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B.TECH. POLYMER TECHNOLOGY
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1. Program Educational Objectives (PEOs)

Bachelor of Technology in Polymer Technology curriculum and syllabus is designed to prepare graduates:

PEO 1: who will be technically proficient in Polymer Technology with a commitment to quality, timeliness and compete with confidence in their career.

PEO 2: who will be professionals with integrity and strong ethical values and will contribute to the professional society.

PEO 3: who will engage in lifelong learning or continuous education opportunities.

PEO 4: who will contribute towards research and professional development and entrepreneurship.

2. Programme Outcomes (POs)

A graduate of this major should be able to:

a. **Engineering Knowledge**: Select and apply the engineering knowledge, technique and skills in Polymer Science and Technology.
b. **Problem Analysis**: Select and apply knowledge of mathematics, science, engineering, and technology to Polymer Technology and engineering problems that require the application of principles and applied procedures or methodologies.
c. **Design/development of solutions**: conduct standard tests and measurements; conduct, analyze, and interpret experiments; and apply experimental results to improve processes.
d. **Conduct investigations of complex problems**: design systems, components, or processes for broadly defined Polymer Technology problems.
e. **Modern Tool Usage**: select and apply appropriate techniques, resources and modern tools in Polymer Science and Technology.
f. **The Engineer and Society**: understand the need for and engage in self-directed continuing professional development.
g. **Environment and Sustainability:** understand the impact of Polymer Technology solutions in a societal and global context
h. **Ethics:** demonstrate an understanding of and a commitment to professional and ethical responsibilities, including a respect for diversity
i. **Individual and team work**: function effectively as a member or leader on a technical team.
j. **Communication:** communicate effectively regarding broadly defined Polymer Technology and Engineering activities.
k. **Project Management and Finance**: Demonstrate knowledge and understanding of engineering and management principles which apply to Polymer Engineering areas.
l. **Life-long learning:** exhibit a commitment to quality, timeliness, and continuous improvement.

3. Programme Specific Outcomes (PSOs)

The graduate is expected to:

PSO1 Polymer industry oriented preparedness: Reveal an ability to identify careers in polymer technology domains like, synthesis of polymers, processing and quality control, which adopt skills required to work in a polymer technology laboratory or a manufacturing facility.

PSO2 Higher Education Preparedness: Demonstrate an ability to appear for competitive examinations to pursue higher studies.

4. PEOs / POs MAPPING

PEOs/ POs	a	b	C	d	e	f	g	h	I	j	k	l	PSO 1	PSO2
PEO 1	✓	✓	✓	✓	✓					✓		✓	✓	✓
PEO 2								✓		✓	✓	✓	✓	✓
PEO 3						✓	✓	✓	✓	✓		✓	✓	✓
PEO 4	✓	✓	✓	✓	✓						✓	✓	✓	✓

5. Semester Course Wise POs Mapping

		Course Title	a	b	c	d	e	f	g	h	i	j	k	l	PSO1	PSO2
I YEAR	SEMESTER 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	√	√	√			√	√		√			√	√	√
	SEMESTER 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	√	√		√	√					√		√	√	√
II YEAR	SMESTER III	Probability and Statistics														
		Fundamentals of Polymer Science	√	√			√	√	√			√	√	√	√	√
		Environmental Science and Engineering	√	√					√	√		√		√	√	√
		Mechanics of Solids	√	√	√		√				√	√		√	√	√
		Introduction to Chemical Engineering	√	√	√		√					√	√	√	√	√
		Polymer Physics	√	√	√		√		√			√	√	√	√	√
		Chemical Engineering Laboratory	√	√	√	√	√	√	√			√			√	√
		Polymer Identification and Analysis Laboratory	√		√		√		√	√	√	√	√	√	√	√
		Interpersonal Skills/Listening and Speaking								√	√	√		√	√	√
	SEMESTER IV	Numerical Methods	√	√	√										√	√
		Fluid Mechanics and Polymer Rheology	√	√	√		√				√	√		√	√	√
		Plastics Materials I	√				√	√	√			√	√	√	√	√
		Rubber Materials	√		√		√		√			√	√	√	√	√
		Process Instrumentation for Polymer Technologist	√	√			√	√				√	√	√	√	√
		Mould Manufacturing Technology	√		√		√					√	√	√	√	√
		Mould Manufacturing Technology Laboratory	√		√		√		√	√					√	√
		Advanced Reading and Writing								√	√	√		√	√	√
III YEAR	SEMESTER V	Plastics Processing	√	√			√					√	√	√	√	√
		Characterization of Polymers	√	√	√	√	√	√	√	√	√	√	√	√	√	√
		Plastics Materials II	√				√	√	√			√	√	√	√	√
		Rubber Compounding	√	√	√		√		√			√	√	√	√	√
		Polymer Preparation Laboratory	√	√	√		√	√		√	√	√	√	√	√	√
		Plastics Processing Laboratory	√	√			√	√	√	√	√	√	√	√	√	√
	SEMESTER VI	Design of Moulds and Dies for Polymers	√	√	√	√	√					√	√	√	√	√
		Rubber Processing and Machinery	√	√	√		√		√			√	√	√	√	√
		Testing of Polymers	√	√	√		√	√	√	√		√	√	√	√	√
		Polymer Blends and Alloys	√	√	√	√	√				√	√	√	√	√	√
		Rubber Processing Laboratory	√	√	√		√			√	√	√	√	√	√	√
		Polymer Testing Laboratory	√	√	√	√	√	√	√	√	√	√	√	√	√	√
IV YEAR	SEMEST	Polymer Product Design	√	√	√		√	√	√			√	√	√	√	√
		Rubber Product Manufacturing	√				√		√			√	√	√	√	√
		Polymer Composites	√	√	√		√	√	√			√	√	√	√	√
		Computer Aided Polymer Product	√	√	√	√	√			√	√	√	√	√	√	√

		Design													
		Comprehension								√	√		√	√	√
	SEM VIII	Project Work	√	√	√	√	√	√	√	√	√	√	√	√	√

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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	PT8311	Polymer 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	PT8401	Rubber Materials	PC	3	3	0	0	3
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	**25**	**19**	**0**	**6**	**22**

SEMESTER V

S. No.	COURSE CODE	COURSE TITLE	CATE GORY	CONTACT PERIODS	L	T	P	C
THEORY								
1.	PT8501	Plastics Processing	PC	3	3	0	0	3
2.	PT8502	Characterization of Polymers	PC	3	3	0	0	3
3.	PL8551	Plastics Materials II	PC	3	3	0	0	3
4.	PT8503	Rubber Compounding	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
PRACTICALS								
7.	PT8561	Polymer Preparation Laboratory	PC	4	0	0	4	2
8.	PT8511	Plastics Processing Laboratory	PC	4	0	0	4	2
			TOTAL	**27**	**19**	**0**	**8**	**23**

* - Course from the curriculum of the other UG Programmes

SEMESTER VI

S. No.	COURSE CODE	COURSE TITLE	CATE GORY	CONTACT PERIODS	L	T	P	C
THEORY								
1	PT8601	Design of Moulds and Dies for Polymers	PC	3	3	0	0	3
2	PT8602	Rubber Processing and Machinery	PC	4	4	0	0	4
3	PT8603	Testing of Polymers	PC	3	3	0	0	3
4	PT8651	Polymer Blends and Alloys	PC	3	3	0	0	3
5		Professional Elective II	PE	3	3	0	0	3
6		Professional Elective III	PE	3	3	0	0	3
PRACTICALS								
7	PT8611	Rubber Processing Laboratory	PC	4	0	0	4	2
8	PT8612	Polymer Testing Laboratory	PC	4	0	0	4	2
			TOTAL	**27**	**19**	**0**	**8**	**23**

SEMESTER VII

S. No.	COURSE CODE	COURSE TITLE	CATE GORY	CONTACT PERIODS	L	T	P	C
THEORY								
1	PT8701	Polymer Product Design	PC	4	4	0	0	4
2	PT8702	Rubber Product Manufacturing	PC	3	3	0	0	3
3	PT8751	Polymer Composites	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		Professional Elective VI	PE	3	3	0	0	3
7		Open Elective II*	OE	3	3	0	0	3
PRACTICALS								
8	PT8711	Computer Aided Polymer Product Design Laboratory	PC	4	0	0	4	2
9	PT8712	Comprehension	EEC	2	0	0	2	1
			TOTAL	**28**	**22**	**0**	**6**	**25**

* - Course from the curriculum of the other UG Programmes

SEMESTER VIII

S. No.	COURSE CODE	COURSE TITLE	CATE GORY	CONTACT PERIODS	L	T	P	C
PRACTICALS								
1	PT8811	Project Work	EEC	20	0	0	20	10
			TOTAL	**20**	**0**	**0**	**20**	**10**

TOTAL CREDITS:177

PROFESSIONAL ELECTIVES

PROFESSIONAL ELECTIVE I, SEMESTER V

S. No.	COURSE CODE	COURSE TITLE	CATE GORY	CONTACT PERIODS	L	T	P	C
1.	PT8001	Design of Machine Elements	PE	3	3	0	0	3
2.	PT8072	Fiber Technology	PE	3	3	0	0	3
3.	PT8073	Plastics Packaging Technology	PE	3	3	0	0	3
4.	GE8071	Disaster Management	PE	3	3	0	0	3

