, mining, dams and their effects on forests and tribal people – Water resources: Use and over- utilization of surface and ground water, floods, drought, conflicts over water, dams-benefits and problems – Mineral resources: Use and exploitation, environmental effects of extracting and using mineral resources, case studies – Food resources: World food problems, changes caused by agriculture and overgrazing, effects of modern agriculture, fertilizer-pesticide problems, water logging, salinity, case studies – Energy resources: Growing energy needs, renewable and non renewable energy sources, use of alternate energy sources. case studies – Land resources: Land as a resource, land degradation, man induced landslides, soil erosion and desertification – role of an individual in conservation of natural resources – Equitable use of resources for sustainable lifestyles. Field study of local area to document environmental assets – river / forest / grassland / hill / mountain.

UNIT IV SOCIAL ISSUES AND THE ENVIRONMENT 7

From unsustainable to sustainable development – urban problems related to energy – water conservation, rain water harvesting, watershed management – resettlement and rehabilitation of people; its problems and concerns, case studies – role of non-governmental

organization- environmental ethics: Issues and possible solutions – climate change, global warming, acid rain, ozone layer depletion, nuclear accidents and holocaust, case studies. – wasteland reclamation – consumerism and waste products – environment 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

OUTCOMES:

- Environmental Pollution or problems cannot be solved by mere laws. Public participation is an important aspect which serves the environmental Protection. One will obtain knowledge on the following after completing the course.
- Public awareness of environmental is at infant stage.
- Ignorance and incomplete knowledge has lead to misconceptions
- Development and improvement in std. of living has lead to serious environmental disasters

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.

REFERENCES:

1. Dharmendra S. Sengar, 'Environmental law', Prentice hall of India PVT LTD,New Delhi, 2007.
2. Erach Bharucha, "Textbook of Environmental Studies", Universities Press(I) PVT, LTD, Hydrabad, 2015.
3. 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.

PT8353 MECHANICS OF SOLIDS L T P C

3 0 0 3

OBJECTIVES:

- To understand the fundamental concepts of stress & strain and its deformation under loads.
- To analyze the determinate beams and determine shear force and bending moment.
- To apply the mathematical knowledge to calculate the deformation behavior of beams.
- To understand the effect of torsion on shafts and springs.
- To analyze a complete two dimensional state of stress.

UNIT I STRESS AND STRAIN 9

Stress and strain at a point – Tension, Compression, Shear Stress – Hooke's Law –Relationship among elastic constants – Ultimate Stress – Yield Stress – Factor of Safety –Thermal Stresses –

strain Energy due to Axial Force – Resilience – Stresses due to impact and Suddenly Applied Load.

UNIT II SHEAR AND BENDING IN BEAMS 9

Beams and Bending- Types of loads, supports – Shear Force and Bending Moment Diagrams for statically determinate beam – cantilever beam – Simply supported beam - with concentrated load - uniformly distributed load

UNIT III DEFLECTION OF BEAMS 9

Double integration method - Macaulay's methods - Area moment method - conjugate beam method for computation of slopes and deflections of determinant beams.

UNIT IV TORSION 9

Torsion of Circular and Hollow Shafts – Stresses and Deflection in Circular Solid and Hollow Shafts – strain energy due to torsion – Power transmitted to shaft – Shaft in series and parallel – Closed and Open Coiled helical springs – Springs in series and parallel.

UNIT V THIN CYLINDERS AND THEORIES OF FAILURE 9

Thin cylinders – Stresses in thin cylindrical shell due to internal pressure – circumferential and longitudinal stresses - Theories of failure - maximum Principal stress - maximum Principal strain - Shear stress - Total strain energy - Energy distortion theories

TOTAL: 45 PERIODS

OUTCOMES

- Thorough understanding of the fundamental concepts of stress and strain
- Ability to analyze the determinate beams.
- Ability to apply the mathematical knowledge in determining the deformation behavior of beams
- Thorough understanding of the effect of torsion on shafts and springs.
- Ability to analyze a complex two dimensional state of stress and to analyze the failure mode.

TEXT BOOKS:

1. Rajput.R.K. “Strength of Materials”, S.Chand and Co, New Delhi, 6th edition 2015.
2. Bhavikatti. S., "Solid Mechanics", Vikas publishing house Pvt. Ltd, New Delhi, 2010.
3. R.S.Khurmi.,”Strength of Materials” S.Chand & Co, New Delhi

REFERENCES:

1. Gambhir. M.L., "Fundamentals of Solid Mechanics", PHI Learning Private Limited., New Delhi, 2009.
2. Timoshenko.S.B. and Gere.J.M, “Mechanics of Materials”, Van NosReinbhold, New Delhi 1995
3. Vazirani.V.N and Ratwani.M.M, “Analysis of Structures”, Vol I Khanna Publishers, New Delhi, 1995
4. Junnarkar.S.B. and Shah.H.J, “Mechanics of Structures”, Vol I, Charotar Publishing House, New Delhi 1997.
5. Ugural. A.C., "Mechanics of Materials", Wiley India Pvt. Ltd., New Delhi, 2013.

PT8352 INTRODUCTION TO CHEMICAL ENGINEERING L T P C
3 0 0 3

OBJECTIVES:

- To learn the fundamental operation involved in chemical engineering
- To attain the knowledge in the subject of fluid flow
- To gain the ideas in the field of heat transfer operation
- To learn the mass diffusion in polymers by the study of mass transfer operations

UNIT I FLUID FLOW 9

Fluid Flow: Newtonian and Non-Newtonian fluid - Bernoulli's theorem-Hagen Poisuille equation, measurement of fluid flow- orifice meter, venturi meter and pitot tube.

UNIT II MECHANICAL OPERATIONS 9

Properties of solids - Sieve analysis; Laws of crushing, Crushers and grinders. Principle of separation and selection and details of equipment for screening, cyclones and hydro cyclones. *(Basic principles and equipment description only. Mathematical consideration not required)*

UNIT III HEAT TRANSFER 9

Modes of heat transfer; Heat transfer by conduction - Fourier's law, conduction across composite walls. Heat transfer by natural & forced convection. Co current, counter current, shell & tube heat exchangers *(Basic principles and equipment description only. Mathematical consideration not required)*

UNIT IV MASS TRANSFER 9

Principles of diffusion, theory of diffusion, Two film theory and mass transfer coefficients Humidification - operation, humidity chart, equipment's - cooling towers and spray chambers Drying - Principles and definitions. Rate of batch drying- Equipment for drying *(Basic principles and equipment description only. Mathematical consideration not required)*

UNIT V UNIT OPERATIONS 9

Absorption - Principle and equipment (packed towers and plate columns). Distillation - flash distillation, and Binary distillation. Industrial equipment for distillation Adsorption - Principle and equipment for adsorption. *(Basic principles and equipment description only. Mathematical consideration not required)*

TOTAL: 45 PERIODS

OUTCOMES

On completion of the course, students

- Will attain the knowledge in fluid flow behaviors and mechanical separation.
- Will understand the conduction and convection modes of heat transfer.
- Will understand the concept of distillation equipment in the process industries.
- Will increase the ability of the student over the fundamentals of chemical engineering

TEXT BOOKS:

1. W.L .Mc Cabe, J.C. Smith, "Unit Operations of Chemical Engineering", McGraw-Hill,7th edition 2014.
2. Shri. K.A. Gavhane, "Unit Operations I & II", NiraliPrakashan Publication, 2015.

REFERENCES:

1. Richardson and Coulson, "Chemical Engineering", Vol. 1, Elesvier , 6th Edition 2006.

2. Richardson and Coulson, “Chemical Engineering”, Vol. 2, Elesvier, 5th Edition 2006.
3. Chemical Engineer’s handbook - Perry and Chilton. McGraw-Hill, 8th Edition 2008.
4. W.L.Badger, J.T. Banchero. “Introduction to Chemical Engineering”, McGraw-Hill, UK, 1st Edition, 2002.

PT8354 POLYMER PHYSICS L T P C
3 0 0 3

OBJECTIVES:

- To make the students understand physical and conformational properties of polymeric materials.
- To know the molecular arrangement in polymers and their orientation under the influence of stress.
- To know the solubility behavior of polymers.

UNIT I FUNDAMENTALS OF POLYMER PHYSICS 9

Potential energy and conformational energy of molecules - conformations and configurations, Tacticity, isomeric states and isomerism in polymers, stereoisomerism, geometric isomerism - Random coils and average end to end distance - (Derivation only)

UNIT II THERMODYNAMIC PROPERTIES 9

Laws of Thermodynamics - Freely jointed and freely rotating chain models - Entropy and enthalpy- Energy driven and entropy driven elasticity - Thermo elasticity -Thermodynamic treatment - entropic and energetic contributions (Derivation only).

UNIT III POLYMER CRYSTAL FORMATION 9

Amorphous State - Transition temperatures- Glass transition temperature Theory- Factors influencing glass transition Temperature- Crystalline State - polymorphism – Polymer single crystals, lamellae, spherulites – Crystallinity -factors affecting crystallinity -X-ray diffraction.

UNIT IV CHAIN ORIENTATION 9

Chain orientation - Concept of chain orientation - orientation in amorphous and crystalline polymers - Uniaxial and biaxial orientation practical significance – Orientation processes: spinning Process – Optical Properties of polymers – Birefringence, Haze, Transparency.

UNIT V POLYMER SOLUTIONS 9

Polymer solutions - Terms and definitions, types of solutions - Hilderbrand approach, Flory Huggins theory - Thermodynamic view of miscibility, upper critical solution temperature (UCST), lower critical solution temperature (LCST) - solubility parameter,determination of solubility parameter of polymers - theta conditions.

TOTAL: 45 PERIODS

OUTCOMES:

Upon completing this course, the students

- Will understand molecular arrangement in polymers.
- Will able to demonstrate the orientation processes in polymer.
- Will acquire the knowledge in solubility behavior of polymers.

TEXT BOOKS:

1. Ulf W. Gedde, Polymer Physics, Springer – Science +Business Media, B.V. 1st Edition,

2001.
2. S. Glasstone and D. Lewis, Elements of Physical Chemistry, Textbook Publishers, 2003.

PT8361 CHEMICAL ENGINEERING LABORATORY L T P C
0 0 4 2

OBJECTIVE:

- To train on various techniques for reducing and separating of particles, flow properties of fluids.

LIST OF EXPERIMENTS:

1. To determine the pipe friction using Flow through rough and smooth pipes.
2. To determine the efficiency of pump using Centrifugal pump.
3. To determine the coefficient of discharge of orifice meter.
4. To find the efficiency of Air compressor
5. To Calibrate the rotameter
6. To find the Pressure drop in packed bed
7. To study the concept of Fluidization by using fluidized bed
8. To determine the coefficient of discharge of Venturi meter
9. To find the Thermal conductivity of solids.
10. To find overall heat transfer coefficient of the Heat exchanger
11. To find the Stefan-Boltzman constant
12. To find the new surface area created by Jaw crusher
13. To find the critical speed of Ball Mill
14. To find the Screening efficiency.
15. To separate the component by Simple distillation
16. To separate the component by using steam distillation
17. To find the Particle size and Surface area of filler particles.

(Any nine Experiments)

TOTAL: 60 PERIODS

OUTCOMES:

Upon completing this course, the students

- Will be able to apply the different technique for size reduction
- Will attain skill in function of fluid pressure apparatus.

LIST OF EQUIPMENT FOR BATCH OF 30 STUDENTS

Fluidized bed	1 No.
Packed bed	1 No.
Stop watch	2 Nos.
Measuring cylinder (1 Lit)	2 Nos.
Sieve shaker and sieve set	1 No.
Ball mill	1 No.
Jaw crusher	1 No.
Electronic balance	1No.
Plastics tray	2Nos.
Friction pipe apparatus	1No.
Single speed centrifugal pump	1No.
Venturi meter apparatus	1No.
Orifice/mouth piece apparatus	1No.
Meter scale	2Nos.

Vernier caliper	2 Nos.
Flow measuring meters	3 Nos.
Thermometer	5 Nos.
Tacho meter	1No.
Measuring jar (2 lit and 1 Lit each one)	2Nos.
Air compressor	1No.
Parallel and counter flow heat exchanger	1No.
Stephen Boltzman apparatus	1No.
Thermal conductivity Apparatus	1No.

REFERENCES:

1. W.L .Mc Cabe, J.C. Smith, "Unit Operations of Chemical Engineering", McGraw-Hill,7th Edition, 2005.
2. W.L.Badger, J.T. Banchero. "Introduction to Chemical Engineering", McGraw-Hill, UK, 1st Edition, 2002.

PL8311 PLASTICS IDENTIFICATION AND ANALYSIS LABORATORY L T P C
0 0 4 2

OBJECTIVE:

- To train the student to identify plastics and rubbers by different methods

EXPERIMENTS

Identification of polymers by simple methods like density, melting point, burning characteristics, solubility and confirmatory test by chemical analysis.

A. PLASTICS

1. Polyethylene
2. Polypropylene
3. Polystyrene
4. Polyvinyl Chloride
5. Polyamide
6. Polyethylene terephthalate
7. Polybutylene terephthalate
8. Polycarbonate
9. Polyacetal
10. Polyphenylene oxide
11. Polyphenylene sulphide
12. Phenol Formaldehyde resin
13. Urea formaldehyde resin
14. Melamine formaldehyde resin

B.IDENTIFICATION OF RUBBERS BY SIMPLE METHODS

1. Natural Rubber (NR)
2. Polybutylene Rubber (BR)
3. Styrene Butadiene Rubber (SBR)
4. Isoprene Rubber (IR)
5. Iso butiene Isoprene Rubber (IIR)
6. Chloroprene Rubber (CR)
7. Acrylonitrile–Butadiene Rubber (NBR)

8. Silicone Rubber

TOTAL PERIODS:60

OUTCOMES:

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

- Identify different types of plastics by their characteristics
- Identify different types of rubbers by their characteristics

LIST OF EQUIPMENT FOR BATCH OF 30 STUDENTS

Bunsen Burner	15 Nos
Electronic Balance	1 No
Thermostatic Water bath	2 Nos
Melting Point Apparatus	1 No
Retort Stand	
Polymer Samples and Glasswares	15 Nos

REFERENCE:

1. Identification of plastics and rubbers by simple methods, CIPET publications 2002

HS8381	INTERPERSONAL SKILLS/LISTENING&SPEAKING	L	T	P	C
		0	0	2	1

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.
- improve general and academic listening skills
- Make effective presentations.

UNIT I

Listening as a key skill- its importance- speaking - give personal information - ask for personal information - express ability - enquire about ability - ask for clarification Improving pronunciation - pronunciation basics taking lecture notes - preparing to listen to a lecture - articulate a complete idea as opposed to producing fragmented utterances.

UNIT II

Listen to a process information- give information, as part of a simple explanation - conversation starters: small talk - stressing syllables and speaking clearly - intonation patterns - compare and contrast information and ideas from multiple sources- converse with reasonable accuracy over a wide range of everyday topics.

UNIT III

Lexical chunking for accuracy and fluency- factors influence fluency, deliver a five-minute informal talk - greet - respond to greetings - describe health and symptoms - invite and offer - accept - decline - take leave - listen for and follow the gist- listen for detail

UNIT IV

Being an active listener: giving verbal and non-verbal feedback - participating in a group discussion - summarizing academic readings and lectures conversational speech listening to and participating in conversations - persuade.

UNIT V

Formal and informal talk - listen to follow and respond to explanations, directions and instructions in academic and business contexts - strategies for presentations and interactive communication - group/pair presentations - negotiate disagreement in group work.

TOTAL: 30 PERIODS

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

- Listen and respond appropriately.
- Participate in group discussions
- Make effective presentations
- Participate confidently and appropriately in conversations both formal and informal

TEXT BOOKS:

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

REFERENCES:

1. Bhatnagar, Nitin and MamtaBhatnagar**. Communicative English for Engineers and Professionals.** Pearson: New Delhi, 2010.
2. Hughes, Glyn and Josephine Moate**. Practical English Classroom.** Oxford University Press: Oxford, 2014.
3. Vargo, Mari**. Speak Now Level 4.** Oxford University Press: Oxford, 2013.
4. Richards C. Jack. **Person to Person (Starter).** Oxford University Press: Oxford, 2006.
5. Ladousse, Gillian Porter**. Role Play.** Oxford University Press: Oxford, 2014

MA8491 NUMERICAL METHODS L T P C
4 0 0 4

OBJECTIVE:

- To introduce the basic concepts of solving algebraic and transcendental equations.
- To introduce the numerical techniques of interpolation in various intervals in real life situations.
- To acquaint the student with understanding of numerical techniques of differentiation and integration which plays an important role in engineering and technology disciplines.
- To acquaint the knowledge of various techniques and methods of solving ordinary differential equations.
- To understand the knowledge of various techniques and methods of solving various types of partial differential equations.

UNIT I SOLUTION OF EQUATIONS AND EIGENVALUE PROBLEMS 12

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

UNIT II INTERPOLATION AND APPROXIMATION 12

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 12

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

UNIT IV INITIAL VALUE PROBLEMS FOR ORDINARY DIFFERENTIAL EQUATIONS 12

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 12

Finite difference methods for solving second order two - point linear boundary value problems - 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: 60 PERIODS

OUTCOMES:

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

- Understand the basic concepts and techniques of solving algebraic and transcendental equations.
- Appreciate the numerical techniques of interpolation and error approximations in various intervals in real life situations.
- 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.

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.

REFERENCES:

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.
5. Sastry, S.S, "Introductory Methods of Numerical Analysis", PHI Learning Pvt. Ltd, 5th Edition, 2015.

PT8451 FLUID MECHANICS AND POLYMER RHEOLOGY L T P C
3 0 0 3

OBJECTIVES:

- To understand the basic concepts of rheology
- To analyze the flow behavior of polymer melts and to carry out the experimental techniques for measuring the rheological properties.
- To understand the basics of fluid mechanism and to analyze behavior of newtonian fluids.
- To experimental with instruments such as orifice meter, venturi meter and pitot tube.

UNIT I FLUID PROPERTIES 9

Units and dimensions-Properties of fluids-mass density, specific weight, specific volume, specific gravity, viscosity, surface tension and capillarity-Terminologies of fluid flow-Laminar and turbulent flow of newtonian fluids-Power law-Reynolds number and its significance

UNIT II FLUID FRICTION AND FLOW MESUREMENT 9

Bernoulli‘s equation–kinetic energy correction factor; head loss; friction factor; major and Minor losses- Flow measurement: Introduction; Orifice meter; Venturi meter; concept of area meters: rotameter; Local velocity measurement: Pitot tube

UNIT III FLUID RHEOLOGY 9

Introduction and Basic concepts of Rheology, classification of fluids, Newtonian and non Newtonian fluids, shear stress, shear strain and shear rate, shear modulus, bulk modulus, Zero shear viscosity, Dependence of viscosity with temp, shear stress , Viscoelasticity - effect of rate of strain, temperature and time on mechanical behaviour of polymeric materials

UNIT IV POLYMER RHEOLOGY 9

Mechanical models - stress strain response of spring and dashpot - visco elastic models -Maxwell element - Voigt kelvin element - response to creep and stress relaxation -four parameter model - Boltzman principle - time temperature super position principle - WLF equation.

UNIT V MEASUREMENT OF POLYMER VISCOSITY 9

Viscosity of polymer melts – die swell and melt fracture - Weissenberg effect - Elongational viscosity. Measurements of rheological properties - capillary rheometers – cone and plate viscometer - Oscillating disc rheometer - Mooney viscometer.

TOTAL: 45 PERIODS

OUTCOMES:

On completion of the course, students

- Will have thorough knowledge on the basic concepts of rheology.
- Will able to analyze the mechanical behavior of polymers under applied load.
- Will carry out the experimental techniques for measuring the rheological properties.
- Will understand the basics of fluid mechanics and to analyze the behavior of newtonian fluids.
- Will be able to the instruments such as orifice meter, venturi meter & pitot tube.

