ANNA UNIVERSITY, CHENNAI

UNIVERSITY DEPARTMENTS

B.TECH. RUBBER AND PLASTICS TECHNOLOGY

REGULATIONS – 2015

CHOICE BASED CREDIT SYSTEM

Programme Educational Objectives (PEOs)

PEO 1: Career Development: Graduates of the programme will have successful technical and professional careers in Rubber and Plastics industry, research and management.

PEO 2: Lifelong learning: Graduates of the programme will have sustained interest to continuously learn and adapt new technology and development to meet the changing industrial scenarios.

Programme Outcomes (POs)

a. Graduate will demonstrate strong basics in mathematics, science and engineering.
b. Graduate will demonstrate the ability to design and conduct experiments, as well as to analyze and interpret data.
c. Graduate will demonstrate the ability to design a system, component or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability and sustainability.
d. Graduate will become familiar with modern engineering tools and analyze the problems within the domains of rubber and plastics as the members of multidisciplinary teams.
e. Graduate will acquire the capability to identify, formulate and solve complex engineering problems related to rubber and plastics technology.
f. Graduate will demonstrate an understanding of professional and ethical responsibility with reference to their career in the field of polymers.
g. Graduate will be able to communicate effectively both in verbal and non verbal forms.
h. Graduate will be trained towards developing and understanding the impact of development of rubber and plastics on global, economic environmental and societal context.
i. Graduate will be capable of understanding the value for life-long learning.
j. Graduate will demonstrate knowledge of contemporary issues focusing on the necessity to develop new material, design, process, testing and solution for environmental related problems related to their field.
k. Graduate will demonstrate the ability to use the techniques, skills and modern engineering tools necessary for engineering practice in the field of rubber and plastics.
l. Graduate will have a firm scientific, technological and communication base that helps them either to find a desire placement or to become an entrepreneur and explore their knowledge in their field.
m. Graduate will be capable of doing higher studies and research in inter and multidisciplinary areas.

Attested

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Centre For Academic Courses
Anna University, Chennai-600 025.

Mapping between POs and PEOs

Sl. No.	Programme Outcomes (POs)	Programme Educational Objectives (PEOs)	
		PEO 1	PEO 2
a)	Graduate will demonstrate strong basics in mathematics, science and engineering.	✓	✓
b)	Graduate will demonstrate the ability to design and conduct experiments, as well as to analyze and interpret data.	✓	
c)	Graduate will demonstrate the ability to design a system, component or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability and sustainability.	✓	
d)	Graduate will become familiar with modern engineering tools and analyze the problems within the domains of rubber and plastics as the members of multidisciplinary teams.		✓
e)	Graduate will acquire the capability to identify, formulate and solve complex engineering problems related to rubber and plastics technology.	✓	✓
f)	Graduate will demonstrate an understanding of professional and ethical responsibility with reference to their career in the field of polymers.	✓	
g)	Graduate will be able to communicate effectively both in verbal and non verbal forms.	✓	✓
h)	Graduate will be trained towards developing and understanding the impact of development of rubber and plastics on global, economic environmental and societal context.	✓	✓
i)	Graduate will be capable of understanding the value for life-long learning.		✓
j)	Graduate will demonstrate knowledge of contemporary issues focusing on the necessity to develop new material, design, process, testing and solution for environmental related problems related to their field.		✓
k)	Graduate will demonstrate the ability to use the techniques, skills and modern engineering tools necessary for engineering practice in the field of rubber and plastics.	✓	
l)	Graduate will have a firm scientific, technological and communication base that helps them either to find a desire placement or to become an entrepreneur and explore their knowledge in their field.	✓	✓
m)	Graduate will be capable of doing higher studies and research in inter and multidisciplinary areas.		✓

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UNIVERSITY DEPARTMENTS

B.TECH. RUBBER AND PLASTICS TECHNOLOGY

REGULATIONS – 2015

CHOICE BASED CREDIT SYSTEM

CURRICULA AND SYLLABI I – VIII SEMESTERS

SEMESTER- I

S.No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
THEORY								
1.	HS 7151	Foundational English	HS	4	4	0	0	4
2.	MA 7151	Mathematics - I	BS	4	4	0	0	4
3.	PH 7151	Engineering Physics	BS	3	3	0	0	3
4.	CY 7151	Engineering Chemistry	BS	3	3	0	0	3
5.	GE 7151	Computing Techniques	ES	3	3	0	0	3
6.	GE 7152	Engineering Graphics	ES	5	3	2	0	4
PRACTICALS								
7.	BS7161	Basic Science Laboratory	BS	4	0	0	4	2
8.	GE 7161	Computer Practices Laboratory	ES	4	0	0	4	2
			TOTAL	**30**	**20**	**2**	**8**	**25**