PROFESSIONAL ELECTIVE II, SEMESTER VI

S. No.	COURSE CODE	COURSE TITLE	CATE GORY	CONTACT PERIODS	L	T	P	C
1.	GE8075	Intellectual Property Rights	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.	PL8072	Biodegradable Polymers	PE	3	3	0	0	3

PROFESSIONAL ELECTIVE III, SEMESTER VI

S. No.	COURSE CODE	COURSE TITLE	CATE GORY	CONTACT PERIODS	L	T	P	C
1.	PT8002	Polymers in Automobiles	PE	3	3	0	0	3
2.	PT8003	Tyres and Tubes Technology	PE	3	3	0	0	3
3.	PT8004	Polymer Reaction Engineering	PE	3	3	0	0	3
4.	GE8076	Professional Ethics in Engineering	PE	3	3	0	0	3
5.	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 PERIODS	L	T	P	C
1.	PT8005	Latex Technology	PE	3	3	0	0	3
2.	PT8071	Conducting Polymers	PE	3	3	0	0	3
3.	PT8075	Polymers for Energy Storage Applications	PE	3	3	0	0	3
4.	PL8073	Biomedical Plastics	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 PERIODS	L	T	P	C
1.	PL8007	Paints and Surface Coatings	PE	3	3	0	0	3
2.	PL8091	Thermoplastic Elastomers	PE	3	3	0	0	3
3.	PL8071	Advanced Plastics Processing	PE	3	3	0	0	3
4.	GE8077	Total Quality Management	PE	3	3	0	0	3

PROFESSIONAL ELECTIVE VI, SEMESTER VII

S. No.	COURSE CODE	COURSE TITLE	CATE GORY	CONTACT PERIODS	L	T	P	C
1.	PT8006	Speciality Polymers	PE	3	3	0	0	3
2.	PT8007	Footwear Technology	PE	3	3	0	0	3
3.	PT8008	Speciality Elastomers	PE	3	3	0	0	3
4.	PT8009	Product Design and Cost Estimation	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.	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.	PT8311	Polymer Identification and Analysis Laboratory	PC	4	0	0	4	2
4.	PT8451	Fluid Mechanics and Polymer	PC	3	3	0	0	3

		Rheology						
5.	PL8451	Plastics Materials I	PC	3	3	0	0	3
6.	PT8401	Rubber Materials	PC	3	3	0	0	3
7.	PT8452	Mould Manufacturing Technology	PC	3	3	0	0	3
8.	PT8461	Mould Manufacturing Technology Laboratory	PC	4	0	0	4	2
9.	PT8501	Plastics Processing	PC	3	3	0	0	3
10.	PT8502	Characterization of Polymers	PC	3	3	0	0	3
11.	PL8551	Plastics Materials II	PC	3	3	0	0	3
12.	PT8503	Rubber Compounding	PC	4	4	0	0	4
13.	PT8561	Polymer Preparation Laboratory	PC	4	0	0	4	2
14.	PT8511	Plastics Processing Laboratory	PC	4	0	0	4	2
15.	PT8601	Design of Moulds and Dies for Polymers	PC	3	3	0	0	3
16.	PT8602	Rubber Processing and Machinery	PC	4	4	0	0	4
17.	PT8603	Testing of Polymers	PC	3	3	0	0	3
18.	PT8611	Rubber Processing Laboratory	PC	4	0	0	4	2
19.	PT8612	Polymer Testing Laboratory	PC	4	0	0	4	2
20.	PT8651	Polymer Blends and Alloys	PC	3	3	0	0	3
21.	PT8701	Polymer Product Design	PC	4	4	0	0	4
22.	PT8702	Rubber Product Manufacturing	PC	3	3	0	0	3
23.	PT8751	Polymer Composites	PC	3	3	0	0	3
24.	PT8711	Computer Aided Polymer Product Design 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	PT 8712	Comprehension	EEC	2	0	0	2	1
4	PT8811	Project Work	EEC	20	0	0	20	10

SUMMARY

Subject Area/Semester	HS	BS	ES	PC	PE	OE	EEC	Total
I	4	12	9					**25**
II	4	10	11					**25**
III	3	4	8	8			1	**24**
IV		4	3	14			1	**22**
V				17	3	3		**23**
VI				17	6			**23**
VII				12	9	3	1	**25**
VIII							10	**10**
Total	**11**	**30**	**31**	**68**	**18**	**6**	**13**	**177**

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:

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

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

Padeepz App

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.

PT8311 POLYMER IDENTIFICATION AND ANALYSIS LABORATORY L T P C
0 0 4 2

OBJECTIVES:

- To train the student to identify plastics and rubbers by different methods
- To analyze the polymers through various techniques

LIST OF EXPERIMENTS

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

Part A
Identification of Polymers

A. PLASTICS

1. Polyethylene

2. Polypropylene
3. Polystyrene
4. Polyvinyl Chloride
5. Polyamide
6. Polyethylene terephthalate
7. Polybutylene terephthalate
8. Polycarbonate
9. Polyacetal

(Any Four of the above)

B. RUBBERS

1. Natural Rubber (NR)
2. Polybutylene Rubber (BR)
3. Styrene Butadiene Rubber (SBR)
4. Isoprene Rubber (IR)
5. Ethylene Propylene Diene Monomer (EPDM)
6. Chloroprene Rubber (CR)
7. Acrylonitrile–Butadiene Rubber (NBR)
8. Silicone Rubber

(Any Four of the above)

Part B

ANALYSIS

1. Determination of molecular weight by end group analysis (COOH group)
2. Determination of molecular weight of polymers by viscosity method.
3. Determination of epoxy equivalent.
4. Determination of acid value of polyester resin.
5. Determination of K - value of PVC resin
6. Analysis of Moisture Content
7. Analysis of water absorption

(Any Four of the above)

TOTAL: 60 PERIODS

OUTCOMES:

Upon completion of this course, students

- will be able to identify different types of plastics and rubber by their characteristics
- will able to characterize the polymer by different techniques.

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 Glassware	15 Nos.
Burette	15 Nos.
Pipette	15 Nos.

Funnel 15 Nos.

REFERENCES:

1. Dietrich Braun. Simple Methods for Identification of f Plastics, Hanser Publications, 5th edition, 2005.
2. Siddaramaiah, “Practicals in Polymer Science”, CBS Publishers & Distributors, New Delhi, 2007.

HS8381	INTERPERSONAL SKILLS/LISTENING AND 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

PT8401 RUBBER MATERIALS L T P C
3 0 0 3

OBJECTIVES:

- To gather basic knowledge on structure and properties of natural rubber, synthetic rubber and thermoplastic elastomers
- To define the reclaim rubber, properties and its applications

UNIT I NATURAL RUBBER 12

Natural Rubber: Origin – Natural Rubber Latex, tapping, processing, properties and applications – Conversion of Latex into dry rubber – smoked sheet, air dried sheet, crepe rubber -Modifications of Natural Rubber–Applications

UNIT II GENERAL PURPOSE ELASTOMERS 7

Manufacturing, structure, properties, curing and applications of- Polyisoprene, Polybutadiene, SBR, EPDM, Nitrile rubber.

UNIT III SPECIAL PURPOSE ELASTOMERS -I 9

Manufacturing, structure, properties, curing and applications of- Butyl rubber, Halobutyl, Neoprene – CSM, Fluoro elastomer (FKM), Epichlorohydrin, Polysulphide.

UNIT IV SPECIAL PURPOSE ELASTOMERS-II 8

Manufacturing, structure, properties, curing, and applications of-Polyurethane Elastomers, Acrylic rubber, Ethylene Vinyl Acetate, Silicone rubber.

UNIT V THERMOPLASTIC ELASTOMERS AND RECLAIMED RUBBERS 9

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

elastomer, Polyurethane thermoplastic elastomers. Reclaimed rubber - process of reclamation – applications.

TOTAL: 45 PERIODS

OUTCOMES:

Upon completion of this course students,

- will explain the basics of natural rubber and modified forms of natural rubber
- will classify different synthetic rubber and compare the structure and properties of synthetic polymers
- will discuss the manufacturing process of synthetic rubbers
- will explain the process of reclamation and morphological behavior of thermoplastic elastomers

TEXT BOOKS:

1. C.M.Blow and C. Hepburn,- Rubber Technology and Manufacture, Buttenvorths, London, 3nd edition, 2009.
2. J.A.Brydson, -Rubber chemistry, Applied science Publishers, 1978.
3. Hoffman, Rubber Technology Handbook -, Hanser Publication. Munich - 1996

REFERENCES:

1. Anil .K. Bhowmick, Howard L. Stephens (Edt), Handbook of Elastomers - New Developments & Technology, Marcel Decker Inc. New York, 2nd Edition, 2000.
2. Maurice Morton, Rubber Technology, Springer Science + Business Media, 1999

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

PT8501 **PLASTICS PROCESSING** **L T P C**
3 0 0 3

OBJECTIVE:

- To make the students learn about different plastic processing techniques such as injection, blow moulding , thermoforming, about various compression and transfer molding process

UNIT I PLASTICS PROCESS TECHNIQUES 9

Introduction to polymer processing - Plastics process techniques - Injection moulding – Types of Injection unit & Elements of plasticating process - Classification of screw - Classification and functions of moulds - Clamping unit –Trouble shooting operations.