TEXT BOOKS:

1. J.A.Brydson, Flow properties of polymer melts, life books, London, 1981.
2. R.J. Crawford, Plastics Engineering, Butterworth - Heinemann, Oxford, 2002, 3rd edition
3. Dr.R.K.Bansal, "A Textbook of Fluid mechanics and Hydraulic Machines", 9th edition, 2017

REFERENCES:

1. P.N.Cogswell, Polymer Melt Rheology, A guide for Industrial Practice, George Godwin,1981.
2. Richard C. Progelh of and James L. Throne, Polymer Engineering Principles, Hanser Publishers, New York, 1998.
3. John M. Dealy and Kurt F. Wissburn, Melt rheology and its role in plastics processing, Chapman, London, Oct 3rd, 2013.
4. R.S. Lenk, Polymer Rheology, Applied Science, London, 2012.
5. J.D. Ferry, Viscoelastic Properties of Polymers, john Wiley & Sons, New York, 1986.
6. Chang Dae Han. Rheology in Polymer Processing, Academic Press, New York, 1976

PL8451 PLASTICS MATERIALS I L T P C
3 0 0 3

OBJECTIVES:

To enable the students

- To learn about the general methods of preparation of individual class of plastics Materials
- To study about the general properties, processing behavior and applications of different class of plastics materials
- To understand about the structure- property relation of different class of plastics materials.

UNIT I INTRODUCTION 9

Basic chemistry of polymers-nomenclature of polymers sources for raw materials. Methods of manufacturing –properties and applications of Natural Polymers - Shellac resin and natural rubber - Cellulosics - Cellulose nitrate, cellulose acetate, cellulose acetate butyrate, Ethyl cellulose and others**.**

UNIT II COMMODITY THERMOPLASTICS-I 9

Preparation- properties - and applications of Polyolefine-Polyethylene- LDPE -LLDPE- HDPE, HMWHDPE- UHMWHDPE - Crosslinked polyethylene- Chlorinated polyethylene –Polypropylene – Homo & Co polymer

UNIT III COMMODITY THERMOPLASTICS-II 9

Preparation - properties - and applications of Vinyl plastics - Polyvinyl chloride, C-PVC, Polyvinyl Acetate, Polyvinylidene chloride, Polyvinyl alcohol. Polystyrene

UNIT IV GENERAL PURPOSE THERMOSETS 9

Preparation - properties - and applications of: Phenol formaldehyde (PF) ,Amino plastics: Urea

formaldehyde (UF) - Melamine formaldehyde (MF),Unsaturated polyesters, Alkyd resins

UNIT V ENGINEERING AND SPECIALITY THERMOSETS 9

Preparation - properties - and applications of: Epoxy Plastics, Polyurethane (PU) Silicones

TOTAL: 45 PERIODS

OUTCOMES:

Upon completing this course, the students

- Will familiarize in natural polymer properties and its applications
- Will acquire skills in selecting additives for plastic materials for specific applications
- Will have knowledge of manufacturing, properties and applications of poly olefins.
- Will have knowledge of manufacturing, properties and applications of vinyl halogenated olefin based plastic materials
- Will have knowledge of manufacturing, properties and applications of special purpose plastics

TEXT BOOKS:

1. J.A.Brydson, “Plastics Materials”, Butterworth- Heinemann - Oxford, 7th Ed., 2001.
2. Feldman.D and Barbalata.A, “Synthetic Polymers”, Chapman Hall, 1996.

REFERENCES:

1. V.R. Gowariker, “Polymer Science” – New Age International (P) Ltd, Publishers
2. OlagokeOlabisi, “Hand Book of Thermoplastics”, Marcel Decker, inc., 1997
3. K.J. Saunders, “Organic Polymer chemistry”, Chapman & Hall, NY, 1988.
4. Irvin.I. Rubin, “Hand Book of Plastic Materials and Technology”, Wiley Interscience, NY, 1990.
5. Charles Gebelein, Biotechnological Polymers: Medical, pharmaceutical and industrial applications, CRC press,1993

ME8391 ENGINEERING THERMODYNAMICS L T P C

3 2 0 4

OBJECTIVE:

- To familiarize the students to understand the fundamentals of thermodynamics and to perform thermal analysis on their behavior and performance.

(Use of Standard and approved Steam Table, Mollier Chart, Compressibility Chart and Psychrometric Chart permitted)

UNIT I BASIC CONCEPTS AND FIRST LAW 9+6

Basic concepts - concept of continuum, comparison of microscopic and macroscopic approach. Path and point functions. Intensive and extensive, total and specific quantities. System and their types. Thermodynamic Equilibrium State, path and process. Quasi-static, reversible and irreversible processes. Heat and work transfer, definition and comparison, sign convention. Displacement work and other modes of work .P-V diagram. Zeroth law of thermodynamics – concept of temperature and thermal equilibrium– relationship between temperature scales –new temperature scales. First law of thermodynamics –application to closed and open systems – steady and unsteady flow processes.

UNIT II SECOND LAW AND AVAILABILITY ANALYSIS 9+6

Heat Reservoir, source and sink. Heat Engine, Refrigerator, Heat pump. Statements of second law and its corollaries. Carnot cycle Reversed Carnot cycle, Performance. Clausius

inequality. Concept of entropy, T-s diagram, Tds Equations, entropy change for - pure substance, ideal gases - different processes, principle of increase in entropy. Applications of II Law. High and low grade energy. Available and non-available energy of a source and finite body. Energy and irreversibility. Expressions for the energy of a closed system and open systems. Energy balance and entropy generation. Irreversibility. I and II law Efficiency.

UNIT III PROPERTIES OF PURE SUBSTANCE AND STEAM POWER CYCLE 9 + 6

Formation of steam and its thermodynamic properties, p-v, p-T, T-v, T-s, h-s diagrams. p-v-T surface. Use of Steam Table and Mollier Chart. Determination of dryness fraction. Application of I and II law for pure substances. Ideal and actual Rankine cycles, Cycle Improvement Methods - Reheat and Regenerative cycles, Economiser, preheater, Binary and Combined cycles.

UNIT IV IDEAL AND REAL GASES, THERMODYNAMIC RELATIONS 9 + 6

Properties of Ideal gas- Ideal and real gas comparison- Equations of state for ideal and real gases- Reduced properties. Compressibility factor-.Principle of Corresponding states. - Generalised Compressibility Chart and its use-. Maxwell relations, Tds Equations, Difference and ratio of heat capacities, Energy equation, Joule-Thomson Coefficient, Clausius Clapeyron equation, Phase Change Processes. Simple Calculations.

UNIT V GAS MIXTURES AND PSYCHROMETRY 9 + 6

Mole and Mass fraction, Dalton's and Amagat's Law. Properties of gas mixture – Molar mass, gas constant, density, change in internal energy, enthalpy, entropy and Gibbs function. Psychrometric properties, Psychrometric charts. Property calculations of air vapour mixtures by using chart and expressions. Psychrometric process – adiabatic saturation, sensible heating and cooling, humidification, dehumidification, evaporative cooling and adiabatic mixing. Simple Applications

TOTAL : 75 PERIODS

OUTCOMES:

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

CO1 Apply the first law of thermodynamics for simple open and closed systems under steady and unsteady conditions.

CO2 Apply second law of thermodynamics to open and closed systems and calculate entropy and availability.

CO3 Apply Rankine cycle to steam power plant and compare few cycle improvement methods

CO4 Derive simple thermodynamic relations of ideal and real gases

CO5 Calculate the properties of gas mixtures and moist air and its use in psychometric processes

TEXT BOOKS :

1. R.K.Rajput, "A Text Book Of Engineering Thermodynamics ",Fifth Edition,2017.
2. Yunus a. Cengel & michael a. Boles, "Thermodynamics", 8th edition 2015.

REFERENCES:

1. Arora C.P, "Thermodynamics", Tata McGraw-Hill, New Delhi, 2003.
2. Borgnakke & Sonnatag, "Fundamental of Thermodynamics", 8th Edition , 2016.
3. Chattopadhyay, P, "Engineering Thermodynamics", Oxford University Press, 2016.
4. Michael J. Moran, Howard N. Shapiro, "Fundamentals of Engineering Thermodynamics", 8th Edition.

5. Nag.P.K., “Engineering Thermodynamics”, 5th Edition, Tata McGraw-Hill, New Delhi, 2013.

PT8453 PROCESS INSTRUMENTATION FOR POLYMER TECHNOLOGIST L T P C
3 0 0 3

OBJECTIVE:

- To enable the students to learn the basic measurements system
- To understand the concepts of temperature pressure and flow measurements system.
- To understand the instrumentation applications in polymer analytical techniques.

UNIT I GENERAL CONCEPTS OF MEASUREMENTS 9

Measurement -The three stages of generalized measurement system, Transducer: classification. Factors considered in selection of Transducers classification of errors, potentiometer, LVDT, tachometer. Strain gauge Types of electric strain gauges. Calibration of strain gauges, Non conduct measurements

UNIT II TEMPERATURE AND PRESSURE MEASUREMENTS 9

Thermometer, Resistance Temperature Detector, thermistor, thermocouple, total radiation pyrometers, optical pyrometer, Pressure measurement: Manometers, Elastic transducers, McLeod gauge, thermal conductivity gauges, calibration of pressure gauge using dead weight tester.

UNIT III FLOW AND MISCELLANEOUS MEASUREMENTS 9

Venturi, Orifice & nozzle meters, Pitot tube, turbine type meters, hot wire anemometer, magnetic flow meters. Level measurement: float level meters & electrical conductivity meters.

UNIT IV INDICATING AND RECORDING INSTRUMENTS 9

Electrical indicating instruments- analog and digital, current Galvanometer, PMMC, Electro Dynamometer – Wattmeter-ammeter, recording –analog and digital , Galvanometer recording , null typer, potentiometeric, magnetic typer, cathode ray tube.

UNIT V INSTRUMENTATION IN ANALYTICAL TECHNIQUE 9

IR spectroscopy, Gas chromatography, X-ray spectrometer, Thermoanalytical method, Thermal conductivity analyzer, Measurement of color.

TOTAL: 45 PERIODS

OUTCOMES:

Upon completing this course, the students

- Will be able to understand the general concept of measurements.
- Will acquire the knowledge in instruments for measurement
- Will familiarize with the indicating and recording instruments used in industry machinery
- Will understand the role of process control in polymer machinery.

TEXT BOOKS:

1. A.K.Shawhney, “A Course in Mechanical Measurements and instrumentation”, Dhanpat Rai, New Delhi, 2001 12th edition.
2. R.S.Khandpur, “Analytical Instrumentation”, Tata McGraw-Hill, New Delhi,2004, 5th edition.

REFERENCES:

1. Rangan, Mani & Sharma, Instrumentation, Tata McGraw-Hill, New Delhi, 1997.
2. I.J. Nagarath and M. Gopal, Control systems engineering, 2nd Ed. New Age International Pvt. Ltd., 1982.

3. R. K. Jain, Mechanical & Industrial measurements, Khanna Publishing. 1988.
4. B.C.Nakra, K.K.Chaudhry, "Instrumentation, Measurement and Analysis". Tata McGraw-Hill, New Delhi, 2006, 7th edition.

PT8452 MOULD MANUFACTURING TECHNOLOGY L T P C
3 0 0 3

OBJECTIVE:

- To impart knowledge on mould making techniques such as metal cutting, metal erosion,
- To provide knowledge of metal deposition, surface texturing and measurements in mold making.
- To understand the electro forming process

UNIT I FUNDAMENTALS OF MOLD MAKING 9

Mold Making: selection of materials for mold making, Mechanism of metal cutting, types of tools, influence of tool angles, Cutting fluids. Basics of machining operations: Turning, Cylindrical Grinding, Surface Grinding & Vertical Milling.

UNIT II ELECTRICAL DISCHARGE MECHANISMS 9

Electrical discharge machining – Principle, Types of EDM - Die Sinking & Wire Cut EDM, Machining Process, Requirements of dielectric fluid, Applications of EDM in mold making.

UNIT III ELECTRO FORMING PROCESS 9

Electroforming for mold manufacturing - discussion of the process, materials for electroforming, design & materials for models, machining for electroformed mold cavities, Advantages, Disadvantages.

UNIT IV HOBBING AND CHEMICAL TEXTURING 9

Hobbing for mold cavity making - Discussion of the hobbing process, elements of hobbing, materials used for cavity, lubrication, and depth of hobbing, advantages and disadvantages.
Surface Texturing of molds – Chemical Texturing, Process description, Advantages- Limitations of chemical texturing.

UNIT V METOROLOGY AND INSPECTION 9

Metrology and inspection: Vernier caliper, Micrometer, Vernier height gauges, Surface plate, Slip gauges, Sine Bar, Rockwell Hardness, Optical profile projectors and Optical flat.

TOTAL: 45 PERIODS

OUTCOMES:

Upon completing this course, the students

- Will demonstrate mold making process
- Will know about the Electro discharge machining process
- Will have the knowledge in surface texturing of mold
- Will attain knowledge in electroforming process
- Will acquire skills in inspection of mold

TEXT BOOKS:

1. KlusStokhert (Edt.), Mold making handbook for Plastic Engineers, Hanser Publishers, 2nd edition, 1998.
2. HMT Production Technology, Tata Mc Graw Hill (India), 1992
3. Plastics Mould design , Tata McGraw-Hill Education , 2007

REFERENCES:

1. C-B & Liv C.N.K. Computer aided design & manufacture, East West Press P.C.Pandey& H. S. Shah, Modern Machining Processes, TMH, 1990
2. R.G.W.Pye, Injection Mold Design, East West Press Pvt. Ltd., New Delhi.3rd Edition, 1983.
3. Stoeckhert & Menning, Mold making handbook, 2nd edition, Carl Hanser Verlag GmbH & Company KG, 2013. .
4. W.A.J Chapman, Workshop Technology Part 2, Taylor & Francis Group, 2016.
5. George Menges& Paul Mohren, How To Make Injection Molds, Hanser Publishers, 2001

PT8461 MOULD MANUFACTURING TECHNOLOGY LABORATORY L T P C
0 0 4 2

OBJECTIVE:

- To train the students about the mould making techniques such as metal cutting, metal erosion, metal deposition, metal displacement and mould polishing.

LIST OF EXPERIMENTS

1. Exercise on Shaping machine - making stepped block
2. Exercise on Shaping machine - making beveled block
3. Exercise on Horizontal Milling-Gear cutting
4. Exercise on Vertical Milling
5. Exercise on lathe - external thread
6. Exercise on lathe- taper turning
7. Exercise on Surface Grinding.
8. Exercise on Slotting Machine.
9. Grinding of Cutting tools.
10. Study of different types of Cutting tools.
11. Measurements using Micrometer, vernier, Height gauge and Slip gauge.
12. Measurement of angle using Sine Bar.
13. Application of Dial gauge.

(Any 8 experiments from the above)

TOTAL: 60 PERIODS

OUTCOMES:

Upon completing this course, the students

- Will understand the mould parts manufacturing technique
- Will attain knowledge in turning operations
- Will attain knowledge in slotting and milling operations
- Will know about the grinding methods
- Will understand the measuring instruments

DEMOMSTRATION EXPERIMENT:

To make a simple mold for hand molding machine

LIST OF EQUIPMENT FOR BATCH OF 30 STUDENTS

Shaping machine	2	Nos.
Vertical milling machine	1	No.
Horizontal milling machine	1	No
Lathe	10	Nos.

Plain surface grinding machine	1	No.
Bench grinder	2	Nos.
Vernier caliper	2	Nos.
Vernier height gauge	2	Nos.
Vernier Depth Gauge	1	No
Micrometer	2	Nos
Sine bar	1	No.

HS8461 ADVANCED READING AND WRITING

L	T	P	C
0	0	2	1

OBJECTIVES:

- Strengthen the reading skills of students of engineering.
- Enhance their writing skills with specific reference to technical writing.
- Develop students' critical thinking skills.
- Provide more opportunities to develop their project and proposal writing skills.

UNIT I

Reading - Strategies for effective reading-Use glosses and footnotes to aid reading comprehension- Read and recognize different text types-Predicting content using photos and title **Writing**-Plan before writing- Develop a paragraph: topic sentence, supporting sentences, concluding sentence –Write a descriptive paragraph

UNIT II

Reading-Read for details-Use of graphic organizers to review and aid comprehension **Writing**-State reasons and examples to support ideas in writing- Write a paragraph with reasons and examples- Write an opinion paragraph

UNIT III

Reading- Understanding pronoun reference and use of connectors in a passage- speed reading techniques-**Writing-** Elements of a good essay-Types of essays- descriptive-narrative- issue-based-argumentative-analytical.

UNIT IV

Reading- Genre and Organization of Ideas- **Writing-** Email writing- visumes – Job application-project writing-writing convincing proposals.

UNIT V

Reading- Critical reading and thinking- understanding how the text positions the reader- identify **Writing**- Statement of Purpose- letter of recommendation- Vision statement

TOTAL: 30 PERIODS

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

- Write different types of essays.
- Write winning job applications.
- Read and evaluate texts critically.
- Display critical thinking in various professional contexts.

TEXT 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 Carne **Reading and Writing (Level 4)** Oxford University Press: Oxford, 2011

REFERENCES

1. Davis, Jason and Rhonda LIss.**Effective Academic Writing (Level 3)** Oxford University Press: Oxford, 2006
2. E. Suresh Kumar and et al. **Enriching Speaking and Writing Skills.** Second Edition. Orient Black swan: Hyderabad, 2012
3. Withrow, Jeans and et al**. Inspired to Write. Readings and Tasks to develop writing skills.** Cambridge University Press: Cambridge, 2004
4. Goatly, Andrew**. Critical Reading and Writing.** Routledge: United States of America, 2000
5. Petelin, Roslyn and Marsh Durham**. The Professional Writing Guide: Knowing Well and Knowing Why.** Business & Professional Publishing: Australia, 2004

PL8501 ADDITIVES AND COMPOUNDING L T P C
3 0 0 3

OBJECTIVES:

To enable the students

- To know various draw backs of polymer materials and suitable remedies.
- To understand the mechanism of degradation of polymers and stabilizing additives
- To know the various compounding methodologies for plastics materials and learn the maintenance of compounding machinery.

UNIT I FILLERS, STABILIZERS, PIGMENTS 9

Fillers and Reinforcement– Antioxidants-Thermal Stabilisers, Ultraviolet stabilizer– Impact Modifiers/ Toughening agents. Colourants-Fire retardants-Coupling agents-blowing-agents

UNIT II PLASTICIZERS 9

Plasticizers- Antistatic agents-Anti blocking agents-Slip and anti slip agents-processing aids - Lubricants- mould releasing agents Additives for recycling.

UNIT III FUNDAMENTALS OF COMPOUNDING 9

Compounding - Selection of polymers and compounding-ingredients-general objectives- Merits and demerits of additives in polymer matrices. Mixing and mixing equipments. Compounding by batch mixer- High speed mixer - Two roll mill - Banbury Mixer - Ribbon blender - Planetary mixers.

UNIT IV COMPOUNDING MECHANISMS 9

Compounding Machineries specifications - temperature control system – operating characteristics and working details of continuous mixers - - Single Screw extruder - Twin Screw extruder- house keeping and maintenance of compounding machines.

UNIT V CASE STUDIES **9**

Case studies on preference of one plastics to other and co-relation of properties of conventional materials and blends and alloys - case studies on application of blends and alloys.

TOTAL: 45 PERIODS

OUTCOMES:

- Students will have clear understanding of various types of additives for plastics and their merits and demerits.
- Students can learn about various compounding methods used in the manufacturing of compounded thermoplastics and thermosets.

TEXT BOOKS:

1. Al – Malaika; S. Golovoy; A and Wilkie (Eds), Chemistry and Technology of Polymer Additives, Black well Science Ltd, Oxford (1999).
2. Matthews; F.L. and Rawlings; R.D, Composite Materials, Engineering and Science Chairman and Hall, London (1994).
3. Plastics Testing Technology Hand Books by Vishu Shah,1984.

REFERENCES:

1. Hand Book of Plastics Test Methods by Brown R.P,1989.
2. Mascia; L.,The Role of Additives in Plastics, Edward Arnold Publishers Ltd., U. K. (1974).
3. Murphy; John, Additives for Plastics Handbook, 2nd Edition, Elsevier Advanced Technology, Oxford,2001.
4. R. Gachter and H. Muller, Plastics Additives Hand Book, Hanser Publishers, Munich, 1993.

PL8502 PLASTICS TESTING I **L T P C**
3 0 0 3

OBJECTIVES:

- To develop the knowledge of National & International standards for testing methods.
- To create the knowledge about the different testing techniques and its basic concepts for evaluating the chemical, mechanical, electrical, optical, thermal, and permanence properties of plastic materials.
- To enable the students to identify and compare the properties of different plastics materials.
- To enable the students to learn about the property of the plastic material for several

UNIT I TESTING STANDARDS **5**

Importance of testing, Standard and specifications- National and International standards-BIS, ASTM, ISO,BS,DIN,JIS etc- Laboratory accreditations – NABL, NABCB, APLAC etc.