SEMESTER-II

S.No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
THEORY								
1.	HS 7251	Technical English	HS	4	4	0	0	4
2.	MA 7251	Mathematics - II	BS	4	4	0	0	4
3.	PH 7252	Materials Science for Technologists	BS	3	3	0	0	3
4.	GE 7153	Engineering Mechanics	BS	4	3	0	0	4
5.	PR 7251	Production Processes	ES	3	3	0	0	3
6.	CY 7257	Physical and Organic Chemistry	ES	3	3	0	0	3
PRACTICALS								
7.	GE 7261	Computer Programming Laboratory	BS	4	0	0	4	2
8.	GE 7162	Engineering Practices Laboratory	ES	4	0	0	4	2
			TOTAL	**29**	**21**	**0**	**8**	**25**

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SEMESTER - III

S.No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
THEORY								
1.	AE 7353	Solid Mechanics	ES	3	3	0	0	3
2.	EE 7254	Principles of Electrical and Electronics Engineering	ES	3	3	0	0	3
4.	GE 7251	Environmental Science and Engineering	HS	3	3	0	0	3
3.	MA 7357	Probability and Statistics	BS	4	4	0	0	4
5.	RP 7301	Introduction to Polymer Science	PC	3	3	0	0	3
6.	RP 7302	Theory of machines and mechanisms	ES	3	3	0	0	3
PRACTICALS								
7.	EE 7261	Electrical and Electronics Engineering Laboratory	ES	4	0	0	4	2
8.	ME 7362	Mechanical Sciences Laboratory	ES	4	0	0	4	2
			TOTAL	**27**	**19**	**0**	**8**	**23**

SEMESTER - IV

S.No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
THEORY								
1.	MA 7354	Numerical Methods	BS	4	4	0	0	4
2.	RP 7401	Fluid Mechanics and Polymer Rheology	PC	3	3	0	0	3
3.	RP 7402	Fundamentals of Chemical Engineering operations	ES	3	3	0	0	3
4.	RP 7403	Physical Properties of Polymers	PC	3	3	0	0	3
5.	RP 7404	Plastics Materials - I	PC	4	4	0	0	4
6.	RP 7405	Rubber Materials	PC	3	3	0	0	3
PRACTICALS								
7.	RP 7411	Computer Aided Parts and Assembly Drawing	PC	4	0	0	4	2
8.	RP 7412	Polymer Chemistry Laboratory	PC	4	0	0	4	2
			TOTAL	**28**	**20**	**0**	**8**	**24**

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SEMESTER - V

S.No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
THEORY								
1.	RP 7501	Plastics Materials - II	PC	3	3	0	0	3
2.	RP 7502	Plastics Processing and Machinery	PC	3	3	0	0	3
3.	RP 7503	Polymer Characterization Techniques	PC	3	3	0	0	3
4.	RP 7504	Rubber Compounding	PC	3	3	0	0	3
5.		Professional Elective I	PE	3	3	0	0	3
6.		Professional Elective II	PE	3	3	0	0	3
PRACTICALS								
7.	RP 7511	Plastics Processing and Testing Lab	PC	4	0	0	4	2
8.	RP 7512	Rubber Materials Lab	PC	4	0	0	4	2
TOTAL				**26**	**18**	**0**	**8**	**22**

SEMESTER-VI

S.No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
THEORY								
1.	HS 7551	Employability Skills	HS	3	3	0	0	3
2.	RP 7601	Plastics Product and Mould Design	PC	3	3	0	0	3
3.	RP 7602	Rubber and Plastics Testing	PC	4	4	0	0	4
4.	RP 7603	Rubber Processing and Machinery	PC	3	3	0	0	3
5.	RP 7604	Rubber Product Design	PC	3	3	0	0	3
6.		Professional Elective III	PE	3	3	0	0	3
7.		Open Elective I*	OE	3	3	0	0	3
PRACTICALS								
8.	RP 7611	Rubber Processing and Testing Laboratory	PC	4	0	0	4	2
			TOTAL	**26**	**22**	**0**	**4**	**24**