UNIT II BLOW MOULDING & THERMOFORMING 9

Blow moulding and thermoforming – Fundamentals of the processes, Extrusion blow moulding, Injection blow moulding, Stretch Blow Molding process, Parison wall thickness control & Parison swell- Thermoforming Methods - Simple vacuum forming, Drape forming, Snap Back Forming, Pressure forming, Plug-assist forming & Matched mold forming- Advantages, Disadvantages.

.

UNIT III COMPRESSION AND TRASFER MOULDING 9

Compression moulding - Types, Advantages & Limitations, Type of compression mould, - Transfer moulding – Types- Pot Type Transfer Mold- Plunger type transfer mold - Advantages -Limitations.

UNIT IV EXTRUSION AND CALENDERING 9

Extrusion and calendering - Principle - Types of Extruders - Single screw and twin-screw extruders - Types of dies - Extrusion of Pipes, Profiles, Cables, Blown films and Sheet- types and processing operations of calenders

UNIT V UNCONVENTIONAL PROCESSES 9

Unconventional processes – rotational molding, casting, machining, joining

TOTAL: 45 PERIODS

OUTCOMES:

Upon completing this course, the students

- Will familiarize injection molding method employed for Plastics.
- Will attain knowledge in Blow molding process.
- Will know about the compression molding and transfer molding process
- Will have the knowledge in extrusion of plastics
- Will familiarize in thermoforming process

TEXT BOOKS:

1. D.V. Rosato Kluwer, “Injection Moulding Handbook”, Springer Science + Business Media LLC, 3rd Edition 2000.
2. Frados J. Van Nostrand Reinhold, “Plastic Engineering Handbook of the Society of the Plastics Industry”, N.Y. (4th edition).

REFERENCES:

1. N.P. Charemisinoff & P.N. Chere, “Handbook of Applied Polymer Processing Tech”, Marcel Dekker, Inc, NY 1996.
2. Herbert Recs, “Understanding of Injection Moulding Tech.”, Hanser Pub., Munich 1994.

PT8502 CHARACTERIZATION OF POLYMERS L T P C
3 0 0 3

OBJECTIVES:

- To introduce basic introduction, techniques for materials characterization and its importance
- To provide basic descriptions of a characterization methods for the determination of the structure and composition of solids by spectroscopy techniques
- To introduce the interpretation of the characterization technique of molecular weight of polymers
- To introduce the interpretation of the characterization technique of thermal properties of polymers and practice on thermal testing.
- To describe the operations and uses of TEM, SEM contact angle and atomic force microscopy.

UNIT I IDENTIFICATION AND ANALYSIS 9

Thermoplastics - melting point, density, viscosity, melt flow index, K-value. moisture analysis, particle size, apparent density, Thermo sets - spiral flow test, cup flow test, gel time and peak exothermic temperature. Resins - acid value, hydroxyl value, isocyanate index, epoxy equivalent

UNIT II SPECTRAL ANALYSIS OF POLYMERS 9

Principle, experimental technique and applications of UV, FTIR spectroscopy & NMR spectroscopy –^{1}H and ^{13}C – Instruments

UNIT III MOLECULAR CHARACTERIZATION OF POLYMERS 9

Determination of molecular weight- molecular weight distribution- gel permeation chromatography (GPC) high-performance liquid chromatography (HPLC)-. X-ray diffraction analysis -wide and small angle X-ray diffraction techniques-Vapour phase osmametry

UNIT IV THERMAL ANALYSIS OF POLYMERS 9

Thermal Analysis: Characterizing polymer using differential thermal analysis (DTA), differential scanning calorimeter (DSC), thermogravimetric analysis (TGA), thermomechanical analysis (TMA), and dynamic mechanical analysis (DMA).

UNIT V MICROSCOPY AND SURFACE PROPERTIES 9

Microscopy: Basic principle of electron microscopy; specimen preparation, instruments, working and applications of scanning electron microscope (SEM), transmission electron microscopy (TEM) and atomic force microscopy (AFM), contact angle measurements .

TOTAL: 45 PERIODS

OUTCOMES:

Upon completing this course, the students

- will have deep understanding of the fundamental testing of materials and able to identify basic techniques for specific materials Characterization.
- will read the basic spectra of materials characterizations
- will understand the determination of molecular characterization techniques
- will be familiar with thermal properties of polymers and critically discuss data interpretation and limitations.
- will understand basic elements, operation and applications of microscopy techniques

TEXT BOOKS:

1. Chermisinoff, Polymer Characterization - Laboratory Techniques and Analysis. Elsevier, 1st Edition, 1996.
2. D. Campbell and J. R. White "Polymer Characterization: Physical Techniques, Chapman & Hall, London, 2000.

REFERENCES:

1. ASTM - 9.01 & 9.02; 8.01 & 8.04, 2000
2. Kampff, Characterization of Plastics using physical methods, Experimental Techniques and practical applications, Oxford University Press, USA, 1988

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.

PT8503 RUBBER COMPOUNDING L T P C
4 0 0 4

OBJECTIVES:

- To enable the students to know about need for additives in compounding of rubber
- To understand the different types of ingredients in compounding.
- To know about property modification by vulcanization
- To enrich knowledge on testing of compounded rubber

UNIT I PRINCIPLES OF COMPOUNDING 12

Introduction- The ingredients and formulation of a mix: Design of compounding experiments and evaluation of data – Compounding to meet processing requirements – Compounding for Vulcanizate properties

UNIT II FILLERS AND PROCESSING AIDS 12

Fillers: Carbon black, Non carbon black – Colors & Pigments - Plasticizers, Process aids, Softeners and Extenders.

UNIT III ANTIDEGRADATION AND MISCELLEOUS 12

Antioxidants, Antiozonants– Mechanism of degradation – Mechanism of ozone attack. Special purpose additives: Chemical blowing agents - Flame retardants – Antistatic agent – Abrasives – Integral bonding additives - stiffening agents.

UNIT IV ADDITIVES FOR VULCANIZATION 12

Vulcanization: Sulphur vulcanization and non-sulphur vulcanizing system for olefins and non-olifins – Accelerators – Activators – Promoters, Peptizing agent.

UNIT V TESTING 12

Test on unvulcanized rubber – Scorch and cure rate: Rotational viscometer, MDR, capillary rheometer, and torque rheometer – Viscoeleastic behavior: Plastimeter and PRI – Tack – Green strength – Density – Hardness, Dispersion analysis

TOTAL: 60 PERIODS

OUTCOMES:

After completing the course, the students

- Will understand concept of rubber compounding.
- Will modify the properties of rubber by incorporation of additives.
- Will develop rubber compound for required end use application.
- Will modify the strength by varying vulcanizing agents.
- Will do testing of rubber and asses' quality of rubber compound.

REFERENCES:

1. John S Dick, "Rubber Technology- Compounding and Testing for Performance" Hanser Publishers, 2001.
2. C. Hepburn, "Rubber Technology and Manufacturing", Butterworth-Heinemann, 2009
3. Brendon Rodgers, "Rubber Compounding- Chemistry and Applications", Taylor and Francies, 2016.
4. Roger Brown, "Physical Testing of Rubber", Chapman & Hall, 3rd Edition, 1996.

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	

PT8511 PLASTICS PROCESSING LABORATORY L T P C
0 0 4 2

OBJECTIVE:

- To train the students on different plastic processing techniques such as extrusion, compression moulding, calendaring, FRP processing etc.

LIST OF EXPERIMENTS

1. Preparation of Blow moulded products
2. Compression moulding of phenolic resin and SMC& BMC
3. Injection moulding of thermoplastics ~~– Hand~~, semiautomatic and Fully automatic
4. Extrusion of thermoplastics
5. Compounding of plastics
6. Preparation of FRP laminates
7. Post processing techniques
8. Preparation of Thermoformed products
9. Recycling of plastic – Scrap grinder
10. Casting of polymer films
11. Manufacturing practices

TOTAL: 60 PERIODS

OUTCOMES:

Upon completing this course, the students

- Will be able to operate the automatic injection, blow moulding machine
- Will be able to prepare the blow mould, thermoformed products
- Will be able to demonstrate the plastic sealing & welding and preparation of polymer films by casting method
- Will be able to describe the mould maintenance and manufacturing practices
- Will be able to dramatize the scrap grinder by using the recycling of plastics

LIST OF EQUIPMENT FOR BATCH OF 30 STUDENTS

Injection moulding (Hand injection moulding machine, Semi Automatic injection moulding machine, Fully automatic injection moulding machine)	1 No.
Extruder for compounding of thermoplastics	1 No.
Hand blow moulding machine	1 No.
Fully automatic blow moulding machine	1 No.
Air compressor	1 No.
Scrap grinder	1 No.
Crane for mould handling	1 No.
Bench grinding and buffing machine	1 No.
Bench wise	1 No.
Sheet cutter	1 No.
Moulds for hand injection moulding	3 Nos.
Mould for automatic injection moulding	1 No.
Mould for semiautomatic injection moulding	1 No.
Mould for hand blow moulding	1 No.
Mould for fully automatic blow moulding	1 No.
Thermo Forming Unit	1 No.
Electronic balance	1 No

PT8601 DESIGN OF MOULDS AND DIES FOR POLYMERS L T P C
3 0 0 3

OBJECTIVE:

- To enable the students to learn the design of moulds such as injection, compression, transfer, blow and extrusion dies and moulds.