UNIT II IDENTIFICATION OF PLASTICS **9**

Identification of plastics by simple methods e.g., visual inspection, density, effects of heat, combustion and solvents analysis, melting & Softening point, elemental analysis, confirmation test-analytical techniques used for identification and quantification of additives and fillers.

UNIT III TESTING OF MECHANICAL PROPERTIES **12**

Preconditioning and test atmosphere, Specimen preparation techniques – Moulding, Contour cutting, contour punching, etc. Techniques for testing of Short term mechanical properties of Plastics – Stress – Strain curve, toughness, brittle and ductile nature of materials, Tensile, Flexural, Compression, Shear, Impact strength, Tear, abrasion, Hardness and friction test.

UNIT IV TESTING OF THERMAL AND OPTICAL PROPERTIES 10

Techniques for testing of Thermal properties – Melting Point, Specific heat capacity, HDT, VSP, Flammability (Rate of burning, UL 94, LOI), Ignition properties of plastics.
Thermal conductivity, Coefficient of Thermal Expansion, Brittleness Temperature
Optical properties – Luminous transmittance, Haze, Specular Gloss, Refractive Index, colour measurement, optical microscopy

UNIT V TESTING OF ELECTRICAL AND FLOW PROPERTIES 9

Techniques for testing of Electrical properties – Surface & Volume Resistivity, Arc Resistance, CTI, Dielectric Strength, Dielectric constant and Dissipation factor- Rheological properties – Melt flow Index, Melt viscosity (as function of temperature and shear rate)

TOTAL: 45 PERIODS

OUTCOMES:

Upon completion of this course,

- Students will learn how the plastics materials are tested for its chemical, mechanical, electrical, optical, thermal, and permanence properties.
- Students will be able to identify the plastic materials for some specified applications based on its property.
- Students will able to understand the basic principle of polymer testing machines.

TEXT BOOKS:

1. Allen; W.S and Baker; P.N, Hand Book of Plastics Technology, Volume 2, Identification
2. Testing & Recycling of Plastics, CBS Publishers and distributors, New Delhi 2004).
3. Brown; Roger P (Ed.), Hand Book of Polymer Testing, Marcel Dekker, Inc, New York (1999).

REFERENCES:

1. Brown; Paul F (Ed), Hand Book of Plastics Test Methods, Longman Scientific and Technical, Harlow (1988).
2. Shah, Vishnu, Hand Book of Plastics Testing Technology, John Wiley and Sons, SPE Monograph (1984).
3. Blythe; A. R., Electrical Properties of Polymers, Cambridge University Press, Cambridge (1979).

PL8551 PLASTICS MATERIALS II L T P C
3 0 0 3

OBJECTIVES:

- To learn about the general methods of preparation of individual class of plastic materials
- To study the general properties, processing behavior of plastics materials.
- To provide the knowledge in applications of different class of plastics materials.

UNIT I ENGINEERING PLASTICS & ITS APPLICATIONS - I 9

Preparation- properties - and applications: Styrene copolymers – High Impact Polystyrene (HIPS), Acrylonitrile Butadiene Styrene (ABS), Styrene acrylonitrile (SAN), Acrylic plastics - Polymethyl Methacrylate, Polyacrylonitrile , Ethylene Vinyl Alcohol (EVA).

UNIT II ENGINEERING PLASTICS & ITS APPLICATIONS – II 9

Preparation- properties - and applications: **Polyamides** - Nylons 6, (6,6), (6,10), 11, 12,
Polyesters – Polyethylene terephthalate, polybutylene terephthalate, Polycarbonate, Polyacetals.

UNIT III HIGH PERFORMANCE PLASTICS - I 9

Preparation - properties - and applications: Aromatic ether - Polypheneylene oxide (PPO), Aromatic thioether - Polyphenylenesulphide (PPS), Polysulfone, Aromatic polyamides

UNIT IV HIGH PERFORMANCE PLASTICS - II 9

Preparation - properties - and applications: Polyimides (PI) Polyamideimide (PAI), Polyimidazoles, Fluoropolymers – Polyvinyl fluoride (PVF), Polyvinylidene fluoride (PVDF), Polytetrafluoroethylene (PTFE), Polychlorotrifluoroethylene (PCTFE).

UNIT V WATER SOLUBLE POLYMERS AND BIO DEGRADABLE POLYMERS 9

Preparation- properties and applications of Biodegradable polymers - poly ξ–caprolactone - polylactic acid- Bacterial polyhydroxyalkonates.– polyvinylpyrrolidone – polyacrylic acid and its homolog's – polyacrylamide –polyethylene oxide – polyethylene amine-Polyvinyl alcohol

TOTAL: 45 PERIODS

OUTCOMES:

Upon completing this course, the students

- Will have the knowledge of manufacturing methods, properties of special purpose polymers applied in special application
- Will have knowledge of manufacturing methods and correlate the high performance polymer properties for special purpose
- Will acquire skills in selection of conducting polymer to suitable application
- Will have the knowledge of manufacturing methods, properties and applications of ionic polymers
- Will have the knowledge of manufacturing methods, properties and applications of water soluble and bio degradable polymers

TEXT BOOKS:

1. Plastic Materials Ed 7 - By Brydson, J A,1999.
2. Hand Book of Plastics Materials & Technology - By Rubin, Irwin, J,1990.
3. Manas Chanda, Salil.K.Roy, "Plastics Technology Hand book", 2nd edition, Marcel Dekker, New York, 1993.
4. Matrin.T.Goosey, "Plastics for Electronics", Elsevier, Applied Science, 1985.
5. R.W. Dyson, "Specialty Polymers", Chapman & Hall, 2nd edition, 1998.

REFERENCES:

1. Plastics Engineering Hand Book Ed. 5 & Society of the Plastic Industry Inc - By SPI,1994.
2. Plastics Materials and Processing - By Schwartz & Goodman,1982.
3. Plastics Materials (Properties & Application) - By Birley & Scott,1982.
4. Modern Plastics Hand Book - By Harper,2000..
5. Birley; Arthur W. and Scott; Martyn J., Plastics Materials: Properties and Applications,
6. Leonard Hill, Blackie and Sons Ltd., 1982.
7. Biron; Michel, Thermoplastics and Thermoplastic Composites: Technical Information for Plastics Users, Elsevier, Amsterdam, 2007.
8. DuBois; P, Plastics in Agriculture, Applied Science Publishers Ltd., London 1978
9. H.F.Mark, (Ed), "Encyclopedia of polymer Science & Engineering", John Wiley & Sons, New York, 1989.
10. Johannes Karl Fink, 'Handbook of Engineering and Speciality Thermoplastics', Volume 10, Water Soluble Polymers, John Wiley & Sons, New Jersy, 2011.
11. David Kaplan ,''Biopolymers from renewable resources" ,Springer,1998.

PL8503 PLASTICS PROCESSING TECHNOLOGY I L T P C
4 0 0 4

OBJECTIVES:

To enable the students

- To understand the various processing techniques of plastic materials.
- To learn the fundamentals and compression molding and transfer molding of thermoset plastics.
- To learn the basic processing of thermoplastics by injection molding, extrusion and blow
- moulding.

UNIT I INTRODUCTION 8

Basic principles of processing - shape and size – Effect of polymer property on processing – Newtonion and Non-Newtonion fluids - Rheology of polymer melts.

UNIT II COMPRESSION MOULDING & TRANSFER MOULDING 11

Basic principles of compression and transfer moulding-Meaning of terms-Bulk factor and flow properties as applied to moulding materials-The methods adopted for estimating these properties and their limitations Process variables-Inter relation between flow properties-Curing time-Mould temperature and Pressure requirements-Preforms and preheating-Techniques of preheating-Machines used-Types of compression mould-Common moulding faults and their correction-Finishing of mouldings.

Fundamental principles of transfer moulding-advantages over compression moulding- Equipment used-Press capacity-Integral moulds and auxiliary ram moulds-Moulding cycles-Tool costs-Moulding tolerances-Materials Theoretical calculation of pressures- Line pressures- Injection ram pressure-clamping-Heating requirements-Finishing of moulded parts—Moulding faults – causes and remedies.

UNIT III INJECTION MOULDING 15

Principles processing outline - Process variables - Mould cycle - Machinery used – Parts and functions –Specifications - Construction and maintenance - Start-up and shut down procedures - Cylinder nozzles - Press capacity projected area -Shot weight Basic theoretical concepts and their relationship to processing - Interaction of moulding process aspect effects in quoted variables - Introduction to trouble shooting.

UNIT IV EXTRUSION 14

Basic principles of extrusion – Types of extruders, general features of extruders viz. barrel, screw, types of screws, drive mechanism, specifications, heating & cooling systems, flow mechanism, die entry effects and exit instabilities. Melt fracture & Bam- booing. Factors affecting the output of an extruder, process variables in extrusion Extrusion processes and the downstream equipments for the production of films, blown film, cast film/slot film, BO film, coextruded film. Tube/pipe-sizing take off equipment, extrusion coating, wire & cable covering –pre treatment of conductor, cooling, takeoff equipment constructional features of dies for the above processes and trouble shooting. Applications of extrusion and new developments.

UNIT V BLOW MOULDING 12

Basic principles and definitions- Processer – viz, Injection Blow moulding, extrusion blow moulding, Accumulation blow moulding, Merits & Demerits - Development of blow moulding industry Processing Parameters-Temperature-Pressure and cycle time Components – Materials requirements related to process and product performance- Materials used-Limitations in product

design presented by process characteristics- Design guide lines for optimum product performance and appearance-Equipment used- Hand and power operated equipment. Screw and Plunger Systems-Cross head and die design-Blow moulding machine features and operation including hydraulic and electrical control systems-faults, causes and remedies.

Parison programming, blow mould construction, cooling methods, mould venting, blow moulding of difficult articles like fuel tanks, odd shaped containers with handles, limitation in blow moulding, decoration of blow moulding products, hot stamping-multi colour printing-faults, causes and remedies.

TOTAL:60 PERIODS

OUTCOMES:

- On completing this course, the students would acquire the knowledge of processing of plastic materials by injection moulding, extrusion, and blow moulding.
- Students can will understand processing techniques like compression molding and transfer moulding of thermoset plastics.

TEXT BOOKS:

1. Allen; W. S. and Baker; P. N., Hand Book of Plastic Technology, Volume-1, Plastic Processing Operations [Injection, Compression, Transfer, Blow Molding], CBS Publishers and Distributors, New Delhi (2004).Injection Molding Theory & Practice By Rubin, Irvin.
2. Injection Molding Hand Book By Rusto,D.V &Rosato, D.V Plastic Engineering Hand Book & D–5 By Society of Plastic Industry Inc.,2000.
3. Plastics Material & Processing By Strong, A, Brent ,Blow Molding Hand Book By Rosato, D.V & Rosato, D.V ,Plastic Extrusion Technology By Hensen.
4. Extrusion of Plastics By Fisher
5. Plastics Extrusion Technology By Grief
6. Plastic Engineering Hand Book By S P I,1991.
7. Plastics Extrusion Technology By Henson,1997.

REFERENCES:

1. A Guide to Injection Molding of Plastics By Bolur, P.C.,
2. Development in Injection Molding By Whelan, A & Craft, J.L.
3. Technician's Hand Book & Plastics By Grandilli, P.A.,1990.
4. Plastics Materials & Processing By Schwartz & Goodman.,1982.
5. Injection Molding By Athalye, A.S.,1997.
6. Injection Molding Technology By V.D.I.
7. Innovation in Polymer Processing By Stevenson.,1996.
8. Extrusion The definitive Processing Guide and Hand Book By Giles, H.H & Others.,2004.
9. Compression Molding By Iyesew, A.I.
10. Polymer Extrusion By Rauwedaal, Chris.,2014.

PL8511 PLASTICS PROCESSING LABORATORY I L T P C
0 0 4 2

OBJECTIVE:

- To practice the students in different types of moulding machines.

Sl. No	Name of M/c/ Equipment/ Mould	Description of Practical Exercise to be done
1	Hand operated	(i) Study of Machine in Idle-Run Observation (IRO), Parts&

	Injection Moulding Machine	functions, operating principle, Free sketch of Machine- parts eg. Nozzle, Torpedo, Hopper, Rack & Pinion Barrel etc., shot capacity definition (ii) Operation practice to produce moulding on Different and injection moulds. Recording the observation and results in practical record books.
2	Injection Moulding Semi Automatic	(i) Study of Semi Automatic Injection Moulding M/cs of all types in IRO. Comparative study of Pneumatic type & Hydraulic type of M/cs, Operating Principle of M/cs. Line diagrams of M/cs with nomenclature of parts, M/cs specifications. (ii) Operation of Pneumatic & Hydraulic type of Semi automatic Injection moulding M/cs, to produce components in different moulds. Cycle-time analysis, observations of Process-Parameters & Procedure to be recorded
3	Extrusion Processes on Extruders	(i) Study of Extruders in IRO, Free sketch of machines, their parts and parts-function, List of products manufactured by Extrusion-Process. Study of different types of extrusion process. (ii) Operation-Practice by Trainee on setting up of Process parameter to produce Blown-Film on Film-plant, observations on extruder output, size of film produced and technical specifications of machines to be recorded
4	Compression moulding – Hand Operated	(i) Study of Hand compression M/c in IRO Free sketch of Parts & study of part-function, comparison of compression moulding M/c with Injection Moulding M/c. Compression moulding processes. (ii) Operating Principle of Hand Compression Press, mould setting-procedure & parameter setting, operation practice on different compression moulds, M/c specification observations and recording
5	Blow Moulding and recording Hand Operated	(i) Study of Hand Blow Moulding M/cs, Free-sketch of M/c with parts & study of part-function, Specification of M/c, Study of Parison-die with sketch. (ii) Die-centering practice by Trainees, operation of Hand Blow Machines, to produce components observations, cycle time analysis Procedure of operation and observations.
6	Scrap Grinding	(i) M/c Study in IRO, specification of M/c, study of parts & function, Line Diagram of M/c. (ii) Operation-practice with different materials and output study in Kg/hour for different materials.
7	Injection Moulding M/c.- Automatic	Study of M/c Parts & function, Study of clamping systems in M/cs, Technical spec. of M/c, study of process sequence in Machine, Study & definitions of terms related to M/c operation e.g. M/c Day light, Locating –Ring Dimensions, ejector-stroke, Tie-Bar distance, M/c Platen sizes & mould clamping arrangements. Definitions of all Processing Parameters & study of controls in M/cs.
8	Compression & Transfer Moulding- Semi Automatic	Technical specification of M/c, Mould clamping on M/c, Parameter setting, operation-practice on different compression & Transfer Moulds, Cycle-time analysis, observation & Procedure of start-up & shut down of M/c.

9	Blow-Moulding Semi Automatic	Technical specification of M/c, Mould clamping on M/c, operation Practice with different moulds, Familiarisation with control-switches/ valves on the M/c, cycle-time analysis & procedure of operation of M/c.
10	Introduction to Maintenance	Basic knowledge of Hydraulic & Pneumatic systems, Electrical system, Definition of terms- Hydraulic fluid, viscosity Directional Valves, Resistance, Current, Voltage, Power, Hydraulic Pumps - Types & function, electrical heaters, thermocouples and temp control parameters and timers, electrical Motors - Types & fn.
11	Introduction to Moulds,Tool Room M/ c & Drawing Practice	Study of Different Types of Moulds & its Parts and function, free hand drawing practice, exposure to tool room machines.

LIST OF EQUIPMENTs/MACHINERY FOR BATCH OF 30 STUDENTS

Sl. No.	Name of M/c/ Equipment/ Mould	No. of machine required
1	Hand operated Injection Moulding Machine	01
2	Injection Moulding Semi-Automatic	01
3	Extrusion Processes on Extruders	01
4	Compression moulding –Hand Operated	01
5	Blow Moulding and recording – Hand Operated	01
6	Scrap Grinding	01
7	Injection Moulding M/c.- Automatic	01
8	Compression& Transfer Moulding- Semi Automatic	01
9	Blow-Moulding Semi-Automatic	01
10	Introduction to Maintenance	-
11	Introduction to Moulds, Tool Room M/c &Drawing Practice	-

TOTAL: 60 PERIODS

OUTCOME:

- Upon completing this practical course, the student will have hands on experience on different types of moulding machines.

PT8561 POLYMER PREPARATION LABORATORY L T P C
0 0 4 2

OBJECTIVE:

- To prepare the students with Methodology for facing the Industrial and academic challenges in Identifying various polymers and Controlling the quality of incoming raw materials and processing

LIST OF EXPERIMENTS

Preparation

1. Preparation of phenol - formaldehyde (Novalac) resin.
2. Preparation of phenol - formaldehyde (Resol) resin.
3. Preparation of Urea formaldehyde resin.
4. Preparation of Bisphenol - An epoxy resin.
5. Bulk polymerization of styrene.

6. Emulsion Polymerization of styrene.
7. Solution Polymerization of acrylonitrile.
8. Bulk Polymerization of Methyl methacrylate.
9. Copolymerization of styrene and methyl methacrylate.
10. Ring opening polymerization of Caprolactone
11. Solution Polymerization of Vinyl acetate.

(Any Nine of the above)

TOTAL: 60 PERIODS

OUTCOMES:

Upon completing this course, the students

- Will acquire skills in preparation of polymers using various polymerization techniques.
- Will develop the conversion of polymeric materials into product.

LIST OF EQUIPMENT FOR BATCH OF 30 STUDENTS

Magnetic stirrer	10 Nos.
Thermostatic Water bath	2 Nos.
Vacuum Pump	1 No.
Heating Mantle	8 Nos.
Water distillation set up	1 No.
Bunsen burner	15 Nos.
Electronic balance	2 Nos.
Air oven	1 No.
Melting point apparatus	1 No.
Retard stands	15 Nos.
Burette	
Pipette	
Funnel	

PL8601 PLASTICS MOULDS AND DIES DESIGN L T P C
3 0 0 3

OBJECTIVES:

- To learn the design concepts for various mould elements.
- To learn the basic design aspects related to Injection Mould , Compression Mould, Transfer Mould, Blow Mould and Extrusion Dies.

UNIT I BASICS OF MOULD DESIGN & INJECTION MOULDS 13

Mould Design: Introduction to Molding process and Moulds – Classification of moulds- Factors considered for Mould Design-Shot Capacity-Plasticizing Rate-Clamping Force- Injection Time – Cooling Time - Number of Cavities –Layout of Cavities.

Injection moulds: Classification - Cold Runner – Hot Runner – Hand – Semi Automatic – Automatic -Two plate - Three Plate – Moulds for Internal & External Undercuts- Elements of Injection Mould - Parting surface and its types , Core, Cavity , Bolsters , Guide pillar, Guide bush, Sprue bush, Locating Ring -Standard Mould System – Mould alignment – Mould Assembly – Mould Clamping.

UNIT II DESIGN OF FEED & EJECTION SYSTEM 8

Feed System: Sprue – types of sprue – Runner – types of runner - cross section and size of runner –runner layout – balancing of runners – Gates - Gate location and balancing - types of gates – Mould Venting.

Ejection System: Requirements – Elements of Ejection system - Ejector grid, Ejector plate assembly, Ejection techniques – Ejection from fixed half - Sprue Pullers- Ejection Force Calculation - Ejection Assembly Actuation

UNIT III DESIOGN OF MOULD TEMPERATURE CONTROL SYSTEM 6

Introduction -Heat Transfer Fluids- Chillers- Temperature Controllers- Factors affecting the Cooling Cycle -Cooling Efficiency - Mould Cooling Variables -Cooling Calculations -Cooling of Integer type mould plates - Cooling of Insert Bolster assembly -cooling of other mould parts- connections of cooling channels and seals.

UNIT IV DESIGN OF COMPRESSION & TRANSFER MOULD 8

Compression Mould Design: Introduction -Types -Open flash, Semi-positive, Positive moulds- Bulk factor - Design of loading chambers and Pressure pad - Calculations of Flash thickness, Projected area, Compression Pressure, Clamping Force, No. of impressions- Design of heating system -Advantages , Disadvantages and Applications Compression Mould.

Transfer Mould Design: Introduction -Types –Design of Pot and Plunger - Calculations of Projected area, Transfer Pressure, clamping force - Design of Pressure pad and Feed system - Advantages, Disadvantages and Applications of Transfer Mould

UNIT V DESIGN OF OTHER MOULDS & DIES 10

Blow Mould Design: Introduction- Types of blow moulds - Blow ratio - Parison design –Pinch off design - parting line - Mould cooling - Mould alignment- Advantages, Disadvantages and Applications

Rotational Mould Design: Introduction– Construction- Advantages, Disadvantages and Applications.