*Course from the curriculum of other UG Programmes

SEMESTER VII

S.No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
THEORY								
1.	RP 7701	Polymer Composites	PC	3	3	0	0	3
2.	RP 7702	Polymer Recycling	PC	3	3	0	0	3
3.	RP 7703	Technology of Tyres and Tubes	PC	3	3	0	0	3
4.		Professional Elective IV	PE	3	3	0	0	3
5.		Professional Elective V	PE	3	3	0	0	3
6.		Open Elective II*	OE	3	3	0	0	3
PRACTICALS								
7.	RP 7711	Mould and Product Design Lab	EEC	4	0	0	4	2
8.	RP 7712	Comprehension	EEC	2	0	0	2	1
9.	RP 7713	Industrial Training	EEC	2	0	0	2	1
			TOTAL	**28**	**18**	**0**	**9**	**23**

* Course from the curriculum of other UG programmes

To enable students pursue Project work in an Industry outside Chennai, students may be permitted to advance an elective in VI or VII Semester

SEMESTER VIII

S.No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
THEORY								
1.		Professional Elective VI	PE	3	3	0	0	3
PRACTICALS								
2.	RP 7811	Project work	EEC	20	0	0	20	10
			TOTAL	**23**	**3**	**0**	**20**	**13**

TOTAL NUMBER OF CREDITS : 179

PROFESSIONAL ELECTIVES (PE)

S.No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1.	AE 7071	Experimental Stress Analysis	PE	3	3	0	0	3
2.	GE 7073	Fundamentals of Nanoscience	PE	3	3	0	0	3
3.	GE 7652	Total Quality Management	PE	3	3	0	0	3
4.	MG 7451	Principles of Management	PE	3	3	0	0	3
5.	PR 7551	Statistical Quality Control and Reliability Engineering	PE	3	3	0	0	3
6.	RP 7001	Adhesives and Surface Coatings	PE	3	3	0	0	3
7.	RP 7002	Advanced Plastics Processing	PE	3	3	0	0	3
8.	RP 7003	Biopolymers and Polymers from Renewable Resources	PE	3	3	0	0	3
9.	RP 7004	Design of Machine Elements	PE	3	3	0	0	3
10.	RP 7005	Entrepreneurship Development	PE	3	3	0	0	3
11.	RP 7006	Finite Element Analysis for Polymers	PE	3	3	0	0	3
12.	RP 7007	Fracture Mechanics	PE	3	3	0	0	3
13.	RP 7008	Latex Science and Technology	PE	3	3	0	0	3
14.	RP 7009	Polymers for Energy Storage Applications	PE	3	3	0	0	3
15.	RP 7010	Polymers in Packaging Technology	PE	3	3	0	0	3
16.	RP 7011	Polyurethane Science and Technology	PE	3	3	0	0	3
17.	RP 7012	Product Design And Cost Estimation	PE	3	3	0	0	3
18.	RP 7013	Rubber Components in Automobiles	PE	3	3	0	0	3
19.	RP 7014	Technology of Footwear	PE	3	3	0	0	3
20.	RP 7015	Technology of Polymer Blends	PE	3	3	0	0	3
21.	GE7071	Disaster Management	PE	3	3	0	0	3
22.	GE7074	Human Rights	PE	3	3	0	0	3
23.	GE7072	Foundation Skills in Integrated Product Development	PE	3	3	0	0	3

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HUMANITIES AND SOCIAL SCIENCES (HS)

S.No.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1.	HS 7151	Foundational English	HS	4	4	0	0	4
2.	HS 7251	Technical English	HS	4	4	0	0	4
3.	HS 7551	Employability Skills	HS	3	3	0	0	3
4.	GE 7251	Environmental science and engineering	HS	3	3	0	0	3

BASIC SCIENCES (BS)

S.No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1.	MA 7151	Mathematics – I	BS	4	4	0	0	4
2.	PH7151	Engineering Physics	BS	3	3	0	0	3
3.	CY 7151	Engineering Chemistry	BS	3	3	0	0	3
4.	BS 7161	Basic science Laboratory	BS	4	0	0	4	2
5.	MA 7251	Mathematics – II	BS	4	4	0	0	4
6.	PH 7252	Materials Science for Technologists	BS	3	3	0	0	3
7.	GE 7153	Engineering Mechanics	BS	4	4	0	0	4
8.	GE 7261	Computer Programming Laboratory	BS	4	0	0	4	2
9.	MA 7357	Probability and Statistics	BS	5	3	2	0	4
10.	MA 7354	Numerical Methods	BS	5	3	2	0	4

ENGINEERING SCIENCES (ES)