UNIT I INJECTION MOULDS 9

Classification of Injection Moulds - Design of mould components – Methodical Mould Design – Calculation related to-Number of Cavities, Clamping force, shot weight, Selection of Injection Moulding Machine, Layout of Cavities in multi-impression Mould, Feed Systems - Design of Runners & gate, Ejection Systems, Cooling Systems, Venting

UNIT II COMPRESSION MOULDS 9

Classification of Compression Moulds - Factors that Influence Thermoset Moulding -Materials Selection in Relation to Moulding Conditions- Calculation related to-Number of Cavities, Clamping force, shot weight- Advantages and Disadvantages of Compression moulds. Mould maintenance.

UNIT III TRANSFER MOULDS 9

Transfer Mould - Types, principles, Design of Pot and Plunger, Feed System, Economic determination of the number of cavities, Technological determination of the number of cavities, design of mould cavity, design of loading chamber, Transfer tonnage, shot weight- Heat losses and energy requirement to heat the mould - Advantages and disadvantages of Transfer mould.

UNIT IV BLOW MOULDS 9

Blow Mould Design - Materials Selection, Mould Cooling, Clamping Force, Mould Venting, Pinch-off, Head die design, Parison Diameter Calculation, Wall Thickness, Vertical-load strength, Blow ratio, Base pushup, Shapes, Design based consideration - Shrinkage, Neck and Shoulder Design, Thread and beads, Bottom Design.

UNIT V DIES 9

Extrusion die design-Construction features of an extruder, Process, Characteristics of Polymer melt, Die geometry, Die head Pressure, characteristics of land length to Profile thickness, Extrudate die swell, Die materials, Classification of dies-Dies for Solid Section, Dies for Hollow Profiles, Blown film dies, Flat film dies, Parison dies, Wire and cable Coating dies, Spiral mandrel die, Fish tail die, Adjustable Core die.

TOTAL 45 PERIODS

OUTCOMES:

Upon completing this course, the students

- Will classify the injection moulds and describe the design of feed system
- Will distinguish the compression moulds and demonstrate the mould maintenance
- Will determine the no. of cavities for transfer mould and recognize the design of transfer mould
- Will defend the suitable material for blow mould and design of blow mould
- Will describe the construction of an extruder and distinguish the dies for extruder

TEXT BOOKS:

1. Plastic Design & Processing - By Sharma, S.C.
2. Ronald George William Pye, Injection Mould Design, Longman Scientific & Technical, 1989.
3. Injection Mould Design Fundamentals (Vol. I& II) - By Glanvill & Denton

.

REFERENCES:

1. Dubois, H , Plastics Product Design Engineering Hand Book, Chapman and Hall, Edition 2, 1984
2. Harold. Belofsky , Plastics Product Design & Process Engineering, Hanser Publishers, 1995
3. László Sors, László Bardócz, István Radnóti, Plastics Moulds & Dies - Van Nostrand Reinhold Co., 1981

PT8602 RUBBER PROCESSING AND MACHINERY L T P C
4 0 0 4

OBJECTIVES:

- To understand knowledge on internal mixer.
- To enable the students about calendaring process and mechanism.

- To understand on different types of extrusion process.
- To enrich knowledge on different molding process.
- To understand principle and process of different vulcanization methods.

UNIT I MIXING AND INTERNAL MIXER 12

Two roll mill – Mixing mills – Mastication on the mixing mill – compound preparation on the mixing mill – Pre-heating on the mixing mill – Internal Mixer – Mastication in internal mixer – compound preparation in internal mixer – Elements and Variables of Internal mixer - Kneader.

UNIT II CALENDERING PROCESS 12

Calendering: Construction –calendaring configuration and operation– Processing: Temperature control -Sheeting – Skim coating – Frictioning – Topping – Doubling – Roll floating, Binding and calender gauze control devices

UNIT III EXTRUSION PROCESS 12

Extrusion; Construction of single screw and twin screw extruder - Ram type – Screw type – Function of ancillary equipment for standard extrusion operation - Different types of rubber extruder: Hot, cold feed extruders, Pin barrel extruder – Criteria for machine selection.

UNIT IV MOULDING PROCESS 12

Construction, Principle and Types of - Compression moulding– Transfer moulding- Injection moluding of rubber articles.

UNIT V VULCANIZATION METHODS 12

Principles and Process of - Batch vulcanization: Hot air oven, Autoclave and Press - Continuous vulcanization: Liquid curing method (LCM), Hot air, Microwave, Drum, fluidized beds, Microwave, Electron beam, High pressure steam tube and roto cure.

TOTAL: 60 PERIODS

OUTCOMES

On completion of the course, students

- Will understand on milling and internal mixer.
- Will understand mechanism and operation of calendaring process.
- Will know the mechanism involved in different types of extrusion process.
- Will get knowledge on various molding process.

TEXT BOOKS:

1. Philip K.Freakley, “Rubber Processing and Production Organization”, Plenum Press, Newyork, 1985.
2. Steven Blow, “Handbook of Rubber Technology”, Galgotia Publication Pvt. Ltd, 1998.
3. Blow.C.M. and Hepburn.C. Rubber Technology and manufacture, Butterworths, 1982.
4. White.J.L., Rubber Processing Technology Materials, Principles, Hanser Publication, New York, 1995.

PT8603 TESTING OF POLYMERS L T P C
3 0 0 3

OBJECTIVES:

- To familiarize the students with standards and methodology in preparing various polymers

specimen

- To enable the students to understand the testing of raw materials and components for evaluating various properties; testing the products for predicting product performance

UNIT I STANDARDS AND SPECIMEN PREPARATION 9

Standards - BIS, ASTM, ISO, SPE, SPI, UL. Preparation of test specimen by various techniques for thermoplastics, thermo sets, and elastomers, conditioning and test atmospheres- Analytical tests: determination of specific gravity, water absorption.

UNIT II MECHANICAL PROPERTIES 9

Tensile, compression, flexural, shear, impact, abrasion, hardness, permanent set, rebound resilience, Dematttia flex and cut growth. fatigue.

UNIT III THERMAL AND FLAMMABILITY PROPERTIES 9

Vicat softening temperature, heat distortion temperature, coefficient of expansion, thermal conductivity, brittleness temperature, flammability- non rigid solid plastics self-supporting plastics in horizontal position solid plastics in vertical position- oxygen index test

UNIT IV ELECTRICAL, OPTICAL AND OTHER PROPERTIES 9

Volume and surface resistivity, dielectric constant and dielectric strength, arc resistance, tracking resistance, Refractive index, transparency, haze, gloss, Environmental stress crack resistance (ESCR) - weathering and chemical resistance, aging, ozone resistance, permeability- adhesion.

UNIT V TESTING OF PRODUCTS 9

Plastic films, pipes, foams, containers, and Rubber hose, tyres and tubes. Non-destructive testing: ultrasonic testing, X-ray fluorescence, Acoustic emission (AE) testing

TOTAL: 45 PERIODS

OUTCOMES:

Upon completing this course, the students

- Will have the knowledge of standard and specification for polymer testing.
- Will be able to demonstrate the mechanical testing of polymer
- Will be know the flammability and thermal properties of polymers
- Will get knowledge on electrical and optical properties of polymers.
- Will develop the skills in testing of polymer products.

TEXT BOOKS:

1. Vishu Shah, “Handbook of Plastics Testing Technology”, John Wiley, 3rd Edition, NewYork, 2007.
2. ASTM: 8.01 & 8.04; 9.01 & 9.02,2000

REFERENCES:

1. Roger P. Brown, “Physical Testing of Rubber”, interscience, New York, 1966.
2. Nicholas P.Cheremisinoff, “Product Design and Testing of Polymeric Materials”, Marcel Dekker, Inc, New York, 1990

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.

PT8611 RUBBER PROCESSING LABORATORY L T P C
0 0 4 2

OBJECTIVE:

- To practice the students on mastication, mixing of rubber and preparing rubber products.