Extrusion Die Design: Principles of extrusion - construction of die - die geometry - die swell - die land design - sizing die -Advantages, Disadvantages and Applications.

TOTAL: 45 PERIODS

OUTCOMES:

Upon completion of this course,

- The students will understand the basics of Plastics mould design and also product design.
- They also acquire knowledge about various moulds for different processing techniques.

TEXT BOOKS:

1. Peter Jones, The Mould Design Guide, Smithers Rapra Technology Limited, 2008, Shawbury, Shrewsbury, Shropshire, SY4 4NR, UK
2. Injection Mould Design for Thermoplastic - By Pye, R.G.W.,2000.

REFERENCES:

1. Injection Mould Design Fundamentals (Vol. I& II) - By Glanvill & Denton
2. Plastics Moulds & Dies - By Sors et al., Second Edition
3. Fundamentals of plastics mould design – By Sanjay K Nayak, Pratap Chandra Padhi and Y. Hidayathullah, 2012.

4. Injection Moulds 130 Proven Design Gastrow., 2006.
5. Dym J.B Injection Mould& Molding A practical manual, Springer, Second Edition.

PL8602 CAD/CAM/CAE FOR PLASTICS ENGINEERING L T P C
3 0 0 3

OBJECTIVES:

To enable the students

- To provide an overview of how computers are being used in Design of Plastic Component, Manufacturing of Tool and Analysis of mould flow.
- To develop the knowledge of computer aided manufacturing.

UNIT I COMPUTER GRAPHICS 9

Fundamentals: Output primitives (Points, lines, curves, etc.,) - 2-D and 3D Transformations- Homogeneous Coordinates- Windowing, Viewing and clipping transformation- Introduction to curves- Analytical Curves- Circle and conics- Synthetic Curves - Bezier and B-spline curves.

Graphics Standards: Standards for computer graphics- Graphical Kernel System (GKS) - standards for exchange images- Open Graphics Library (OpenGL) - Data exchange standards - IGES, STEP, CALS etc. - Communication standards

UNIT II SURFACE MODELING AND SOLID MODELING 9

Surface modeling: Bezier and B-Spline surface- Bi- linear surface- Boundary Representation- Sweep representation.

Solid modeling: Primitives- Boolean set operations- Boundary Representation - Constructive Solid Geometry, User interface for solid modeling, Introduction to Parametric and Variation modeling, Creation of prismatic and lofted parts based on software packages.

Assembly Modeling: Assembly of parts, Tolerance analysis, Mass property calculations, and Interference Checking

UNIT III COMPUTER AIDED MANUFACTURING 8

Integrating CAD with CAM - NC - CNC - DNC- NC programming – Basics, Languages, G Codes & M Codes and APT – Part programming for CNC Turning Center and CNC Machining Center- CAM software packages –Tool Path generation and verification.

UNIT IV CAE – STRUCTURAL ANALYSIS 10

FEA: Introduction to Finite Element Analysis - Types of analysis - Procedure for finite element analysis – Mesh generation - Finite Element Analysis packages and its application.

Structural Analysis: Types - Analysis of One Dimensional Bar elements- Derivation of Shape function and Stiffness matrix and force vector – Assembly of matrix – Field problems.

UNIT V CAE – FLOW ANALYSIS 9

Mold Flow Analysis: Introduction - Product design and Mold flow - Sequence of analysis- Mold flow concepts- Meshes used in Mold flow analysis- Types, Requirement- Geometry Creation- Importing Geometry- 3D Modelling using MF/view- Mold flow design procedure- Analysis steps framework- Evaluate an Initial design- optimized the design-

Types of Analysis: Flow analysis- Cooling analysis - Shrink/Warp analysis - Stress analysis- Case studies – Interpretation of results - Part defects

TOTAL: 45 PERIODS

OUTCOMES:

- Upon completion of this course, the students will acquire the knowledge of computer aided design and manufacturing for moulds for plastics processing.
- Knowledge on various CNC machining processes used in Mould manufacturing.
- They also learn about various types of analysis involved in Mould flow.

TEXT BOOK:

1. Ibrahim Zeid “Mastering CAD CAM” Tata McGraw-Hill Publishing Co., 2007

REFERENCES:

1. Chris McMahon and Jimmie Browne “CAD/CAM Principles", "Practice and Manufacturing management “ Second Edition, Pearson Education.
2. P.RadhaKrishnan, S.Subramanyan, V.Raju, “CAD/CAM/CIM”, Third Edition, New Age International Publisher
3. Donald Hearn and M. Pauline Baker “Computer Graphics”'. Prentice Hall, Inc, 1992.
4. Rao P N, Tiwari N K, Kundra T, “Computer Aided Manufacturing” Tata McGraw Hill 2014.
5. Seshu.P, “Text book of Finite Element Analysis” PHI learning Private limited, 2008.
6. Jay Shoemaker “Moldflow Design Guide: A Resource for Plastics Engineers”, Volume 10, Hanser, 2006

PL8603 PLASTICS TESTING II L T P C
3 0 0 3

OBJECTIVES:

- To impart knowledge of National & International standards for testing methods.
- To create the knowledge about the different testing techniques and its basic concepts for evaluating the chemical, mechanical, electrical, optical, thermal, and permanence of plastic materials.
- To enable the students to identify and compare the properties of different plastics materials.
- To enable the students to learn about the property of the plastic material for several applications.

UNIT I TESTING OF MECHANICAL AND PERMANANCE PROPERTIES 9

Mechanical Properties: Fatigue properties-burst strength- folding endurance, Compression set, Long term mechanical properties: -creep & Stress relaxation. Permanence Properties: Water absorption-soluble and insoluble matter-chemical resistance- environmental stress cracking resistance-ageing-gas permeability-water vapour permeability.

UNIT II TESTING OF THERMAL AND WEATHERING PROPERTIES 9

Thermal Properties: Thermal endurance, thermal stability, thermal ageing, glass transition temperature, Marten’s heat resistance test, flexibility test, shrinkage. Weathering properties-Weather and Climatic impact on properties of plastics-UV-A and UV-B weathering- Accelerated weathering-Xenon arc weatherometer.

UNIT III ANALYTICAL TECHNIQUES 9

Characterization Principles and analysis of polymer samples- FTIR, DSC, TGA, DMA, XRD, SEM, GPC,TMA, GC, AAS, TEM, XRF.

UNIT IV PRODUCT TESTING **9**

Product testing: Testing of plastics pipes, film, sheets, FRP, woven sack, Water bottles and containers, Electrical Conduits, emitters and laterals.

UNIT V FAILIURE ANALYSIS **9**

Failure analysis of products and its measurement techniques Concepts of non-destructive testing.

TOTAL: 45 PERIODS

OUTCOMES:

Upon completion of this course,

- Students will learn how the plastics materials are tested for its chemical, mechanical, electrical, optical, thermal, and permanence properties.
- Students will be able to identify the plastic materials for some specified applications based on its property.

TEXT BOOKS:

1. Allen; W.S and Baker; P.N, Hand Book of Plastics Technology, Volume 2, Identification,
2. Testing & Recycling of Plastics, CBS Publishers and distributors, New Delhi (2004).
3. Brown; Roger P (Ed.), Hand Book of Polymer Testing, Marcel Dekker, Inc, New York (1999).

REFERENCES:

1. Brown; Paul F (Ed), Hand Book of Plastics Test Methods, Longman Scientific and Technical, Harlow (1988).
2. Shah, Vishnu, Hand Book of Plastics Testing Technology, John Wiley and Sons, SPE Monograph (1984).
3. Blythe; A. R., Electrical Properties of Polymers, Cambridge University Press, Cambridge (1979).

PL8604 PLASTICS PROCESSING TECHNOLOGY II **L T P C**

3 0 0 3

OBJECTIVES:

To enable the students

- To understand the processing techniques like thermoforming, calendaring, and rotational moulding.
- To learn the manufacturing of cellular plastics.
- To learn the basic of machining and joining of plastics by various adhesion and welding techniques.

UNIT I THERMOFORMING AND CALENDERING **9**

Basic principles –Raw materials & types of thermoforming processes, Thermoforming moulds-processing parameters—faults, causes and remedies. Calendering - Principle and process description, types of calender units 2, 3 and 4 rolled calenders, Design of calender roll, Heating and temp control, roll crown, roll crossing and roll bending, materials for calendering, calendering sheets and films, embossing, coating and lamination by calender, comparison between calendering and extrusion.

UNIT II FRP & LAMINATES **9**

Introduction, FRP Processing methods-contact moulding-hand lay up, Spray up method-vacuum bag & pressure bag moulding, Autoclave- filament winding, Centrifugal casting, pultrusion,

pulforming matched die moulding – Laminates, definition of terms-high, medium and low pressure laminating process, types of machinery, impregnation systems – decorative and industrial laminates, continuous high pressure laminating process, application.

UNIT III CELLULAR PLASTICS 9

Introduction-process to create foam in resins-mechanical foaming, chemical foaming, physical foaming-processes to shape and solidify foams – low Pressure foam moulding, high pressure foam moulding, RIM Casting foams, steam chest moulding structural foam moulding–applications – Foamed extrusion.

UNIT IV ROTATIONAL MOULDING, CASTING AND COATING PROCESS 9

Rotational moulding - Introduction-principle-process-machinery used-materials-moulds process parameters-merits & demerits of roto moulding.

Casting Processes - Introduction – casting processes viz: Mould casting, Embedding /potting, Encapsulation –Dip casting-slush casting Roto casting, cell casting, static powder casting, continuous casting, solvent casting, operation and control of above casting processes plastisol processing.

Coating Process - Introduction-Roller coating methods, powder coating-fluidized bed coating, Electro static spray coating-Equipment, process and applications.

UNIT V POST MOULDING / SECONDARY PROCESS ON PLASTICS PRODUCTS 9

Introduction-Importance of machining – methods viz; cutting, drilling, blending, filling etc., joining-principles-cohesion principle, adhesion principle – solvent cementing. Dop cementing, welding of plastics-viz high frequency welding thermal sealing, spin welding, vibration welding, hot plate welding, ultrasonic welding, Adhesive bonding-examples: Mechanical fasteners- Printing, painting, Hot stamping, In mould decoration, Electro plating and vacuum metalizing.

TOTAL: 45 PERIODS

OUTCOMES:

Upon completion of this course,

- The students will acquire the knowledge of specific processing techniques such as thermoforming, calendaring, and rotational moulding.
- They also learn the machining and joining of plastic materials.

TEXT BOOKS:

1. Development in Injection Molding - By Whelan, A & Craft, J.L.
2. Technician’s Hand Book & Plastics - By Grandilli, P.A.,1981.

REFERENCES:

1. Plastics Materials & Processing - By Schwartz & Goodman.,1982.
2. Innovation in Polymer Processing - By Stevenson.,1996.
3. Thermoforming - By James & Throne.,2013.
4. Basic Principle of rotational molding - By Crawford, R.J & Throne, J.L.
5. Basic Principle of Rotational Molding - By Bruins.
6. Basic Principle of Thermoforming - By Brycle, D.M

PL8605 **RUBBER TECHNOLOGY** **L T P C**
3 0 0 3

OBJECTIVES:

- To provide the students with basic knowledge on the natural rubber and various synthetic rubbers and their processing.
- To enable the students to understand the need of various additives and compounding of rubbers and vulcanization.
- To enable the students to learn the basic processing of rubber products like hose conveyor belts etc.

UNIT I NATURAL RUBBER **9**

Tapping latex, Processing of Latex - Dry rubber production (Smoked sheet, air dried sheet, Crepe etc.) - Grading of rubbers - Modified natural rubber, Reclaimed rubber - process of reclamation – applications.

UNIT II COMPOUNDING DESIGN AND VULCANIZATION **9**

Sulphur vulcanization and non-sulphur vulcanization, vulcanization systems - accelerators, activators, promoters, antioxidants, antiozonants, processing aids, fillers and effect of fillers, Blowing agents etc.

UNIT III SYNTHETIC ELASTOMERS **9**

Manufacturing, structure, properties, compounding, curing and applications - Polyisoprene, Polybutadiene, SBR, EPDM, Butyl rubber, Neoprene, Nitrile rubber, Silicone rubber, Fluoroelastomer, Polysulphide rubber, polyurethane rubber, Acrylic rubber.

UNIT IV THERMOPLASTIC ELASTOMERS **9**

Basic structure, Manufacture, Morphology, Commercial grades and Applications – Thermoplastic styrene block copolymers, Polyester thermoplastic elastomers, polyamide thermoplastic elastomer, Polyurethane thermoplastic elastomers.

UNIT V RUBBER PRODUCT MANUFACTURING **9**

Manufacturing of Belting, Hoses, Footwear, Rubber metal bonded items, sports goods, cellular rubber, tyres etc.

TOTAL: 45 PERIODS

OUTCOMES:

- Upon completion of this course, the students will acquire the knowledge of natural rubber and other synthetic elastomers.
- They learn the basics of rubber compounding and vulcanization and rubber products manufacturing.

TEXT BOOKS:

C.M.Blow and Hepburn, - Rubber Technology and Manufacture, 2nd edition, 1982.
Hoffman, Rubber Technology Handbook -, Hanser Pub. Munich - 1996

REFERENCES:

1. Anil .K. Bhowmic, Howard L. Stephens (Edt), Handbook of Elastomers - New Developments & Technology, Marcel Decker Inc. New York 1988.
2. Maurice Morton, Rubber Technology.,1998.

PL8611 PLASTICS PROCESSING LABORATORY- II L T P C
0 0 4 2

OBJECTIVE:

- To practice the students in different types of semi auto / automatic moulding machines.

S. N.	Name of M/c / Equipment/ Mould	Description of Practical Exercise to be done
1	Automatic Injection Moulding M/C	Idle-run observation (IRO) & study of Injection Unit, Clamping Unit, Process- Control knobs, safety precautions, start-up Procedure, Shut-down Procedure, Sketch of Machine Platens, Clamping system, type of nozzle used in M/c etc., study of Hydraulic System used in the M/c. M/c Operation- Practice, Process parameter setting for a particular mould on the Machine, Operation of Machine in Hand, Semi Automatic & Automatic- mode to produce components, observations of all parameters, cycle-time analysis, use of different plastics material for moulding & comparison, Moulding faults analysis for causes and remedies.
2	Micro-Processor Controlled Injection Moulding M/C	Study of Basic concepts of Micro processor control, Comparison of Micro Processor- Controlled M/cs with Conventional M/Cs, Machine Setting Procedure, Procedure for Process-Parameter setting on monitor or control Panel. Operation of M/c with Mould fixing & setting on the M/c with different plastics materials, cycle- time analysis, Analysis of Product defects, causes & remedies during M/c operation, listing of important operating procedure points, safety precautions through M/C Instruction/Manual operating.
3	Extrusion Process on Blown Film Extruder Pipe/Tube Extruder	Procedure for setting up of Process-parameters eg. Temperature on different zones, Screw-Speed, Nip-roller speed, Winder Speed, Blow-ratio, control of cooling-Air on bubble, Methodology & practice by trainees to fix the Blown Film die on M/C familiarization of Die-parts & their function, Technical specification of M/cs, defects, causes & remedies, Practice of operating M/c to produce different sizes of Blown Film. Study of the Machine-parts & function from Screw drive to the Cater pillar. Practice of Die setting on the machine, sizing techniques, Procedure for setting up of parameters & operation practice in running the Machine to produce pipe/ Tube/ film.
4	Compression & Transfer Moulding (Semi-Automatic)	Setting up procedure for operation of M/c, safety precautions, Type of Mould Clamping arrangement available on M/c- Platen, Mould Clamping procedure on M/c, Operation of M/c by setting the optimum Temperature, curing time, clamping force, ejector- stroke etc. on continuous basis, Analysis of Product defects & remedies, Analysis of Cycle-time, Practice on operation of compression & Transfer moulds with thermoset
5	Automatic Blow Moulding Machine	Machine-setting Procedure, Parameter-setting Procedure, Method of Mould fixing &parison-die setting on the M/c, Practice by trainees to remove& fix the parison die to produce on appropriate Parison for blowing, type of blowing systems, operation-practice on different moulds, cycle-time analysis, process-faults & remedies.
6	Thermoforming	Study of Process Principle, type of moulds & material used,

	(Vacuum forming)	Familiarisation with the M/c controls for operation, Operation Practice by trainee, observation on Cycle-time, processing- defects & remedies
7	Rotational Moulding	Machine study in IRO, Process Principle & sequence Of operation, Raw materials used, Mould-clamping practice on the M/c, operation practice to produce Roto moulded components, Cycle-time analysis, Comparison of process with other processing processes.
8	Plastics-coating. Sealing, Welding & Screen-Printing	Principle of coating equipments, Process-method, type of material used, sequence of Operation in Coating. Principle of Operation of Heat-Sealing equipments, High frequency Welding & Hot stamping operation. Familiarisation of screen printing process, methodology for screen preparation, type of inks used
9	Moulds Study	Study of different types of moulds injection moulds, Mould maintenance & storage
10	FRP Demonstration Facility	Study of types of Resin, fibres used in the process, sequence of Process operation in Hand-lay up process, operation Practice for Hand-lay up Process for producing FRP-products, Precautions during the process, Process-defects & analysis for the remedies.
11	Maintenance Work on Processing M/cs	Practical exposure to the preventive maintenance checkpoints for all processing M/cs. Daily startup and shut down maintenance checks, housekeeping checking hydraulics and electrical circuit for safety, routine faults and remedies.

TOTAL: 60 PERIODS

OUTCOME:

- Upon completing this practical course, the student will have hands on experience on different types of automatic & Semiautomatic moulding machines

PL8612 PLASTICS TESTING LABORATORY I L T P C
0 0 4 2

OBJECTIVE:

- To train the students on testing of plastic materials

LIST OF EXPERIMENTS

S. No.	EXPERIMENT
1.	Preparation of test specimen using Injection moulding, Contour cutting, and Contour punching.
2.	Determination of Rate of flow of plastics (Melt flow index)
3.	Determination of Tensile Properties of rigid & flexible plastic materials
4.	Determine the flexural properties of rigid Plastic materials
5.	Determine the compressive strength of rigid plastics and polymeric foams.
6.	Determine the compression set for rubber materials
7.	Determine the hardness (Shore A & D, Barcol and Rockwell) of plastic materials
8.	Determine the abrasion resistance of Plastic materials
9.	Determine the impact strength (Izod and Charpy) of Plastic materials
10.	Determine the Density, moisture content and water absorption for plastic materials.

TOTAL: 60 PERIODS

OUTCOMES:

Upon completion of this course, the students would be able to

- Determine important properties of plastic materials
- Prepare specimen by injection moulding and contour cutting

TEXT BOOKS:

1. Vishu Shah, Hand Book of Plastics Testing Technology, John Wiley & Sons. Inc.New York, 1998.
2. R.P. Brown, Hand Book of Plastics Test Methods, George Godwin Ltd., London,1981

REFERENCES:

1. ASTM test standards for plastics Vol.8.01 to 8.04, 9.01 & 9.02, 2002.
2. ISO test standards, 1998.
3. J.S. Anand, K. Ramamurthy, K. Palanivelu& C. Brahatheeswaran, How to Identify Plastics by Simple Methods, 1997.

LIST OF EQUIPMENT FOR BATCH OF 30 STUDENTS

S. No.	Name of the Equipment	Quantity Required
1	Melt Flow Index Tester	**1**
2	Universal testing machine	**1**
3	Tear strength tester	**1**
4	Impact strength tester	**1**
5	Dart Impact tester for Films and laminates	**1**
6	Shore A – Hardness tester	**1**
7	Shore D – Hardness tester	**1**
8	Rockwell Hardness tester	**1**
9	Barcol Hardness tester	**1**
10	Q-UV weatherometer	**1**
For specimen preparation		
11	Melt Flow Index Tester	**1**
12	Injection moulding machine	**1**
13	Compression moulding machine	**1**
14	Two roll mill	**1**
15	Contour cutter	**1**

PT8751 **POLYMER COMPOSITES** **L T P C**
3 0 0 3

OBJECTIVES:

- To enable the students to understand the basic materials in FRP system.
- To understand the raw materials for matrix resins and reinforcements.
- To acquire knowledge about various processing methods of composites
- To understand the post processing operations, various applications of composites
- To understand the various testing of FRP materials

UNIT I REINFORCEMENTS FOR COMPOSITES 9

Composites- classifications - metal matrix composites, ceramic matrix composites, Polymer Composites- general properties and applications- Reinforcements: Properties and applications of - various types of glass fiber, carbon fibers, aramid fibers, boron fibers, natural fibers.