LIST OF EXPERIMENTS

1. Mastication of NR on two roll mill
2. Mixing of rubber compounds
3. Compression moulding of rubber compounds
4. Preparation of dry rubber products – play ball
5. Preparation of dry rubber products – Hawaii sheet
6. Preparation of dry rubber products – M.C Sheet
7. Preparation of dispersions for compounding of latex
8. Preparation of latex products
   (i) Hand Gloves **(ii)** Balloon **(iii)** Rubber band **(iv)** Thread
9. Compression moulding of fabric/rubber composite
10. Preparation of rubber blends
    (Any Nine Experiments)

TOTAL: 60 PERIODS

OUTCOMES:

Upon completing this course, the students

- Will distinguish the application of natural rubber and synthetic rubber.
- Will demonstrate the vulcanization process
- Will attain the knowledge of compounding materials

LIST OF EQUIPMENT FOR BATCH OF 30 STUDENTS

Equipment for Rubber processing:

1.	Two roll mill for rubber mixing	1	No.
2.	Ball mill	1	No
3.	Compression moulding machine	1	No.
4.	Sheet cutter	1	No.

Moulds for rubber processing:

1.	Moulds for sheet moulding	1	No.
2.	Moulds for M/C sheet moulding	1	No.
3.	Moulds for play ball	1	No.
4.	Moulds for Hand gloves	1	No.
5.	Moulds for Ballon	1	No.
6.	Moulds for Rubber band	1	No.
7.	Moulds for play thread	1	No.
8.	Moulds for flex specimen moulding	1	No.
9.	Electronic balance	1	No.

PT8612 **POLYMER TESTING LABORATORY** **L T P C**
0 0 4 2

OBJECTIVES:

- To familiarize the students with standard and methodology in preparing various polymers specimen
- Testing raw materials and components for evaluating various properties
- Testing products for predicting product performance.

LIST OF EXPERIMENTS

1. Testing of Latex

Determination of total solid content of NR latex, dry rubber content of NR latex. total alkalinity of NR latex, Mechanical stability of Latex, KOH number

2. Testing of Mechanical Properties

Plastics – Tensile, Compression, Flexural, Impact, Hardness. Rubber – Tensile, Abrasion, Rebound resilience, Flex resistance, Hardness, Heat Build up

3. Testing of Thermal properties

Vicat softening point, Heat Distortion Temperature

4. Testing of Electrical & Optical properties

Volume & Surface resistivity, Dielectric strength, Arc resistance, opacity

5. Testing of weathering properties

Chemical resistance, ESCR, Thermal ageing resistance
(Any Ten from the above all experiments)

OUTCOMES:

Upon completion of this course, the students

- Will be able to prepare the test sample for various polymer test
- Will have knowledge on latex testing
- Will acquire skills in polymer testing
- Will be able to measure the polymer properties

LIST OF EQUIPMENT FOR BATCH OF 30 STUDENTS

1. Universal tensile testing machine (UTM) 1 No.
2. Shore - A hardness tester 1 No.
3. Shore - D hardness tester 1 No.
4. Izod and charpy impact tester 1 No.
5. Falling dart impact tester 1 No.
6. Din Abrader 1 No.
7. Rebound Resilience tester 1 No.
8. De-Mattia Flex Resistance tester 1 No.
9. Vicat softening point tester (VSP) 1 No.
10. HDT Tester 1 No.
11. Environmental stress crack resistance tester (ESCR) 1 No.
12. Volume and surface resitivity tester 1 No.
13. Arc resistance tester 1 No.
14. Dielectric Strength tester 1 No.

15. Opacity tester 1 No.

TOTAL: 60 PERIODS

TEXT BOOKS:

1. Vishu Shah, Hand Book of Plastics Technology, John Wiley Intersciencs Inc., New York.1998
2. G. C. Ives, J. A. Mead, and M. M. Riley, Hand Book of Plastics Test Methods, I4FFE Books London, 1971.

REFERENCE:

1. ASTM - Vol. 8.01 - 8.04, Vol.

PT8701 POLYMER PRODUCT DESIGN L T P C
4 0 0 4

OBJECTIVES:

To enable the students

- To understand the concepts of plastic and elastomer product design
- To learn the design for threaded moulds and insert moulded products.

UNITI STRUCTURAL DESIGN OF BEAMS AND MEMBERS 12

Introduction to structure and physical properties of polymers, stress - strain behaviour of polymers, effect of fillers on properties of polymers, stress analysis of polymers, structural design of beams, plates and other structural members

UNIT II DYNAMIC LOADING ON PLASTIC PARTS 12

Dynamic load response of polymers, effects of cyclic loading, other forms of stress applied to polymer parts, design for stiffness, processing limitations on polymers product design. Material and process interaction and the effects on the performance of plastic parts and the resulting design limitations, performance in service and environmental exposure

UNIT III DESIGN PROCEDURE FOR PLASTIC PARTS 12

Design procedure for plastic parts- Tolerance-Moulded holes-threads-radius- moulded hinges-integral hinge-snap fits Design of plastic structural parts for static loads, design of dynamically loaded plastic parts, design of plastic parts for electrical applications, design of plastic parts for optical applications.

UNIT IV DESIGN OF GEAR,BEARINGS AND PIPE 12

Gear Design: materials, strength and durability, moulded V/s cut plastic gearing inspection assembly and operation. Bearings: Self lubricated plastic materials rubber bearing, type of bearings, designers check list. PVC piping: Raw materials, pipe design, specification and test procedure, manufacturing process.

UNIT V DESIGN OF STATIC, DYNAMIC SEALS and VIBRATION DAMPERS 12

Elastomeric ring seals: Basic configurations, design method, design consideration static and dynamic seals. Vibration dampers: Basic vibration damping relations, Octave rule for damped systems, Estimating damping in structures, controlling resonant peaks with damping, response of damped structures to shock. Flexible Coupling - Vibration of two mass system, specification and selection of couplings, types of couplings.

TOTAL: 60 PERIODS

OUTCOMES:

On completion of the course, students

- Will explain the terminology involved in product design
- Will discriminate the moulded hole, insert and undercut
- Will describe the processing limitation of product design and stress analysis for product
- Will demonstrate the plastic products for load bearing applications
- Will paraphrase the elastomeric products for load bearing applications

TEXT BOOKS:

1. Robert A. Malloy, "Plastic Part Design for Injection Moulding", Hanser Publishers, Munich Vienna, New York, 1994..
2. Plastics Product Design Engineering Hand Book- By Dubois, H.
3. Paul A. Tres, "Designing Plastic Parts for Assembly", 2nd Revised Edition, Hanser Publishers, Munich Vienna New York, 1994.

REFERENCES:

1. N G Mc Crum, Principles of Polymer Engineering, Oxford Science Publications, New York, 1997.
2. Belofsky, H., "Plastics Product Design and Processing Engineering, Hanser Publishers, Munich Vienna New York, 1994.
3. Plastics Product Design & Process Engineering -By Belofsky, Harold.

PT8702 RUBBER PRODUCT MANUFACTURING L T P C
3 0 0 3

OBJECTIVE:

- To enable the students to learn the manufacturing technique for different rubber products.

UNIT I TYRE MANUFACTURING 9

Tyre- Introduction- functions and requirements– Composition - Various Types – Bias – Belted – Radial – Tubeless Tyre – Tyre Building- Manufacturing methods – moulding & vulcanization.

UNIT II BELT AND HOSES MANUFACTURING 9

Belting and Hoses - Conveyor belting, passenger conveyor belting, - Components and Functions – V Belts - Building & Manufacturing- Hose-Types- moulded, machine, handmade- Compounding aspects

UNIT III FOOTWEAR AND SPORTS GOODS MANUFACTURING 9

Footwear and Sports Goods– Footwear Components- sole and heel units –Various manufacturing process- Sports Goods - Tennis Balls – Golf Balls- Tennikoit rings

UNIT IV OIL SEALS AND ENGINE MOUNT MANUFACTURING 9

Manufacturing, curing of Oil Seals, Gaskets, Engine Mounts, Bridge and railway pads- Rubber to Metal bonding - Good manufacturing practices - Effluent- Control and Treatment- Safety in rubber industry

UNIT V LATEX PRODUCTS MANUFACTURING 9

Latex Products –Dipped goods- rubber band, Gloves, balloon - Manufacturing of Latex Foam - Rubber thread, use of latex in cement, adhesives, road rubberisation –Rubber Recycling products.

TOTAL: 45 PERIODS

OUTCOMES:

Upon completing this course, the students

- Will have the knowledge of tyre manufacturing technique.
- Will understand about manufacturing of belts and hoses
- Will familiarize in latex product manufacturing process
- Will attain knowledge in production of Footwear and sports Goods
- Will acquire skills in manufacturing of Latex Products

TEXT BOOKS:

1. A.K.Bhowmick, M.M. Hall and H.A. Benaney, Rubber Products Manufacturing technology, Marcel Dekker Inc, New York, 1994.
2. A.S. Craig, Rubber Technology, Oliver and Boyd, Edinburgh, 1982.
3. C.W. Evans, Hose Technology, Elsevier Applied Science Publishers, 1979.

REFERENCE:

1. D.C. Blackley, High Polymer Latices, Vol I & II, Applied Science Publishers, London, 1966.

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

PT8711 COMPUTER AIDED POLYMER PRODUCT DESIGN LABORATORY L T P C
0 0 4 2

OBJECTIVE:

- To teach the students to design the various moulds and dies for polymer products.