UNIT II GENERAL PURPOSE RESINS 9

Methods of manufacturing- properties, curing characteristics and applications of unsaturated polyesters - vinyl ester -phenol formaldehyde resin-urea formaldehyde resin-melamine formaldehyde resin.

UNIT III SPECIAL PURPOSE THERMOSETS 9

Methods of manufacturing, properties, curing characteristic and applications of epoxy resins, Polyimide, Thermoset polyurethanes and Cyanate esters resins.

UNIT IV PROCESSING OF COMPOSITES 9

Composites Processing techniques - Hand Lay-Up, Spray- Up, Bag Molding, Resin Transfer Molding (RTM), Filament Winding, Pultrusion, Prepregs, SMC, DMC.

UNIT V LAMINATES & TESTING OF COMPOSITES 9

Mechanics of composites-Fracture and damage mechanics - laminates –delamination - Measurement of physical and mechanical properties: density-fibre volume fraction-void content, test for tensile-compression- flexural in fiber direction –Non- Destructive Evaluation Methods for Composites – Visual Inspection, Ultrasonic Methods, X-Ray Imaging.

TOTAL: 45 PERIODS

OUTCOMES:

Upon completing this course, the students

- Will familiarize about the resins used in FRP system
- Will attain the knowledge of reinforcement mechanism
- Will able to understand the processing methods of composites
- Will attain the knowledge post processing operations of composites
- Will develop the knowledge in testing of composites

TEXT BOOKS:

1. J.A.Brydson, "Plastics materials", Butterworth- Heinemann - Oxford, 6th Ed., 1995.

2. S.T.Peters, “Handbook of Composites”, Chapmun& hall, 2nd Edition 1998.

REFERENCES:

1. G Lubin, “Hand Book of Composites”, 2nd Ed, Van Nostrand Reinhold, New York, 1982.
2. F.L. Matthews and R.D. Rawlings, 'Composite materials: engineering and science', Chapman and Hall, 1994.
3. P.K. Mallick, 'Composites Engineering Handbook', Marcel Dekker Inc.NY., 1997.
4. D. Hull and T. W. Clyne, "An introduction to Composite Materials 2nd Ed", Cambridge, 1996

PL8701 PLASTICS PRODUCT DESIGN L T P C

3 0 0 3

OBJECTIVES:

To enable the students

- To understand the concepts and features of Plastic Product design.

- To learn the basic concepts of designing with plastics for various loading applications, structural elements and joints.
- To understand the concepts of composite product design.

UNIT I PRODUCT DESIGN REQUIREMENT 9

Introduction to Product Design – Principles & Methodical approach for Product Design – Design Process – Material selection – Process selection – Safety Factors in Product Design- – Product Design Appraisal- Geometric Dimensioning and Tolerances on Product-Product Design criteria – Structural, Environmental, Assembly, Aesthetics & Decoration- Design for Manufacture & Assembly (DFMA)- Tooling Aspects on Product Design – Cost Analysis for Product Design

UNIT II PRODUCT DESIGN FEATURES 9

Wall thickness – variations in wall thickness – suggested wall thickness for various plastics materials – Taper & Draft – Design of radii, fillets, ribs and bosses- Shrinkage - Fits & Tolerances- External & Internal Undercuts

UNIT III HOLES & THREADS 9

Moulded Holes & its types - Drilled and tapped holes- Hinges – Types - Design of Integral hinges. Moulded threads – thread types- Inserts – materials – selection of metal for inserts –location of inserts in the part – moulded inserts – pressed in inserts.

UNIT IV ASSEMBLY FEATURES 9

Part Consolidation-Mechanical Fasteners- Snap Fits Joints- Snap Fit Theory, Annular and Torsional Snap fits, Assembly Procedures and Issues with Snap Fits- Welding -Ultrasonic Welding, Vibration and Hot-Plate Welding, Spin Welding- Bonding - Solvent and Adhesive Bonding-Retention Features-Alignment Features- Orientation-Expansion Differences- Tolerances – Introduction to In-mould Assembly.

UNIT V DESIGN FOR COMPOSITES 9

Design Criteria for Composites- Cost, Size, Mechanical Properties, Repeatability and Precision, Damage Tolerance and Durability, Environmental Constraints - Design allowables- Need for Design allowables- development of design allowables- Important factors that affect the selection of allowables - Specific techniques used in the statistical development of allowable values.

TOTAL: 45 PERIODS

OUTCOMES:

- Students will acquire the knowledge and principles of basic product design
- Students can able to design the plastics for various applications.

TEXT BOOKS:

1. Robert A. Malloy, “Plastic Part Design for Injection Moulding”, Hanser Publishers, Munich Vienna, New York, 1994.
2. R.D.Beck “Plastics Product Design”, Van Nostrand Reinhold, New York,1980

REFERENCES:

1. Belofsky, H, “Plastics Product Design and Processing Engineering, Hanser Publishers, Munich Vienna New York, 1994.
2. Sidney levy J. Harry Dubois, “Plastics Product Design Engineering Hand Book”, Second Edition, Chapman and Hall Ltd, 1984
3. Paul A. Tres, “Designing Plastic Parts for Assembly”, 2nd Revised Edition, Hanser Publishers, Munich Vienna New York, 1994

4. Alfredo Campo E. “The Complete Part Design Handbook for Injection Molding of Thermoplastics”, Hanser Publishers, Munich, 2006
5. Daniel B. Miracle and Steven L. Donaldson “Composites” Volume 21, ASM Handbook,ASM International, 2001.
6. P.K. Mallick, “Fiber-Reinforced Composites: Materials, Manufacturing, and Design”, Third Edition, CRC Press 2007

PL8702 ADVANCED PLASTICS AND SPECIALITY POLYMERS L T P C
3 0 0 3

OBJECTIVES:

To enable the students

- To learn about the general methods of preparation of individual class of advanced plastic Materials
- To study about the general properties, processing behavior and applications of different class of advanced plastic and polymeric materials
- To understand about the structure- property relation of different class of plastic materials

UNIT I THERMOPLASTIC ELASTOMERS 9

Polyurethane elastomers, polyolefin elastomers, polyester elastomers styrene elastomers, polyamide elastomers, elastomer- thermoplastic blends, dynamic vulcanisites.

UNIT II SPECIALITY POLYMERS 9

PEEK, polyimides, PAI & Ionomer, Liquid Crystalline polymers, Metallocene Polymers. High tech-areas for applications of plastics. High & Low Temperature Polymers. Interpenetrating Polymers Networks. Ultra-high modulus fibres, Polymeric foams.

UNIT III POLYMER BLENDS AND ALLOYS 9

Definition, advantages of polymers, blends and alloys, role of composition, properties and applications of parameters for compatibility, PVC – Nitrile rubber, ABS-PVC and PP-EPDM.

UNIT IV FILLED POLYMERS 9

Polyolephines, Nylons & Polycarbonates with fillers like Glass, Mica, Talc, $CaCO_3$, etc Polymer Concretes & Advanced ceramic

UNIT V SPECIALITY POLYMERS 9

Preleminary concepts of new materials such as electrically active polymers, Optoelectronic plastics, Bio-polymers, membrane plastics in bio medical applications.

TOTAL: 45 PERIODS

OUTCOMES:

Students gather knowledge on various methods of preparation of different plastic materials.

- They also understand about the properties of speciality polymers based on the structure.
- They learn about various processing techniques suitable for particular end use applications.
- They can also select the individual advanced plastic materials based on end use applications.

TEXT BOOKS:

1. Plastic Materials Ed 7 - By Brydson, J A.,1999.

2. Hand Book of Plastics Materials & Technology - By Rubin, Irwin, J,1990

REFERENCES:

1. Plastics Engineering Hand Book Ed. 5 & Society of the Plastic Industry Inc - By SPI.,1991.
2. Plastics Materials (Properties & Application) - By Birley & Scott.,1982.
3. Modern Plastics Hand Book - By Harper.,2000.
4. Biron; Michel, Thermoplastics and Thermoplastic Composites: Technical Information for Plastics Users, Elsevier, Amsterdam, 2007.
5. Davidson; Theodore, Polymers in Electronics, ACS Symposium Series 242, American

PL8711 PLASTICS TESTING LABORATORY- II L T P C
0 0 4 2

OBJECTIVES:

- To understand the mechanical and electrical properties of plastics
- To familiarize with various testing standards

LIST OF EXPERIMENTS

S. No.	Experiment
1.	Preparation of polymer blends using twin screw extruder, and preparation of test specimens.
2.	Preparation of polymer compounds using two roll milling and preparation of test specimens.
3.	Testing of electrical properties of plastics a) Arc resistance b) Surface and Volume resistance c) Comparative tracking index (CTI) d) Dielectric strength e) Dielectric constant and dissipation factor
4.	Testing of HDPE and UPVC pipes as per IS:4984 and IS:4985
5.	Testing of LDPE Films as per IS: 2508
6.	Testing of HDPE/PP Woven Sacks and tapes as per IS:14887 and IS:11197
7.	Testing of roto moulded Water Storage Tanks as per IS 12701
8.	Testing of Plastic pouches as per IS 15609

TOTAL: 60 PERIODS

OUTCOMES:

Upon completion of this lab student should able to

- Carry out testing independently
- Understand the operating procedure of various testing machines

TEXT BOOKS:

1. Vishu Shah, Hand Book of Plastics Testing Technology, John Wiley & Sons. Inc.New York, 1998.
2. R.P. Brown, Hand Book of Plastics Test Methods, George Godwin Ltd., London,1981

REFERENCES:

1. ASTM test standards for plastics Vol.8.01 to 8.04, 9.01 & 9.02, 2002.
2. ISO test standards, 1998.
3. J.S. Anand, K. Ramamurthy, K. Palanivelu& C. Brahatheeswaran, How to Identify Plastics by Simple Methods, 1997.

Equipment required

Mechanical and Product Testing		
1.	Universal testing machine	**1**
2.	Tear strength tester	**1**
3.	Impact strength tester	**1**
4.	Abrasion resistance tester	**1**
5.	Burst strength tester	**1**
6.	Humidity chamber	**1**
7.	Gas permeability tester	**1**
8.	Hydrostatic bursting pressure tester	**1**
9.	Reversion tester	**1**
10.	Falling Dart Impact Tester for films and Pipes	**1**
Electrical and Optical Properties		
11.	Volume and Surface resistivity	**1**
12.	Dielectric strength	**1**
13.	Arc Resistance	**1**
14.	Haze meter	**1**

PL8712 **CAD/CAM/CAE LABORATORY** **L T P C**
0 0 4 2

OBJECTIVE:

- To practice the students in Computer Aided Design, Manufacturing and Engineering software for mould design

LIST OF EXPERIMENTS

I. Mold Design using CAD

a) Injection Mould design

Design calculations for No. of cavities, Selection of injection moulding machine, shot capacity, plasticizing rate, Clamping force and 2 D / 3 D Modeling for Two plate, Three Plate and split Moulds

b) Compression Mould Design

Design calculations for No. of cavities, Flash thickness allowances, Design of loading chamber, Bulk factor, Pressure pad, Heaters and 2 D / 3 D Modeling for Compression Mould.

c) Transfer Mould Design

Design calculations for Pot, Bulk factor, Heaters and 2 D / 3 D Modeling for Pot and Plunger transfer Moulds.

d) Blow Mould Design

Design calculations for Clamping force, pinch-off, Head die design, Parison dimensions and 2 D / 3 D Modeling for Blow Mould.

II CAM Programming

Programming and Machining of mould elements (Core,Cavity, Gide Pillar and Guide Bush) using CNC Turning Center and CNC Machining Center.

III Mould flow Analysis

Design Optimization of Plastic Part,Mouldand Process parameters optimization using Moldflow Software

- Modeling, Mesh Creation, Mesh Checking, Surface repair , Creating Feed system and cooling system.
- Analysis: Gate location, Molding window Fill, Flow, Cool, Pack, Warp, Shrinkage, Stress

TOTAL: 60 PERIODS

OUTCOME:

- At the end of this course, the students can design and develop the moulds using CAD/ CAM/CAE softwares

LIST OF EQUIPMENT FOR BATCH OF 30 STUDENTS

S. No.	Description	Qty.
1	Computer Systems	30 Nos.
2	2 D & 3D Modeling Software	30 Licenses
3	Flow Simulation software	30 Licenses
4	CNC Turning Center	2 Nos.
5	CNC Machining Center	2 Nos.
6	Printer	1 No.

.

REFERENCES:

1. R.G.W.Pye, Injection Mould Design, SPE Publication.
2. P.S.Cracknell and R.W.Dyson, Hand Book of thermoplastics injection mould design, Chapman & Hall, 1993.
3. Herbert Rees, Mould Engineering, Hanser publishers, Munich, Vienna N.Y. 1994.
4. Technical Directory on Design and Tooling for plastics, CIPET, Guindy, Chennai.
5. Design calculations for Compression moulds, Machinery publications, Yellow series, U.K.
6. Mould Flow Manual & Part - Adviser Manual - MOULD FLOW.
7. LaszcoSors and ImreBlazs, Design of Plastic Moulds and Dies, Elsevier, Amsterdam - Oxford - Tokyo - NY, 1989.
8. Jay Shoemaker “Moldflow Design Guide: A Resource for Plastics Engineers”, Volume 10, Hanser, 2006

PL8713 COMPREHENSION L T P C

0 0 2 1

In the VII Semester a comprehension test will be conducted with at least one written test in the middle of the Semester with Objective type of questions and a terminal viva-voce test in order to evaluate the comprehension of the students in all the subjects covered in the all previous semester subjects.

PL8811 **PROJECT WORK** **L T P C**
0 0 20 10

Each student will be assigned a project involving some design and fabrication work as well as theoretical and experimental studies on issues related to Polymer Technology. Continuous internal assessment marks for the project will be given during project review meeting. The student has to prepare and present a detailed project report at the end of the semester and give a presentation about the work done. End semester examination mark will be based on viva voce examination.

PT8073 **PLASTICS PACKAGING TECHNOLOGY** **L T P C**
3 0 0 3

OBJECTIVES:

- To study about the functions of packaging.
- To enable the students to understand the concepts testing of packaging material.
- To know about the different packaging materials like cans, bottles, flexible films etc.
- To study about the various methods of packaging to improve the shelf life of the products.
- To learn about the testing of packaging.

UNIT I SELECTION CRITERIA FOR PACKAGING MATERIALS 9

Introduction to plastics packaging: functions of packaging, advantages of plastic packaging, special requirements of food and medical packaging,. Packaging as a system: Elements, approach, package, design, relation criteria for packaging materials, packaging equipment checklist, case histories Major packaging plastics Introduction - PE, PP, PS, PVC, polyesters, PVA, EVA, PA, PC, ionomers & fluoro polymers.

UNIT II CONVERSION PROCESS FOR PACKAGING MATERIALS 9

Conversion process - Compression & transfer for moulding, Injection moulding, Blow moulding, Extrusion, roto moulding, thermoforming, Lamination, metallizing, decoration process, Shrink wrapping, Pallet & stretch wrapping

UNIT III PROCESS FOR FLEXIBLE PACKAGING 9

Extrusion, film and flexible packaging - extrusion, cast film & sheet, Blown film, Multi layer film & sheet coatings, coextrusions, pouching, sealing, evaluation of seals in flexible packages, advantages of flexible packaging - flexible packaging products.

UNIT IV PROCESSES FOR RIGID PACKAGING 9

Thermoformed, moulded and rigid packages, Thermoforming packages: Position & thermoforming & wrap forming, solid phase pressure forming, scrabbles, twin sheet & melt - to- mold thermoforming, skin packaging, Polystyrene & other foams systems cushioning, plastic pallets, drums , shipping containers.

UNIT V TESTING OF PLASTIC PACKAGING 9

Testing of plastic packages, Barrier, Migration & compatibility, Sterilization systems and health care products. Packaging hazards and their controls. Waste management act 2016.

TOTAL: 45 PERIODS

OUTCOMES:

Upon completing this course, the students

- will Apply and examine the knowledge of properties for selection of packaging materials

- will Select between different techniques of packaging
- Will familiarize in testing of plastic packaging

TEXT BOOKS:

1. Susan E.M. Seleke, “Understanding Plastic Packaging Technology”, Hanser publications - 1997
2. A.S. Altalye, “Plastics in Packaging”, Tata McGraw-Hill publishing Co. Ltd., New Delhi,1992.

REFERENCES:

1. Walter Soroka, ‘Fundamentals of Packing Technology’ Institute of Plastics Packaging, 1999.
2. Neil Farmer (Ed.) Trends in Packaging of Food, Beverages and Other Fast-Moving Consumer Goods, Wood Head Publishing India Pvt Ltd. 2013.

PT8072 FIBER TECHNOLOGY L T P C
3 0 0 3

OBJECTIVES:

To enable the students

- To learn about the production technologies of synthetic fibres such as melt spinning, wet spinning, dry spinning, texturing and stretching methods; colouration techniques of fibres.
- To learn about modification and testing fibre

UNITI CRITERIA FOR FIBRE FORMING POLYMERS 9

Development of synthetic - commercial synthetic fibres, Raw materials manufacture. DMT, TPA, MEG, caprolactum, adipic acid, hexamethylene diamine, acrylonitrile, polymerisation - types of polymers - criteria for fibre forming polymers - production of polyethylene terephthalate polymer - polyamides - production of nylon 66 polymer -nylon 6 polymer.

UNIT II FIBRE PRODUCTION METHODS-1 9

Production of acrylic fibres - polypropylene - production of other fibres - PVC fibres - PVA fibres - Aramid fibres - Melt spinning - Polymer feed - melt spinning equipment - high speed spinning - spin draw processes - crystallization method - melt spinning of PET & PP stable fibres - wet and dry spinning comparison. Spin finishes - functions of spin finish - methods of application of spin finish - spin finish for polyester staple fibres - spin finish for texturing process - effect of spin finish on dyeing.

UNIT III FIBRE DRAWING PROCESSES 9

Stretching or drawing - conditions of drawing - machines for draw warping - texturing -false twist process - draw texturing- staple fibre production, melt spinning - drawing, heat setting - crimping in fibre line - production of melt spin staple fibre - polyester tops for wool blending - Mass coloration and tow dyeing of polyester, nylon, acrylic -polypropylene - dyeing in loose fibre and yarn forms of polyester, nylon, acrylic, PP, other synthetic fibres - loose fibre dyeing.

UNITIV MODIFIED SYNTHETIC FIBRES 9

Modified synthetic fibres - modified polyester, Nylon, PP, acrylics - Hydrophilic -Hollow -Low pilling - flame retardant- bicomponent fibres - Dyeability of synthetic fibres

UNIT V TESTING OF YARN AND FIBRES 9

Quality control - testing raw material - testing polymers - testing yarns & fibres - waste utilisation of polyester - nylon 6 - 66 - acrylics - PP- Energy conservation - pollution control.

TOTAL: 45 PERIODS

OUTCOMES:

Upon completing this course, the students

- Will have knowledge of polymer used in fiber formation.
- Will demonstrate the processing techniques for fiber formation.
- Will able to prepare a fiber forming polymers
- Will able fiber stretching polymers
- Will attain the knowledge of testing of fiber.

TEXT BOOK:

1. A.A. Vaidya, Production of synthetic fibres, Prentice Hall of India Pvt. Ltd., New Delhi, 1988.

REFERENCES:

1. Fourne, Franz, “Synthetic Fibres, Machines and Equipment, Manufacture, Properties”, Hanser Publishes, 1999.
2. Corbman Bernard P., “Textiles: fibre to fabric”, Sixth Edition, McGraw Hill, 1983.

GE8071 DISASTER MANAGEMENT L T P C

3 0 0 3

OBJECTIVES:

- To provide students an exposure to disasters, their significance and types.
- To ensure that students begin to understand the relationship between vulnerability, disasters, disaster prevention and risk reduction
- To gain a preliminary understanding of approaches of Disaster Risk Reduction (DRR)
- To enhance awareness of institutional processes in the country and
- To develop rudimentary ability to respond to their surroundings with potential disaster response in areas where they live, with due sensitivity

UNIT I INTRODUCTION TO DISASTERS 9

Definition: Disaster, Hazard, Vulnerability, Resilience, Risks – Disasters: Types of disasters – Earthquake, Landslide, Flood, Drought, Fire etc - Classification, Causes, Impacts including social, economic, political, environmental, health, psychosocial, etc.- Differential impacts- in terms of caste, class, gender, age, location, disability - Global trends in disasters: urban disasters, pandemics, complex emergencies, Climate change- Dos and Don’ts during various types of Disasters.

UNIT II APPROACHES TO DISASTER RISK REDUCTION (DRR) 9

Disaster cycle - Phases, Culture of safety, prevention, mitigation and preparedness community based DRR, Structural- nonstructural measures, Roles and responsibilities of- community, Panchayati Raj

Institutions/Urban Local Bodies (PRIs/ULBs), States, Centre, and other stake-holders- Institutional Processes and Framework at State and Central Level- State Disaster Management Authority(SDMA) – Early Warning System – Advisories from Appropriate Agencies.

UNIT III INTER-RELATIONSHIP BETWEEN DISASTERS AND DEVELOPMENT 9

Factors affecting Vulnerabilities, differential impacts, impact of Development projects such as dams, embankments, changes in Land-use etc.- Climate Change Adaptation- IPCC Scenario and Scenarios in the context of India - Relevance of indigenous knowledge, appropriate technology and local resources.

UNIT IV DISASTER RISK MANAGEMENT IN INDIA 9

Hazard and Vulnerability profile of India, Components of Disaster Relief: Water, Food, Sanitation, Shelter, Health, Waste Management, Institutional arrangements (Mitigation, Response and Preparedness, Disaster Management Act and Policy - Other related policies, plans, programmes and legislation – Role of GIS and Information Technology Components in Preparedness, Risk Assessment, Response and Recovery Phases of Disaster – Disaster Damage Assessment.

UNIT V DISASTER MANAGEMENT: APPLICATIONS AND CASE STUDIES AND FIELD WORKS 9

Landslide Hazard Zonation: Case Studies, Earthquake Vulnerability Assessment of Buildings and Infrastructure: Case Studies, Drought Assessment: Case Studies, Coastal Flooding: Storm Surge Assessment, Floods: Fluvial and Pluvial Flooding: Case Studies; Forest Fire: Case Studies, Man Made disasters: Case Studies, Space Based Inputs for Disaster Mitigation and Management and field works related to disaster management.

TOTAL: 45 PERIODS

OUTCOMES:

The students will be able to

- Differentiate the types of disasters, causes and their impact on environment and society
- Assess vulnerability and various methods of risk reduction measures as well as mitigation.
- Draw the hazard and vulnerability profile of India, Scenarious in the Indian context, Disaster damage assessment and management.

TEXT BOOKS:

1. Singhal J.P. “Disaster Management”, Laxmi Publications, 2010. ISBN-10: 9380386427 ISBN-13: 978-9380386423
2. Tushar Bhattacharya, “Disaster Science and Management”, McGraw Hill India Education Pvt. Ltd., 2012. **ISBN-10:** 1259007367, **ISBN-13:** 978-1259007361]
3. Gupta Anil K, Sreeja S. Nair. Environmental Knowledge for Disaster Risk Management, NIDM, New Delhi, 2011
4. Kapur Anu Vulnerable India: A Geographical Study of Disasters, IIAS and Sage Publishers, New Delhi, 2010.

REFERENCES:

1. Govt. of India: Disaster Management Act , Government of India, New Delhi, 2005
2. Government of India, National Disaster Management Policy,2009.

PL8072 BIODEGRADABLE POLYMERS L T P C

3 0 0 3

OBJECTIVES:

- To enable the students to understand the method to develop biodegradable polymers
- To get knowledge on need of biodegradable polymer.
- To enrich various testing methods used for analyzing the biodegradability.

UNIT I CHEMISTRY AND BIOCHEMISTRY OF POLYMER DEGRADATION 9

Introduction, enzymes - enzyme nomenclature - enzyme specificity - physical factors affecting the activity of enzymes - enzyme mechanism, Chemical degradation initiates biodegradation, Hydrolysis of synthetic biodegradable polymers.

UNIT II PARTICULATE STARCH BASED PRODUCTS 9

Development of Technology, Current objectives, relative starch technology, Manufacture of master batch, Conversion technology - processing precautions - moisture and temperature - rheological considerations, cyclic conversion process, physical properties of products - sample preparation - physical testing methods

UNIT III BIOPOLYESTERS 9

Introduction, History, biosynthesis, Isolation - solvent extraction - sodium hypo chloride digestion, enzymatic digestion, Properties - crystal structure - nascent morphology, degradation-Intracellular biodegradation - extra cellular biodegradation - thermal degradation - hydrolytic degradation - environmental degradation -

UNIT IV RECYCLING TECHNOLOGY FOR BIODEGRADABLE PLASTICS 9

Introduction, conventional recycling - recycling problems, degradable complicate recycling - polyethylene/starch film, reprocessing polyethylene/cornstarch film scrap - learning to reprocess PE/S - Calcium oxide moisture scavenger -temperature control - accounting for pro-oxidant - handling PE/S repro - economics of in-plant recycling, Using PE/S repro – comparative study of PE/S repro on film properties, recycling other degradables.

UNIT V TEST METHODS & STANDARDS FOR BIODEGRADABLE PLASTICS 9

Introduction, defining biodegradability, criteria used in the evaluation of biodegradable polymers, choosing the most appropriate methodology, description of current test methods -screening test for ready biodegradability, tests for inherent biodegradability, tests for simulation studies, - petri dish screen -environmental chamber method - soil burial tests

TOTAL: 45 PERIODS

OUTCOMES:

Upon completing this course, the students

- Will develop biodegradable polymer by various methods.
- Will understand mechanism of degradation of rubber compounds.
- Will assess bio-degradability of polymers.
- Will do recycle of biodegradable polymer.
- Will understand standards for biodegradable polymer.

TEXT BOOKS:

1. G.J.L Griffin Blackie (ed.), Chemistry & Technology of Biodegradable Polymers Academic & Professional London 1994.
2. Yoshiharu Doi, Kazuhiko Fukuda (ed.) Biodegradable Plastics & Polymers Elsevier 1994.

REFERENCES:

1. Abraham J.Donb& Others (ed.) Handbook of Biodegradable polymers.
2. Harvard Academic Publishers Australia 1997.

PL8075 POLYURETHANE TECHNOLOGY L T P C
3 0 0 3

OBJECTIVES:

- To enable the students to understand the principles of PU chemistry and its applications.
- To get the knowledge in PU raw materials and processing techniques.
- To understand the concepts of PU foams, coatings and adhesives.

UNIT I PRINCIPLES OF PU CHEMISTRY AND APPLICATIONS 12

Reactions of isocyanate group-building blocks for PUs-polyols, isocyanates, chain extenders – Preparation methods like prepolymer process, one shot process-preparation of aqueous two phase systems – Special areas like ionomers,LCP based on PUs, hydrogels, promoters- Uses in medical areas, bio technology, optical lenses etc Structure-property relationships in hard and soft segments - Morphology of domains-Effect of cross links on PU properties, structure-property relationships in ionomers

UNIT II RAW MATERIALS AND AN OVERVIEW OF PROCESSING OF PU 6

Polyols, isocyanates – Their preparation and characteristics, conversion products of the raw materials – Additives – Industrial hygiene –Principles of PU processing

UNIT III PU FOAMS 9

Rigid polyurethane foams-chemistry of raw materials, manufacturing of rigid PU (manufacturing of buns, panels, foaming of applications, molded rigid foams), properties, application of rigid polyurethane. Polyurethane skin integral foam- production, properties and applications.Flexible foams-(production, properties and application slabstock foam, carpet backing, flexible molded foams & semi rigid molded foams.

UNIT IV SOLID PU MATERIALS 9

Solid polyurethane materials- polyurethane casting systems (cast elastomers and casting resins)-thermoplastic polyurethane elastomers: productions / processing, properties and applications-elastomers fibers, manufacture / processing and applications.

UNIT V PU COATINGS AND ADHESIVES 9

Solvent based coatings, air dried coatings, solvent free paints and coatings, applications of PU based coatings two components and one component adhesives based on PUs, solvent based adhesives, dispersion adhesives, hot melts, PU binders.

TOTAL: 45 PERIODS

OUTCOMES:

Upon completing this course, the students

- Know about building blocks for Polyurethanes
- Learn about Various types of raw materials used in preparation of PU
- Study about the production of flexible and rigid polyurethane foam
- Will have the knowledge of production, properties and uses of solid polyurethane
- Will have the knowledge of PU applications as coatings and adhesives

TEXT BOOK:

1. Dr. Gumter Oertal (ed.), Polyurethane Hand Book, Hanser Publication Munich. Edition 2, 1994

REFERENCES:

1. George woods, The ICI Polyurethane book -published journals by ICI, John Wiley

and sons, New York.
2. Hepburn C, “PU Elastomers II” Edition, Springer Science, 1992.
3. Benjamin M. Walker, Handbook of Thermoplastic Elastomer, Springer US, 1988
4. N. R. Legge, G. Holden, .H. E. Sehroeder, Thermoplastic Elastomers: A Comprehensive Review, 1987
5. J. A. Brydson, Rubber Materials & Their Compounds, Springer Netherlands, 1988

PL8074 PLASTICS WASTE MANAGEMENT AND RECYCLING TECHNIQUES L T P C
3 0 0 3

OBJECTIVES:

To enable the students

- To know various sources of plastics waste generation
- To know segregation methods for recycling the plastics
- To know recycling codes of commodity and engineering plastics.
- To learn about primary recycling techniques with examples/case studies.
- To understand the recycling of various commodity and engineering plastics.

UNIT I PLASTIC WASTE GENEATION &SEPARATION TECHNIQUES 9

Plastics production and consumption- Plastic wastes generation source and types – Plastic waste composition, quantities - Plastics identification methods physical, chemical and instrumental – sorting and separation technologies - disposal alternatives – Recycling methods – Primary, Secondary and tertiary recycling of plastics-Plastic road.

UNIT II PROCESSING OF COMMINGLED PLASTIC WASTE 9

Size reduction of recycled plastics – cutting / shredding, densification, pulverization and chemical size reduction processes- municipal solid waste and composition – recycling of plastics from urban solid wastes - household waste – industrial sector –density and mechanical properties of recyclable plastics– Processing of commingled / mixed plastic waste – super wood, plastic lumber

UNIT III RECYCLING OF POLYOLIFINS, PET &PVC 9

Recycling of polyolefins – polyethylene films – Polypropylene battery recyling- Recycling of HDPE fuel tanks - PET recycling methods – PET film recycling - Applications of polyolefin and PET recyclate – PVC recycling

UNIT IV RECYCLING OF ENGINEERING THERMOPLASTICS 9

Engineering thermoplastics and their major areas where engineering polymers are recycled – major recyclers of engineering plastics – GE/ Bayer/ MRC Polymers – PC, PBT, Nylon, PPO, ABS and polyacetals and their blends

UNIT V RECYCLING OF THERMOSET COMPOSITES 9

Recycling of Polymer thermoset composites – regrind processes - SMC scrap – pyrolysis and energy recovery –Types of rubber products – rubber grinding methods – tyre grinding – rubber crumb applications – Reclaiming and de-vulcanization processes tyre derived fuel and energy recovery – Pyrolysis of scrap tyres-Act on plastic waste management

TOTAL: 45 PERIODS

OUTCOMES:

- Will understand the impact of plastic waste on environment
- Will able to recycle of both commercial and engineering plastics.
- Will through with policies related to environmental issues of plastics waste.

- Will know legislations related to environmental issues of plastic waste.

TEXT BOOKS:

1. Polymer recycling, "Science, Technology and Applications, John Scheirs, John Wiley & Sons, England 1988
2. "Recycling of Plastic Materials (Ed)", Francesco Paolo La Mantia, Chem Tec Publishing.
3. "Plastics Waste Management (Ed)", Nabil Mustafa, Marcel Dekker, New York,1995.

REFERENCES:

1. Degradeable polymers, Recycling and Plastic Waste Management (Eds) Ann Christine Albertson and Samuel J. Huang, Marcel Dekker, New York.
2. John Schiles, Polymer Recycling.
3. Recycling & Plastics Waste Management, Edited by Dr.J.S.Anand, CIPET, 1 997.

PT8074 POLYMER NANOCOMPOSITES L T P C
3 0 0 3

OBJECTIVES:

To enable the students

- To understand the basics and chemistry of nano size materials and their synthesis, characterization and applications.
- To know the manufacturing and processing of clay/polymer nanocomposites.
- To learn about the flow behavior of nanofiller/polymer systems and their processing and applications.

UNIT I INORGANIC AND ORGANIC POLYMER NANOMATERIALS 9

General introduction to nanocomposites; Basics of Inorganic Materials Chemistry and Nanochemistry. Inorganic-Organic and Inorganic-Polymer Nanocomposite Materials.

UNIT II POLYMER/GRAPHENE NANOCOMPOSITES 9

Nanocomposites: particulate, clay, and carbon nanotube, graphene nanocomposites. Nanocomposite: synthesis, characterization, properties, and applications.

UNIT III POLYMER/CLAY NANOCOMPOSITES 9

Clay/Polymer Nanocomposites: Physical and chemical properties of clay nanoparticles; Synthesis; Potential Applications

UNIT IV POLYMER/METAL NANOCOMPOSITES 9

Metal/Polymer Nanocomposites: Physical and chemical properties of metal nanoparticles; Synthesis; Potential Applications. Carbon Nanotubes Polymer nanocomposites: Structure, Properties, Synthesis Methods; Potential Applications

UNIT V POLYMER NANOCMPOSITES APPLICATIONS 9

Rheology and processing, Applications and economics of polymer nanocomposites.

TOTAL: 45 PERIODS

OUTCOMES:

Upon completing this course, the students

- will have a clear understanding of nanocomposites
- will demonstrate clay /polymer nanocomposites, carbon nanotube polymer composites and metal/polymer nanocomposites

- will correlate the processing and economics of polymer nanocomposites compared to conventional polymer composites.

TEXT BOOKS:

1. Polymer nanocomposites: synthesis, characterization, and modeling / Ramanan Krishnamoorti, editor; Richard A. Vaia, editor. Washington, D.C.: American Chemical Society: Distributed by Oxford University Press (2002)
2. Polymer-clay nanocomposites / edited by T.J. Pinnavaia and G.W. Beall,Chichester; New York: John Wiley(2000).
3. Polymer-layeredsilicatenanocomposites: preparation, properties, and uses of a new class of Materials, M.Alexandre, P. Dubois, Mater. Sci. Eng., 28, 1-63 (2000).

REFERENCE:

1. Polymer matrix nanocomposites,processing,manufacturing,and application:An overview, F. Hussain,M.Hojjati, M. Okamoto,R.E. Gorga, J.Comp. Mater., 40, 1511- 1575 (2006).

GE8075 INTELLECTUAL PROPERTY RIGHTS L T P C
3 0 0 3

OBJECTIVE:

- To give an idea about IPR, registration and its enforcement.

UNIT I INTRODUCTION 9

Introduction to IPRs, Basic concepts and need for Intellectual Property - Patents, Copyrights, 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 10

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 10

International Treaties and Conventions on IPRs, TRIPS Agreement, PCT Agreement, Patent Act of India, 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 and IP Laws – Case Studies.

UNIT V ENFORCEMENT OF IPRs 7

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

TOTAL:45 PERIODS

OUTCOME:

- Ability to manage Intellectual Property portfolio to enhance the value of the firm.

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

REFERENCES:

1. Deborah E. Bouchoux, “Intellectual Property: The Law of Trademarks, Copyrights, Patents and Trade Secrets”, Cengage Learning, Third Edition, 2012.
2. Prabuddha Ganguli,”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.

PT8651 POLYMER BLENDS AND ALLOYS L T P C
3 0 0 3

OBJECTIVE:

- To enable the students to understand the miscibility of polymers, characteristics of blends and mechanism of toughening

UNIT I CLASSIFICATION OF POLYMER BLENDS AND ALLOYS 9

Definition of polymer blends and alloys - Classification - Criteria for selection of polymer – Thermodynamics of miscibility – Phase morphology – Phase separation behavior - Determination of morphology of polymer blend – Mechanical compatibility - Electron Microscopy.

UNIT II PREPARATION OF POLYMER BLENDS AND ALLOYS 9

Principles and methods involved in preparation of Polymer blends and alloys - Introduction to polymer rheology in blend – Interpenetrating polymer network: Synthesis, Morphology, Properties and application of polymer blend - Enhancement of polymer miscibility – utilization of miscible polymers.

UNIT III TYPES OF POLYMER BLENDS 9

Liquid Crystalline Polymer, Blends-Ternary Polymer – Elastomer, Blends-Polymer blends containing block copolymers-– Biodegradable polymer blends- Recycled polymer blends

UNIT IV TOUGHENED THERMOPLASTICS AND THERMOSETS 9

Toughened polymers- Specific examples for toughened thermoplastics and thermosets - specific interaction - hydrogen bonding interaction, dipole-dipole interaction, ion–dipole & ion-ion interaction and additional specific interaction

UNIT V APPLICATION OF BLENDS AND ALLOYS 9

Application of Blends in Emerging technology - Photovoltaic, Light Emitting Diode, Electro chromic, Electric conductivity polymer and blends, Lithium battery & Fuel cells Applications

TOTAL: 45 PERIODS

OUTCOMES:

Upon completing this course, the students

- Able to express the basic concepts of polymer blend
- Able to infer the thermodynamic of polymer -polymer miscibility
- Able to classify the types of polymer blends
- Able to interpret the characterized polymer blends

- Able to discover the application of polymer blends

TEXT BOOKS:

1. Lloyd M. Robeson - Polymer Blends: A Comprehensive Review, Hanser Publishers, 2007
2. D R Paul and S Newman, “Polymer Blends Vol. I & II”, Academic Press Inc, 1978.

REFERENCES:

1. Olabisis, I W Rubison and M T Shaw Polymer - Polymer Miscibility Academic Press - New York 1979.
2. Utracki, “Polymer Blends and Alloys”, Hanser Publisher.
3. G. Lubin, “Hand Book of Composites”, 2nd Ed., Van Nostrand Reinhold, NY, 1982.
4. S.M.Lee, “Dictionary of Composites Materials Technology”, Technomic Lancaster, Pa, 1989.
5. B.T. Astrom, “Manufacturing of Composites”, Chapman & Hall, 1997.

PL8091 THERMOPLASTIC ELASTOMERS L T P C
3 0 0 3

OBJECTIVES:

- To enable the students to understand the structural properties of thermoplastic elastomers.
- To study the synthesis method, compounding, processing characteristics and application of elastomeric blends.

UNIT I THERMOPLASTIC STYRENIC BLOCK COPOLYMER 9

Synthesis, morphology, Properties, formulating, compounding and application of styrenic block copolymers

UNIT II THERMOPLASTIC POLYURETHANE 9

Thermoplastic Polyurethane – Synthesis – Morphology –thermal transition – Properties – Applications – Blends of TPU with other polymer – Bonding and welding.

UNIT III THERMOPLASTIC POLYAMIDES AND POLYESTERS 9

Thermoplastic Elastomer based on polyamides and Thermoplastic Polyether ester elastomers – Synthesis – Morphology – Properties – Compounding - Bonding and welding – Applications - Blends.

UNIT IV THERMOPLASTIC POLYOLEFINS AND BLENDS 9

Synthesis, Morphology, Property, Blends and application of TPE based on Polyolefin – TPE based on Halogen: PVC/NBR, FKM – Ionic TPE - Other TPEs – Elastomeric stat block copolymers – TPEs based on Interpenetrating Network – Based on Polyacrylates.

UNIT V THERMOPLASTIC ELASTOMERS PROCESSING 9

Processing Methods –Introduction – Mixing and blending equipment – Extrusion –Injection molding – Compression molding – Transfer molding – Blow molding - Foaming – Thermoforming – secondary manufacturing process.

TOTAL: 45 PERIODS

OUTCOMES:

Upon completing this course, the students

- Will be able to understand the synthesis methods of various thermoplastic elastomers.
- Will be able to analyze the properties of elastomers based on their morphology and structure.

- Will be able to understand the properties and applications of blends of thermoplastic elastomers.
- Will be able to recognize the processing methods for different thermoplastic elastomers.