LIST OF EXPERIMENTS

1. Design of two plate injection mold for thermoplastic product
2. Design of three plate injection mold for thermoplastic product
3. Design of semi automatic compression mold for thermoset plastic product
4. Design of transfer mold for thermoset plastic product
5. Design of blow mold for bottle
6. Design of extrusion die for pipe

(Any Five)

TOTAL: 60 PERIODS

OUTCOMES:

Upon completing this course, the students

- Will develop the knowledge on designing the polymer products.
- Will evaluate the various polymer processing parameters.

- Will design the injection, compression and transfer mould for polymer products.
- Will design the blow and extrusion molding die for polymer products.
- Will develop new polymer products.

LIST OF EQUIPMENT FOR BATCH OF 30 STUDENTS

1. Computers with LAN - 8 Nos.
2. Software packages
   Pro-E - 1 No
3. Printer - 1 No.

TEXT BOOKS:

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.

REFERENCES:

1. Herbert Rees, Mould Engineering, Hanser publishers, Munich, Vienna N.Y. 1994.
2. Technical Directory on Design and Tooling for plastics, CIPET, Guindy, Chennai.
3. Design calculations for Compression moulds, Machinery publications, Yellow series, U.K.
4. Mould Flow Manual & Part - Adviser Manual - MOULD FLOW
5. LaszcoSors and ImreBlazs, Design of Plastic Moulds and Dies, Elsevier, Amsterdam - Oxford - Tokyo - NY, 1989.

PT 8712 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.

PT8811 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.

PT8001 DESIGN OF MACHINE ELEMENTS L T P C
3 0 0 3

OBJECTIVES

- To familiarize the various steps involved in design process
- To design the different types of joints, bolts and keys
- To design the shafts, couplings & brakes
- To design the different types of drives, belt drives
- To design the springs and bearings

UNIT I INTRODUCTION 9

Introduction to machine design – Engineering Design, Stages in Design, Design consideration – Standards and Codes – Economical and reliable design-Selection of Materials – Design against static and dynamic load – modes of failure – Factor of safety, Principal stresses, Theories of Failure – stress concentration, variable stress, Fatigue Failure, Endurance limit.

UNIT II DESIGN OF JOINTS 9

Design of Bolts under Static load, Design of bolt with tightening/initial stress, Design of bolts subjected to fatigue – keys – types, selection of square and flat keys – Design of riveted joints and welded joints

UNIT III DESIGN OF SHAFTS, COUPLINGS AND BRAKES 9

Design of shaft – for static and varying loads, for strength and rigidity – Design of Coupling – types- flange, Muff - Design of Brakes - Block and Band brakes.

UNIT IV DESIGN OF TRANSMISSION ELEMENTS 9

Design of Spur, Helical, Bevel and Worm gear drives – Design of belt drives – flat and V belts

UNIT V DESIGN OF SPRINGS AND BEARINGS 9

Design of Helical Spring – types, materials, static loading – design of leaf spring – Design of Journal Bearing – Anti friction Bearing – types, life of bearing, reliability consideration, selection of ball and roller bearings.

TOTAL: 45 PERIODS

OUTCOMES

On completion of the course, students

- Will understand the various steps involved in design process
- Will design the different types of joints, bolts and keys
- Will design the shafts, coupling and brakes
- Will design the different types of gears and belts
- Will design various types of springs and bearings

TEXT BOOK

1. Shingley J.E, Mischke C., “Mechanical Engineering Design”, Mc Graw Hill, International Edition, 1992.

REFERENCES

1. Bhandari V.B, “Design of Machine Elements”, Tata McGraw Hill Publishing Co Ltd, 1993
2. Sharma C.S, Purohit K., “Design of Machine Elements”, Prentice Hall of India Pvt Ltd, 2003
3. Norton R.L, “Machine Design – An Integrated Approach”, Prentice Hall, International Edition, 2000

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.

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.

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 Processess 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.

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

OUTCOMES:

Upon completing this course, the students

- 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.

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).

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.

PT8002 POLYMERS IN AUTOMOBILES L T P C
3 0 0 3

OBJECTIVES:

To enable the students

- To know various sources of materials used in automobiles.
- To know polymeric materials importance in automobiles structural and mechanical components.
- To know the rubber components in automobiles.

UNIT I INTRODUCTION 9

History of Automobile industry – Need For Plastics – Advantages and limitation of Plastics – Competition between plastics, composites and other materials – Processing – Designing with Plastics – Material selection.

UNIT II POLYMERS IN THE INTERIOR OF THE VEHICLE 9

Interiors – Dominance of Plastic – Fashion and function – Plastics surfaces: Texture and fogging – Plastic structure and panel application: Sandwich concept, Instrumental panel, other sensitive panels – Structural and mechanical components: Seating, Door and window furniture, steering wheel, airbags, seat belts, pedals, instrumental and others.

UNIT III POLYMERS IN THE EXTERIOR OF THE VEHICLE 9

Exteriors: Body panels and structure – Painting problems – Bumpers – Other exteriors: Grills, Spoilers, Mirrors, Door handles, Wheel trim, Road wheels, Sun roof components, Windscreen wiper assemblies.

UNIT IV ENGINE, POWERTRAIN AND CHASSIS 9

The engine compartment – Cooling system – under bonnet structure – Transmission – Engine hang on parts – Engine interior – composite engine – Suspension – Steering –Brakes –Fuel Tanks -Electrics: Battery boxes, Circuitry – Lighting and Instrumentation –Electronics.

UNIT V RUBBER PRODUCTS 9

Rubber Mounts – spring – Seals –O-ring – Rubber to mental bonding components - Coupling – Hoses – Brake Lining – Disc brakes.

TOTAL: 45 PERIODS

OUTCOMES:

Upon completing this course, the students

- Will have knowledge about needs of automobile industry.
- Will explain the plastic components used in automobile interior and exterior parts.
- Will specify the composites used in automobile engines.
- Will understand the rubber components used in automobile parts.

TEXT BOOK:

1. James Maxwell, “Plastics in the Automotive Industry”, SAE internationals, woodhead Publication, England, 1994.

REFERENCES:

1. Kalyan Sehanobish, “Engineering Plastics and Plastic composites in Automotive Applications”, SAE internationals, Warrendale, 2009.
2. Automotive Plastics and Composites, Reinforced Plastic Magazine, Elsevier Advanced Technology, 1999.

PT8003 TYRES AND TUBES TECHNOLOGY L T P C
3 0 0 3

OBJECTIVES:

- To enable the students to understand the role of rubber in tyre.
- To get knowledge on cord reinforced rubber in tyre.
- To enrich various methods of manufacturing and testing of tyre.

UNIT I INTRODUCTION 9

Functions of tyres– Role of Rubber and unique properties of rubbers for the applications. tyre constructions – Generic design features and materials. Tubeless tyres – Comparison. Role of carcass in tyrebehaviour and materials. Carcas design variables and construction principles.

UNIT II TYRE CORD AND CORD REINFORCED RUBBER 9

Mechanics of rubber – Cord composites. Inflation pressure – Contact area, tyre deflections– Design factors and principles. Classifications of tyres – Essential design criteria. Rolling resistance, friction, mechanical loss on tyrebehaviour.

UNIT III STRUCTURE OF THE PNEUMATIC TYRE 9

Tread design – Principles and materials. Abrasion – Concepts and recent understanding. Design of tyremoulds and moulding techniques. Forces acting on beads and carcass. Tyre endurance and life related properties.

UNIT IV TYRE STRESS, DEFORMATION, TYRE TRACTION AND WEAR 9

Rubber-to-non rubber bonding: Rubber-cord and rubber-bead adhesion. Mechanism, materials and methods. Evaluation procedures and effect of rubber ingredients on adhesions. RFL systems, in-situ bonding agents. Methods of heat treatment and effect on tyre cord properties.

UNIT V MANUFACTURING AND TESTING OF TYRES 9

Tyre nomenclature-Aero tyres and tube assembly. Inner tube extrusion, concepts and manufacturing techniques-Building and curing of passenger car tyre, truck tyre, four wheeler tyre – Tyre labeling, Testing of tyres and tubes – Defects and tyre failure analysis. Tyre retreads –

Methods and materials – Compounding principle, and evaluation process.

TOTAL: 45 PERIODS

OUTCOMES:

Upon completing this course, the students

- Will classify different types of tyre and its application.
- Will develop tubeless tyre and asses its quality.
- Will assemble tyre for various applications.
- Will develop the skill on testing of tyre.
- Will identify defects and assess quality of tyre.

REFERENCES:

1. Setright J.K., " AutomobileTyres", Champan& Hall, 1972.
2. Woods, E.C." PnuematicTyre Design", W.Heffer, 1952.
3. Frederick J Kovac, "Technology Forecasting: Tyres", The Goodyear Tire Company, 1973.
4. Clark, S.K. "Mechanics of Pneumatic Tyres", US Department of Transportation, 1981
5. Wake W.C. and Wootton, D.B., "Textiles in Reinforcement of Elastomers",Springer Netherlands, 2012.
6. Gent A N & Walter J D, "The Pneumatic Tire," published by NHTSA, DOT, USA, 2005,

PT8004 POLYMER REACTION ENGINEERING L T P C

3 0 0 3

OBJECTIVES:

- To learn the fundamental reactions involved in chemical engineering
- To attain the knowledge in reaction mechanism
- To obtain the ideas in the design of reactors
- To learn the multiple reactor system.
- To learn about various mechanisms in polymerization reactors.