TEXT BOOKS:

1. Jiri George Drobny, "Handbook of thermoplastic Elastomers", William Andrew Publication, Plastics Design Library, 2007.
2. Hoffman, Rubber Technology Handbook -, Hanser Pub. Munich - 1996

REFERENCES:

1. Geoffrey Holden, "Understanding Thermoplastic Elastomers", Hanser 2000.
2. K.E.Kear, Developments in Thermoplastic Elastomers, Rapra Technology, 2003.
3. Anil K. Bhowmick, Howard Stephens, "Handbook of elastomers", Marcel Dekker, 2nd edition, 2001.
4. C.M.Blow and C. Hepburn,- Rubber Technology and Manufacture, Eds, Buttenvorths, London 2nd edition, 1982.

PL8001 WOVEN SACKS TECHNOLOGY L T P C
3 0 0 3

OBJECTIVES:

- To learn about the manufacturing process of weaving fabrics and its types
- To learn about the testing and quality control of woven sacks

UNIT I MATERIALS FOR FILAMENTS AND YARN 9

Materials for filaments/ Yarns- High Density Polyethylene (HDPE), Polypropylene (PP), Polyester- Process- Properties – Tenacity, Denier, Elongation at break, thermal shrinkage- Dimensional stability.

UNIT II HYBRID YARNS 9

Hybrid Yarns For Thermoplastic Composites: Types of hybrid yarns. Manufacture of thermoplastic composites with hybrid yarns. Compaction and consolidation of hybrid yarns Hybrid yarn structure – composite property relations. Potential application areas of thermoplastic composites. Trends in thermoplastic composite applications

UNIT III MANUFACTURING PROCESS OF WEAVING 9

Manufacturing process of weaving- Circular (Narrow width) Fabric, Wide Round Fabric, Flat Woven Fabric- Types of Weaving - Plain weave, Twill weave, Satin weave, Basket weave, Leno weave, Mock Leno weave- Properties and its applications

UNIT IV TYPES OF WOVEN FABRICS 9

Types of woven fabrics – Laminated and unlaminated woven sacks- Sacks with and without liner- Classification of woven sacks- Perforated, Sand, Valve, Gusseted, Boxed, Air Stripe, BOPP coated bags, Flexible Intermediate Bulk Container (FIBC)- Properties and its application. Woven sacks for food grain packaging, Cement packing, Sugar packing, Flour packing.

UNIT V TESTING OF WOVEN SACKS 9

Testing and Quality control of woven sacks- Dimension – inner and outer, ends & picks per decimeter, Mesh number, Breaking strength, Elongation at break, Bottom Seam strength, UV resistance- Ash content- Over all migration.

TOTAL: 45 PERIODS

OUTCOME:

- At the end of the course student will be able to know the weaving process and applications of filaments, yarns. Have clear idea about the testing and quality control of woven sacks as per Std.

TEXT BOOKS:

1. Plastics Testing Techniques – Vishu Shah.,1998.
2. Plastic Materials – Brydson.,1999.

REFERENCES:

1. Hand Book Of Packaging Technology- Eiri Board,2004.
2. ISI 14887 – Testing of HDPE woven sacks.

PL8002 POLYMERS IN FUEL CELLS L T P C
3 0 0 3

OBJECTIVES:

To enable the students to understand the following:

- Fuel cells - concepts of terminology, theories
- Types of specialty fuel cells and their application
- Technology - Fabrication and characterisation

UNIT I BASICS OF FUEL CELL 12

Fuel cell definition, Difference between batteries and fuel cells, fuel cell history, components of fuel cells, principle of working of fuel cells Fuel cell thermodynamics - second law analysis of fuel cells, efficiency of fuel cells fuel cell electrochemistry - Nernst equation, Electrochemical kinetics, Butler-Volmer equation Fuel cell types - Classification by operating temperature/electrolyte type, Fuel Cell Performance, Activation, Ohmic and Concentration over potential Fuel cell design and components - Cell components, stack components, system components

UNIT II OVERVIEW OF INTERMEDIATE/HIGH TEMPERATURE FUEL CELLS 12

Solid oxide fuel cells (SOFC), Molten carbonate fuel cells (MCFC), Phosphoric acid fuel cells (PAFC) Polymer Electrolyte fuel cells (pefc) - Heat and mass transfer in polymer electrolyte fuel cells, water management in PEFCs, Current issues in PEFCs Direct methanol fuel cells (DMFC) - Electrochemical kinetics methanol oxidation, Current issues in DMFCs, Fuel crossover in DMFCs, Water management in DMFCs, high methanol concentration operation, limiting current density

UNIT III PEM FUEL CELL TECHNOLOGY 12

Applications – portable applications – propulsions - current status- Hyflon ion ionomers – Phosporic acid doped polybenzimidazole membrane – hydrocarbon based membranes – solid polymer electrolyte fuel cells – parameters influencing long term performance and durability – degradation

UNIT IV FABRICATION AND CHARACTERISATION 9

Fabrication and characterisation of micro PEM fuel cells – PEM fuel cell with hydrogen, methanol and formic acid

TOTAL: 45 PERIODS

OUTCOMES:

- Will attain the knowledge in terminology, theories of fuel cells

- Will familiarize about the Types of specialty fuel cells and their application
- Will demonstrate the Technology - Fabrication and characterisation

TEXT BOOKS:

1. J. Larminie and A. Dicks, Fuel Cell Systems Explained, 2nd Edition, Wiley (2003)
2. Xianguo Li, Principles of Fuel Cells, Taylor and Francis (2005)
3. S. Srinivasan, Fuel Cells: From Fundamentals to Applications, Springer (2006)
4. O'Hayre, S. W. Cha, W. Colella and F. B. Prinz, Fuel Cell Fundamentals, Wiley (2005)
5. J. Bard and L. R. Faulkner, Electrochemical Methods: Fundamentals and Applications, 2nd Edition, Wiley 2000
6. Faghri and Y. Zhang, Transport Phenomena in Multiphase Systems, Elsevier 2006

REFERENCES:

1. Tomorrows Energy: Hydrogen, Fuel cells and the prospects for a cleaner planet**,** Peter Hoffman, The MIT Press, Cambridge, London, England.,2001.
2. Introduction to Fuel Cell Technology, Chris Rayment and Scott Sherwin, Department of Aerospace and Mechanical Engineering, University of Notre Dame, Notre Dame, U.S.A.,2003.
3. Fuel Cell Handbook, (Seventh Edition), By EG&G Technical Services, Inc. U.S. Department of Energy Office of Fossil Energy National Energy Technology Laboratory , Morgantown, West Virginia, USA.,2004.

GE8076 PROFESSIONAL ETHICS IN ENGINEERING L T P C
3 0 0 3

OBJECTIVE:

- To enable the students to create an awareness on Engineering Ethics and Human Values, to instill Moral and Social Values and Loyalty and to appreciate the rights of others.

UNIT I HUMAN VALUES 10

Morals, values and Ethics – Integrity – Work ethic – Service learning – Civic virtue – Respect for others – Living peacefully – Caring – Sharing – Honesty – Courage – Valuing time – Cooperation – Commitment – Empathy – Self confidence – Character – Spirituality – Introduction to Yoga and meditation for professional excellence and stress management.

UNIT II ENGINEERING ETHICS 9

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

UNIT III ENGINEERING AS SOCIAL EXPERIMENTATION 9

Engineering as Experimentation – Engineers as responsible Experimenters – Codes of Ethics – A Balanced Outlook on Law.

UNIT IV SAFETY, RESPONSIBILITIES AND RIGHTS 9

Safety and Risk – Assessment of Safety and Risk – Risk Benefit Analysis and Reducing Risk - Respect for Authority – Collective Bargaining – Confidentiality – Conflicts of Interest – Occupational Crime – Professional Rights – Employee Rights – Intellectual Property Rights (IPR)

– Discrimination.

UNIT V GLOBAL ISSUES 8

Multinational Corporations – Environmental Ethics – Computer Ethics – Weapons Development – Engineers as Managers – Consulting Engineers – Engineers as Expert Witnesses and Advisors – Moral Leadership –Code of Conduct – Corporate Social Responsibility.

TOTAL: 45 PERIODS

OUTCOME:

- Upon completion of the course, the student should be able to apply ethics in society, discuss the ethical issues related to engineering and realize the responsibilities and rights in the society.

TEXT BOOKS:

1. Mike W. Martin and Roland Schinzinger, “Ethics in Engineering”, Tata McGraw Hill, New Delhi, 2003.
2. Govindarajan M, Natarajan S, Senthil Kumar V. S, “Engineering Ethics”, Prentice Hall of India, New Delhi, 2004.

REFERENCES:

1. Charles B. Fleddermann, “Engineering Ethics”, Pearson Prentice Hall, New Jersey, 2004.
2. Charles E. Harris, Michael S. Pritchard and Michael J. Rabins, “Engineering Ethics – Concepts and Cases”, Cengage Learning, 2009.
3. John R Boatright, “Ethics and the Conduct of Business”, Pearson Education, New Delhi, 2003
4. Edmund G Seebauer and Robert L Barry, “Fundamentals of Ethics for Scientists and Engineers”, Oxford University Press, Oxford, 2001.
5. Laura P. Hartman and Joe Desjardins, “Business Ethics: Decision Making for Personal Integrity and Social Responsibility” Mc Graw Hill education, India Pvt. Ltd.,New Delhi, 2013.
6. World Community Service Centre, ‘ Value Education’, Vethathiri publications, Erode, 2011.

Web sources:

1. www.onlineethics.org
2. www.nspe.org
3. www.globalethics.org
4. www.ethics.org

GE8073 FUNDAMENTALS OF NANOSCIENCE L T P C

3 0 0 3

OBJECTIVE:

- To learn about basis of nanomaterial science, preparation method, types and application

UNIT I INTRODUCTION 8

Nanoscale Science and Technology- Implications for Physics, Chemistry, Biology and Engineering-Classifications of nanostructured materials- nano particles- quantum dots, nanowires-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, Ultrasonication, Mechanical Milling, Colloidal routes, Self-assembly, Vapour phase deposition, MOCVD, Sputtering, Evaporation, Molecular Beam Epitaxy, Atomic Layer Epitaxy, MOMBE.

UNIT III NANOMATERIALS 12

Nanoforms of Carbon - Buckminster fullerene- graphene 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-Nanometal 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-Nanoindentation.

UNIT V APPLICATIONS 7

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 sunbarrier products - In Photostat, printing, solar cell, battery.

TOTAL: 45 PERIODS

OUTCOMES:

- Will familiarize about the science of nanomaterials
- Will demonstrate the preparation of nanomaterials
- Will develop knowledge in characteristic nanomaterial

TEXT BOOKS:

1. A.S. Edelstein and R.C. Cammearata, eds., “Nanomaterials: Synthesis, Properties and Applications”, Institute of Physics Publishing, Bristol and Philadelphia, 1996.
2. N John Dinardo, “Nanoscale Charecterisation of surfaces & Interfaces”, 2nd edition, Weinheim Cambridge, Wiley-VCH, 2000.

REFERENCES:

1. G Timp, “Nanotechnology”, AIP press/Springer, 1999.
2. Akhlesh Lakhtakia,“The Hand Book of Nano Technology, Nanometer Structure, Theory, Modeling and Simulations”. Prentice-Hall of India (P) Ltd, New Delhi, 2007.

PL8073 BIOMEDICAL PLASTICS L T P C

3 0 0 3

OBJECTIVES:

- To understand various natural and synthetic polymers used for biomedical applications and their compatibility with biological system
- To learn about the plastics that is used as implants in cardiovascular, ophthalmology, and other artificial organs.

UNIT I BIOMATERIALS 9

Biomaterials, Biocompatibility, Stabilization, Inflammation and Wound Healing, Blood Clotting System, skin System, Biological response to Implants, Implant Design And Applications.

UNIT II BIOMEDICL POLYMERS 9

Criteria for the Selection of Biomedical Polymers Physicochemical Aspects of the Blood Compatibility of Polymeric Surface.

Biomedical Polymers from biological source, Poly hydroxyl Alkanoic Acids, Microbial polysaccharides, Silk, Collagen. , Microbial Cellulose, Hyaluronic Acid, Synthetic Polymers such as PMMA, Silicone Rubber, Polyethylene, Natural Rubber, Hydrogels.

UNIT III BIOMEDICAL APPLICATIONS OF POLYMERS 9

Permanent Implants For Function-Orthopedics, Cardio Vascular, Respiratory Patches and Tubes, Digestive System, Genitourinary System, Nervous System, Orbital (Corneal And Lens Prosthesis)–Permanent Implant For Cosmoses, Other Applications of Engineered Material In Clinical Practices, Silicone Implants. Polymer Membranes, Polymer Skin, Polymeric Blood.

UNIT IV POLYMERIC LENSES 9

Contact Lenses, Hard Lenses, Gas Permeable Lenses, Flexible Lenses, Soft Lenses, Hydrogels, Equilibrium Swelling, Absorption And Desorption, Oxygen Permeability, Types of Soft Lenses, Manufacture, Cleaning And Disinfection.

UNIT V DENTAL POLYMERS: 9

Dental applications, denture bases, crown and bridge resins, plastic teeth, mouth protectors, maxillofacial prosthetic materials, restorative material, polyelectrolyte based restoratives, sealants, adhesives, dental impression and duplicating materials, agar, algmater elastomers.

TOTAL: 45 PERIODS

OUTCOMES:

- Able to describe the criteria for selection of bio medical polymers
- Able to explain the biomedical applications of polymers
- Able be familiarized with the polymers used in dental applications
- Able to attain the skill on polymeric lenses used in medical applications

TEXT BOOKS:

1. J B Park, Bio-materials, An Introduction –, CRC Press, 2003.
2. J S Brydson, Plastics Materials –.
3. H.F. Mark (Ed), Encyclopedia of polymer science and engineering, John Wiley and Sons New York, 1989.

REFERENCES:

1. Comprehensive Polymer Science Vol.7 Alcock., Contemporary Polymer Chemistry.
2. Second Ed. Manas Chanda, Salil K. Roy (Ed) Plastic Technology Hand Book Marcel Dekker, Inc. New York, 1993
3. Chiellini; Emo, Sunamoto; Junzo, Migliaesi; Claudio, Ottebrite; Raphael and Cohn; Daniel (Eds.), Biomedical Polymers and Polymer Therapeutics, Kluwer Academic/Plenum Publishers, New York (2001).
4. Galaev; Igor and Mattiasson; Bo (Eds.), Smart Polymers; Applications inBiotechnology and Biomedicine, CRC Press, Boca Raton (2008).

PL8003 ADVANCED MOULD AND DIE MANUFACTURING TECHNIQUES L T P C
3 0 0 3

OBJECTIVES:

- To impart knowledge on various Cutting Tools and CNC Machines
- To develop the knowledge on elements of the mould and manufacturing processes with CAD/CAM/CAE
- To learn the application of additive manufacturing in mould development
- To acquire skills in advanced measuring instruments for inspection of mold

UNIT I CNC MACHINING CENTERS 9

Introduction to CNC Machining Center- Classification - Working Principle and Construction - coordinate system -Dimensioning method -Cutter radius and length compensation – Interpolations - Preparatory and miscellaneous functions– Cutting Tools - Types, Materials and Selection – Cutting parameters - Tool holding devices – Work holding devices – work piece alignment & datum setting – Part programming - types, cycles – CAM Programming – Execution of NC file- Manufacturing of mould elements with CAD/CAM

UNIT II CNC TURNING CENTERS 9

Introduction to CNC Turning Center- Classification - Working Principle and Construction - coordinate system -Dimensioning method -Tool Nose radius and length compensation – Interpolations - Preparatory and miscellaneous functions– Cutting Tools - Types, Materials and Selection – Cutting parameters - Tool holding devices – Work holding devices – work piece alignment & datum setting – Part programming- types, cycles – CAM Programming – Execution of NC file- Manufacturing of mould elements with CAD/CAM

UNIT III CNC DIE SINKING EDM AND WIRE EDM 9

CNC DIE SINKING EDM: Introduction - theory of metal removal- Working Principle and Construction – Process parameters– Electrode materials and selection- Electrode Design- Dielectric fluid – Functions, requirements and properties - Factors affecting Metal Removal Rate – Applications, advantages and disadvantages– Programming and Manufacturing of mould elements.

CNC Wire EDM: Introduction - Working Principle and Construction – Process parameters– specification and selection of Tool (Wire) -– Dielectric fluid – Functions, requirements and properties - Factors affecting cutting process– Applications, advantages and disadvantages- comparison of EDM and wire EDM– Programming and Manufacturing of mould elements.

UNIT IV RAPID TOOLING 9

Introduction to Additive manufacturing - Difference between rapid tooling & conventional tooling - Development of mould elements with RP- conformal cooling of mold elements – silicon moulds for Vacuum Casting - Epoxy Tooling System.

UNIT V ADVANCED METROLOGY 9

Co-ordinate measuring machine – Constructional features – Types – Applications of CMM – CNC CMM applications – Computer Aided Inspection – Machine Vision - Form Measurement – Straightness, Flatness and roundness – Nano metrology – Introduction – Principles – Nanometer metrology systems – Methods of measuring length and surfaces to nano scale result with interferometers and other devices.

TOTAL:45 PERIODS

OUTCOMES:

Upon completing this course, the students

- will have the knowledge in CNC Machine Tools for mould manufacturing
- will acquire skills in 3 D printing and Rapid tooling
- will acquire skills in advanced measuring equipment for inspection of mold

TEXT BOOKS:

1. Klus Stokhert, Mold making handbook for Plastic Engineers, Hanser Publishers, NY, 3rd Edition 2013
2. HMT Production Technology, Tata McGraw Hill, 2001

REFERENCES:

1. R.G.W.Pye, Injection Mold Design, East West Press Pvt. Ltd., New Delhi.,2000.
2. Hajra Chouldhary S.K and Hajra Choudhury. AK., "Elements of workshop Technology", volume II, Media promoters and Publishers Private Limited, Mumbai, 2010.
3. W.A.J Chapman, Workshop Technology, Vol I & II, ELBS.
4. Peter Jones, "The Mould Design Guide", Smithers Rapra Technology Ltd., 2008
5. Herbert Rees, Mold Engineering, Hanser Publishers, NY.,2002.
6. George Menges & Paul Mohren, How To Make Injection Molds, Hanser Publishers,2001.
7. Douglas M. Bryce, Plastic Injection Molding manufacturing process fundamentals, Society of Manufacturing Engineers, Dearborn, Michigan.,1996.
8. Jain R K ," Engineering Metrology" , 19th Edition , Khanna Publishers , 2005
9. Gaylor, Shotbolt and Sharp, Metrology for Engineers, Publisher: O.R.Cassel, London,1993.
10. White house, D. J, Handbook of Surface & Nanometrology, Publisher: The institute of Physics.,2010.
11. Graham T. Smith, Industrial Metrology, Publisher: Springer-Verlag London Ltd.,2002

PT8075 POLYMERS FOR ENERGY STORAGE APPLICATIONS L T P C
3 0 0 3

OBJECTIVE:

- To enable the students to understand the basic concepts on conducting polymers, conduction mechanism, various methods of synthesis and characterization of conducting polymers and their applications

UNIT I ELECTROCHEMISTRY OF CONDUCTING POLYMERS 8

Electrochemistry of electronically conducting polymers-source of electronic conduction in polymers – solitons, polarons and bipolarons – semiconductors and conducting polymers.

UNIT II GENERAL SYNTHESIS OF CONDUCTING POLYMERS 9

Synthesis of conducting polymers – chemical, electrochemical and enzymatic methods – doping – general considerations – measurement of conductivity – van der Pauw technique – factors affecting conductivity.

UNIT III CHARACTERIZATION OF CONDUCTING POLYMERS 8

Characterization of conducting polymers – electro analytical techniques – cyclic voltammetry, chronoamperometry and chronocoulometry, spectral methods - use of UV-vis, Raman, XRD and NMR.

UNIT IV SYNTHESIS, PROCESSABILITY AND APPLICATIONS 10

Synthesis, processability and applications of acetylene, aniline, pyrrole, thiophene and para – phenylene based conducting polymers.

UNIT V APPLICATIONS OF CONDUCTING POLYMERS 10

Conducting polymers in microelectronics – corrosion and ESD protection, EMI shielding and lithography. LED- rechargeable batteries – artificial muscles - electrochromic devices– sensor devices–conductive composites.