UNIT I KINETICS OF HOMOGENOUS REACTIONS 9

Introduction to chemical kinetics – Classification of chemical reactions – Rate of Reaction - Temperature dependent term of a rate equation - Concentration dependent of a rate equation.

UNIT II INTERPRETATION OF BATCH REACTOR DATA 9

Interpretation of Batch Reactor data for irreversible reactions taking place in constant volume and variable volume batch reactors – Integral and Differential method of Analysis.

UNIT III DESIGN FOR SINGLE IDEAL REACTORS 9

Chemical Reactors - Performance equations for Batch Reactor – Stirred Tank Reactor - MFR/CSTR - Plug flow reactors (PFR).

UNIT IV DESIGN FOR SINGLE REACTIONS 9

Multiple reactor system – CSTR in series (Equal & Unequal Size) - PFR in series - Residence time distribution in non-ideal flow reactors.

UNIT V POLYMERIZATION REACTORS 9

Polymerization reactors - Free radical polymerization - stepwise addition and condensation polymerization and copolymerization

TOTAL: 45 PERIODS

OUTCOMES:

Upon completing this course, the students

- Will attain the knowledge in reaction kinetics.
- Will understand the knowledge in reaction mechanisms.
- Will understand the batch and continuous flow reactors.
- Will understand the Design of reactors.
- Will increase the ability to design polymerization reactors

TEXT BOOKS:

1. K A Gavhane "Chemical Reaction Engineering I" Nirali Publication; 1st edition (2016)
2. London.OctaveLevenspiel, "Chemical Reaction Engineering", Wiley Eastern Ltd.

REFERENCES:

1. M.Kh. Karapetyants, "Chemical Thermodynamics", Mir Publications, USSR, 1978.
2. G.N.Pandy, J.C.Chaudari, "Chemical Engg. Thermodynamics", Khanna Publishers.
3. L.H.Sperling, "Introduction to Physical Polymer Science", John Wiley & Sons.
4. C.D. Holland & G. Rayboard Anthony, "Fundamentals of Chemical Reaction Engineering".

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-thinfilms-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:

Upon completing this course, the students

- 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.

PT8005 LATEX TECHNOLOGY L T P C

3 0 0 3

OBJECTIVE:

- To enable the students to understand the basic concept of latex, latex compounding, latex dipping process for preparation of products.

UNIT I LATEX CHARACTERISTICS AND CONCENTRATION METHODS 9

Definition of Latex, classification, Latex particle size and distribution, stability and destabilization of latices, Comparison between latices and polymer solution; Natural rubber latex –origin, tapping, bulking and preservation, composition of field latex, properties, preservation, methods of concentrating latex - creaming, centrifuging, & evaporation,– Specification and testing- (National and ISO) for latex grades (ASTM D 1076)

UNIT II LATEX COMPOUNDING 9

Latex compounding-Ingredients, Preparation of Dispersions, Emulsion, Slurries; Machineries- Ball mill, Pearl mill; Preparation of latex compound and maturation; Prevulcanized latex, MG Latex, - Preparation, properties and application; Evaluation of the latex compound- Chloroform number, swelling index test; Design for latex products formulation.

UNIT III LATEX DIPPING PROCESS 9

Principle and types of dipping process, Dipping plant design, formers, sequence of operation, post processing; Manufacture of Condoms, Gloves, Catheters, Balloons-formulations, process, specification, testing and troubleshooting.

UNIT IV LATEX FOAM, SHEETING AND SPRAYING 9

Principle and Manufacture of Foam-Dunlop and Talalay process, Compound design-Process details, Foam properties, testing and defects, foam applications;Latex sheeting; latex binders and carpet backing- Basics and process.

UNIT V EXTRUSION AND PRODUCTS BASED ON SYNTHETIC LATEX 9

Principle and Manufacture of latex elastic threads; latex tubing; latex casting process specification and testing, defects.

Synthetic latex- Types, properties, and application- surface coatings, adhesives, paper industries.

TOTAL: 45 PERIODS

OUTCOMES:

Upon completing this course, the students

- Will paraphrase the various concentration methods of latex system
- Will describe the function of latex and prevuclcanized latex compounding material and to select the suitable compounding machineries
- Will write the basic formulation of latex products of Gloves, catheters, ballons and elucidate the dipping process
- Will compute the compounding design for latex foam, sheeting
- Will describe manufacturing of synthetic latex products like toys and extrusion latex products like elastic threads

TEXT BOOKS:

1. Blackley, D.C., High Polymer Latices, Springer Netherlands, Edition 2, 1997
2. Mausser,R.F., The Vanderbilt Latex Hand book 3rd edn, 1987

REFERENCES:

1. Waterman,R., Mausser R.F., & Miller,E.E., Vanderbilt Latex Book on Process and Compounding Ingredients, Publ. By R T Vanderbilt.
2. C.M.Blow and C. Hepburn,- Rubber Technology and Manufacture, Eds, Buttenvorths, London 3nd edition, 2009.
3. J.A.Brydson, -Rubber chemistry, Applied science Publishers, 1978.

4. Hoffman, Rubber Technology Handbook -, Hanser Pub. Munich - 1996

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.

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.

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).

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.

PT8007 PAINTS AND SURFACE COATINGS L T P C
3 0 0 3

OBJECTIVES:

- To learn the various polymer resins and synthesis
- To know the various pigments and solvents for paints
- To know the various additives for paints
- To learn the particle size measurements and application of paints
- To know the mechanical properties of paints and coating

UNIT I ORGANIC FILM FORMERS 9

Natural polymers – Oils and Fatty acids – Alkyd resins – polyester resin – Acrylic Polymer – Emulsion and dispersion polymerization – Non-aqueous dispersion polymerization – Amino resins – Phenol formaldehyde resin – Epoxy resin – Isocyanates – silicone resin – Vinyl resin.

UNIT II PIGMENTS FOR PAINTS 9

Introduction – classification – Nature of Pigments and dispersion process – Manufacturing of pigments – choosing Pigments – Toxicity. Solvents, Thinner and diluents – solvent power – Effects on viscosity – evaporation of solvent from cavity - Flashpoint – Toxicity, enamel, varnish

UNIT III ADDITIVES FOR PAINTS 9

Anti-corrosive Pigments – Antifoams – Antisettling agent – Antiskinning agents – Can corrosive inhibitors – Dehydrates – Dispersion aids – Driers – Flash corrosion inhibitors – floating and flooding additives – Reodorants – UV absorbance.

UNIT IV APPLICATIONS OF PAINTS AND COATINGS 9

Application of coating – Coating for building – Automotive parts – Automotive refinish paints - General industrial paints – Painting of ships.

UNIT V MECHANICAL PROPERTIES OF PAINTS AND COATINGS 9

Determination of mechanical properties of coating – Transient method – Dynamic method – Hardness test – Flexibility – Impact test – Acoustic emission – Durability test.

TOTAL: 45 PERIODS

OUTCOMES:

Upon completing this course, the students

- Will understand the various polymerization techniques for different resins
- Will specify the effects of pigments in paints
- Will classify the additives in paints
- Will mention the impact of the particle sizing methods and various application of coatings
- Will explain the mechanical properties of paints and coating

TEXT BOOK:

1. R.Lambourne and T.A.Strivens, "Paint and Surface Coating: Theory and Practice", 2nd Edition, William Andrew Publishing, 1993.

REFERENCES:

1. Arthur.A.Traction, "Coatings materials and surface coatings", CRC Press, 2007.
2. Rodger Talbert, "Paint Technology Handbook", CRC Press, London, 2008.
3. Swaraj Paul, "Surface coatings: science & technology", 2nd edition, J. Wiley, 1996.
4. Philip A. Schweitzer, P.E. "Paints and coating: Applications and Corrosion Resistance", CRC Press, 2005.

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.

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.

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

PT8006 SPECIALITY POLYMERS L T P C
3 0 0 3

OBJECTIVE:

- To enable the students to learn properties and applications of special polymers such as high performance, conducting, electrical and electronics properties of polymers, ionic polymers polymers in concrete, polymers as binders.

UNIT I HIGH PERFORMANCE POLYMERS 9

High temperature and fire resistant polymers –Requirement for heat resistance- polymers, for low fire hazards - polymers for high temperature Resistance - applications of heat resistant polymers like, polyimides, polyquinolines, polyquinoxalines, PBO, PBI, PPS, PPO, PEEK

UNIT II CONDUCTING POLYMERS 9

Conducting polymers preparation and applications, conducting mechanisms, requirements for polymer to work as conductor, types of conducting polymers - doping of polymeric systems, polyaniline, polyacetylene, polyparaphenylene, polypyrrole, organometallic polymers, Photosensitive polymers

UNIT III OPTOELECTRONIC POLYMERS 9

Polymers with electrical and electronic properties, polymers in non-linear optics, polymers with piezoelectric, pyroelectric and ferroelectric properties, photoresists for semi conductor fabrication - Polymers in telecommunications and power transmission - liquid crystalline polymers

UNIT IV IONIC POLYMERS 9

Ionic Polymers, synthesis, physical properties and applications, Ion-exchange, Hydrophilicity, Ionomers based on polyethylene, elastomeric ionomers. Ionomers based on polystyrene, Ionomers based on PTFE, ionomers with polyaromatic backbones, polyelectrolytes for ion exchange, polyelectrolytes based on carboxylates, polymers with integral ions, polyelectrolyte complexes.