TOTAL: 45 PERIODS

OUTCOMES:

They should be able to:

- Draw the molecular structure of common conducting polymer monomers/polymers
- Know basic synthetic methods
- Understand the concept of doping and dedoping
- Be familiar with common applications of conducting polymers and the science behind them
- Be familiar with the history of the field, some leading scientists and classical references, and some current research activities in the field

REFERENCES

1. Skotheim.T.A., Elsenbaumer.R.L. and Reynolds J.R., "Hand book of Conducting Polymers", 2nd Edn, Marcel Dekker Inc., New York, 1998.
2. Margolis J.M., "Conducting Polymers and Plastics", Chapman and Hall, London, 1989.
3. Seymour R.B., "Conductive Polymers", Plenum Press, New York, 1981.
4. Tadmore Z., "Principles of Polymer Processing," Wiley – Interscience, New York, 1979.
5. Wessling B., "Electronic Properties of Conjugated Polymers," Vol.3, Springer, Berlin, 1989.
6. Kiess H.G., "Conjugated Conducting Polymers," Springer, Berlin, 1992.
7. Soane.D.S. and Martynenko.Z., "Polymers in Microelectronics", Elsevier,Amsterdam, 1989.

PT8071 CONDUCTING POLYMERS L T P C

3 0 0 3

OBJECTIVE:

- To enable the students to understand the basic concepts on conducting polymers, conduction mechanism, various methods of synthesis and characterization of conducting polymers and their applications

UNIT I ELECTROCHEMISTRY OF CONDUCTING POLYMERS 9

Introduction to conducting polymers - discovery of polyacetylene - concept of doing and n-type - polarons and bipolarons - conduction mechanism - redox type polymers (electro - active polymers)

UNIT II GENERAL SYNTHESIS OF CONDUCTING POLYERS 9

Synthesis of conducting polymers - Chemical synthesis - electrochemical synthesis -template synthesis - precursor synthesis - soluble polymers (colloids and dispersions) -advantages and disadvantages of various synthesis methods.

UNIT III CHARACTERIZATION OF CONDUCTING POLYMERS 9

Characterization methods - elemental analysis for dopants - IR - UV (electro chemical) scanning electro microscopy (SEM) - electro chemical characterization - cyclic voltometry- electrochemical quartz crystal microbalance (EQCM) - probe beam deflection (PBD) -Langmuir - blodgett

technique.

UNIT IV SYNTHESIS, PROCESSABILITY AND APPLICATIONS 9

Applications tested - rechargeable batteries, lights emitting diodes - gas sensors - bio sensors - photo voltaic energy devices - micro electronics (PCB fabrications) electro catalysis - applications - proposed - antistatic coatings - electro chem. Mechanical devices - super capacitors

UNIT V APPLICATIONS OF CONDUCTING POLYMERS 9

Recent trends in conducting polymers - functionalised conducting polymers (second generation polymers) - super conductors (inorganic - organic hybrid structures) - conducting polymers based on nano composites.

TOTAL: 45 PERIODS

OUTCOMES:

Upon completing this course, the students

- Will understand the basic concepts and the mechanism of conduction in polymers
- Will synthesis conducting polymers by various method.
- Will characterize the conduction in polymers
- Will understand the application of conductivity polymer in various devices.
- Will be familiar in the recent and future trend of conducting polymers.

TEXT BOOKS:

1. R. G. Linford, Electro Chemical Science and Technology of Polymers - 1&2, ed., elsevier applied sciences, London, 1987 and 1990.
2. M. Schlvxinger and M. Paunovic, (eds.) Modern Electro Plating, john Wiley and sons Inc., New York, 2000.

REFERENCES:

1. Hari Singh Nalwa (ed.), Hand Book of Organic conductive molecules and polymers, 4 - volume set, John wiley& sons, England, 1997.
2. T.Asaka, S. Komabe and T. Momma, Conductive Polymers.

GE8074 HUMAN RIGHTS L T P C
3 0 0 3

OBJECTIVE:

- To sensitize the Engineering students to various aspects of Human Rights.

UNIT I 9

Human Rights – Meaning, origin and Development. Notion and classification of Rights – Natural, Moral and Legal Rights. Civil and Political Rights, Economic, Social and Cultural Rights; collective / Solidarity Rights.

UNIT II 9

Evolution of the concept of Human Rights Magana carta – Geneva convention of 1864. Universal Declaration of Human Rights, 1948. Theories of Human Rights.

UNIT III 9

Theories and perspectives of UN Laws – UN Agencies to monitor and compliance.

UNIT IV **9**

Human Rights in India – Constitutional Provisions / Guarantees.

UNIT V **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

OUTCOME:

- Engineering students will acquire the basic knowledge of human rights.

REFERENCES:

1. Kapoor S.K., "Human Rights under International law and Indian Laws", Central Law Agency, Allahabad, 2014.
2. Chandra U., "Human Rights", Allahabad Law Agency, Allahabad, 2014.
3. Upendra Baxi, The Future of Human Rights, Oxford University Press, New Delhi.

PL8004 ADDITIVE MANUFACTURING IN PLASTICS PRODUCTS L T P C
3 0 0 3

OBJECTIVES:

- To educate students with fundamental and advanced knowledge in the field of Additive manufacturing technology for plastics product
- To learn the fundamentals process of additive manufacturing process.

UNIT I INTRODUCTION **6**

Introduction to Additive Manufacturing (AM)- AM evolution- Distinction between AM & CNC machining- Advantages of AM- AM process chain- Conceptualization- CAD- conversion to STL- Transfer to AM- STL file manipulation- Machine setup- build -removal and clean up-post processing- Classification of AM processes.

UNIT II DESIGN FOR AM **9**

Motivation- DFMA concepts and objectives- AM unique capabilities- Exploring design freedoms- Design tools for AM- Part Orientation- Removal of Support- Hollowing out part- Inclusion of Undercuts and Other Manufacturing Constraining Features- Interlocking Feature- Reduction of Part Count in an Assembly- Identification of markings / numbers etc.

UNIT III SOLID & LIQUID BASED AM **9**

Liquid Based AM: Stereolithography Apparatus (SLA) - Solid Ground Curing (SGC) - Principle, pre-build process, part-building and post-build processes, resins, Advantages, limitations and applications

Solid Based AM: Fused deposition Modeling (FDM) - Laminated Object Manufacturing (LOM) - Principles, details of processes, materials, advantages, limitations and applications.

UNIT IV POWDER BASED AM **9**

Selective Laser Sintering (SLS) - Laser Engineered Net Shaping (LENS) - Principles, details of processes, materials, advantages, limitations and applications.

Other Additive Manufacturing Systems: Principles of Shape Deposition Manufacturing (SDM), Ballastic Particle Manufacturing (BPM), Selective Laser Melting, Electron Beam Melting.

UNIT V POST PROCESSING & APPLICATIONS OF AM 12

Post processing of AM parts: Support material removal - Surface texture improvement- Accuracy improvement - Aesthetic improvement - Preparation for use as a pattern- Property enhancements using non-thermal and thermal techniques.

Applications of AM: Functional models- Pattern for investment and vacuum casting - Medical models - art models - Engineering analysis models- Rapid tooling (Direct and Indirect method- New materials development- Bi-metallic parts- Re-manufacturing- Application examples for Aerospace, defense, automobile, Bio-medical and general engineering industries;

TOTAL: 45 PERIODS

OUTCOMES:

Upon completing this course, the students

- Will learn about a variety of Additive Manufacturing (AM) technologies, their potential to support design and manufacturing
- Will learn the important research challenges associated with AM and its data processing tools

REFERENCES:

1. Chua, C.K., Leong K.F. and Lim C.S., “Rapid prototyping: Principles and applications”, second edition, World Scientific Publishers, 2010
2. Kamrani, A.K. and Nasr, E.A., “Rapid Prototyping: Theory and practice”, Springer, 2006.
3. Gibson, I., Rosen, D.W. and Stucker, B., “Additive Manufacturing Methodologies: Rapid Prototyping to Direct Digital Manufacturing”, Springer, 2010
4. Andreas Gebhardt, Understanding Additive Manufacturing: Rapid Prototypying, Rapid Tooling , Rapid Manufacturing.,2012.

PL8071 ADVANCED PLASTICS PROCESSING L T P C

3 0 0 3

OBJECTIVES:

- To understand the specialized injection moulding process viz., Co-injection moulding, Two-colour injection moulding process, Gas assisted Injection Moulding ,Reaction Injection Moulding, Liquid injection moulding, structural foam moulding and to understand the effect of shrinkage, merit & demerits of the process
- To understand advanced blow moulding process & advanced Extrusion process.To expertise the student with sufficient background for selection of processing techniques.

UNIT I SPECIALIZED INJECTION MOULDING PROCESS - I 9

Introduction - Co-injection moulding, Two-colour injection moulding process - applications, Gas assisted Injection Moulding - Basic processes and procedures - Moulding aspects -shrinkage and summary. Reaction Injection Moulding (RIM) - Process - Mould – Process-Controls – Merits.

UNIT II SPECIALISED INJECTION MOULDING PROCESS – II 9

Multi-layer Moulding, Counter flow moulding, Liquid Injection Moulding processes. Structural foam moulding - Low pressure and high pressure processes - Merits &demerits.

UNIT III ADVANCED BLOW MOULDING - I **9**

Introduction - Classification of advanced Blow moulding processes - Deep draw Double Wall Blow Moulding Technology - Split moulds- Versatility - Applications. Press Blow Moulding Technology Process - Applications, Three dimensional Blow Moulding Process -Applications.

UNIT IV ADVANCED BLOW MOULDING – II **9**

Stretch blow moulding - Injection stretch blow moulding - Extrusion stretch blow moulding- Process - Merits & demerits - Applications. Multi-layer Blow Moulding - Process -Applications.

UNIT V ADVANCED EXTRUSION PROCESSES **9**

Introduction - Profile Extrusion - Material - Process - Process optimization - Cooling Profile applications. Process, down stream equipments - dies and application. Multi-layer films, co-extruded sheets, Pipes, Corrugated pipes.

TOTAL:45 PERIODS

OUTCOME:

- At the end of the course, the students will have knowledge on advance processing technique, end product application & it's importance with industrial relevance.

TEXT BOOKS:

1. Osswald, Tim A, Lih-Sheng Turng and Gramann, Paul, Injection Molding Hand Book, 2nd Ed., Hanser Publisher, Munich 2008Rubin, Irvin I., Injection Molding Theory & Practice, Johnwiley & sons Inc.,US, 1972
2. Levy, Sydney and Carley, James F., Plastics Extrusion Technology Hand Book, 2nd Ed., Industrial Press Inc., Newyork 1989.
3. Lee, N. C., Plastic blow Moulding Handbook, Van Nostrand Reinhold.,1990.
4. Rosato, Donald and Rosato, Dominick.V., Injection Moulding Handbook, 2nd Ed., International Thomson Publishing company, Newyork 1995.
5. Strong, Brent A., Plastics – Materials & Processing, 3rd Ed., Pearson Education Ltd., Newyork, 2006.

REFERENCES:

1. James F. Stenvension, Innovation in Polymer Processing Moulding, HanserPublishers, New York, 1996.
2. Friedhelm Henson, Plastics Extrusion Technology, Hanser Publishers, New York,1988.
3. Rubin, Irvin I., Injection Molding Theory & Practice, Johnwiley & sons Inc.,US, 1972.
4. Kamal, Musa R, Isayev, Avaram. I and Shih – Jung Liu, Injection M olding – Technology & Fundamentals, Hanser Punlishers, Munich, 2009.
5. Fisher, E.G., Extrusion of Plastics, 2nd Ed., Little Books Pvt. Ltd., London, 1964.
6. Hensen, Freidhelm, Plastics Extrusion Technology, 2nd Ed., Hansen Publishers, Munich 1997.
7. Giles, Harold F., Wagner, John R. and Mount Eldridge M., Extrusion. The Definitive Processing Guide and Hand Book, William Andrew Publishing, Newyork, 2005.
8. Crawford, R.J. , Plastics Engineering, 3rd Ed., Elsevier India Pvt. Ltd., New Delhi 2006.
9. Charles A Harper Handbook of plastics Processes.,2005.
10. Onasch, J., Back or forward to Basics in B, P and R, May 1987
11. Schar, J., Press blowing option for tough to blow parts, SPE ANTEC April'87.
12. Engineered Materials Handbook, ASM International Handbook committee, USA.,1995.

PL8005 **ELECTRICAL DEVICES** **L T P C**
3 0 0 3

OBJECTIVES:

- To develop knowledge and understanding of electrical devices including programmable devices, sensors and actuators.
- To develop understanding of signal conditioning techniques and signal conversion devices.

UNIT I INTRODUCTION **9**

Electrical Device**-**definition and symbols of electrical devices**,** operation of basic electrical devices- fuse, switches, circuit breaker, relay, meters- ammeter, voltmeter, energy meter, ohmmeter, generator, and motor.

UNIT II ELECTRICAL SENSORS AND ACTUATORS **9**

Function and operation of electrical sensors used to measure a range of physical properties i.e. Light- photo-diode, phototransistor, temperature -thermistor, thermocouple, force/pressure - strain gauge, load cell, position - optical encoder, linear variable differential transformer, hall effect sensor, speed -. tacho-generator, Doppler effect sensor, flow -. vane controlled potentiometer, sound – microphone, electric linear actuator , electric rotary actuator , linear solenoid actuator .

UNIT III PROGRAMMABLE DEVICES **9**

Function of programmable logic devices (PLDs) -programmable logic array (PLA),programmable array logic (PAL) , field programmable gate array (FPGA), static random access memory (SRAM) ,electrically programmable read only memory (EPROM) ,flash memory , internal architecture and typical system configurations (e.g. input ports, output ports, peripheral devices) for circuits using programmable devices -microprocessor ,microcontroller ,programmable interface controller (PIC) ,programmable logic controller (PLC) .

UNIT IV SIGNAL CONDITIONING TECHNIQUES AND SIGNAL CONVERSION DEVICES **9**

Signal conditioning and interfacing - sensor output signal type i.e. voltage , current , filtering using operational amplifier (op-amp) circuits - low-pass filter , high-pass filter, function and operation of signal conversion devices - analogue to digital conversion , digital to analogue conversion, parallel to serial conversion ,serial to parallel conversion , calculation of baud and bit rate for a serial data signal .

UNIT V MATERIALS USED IN ELECTRICAL DEVICES **9**

Classification of Electrical Engineering Materials, Physical Properties of Materials, Mechanical properties of engineering materials, Chemical Properties of Materials, Selection of material for Engineering Material for engineering application, Low Resistivity or high conductivity of conducting material, High resistivity or low conductivity of conducting material, Factors effecting the resistivity of electrical materials, Materials used for heating elements ,bimetals, piezoelectricity, dielectric materials.

TOTAL: 45 PERIODS

OUTCOMES:

Upon completing this course, the students

- Will gain knowledge about various electrical devices.
- Will have knowledge about the materials used in electrical devices.

TEXT BOOK:

1. Mechatronics: Electronic Control Systems in Mechanical and Electrical Engineering, by Bolton, Third Education, Pearson Education India.,2015.

REFERENCES:

1. Handbook of electrical Design Details, Second Edition by Neil Scalter 2003,The McGraw –Hill companies,Inc.,2003.
2. Mechatronics Systems, sensors and actuators, Fundamentals and modelling by Robert H.,2007.
3. Digital Electronics, Principles and integrated circuits by Anil Maini.,2007.
4. Electrical engineering materials and semiconductor devices by J.B Gupta Renu Gupta 2013.

PL8006 ADHESIVES AND SURFACE COATINGS L T P C
3 0 0 3

OBJECTIVES:

To enable the students to understand the following:

- Types of specialty adhesives and their application
- Adherend surfaces and joint design
- Surface coatings - constituents and classification
- Evaluation of properties of surface coatings

UNIT I **9**

Adhesives - concepts and terminology, functions of adhesives, advantages and disadvantages of adhesive bonding, theories of adhesion-mechanical theory, adsorption theory, electrostatic theory, diffusion theory, weak-boundary layer theory, requirements for a good bond, criteria for selection of adhesives.

UNIT II **9**

Types of adhesives, structural adhesives, Urethane structured adhesives, Modified acrylic structural adhesives, phenolic adhesives and modifiers, anaerobic adhesives, cyanoacrylate adhesives, hot melt adhesives, pressure sensitive adhesives, RTV Silicone adhesives, sealants, water based adhesives. Specialty adhesives, adhesives in aerospace, adhesive in automobile industry, conductive adhesives, adhesives in building construction, adhesive in electrical industry.

UNIT III **9**

Joint design, stress, types of joints, selection of joint detail, joint criteria, surface preparation of adherends-metals, plastics and rubbers. Adhesive bonding process methods for adhesives application and bonding equipment, adhesives for specific substrates, testing of adhesives, adhesive specifications and quality control.

UNIT IV **9**

Introduction to surface coatings -Components of paints. Pigments, pigment properties, different types, extenders, solvents, oils, driers, diluents, lacquers, varnishes, paint preparation, formulation, factors affecting pigment dispersion, preparation of pigment dispersion. Different types of paints- classification based on polymeric resin, emulsion, oil and alkyd paints, acrylic paints, epoxy coatings, polyurethane, silicones, formaldehyde based resins, chlorinated rubbers, hydrocarbon resins. Classification based on application, fluropolymers, vinyl resins, appliance furnishes, automotive finishes, coil coatings, can coatings, marine coatings, aircraft coatings.

UNIT V **9**

Surface preparation and paint application. Paint properties and their evaluation -mechanism of film formation, factors affecting coating properties, methods used for film preparation - barrier properties, optical properties, ageing properties, rheological properties and adhesion properties of coatings.

TOTAL: 45 PERIODS

OUTCOMES:

Upon completing this course, the students

- Will attain the knowledge in mechanism of adhesion
- Will familiarize about the compounding of paints
- Will demonstrate the adhesive types and application

TEXT BOOKS:

1. Gerald L. Schreberger, “Adhesive in Manufacturing”, Marcel Dekker Inc., New York, 1983
2. W.C. Wake, “Adhesion and the Formulation of Adhesives”, Applied Science Publishers, London, 1976.
3. Premamoy Ghosh, Adhesives and Coatings Technology, (2008)
4. Formulating Adhesives and sealants, B. Muller, Walter lath, (2010).

REFERENCES:

1. Swaraj Paul, “Surface Coatings”, John Wiley & Sons, NY, 1985.
2. George Mathews, “Polymer Mixing Technology”, Applied Science Publishers. Shields, “Hand Book of Adhesives”, Butterworths,1984

GE8077 TOTAL QUALITY MANAGEMENT L T P C

3 0 0 3

OBJECTIVE:

- To facilitate the understanding of Quality Management principles and process.

UNIT I INTRODUCTION **9**

Introduction - Need for quality - Evolution of quality - Definitions of quality - Dimensions of product and service quality - Basic concepts of TQM - TQM Framework - Contributions of Deming, Juran and Crosby - Barriers to TQM - Customer focus - Customer orientation, Customer satisfaction, Customer complaints, Customer retention.

UNIT II TQM PRINCIPLES **9**

Leadership - Quality Statements, Strategic quality planning, Quality Councils - Employee involvement - Motivation, Empowerment, Team and Teamwork, Recognition and Reward, Performance appraisal - Continuous process improvement - PDCA cycle, 5S, Kaizen - Supplier partnership - Partnering, Supplier selection, Supplier Rating.

UNIT III TQM TOOLS AND TECHNIQUES I **9**

The seven traditional tools of quality - New management tools - Six sigma: Concepts, Methodology, applications to manufacturing, service sector including IT - Bench marking - Reason to bench mark, Bench marking process - FMEA - Stages, Types.

UNIT IV TQM TOOLS AND TECHNIQUES II **9**

Quality Circles - Cost of Quality - Quality Function Deployment (QFD) - Taguchi quality loss function - TPM - Concepts, improvement needs - Performance measures.

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.

TOTAL: 45 PERIODS

OUTCOME:

- The student would be able to apply the tools and techniques of quality management to manufacturing and services processes.

TEXT BOOK:

1. Dale H.Besterfiled, 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.

REFERENCES:

1. James R. Evans and William M. Lindsay, "The Management and Control of Quality", 8th Edition, First Indian Edition, Cengage Learning, 2012.
2. Janakiraman. B and Gopal .R.K., "Total Quality Management - Text and Cases", Prentice Hall (India) Pvt. Ltd., 2006.
3. Suganthi.L and Anand Samuel, "Total Quality Management", Prentice Hall (India) Pvt. Ltd., 2006.
4. ISO9001-2015 standards

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