UNIT V BIOPOLYMERS 9

Applications of Polymer concrete, polymer impregnated concrete ultra high modulus fibres, natural biopolymers and synthetic biopolymers and their biomedical applications polymeric binders for rocket propellants, polymer supported reagents.

TOTAL: 45 PERIODS

OUTCOMES:

Upon completing this course, the students

- Will have the knowledge of high performance polymers applied in special application
- Will correlate the conducting polymer preparation, properties, and applications
- Will acquire skills of electrical and electronic properties of polymers to suitable application
- Will have the knowledge of ionic polymers preparation, properties and applications.
- Will have the knowledge of applications of polymers in concrete, fibers, biomedical and binders for rocket propellants.

TEXT BOOKS:

1. Manas Chanda, Salil.K.Roy, “Plastics Technology Hand book”, 2nd edition, Marcel Dekker, New York, 1993.
2. Matrin.T.Goosey, “Plastics for Electronics”, Elsevier, Applied Science, 1985.
3. R.W. Dyson, “Specialty Polymers”, Chapman & Hall, 2nd edition, 1998.

REFERENCE:

1. H.F.Mark, (Ed), “Encyclopedia of polymer Science & Engineering”, John Wiley & Sons, New York, 1989.

PT8007 **FOOTWEAR TECHNOLOGY** **L T P C**
3 0 0 3

OBJECTIVES:

- To enable the students to understand the production of footwear.
- To get knowledge on cellular and microcellular materials.
- To enrich various methods of manufacturing of shoes

UNIT I PRODUCTION OF FOOTWEAR 10

Operations involved in making footwear – 'Built-up' footwear – DVP/DIP (Direct Vulcanising / Direct injection Moulding) process – Materials used in manufactures of footwear (Other than rubber)

UNIT II ADHESIVES AND SYNTHETIC FABRICS IN FOOTWEAR 9

Fabrics used – Cotton, Rayon, Nylon, Polyester – treatment of textiles for combining with rubber – types of adhesives water, chloroprene, NBR, PU passed adhesives – NR and synthetic rubber latex based adhesives.

UNIT III CELLULAR AND MICROCELLULAR MATERIALS 10

Natural and Synthetic Rubber based microcellular materials – PU, PVC, EVA in microcellular soling – Direct vulcanizing / injection processes.

UNIT IV MANUFACTURE OF FOOTWEAR COMPONENTS 8

Process manufacture of different footwear – traditional and modern methods.

UNIT V SPECIALITY SHOES 8

Sports / athletics shoes, mountaineering / hiking shoes, fireman, hospital (operating heatre) and oil refinery shoes.

TOTAL: 45 PERIODS

OUTCOMES:

Upon completing this course, the students

- Will develop cellular and microcellular materials
- Will develop footwear components
- Will identify adhesive and synthetic fabrics in footwear

REFERENCES

1. Thornton, J.H, "Text Book of Footwear Manufacture", National Trade Press Ltd., London, 1970.
2. Blakeman, J., "An Introduction to applied Science for Boot and Shoe Manufacture", The Anglo American Technical Co.Ltd., London,1924.
3. RavindraGoontilleke, "Science of Footwear" CRC Press, 2013.

PT8008 **SPECIALITY ELASTOMERS** **L T P C**
3 0 0 3

OBJECTIVE:

- To impart knowledge on manufacturing, compounding, processing and curing of specialty elastomers

UNIT I SPECIALITY RUBBER AND THEIR COPOLYMERS 9

Introduction of speciality Rubbers - Silicones (Q) - Introduction, Manufacture - Structure and its

influence on properties - Compounding - Fabrication - Curing - General properties - Applications - Copolymers - PMQ, PVLQ, FMQ, FVMQ - Silicones Rubber for medical use.

UNIT II CHLORO AND FLUORO ELASTOMERS 9

Chlorosulphonated polyethylene - Introduction - Manufacture - Structure and its influenceon properties - Compounding - Curing - Properties - Applications Epichlorohydrin - (CO, ECO, ETIR)- Introduction - Manufacture - Structure and its influence on properties - Compounding and Curing Properties and application Fluoro Elastomers (FKM) - Introduction - Manufacture - Structure and its influence on properties - Compounding - Curing - Properties and applications.

UNIT III POLYSULPHIDE AND TPU 9

Polysulphides (TM) - Introduction, Manufacture - Cross linked Polyethylene (XLPE) - Polyurethane Rubbers - Introduction Manufacture - Structure and its influence on properties - Compounding - Curing - Properties and applications. Thermoplastic Polyurethanes - Introduction - Manufacture - Structure and its influence on Properties - Compounding - Curing - Properties and applications

UNIT IV ACM and THEIR COPOLYMERS 9

Acrylic Rubber (ACM), Ethylene acrylic copolymers, Introduction, Manufacture-Structure and its influence on Properties - Compounding - Curing - Properties and applications Ethylene Vinyl Acetate - Copolymer - Introduction, Manufacture - Structure and its influence on Properties - Compounding - Curing - Properties and applications

UNIT V CHLORONATED PE AND EPDM 9

Chlorinated Polyethylene - Introduction - Manufacture - Structure and its influence on Properties - Compounding - Curing - Properties and applications. EPM, EDPM - Introduction, Manufacture - Structure and its influence on Properties -Compounding - Curing - Properties and applications.

TOTAL: 45 PERIODS

OUTCOMES:

Upon completing this course, the students

- will describe the fabrication, curing and properties of speciality polymers
- will familiarize the elastomer used in special application
- will demonstrate the manufacturing and applications of speciality polymer
- will attain the skill on compounding and curing characteristics for speciality rubbers

TEXT BOOKS:

1. Hoffmann, “Rubber Technology Hand Book”, Hanser Publishers Munich- 1989.
2. Anil. K., Bhowmick, Howard L. Stephens (ed.) Hand Book of Elastomers, New Development & Technology, Marcel Decker Inc., New York, 1988.

PT8009 PRODUCT DESIGN AND COST ESTIMATION L T P C

3 0 0 3

OBJECTIVE:

- The course aims at providing the basic concepts of product design, development, process planning and to estimate the overall costing for product development, analyzing overhead expenses along with the overview on intellectual property rights.

UNIT I INTRODUCTION TO PRODUCT DEVELOPMENT 9

Selection of the right product – Steps in product development – Research – Types - Source and types of data – Types of survey - Market research and development - Criteria for a successful product - production, functional , operational, modular, aesthetic, quality, durability and reliability aspects – Design optimization - Product life cycle – Case study.

UNIT II PROCESS PLANNING 9

Process Planning – Objective – Information required – Make or buy decision - Process selection - Process Sheet – Steps to prepare detailed process sheets – case studies – Break even analysis – Applications.

UNIT III ESTIMATING, COSTING AND ELEMENTS OF COST 9

Cost estimation – importance of estimation – Costing – importance of costing – Difference between costing and estimation – Importance of realistic estimates – Estimation procedure – Elements of cost – Material Cost – Determination of Material cost – Labour cost – Determination of Labour Cost – Expenses – Cost of Product (Ladder of cost) –- Illustrative examples.

UNIT IV ANALYSIS OF OVERHEAD EXPENSES 9

Overhead expenses – Factory expenses – Depreciation – Causes of depreciation – Methods of depreciation – Administrative expenses – Selling and Distributing expenses – Allocation of overhead expenses – Critical analysis of a typical product.

UNIT V AN OVERVIEW ON INTELLECTUAL PROPERTY RIGHTS 9

Intellectual Property Rights (IPR) – Significance – International protection of IPR - Forms of IPR – Patent – Copyright – Trademark – Industrial Design – Commercialization – Others - Case study.

TOTAL: 45 PERIODS

OUTCOMES

Upon completing this course, the students

- Will understand the concepts to develop a new product and its selection criteria.
- Will have thorough knowledge in the preparation of process planning sheets.
- Will know the techniques of cost estimation and will be able to estimate the product costs.
- Will be able to analyze the various expenses of a typical product.
- Will understand the basic and significance of intellectual property rights.

REFERENCES

1. Narang G B S and Kumar V , “Production and Costing”, Khanna Publishers, 2000.
2. Banga T R and Sharma S C , “Estimating and Costing”, Khanna Publlishers, 2000.
3. Khanna O P,”Mechanical Estimating and Costing”, Dhanpat Rai Publications, 1999.
4. Mahajan M, “Industrial Engineering and Production Management”, Dhanpat Rai Publication,2008.
5. Narayanan P, “Law of Copyright and Industrial Designs”, Eastern law House, 2010.
6. Wadehra B.L., “Law relating to Patents, Trade Marks, Copyright, Designs and Geographical Indications”, Universal law Publication, 2000.
7. G. P. Reddy, “Intellectual Property Rights & Other Law”, Gogia Law Agency, 2004.