S.NO	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1.	GE 7152	Engineering Graphics	ES	5	3	2	0	4
2.	GE 7151	Computing Techniques	ES	3	3	0	0	3
3.	GE 7161	Computer Practices Laboratory	ES	4	0	0	4	2
4.	PR 7251	Production Processes	ES	3	3	0	0	3
5.	CY 7257	Physical and Organic	ES	3	3	0	0	3

		Chemistry						
6.	GE 7162	Engineering Practice Laboratory	ES	4	0	0	4	2
7.	EE 7254	Principles of Electrical and Electronics Engineering	ES	3	3	0	0	3
8.	EE 7261	Electrical and Electronics Engineering Lab.	ES	4	0	0	4	2
9.	AE 7353	Solid Mechanics	ES	3	3	0	0	3
10.	RP 7402	Fundamentals of Chemical Engineering operations	ES	3	3	0	0	3
11.	RP 7302	Theory of machines and mechanisms	ES	3	3	0	0	3
12.	ME 7362	Mechanical Sciences Laboratory	ES	4	0	0	4	2

PROFESSIONAL CORE (PC)

S.No.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1.	RP 7301	Introduction to Polymer Sciences	PC	3	3	0	0	3
2.	RP 7401	Fluid Mechanics and Polymer Rheology	PC	3	3	0	0	3
3.	RP 7403	Physical Properties of Polymers	PC	3	3	0	0	3
4.	RP 7404	Plastics Materials - I	PC	4	4	0	0	4
5.	RP 7405	Rubber Materials	PC	3	3	0	0	3
6.	RP 7504	Rubber Compounding	PC	3	3	0	0	3
7.	RP 7603	Rubber Processing and Machinery	PC	3	3	0	0	3
8.	RP 7501	Plastics Materials - II	PC	3	3	0	0	3
9.	RP 7502	Plastics Processing and Machinery	PC	3	3	0	0	3
10.	RP 7602	Rubber and Plastics Testing	PC	3	3	0	0	3
11.	RP 7503	Polymer Characterization Techniques	PC	3	3	0	0	3
12.	RP 7601	Plastics Product and Mould Design	PC	3	3	0	0	3
13.	RP 7604	Rubber Product Design	PC	3	3	0	0	3
14.	RP 7701	Polymer Composites	PC	3	3	0	0	3

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15.	RP 7703	Technology of Tyres and Tubes	PC	3	3	0	0	3
16.	RP 7702	Polymer Recycling	PC	3	3	0	0	3
17.	RP 7412	Polymer Chemistry Laboratory	PC	4	0	0	4	2
18.	RP 7411	Computer Aided Parts and Assembly Drawing	PC	4	0	0	4	2
19.	RP 7611	Rubber Processing and Testing Laboratory	PC	4	0	0	4	2
20.	RP 7512	Rubber Materials Lab	PC	4	0	0	4	2
21.	RP 7511	Plastics Processing and Testing Lab	PC	4	0	0	4	2
22.	RP 7711	Mould & Product Design Lab	PC	4	0	0	4	2

EMPLOYABILITY ENHANCEMENT COURSES (EEC)

S.No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1.	RP7712	Comprehension	EEC	3	0	0	3	2
2.	RP7713	Industrial Training*	EEC	2	0	0	2	1
3.	RP7711	Mould and Product Design lab	EEC	4	0	0	4	2
4.	RP7811	Project work	EEC	20	0	0	20	10

SUMMARY

Semester	HS	BS	ES	PC	PE	EEC	OE	Total Credits
1	4	12	9	-	-	-	-	**25**
2	4	13	8	-	-	-	-	**25**
3	3	4	13	3	-	-	-	**23**
4	-	4	3	17	-	-	-	**24**
5	-	-	-	16	6	-	-	**22**
6	3	-	-	15	3	-	3	**24**
7	-	-	-	9	6	5	3	**23**
8	-	-	-	-	3	10	-	**13**
Total	**14**	**33**	**33**	**60**	**18**	**15**	**6**	**179**

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HS7151 FOUNDATIONAL ENGLISH L T P C
4 0 0 4

COURSE DESCRIPTION:
This course aims at developing the language skills necessary for the first year students of Engineering and Technology.

OBJECTIVES:
- To develop the four language skills – Listening, Speaking, Reading and Writing.
- To improve the students' communicative competence in English.
- To teach students the various aspects of English language usage.

CONTENTS

UNIT I GREETING AND INTRODUCING ONESELF 12
Listening- Types of listening – Listening to short talks, conversations; **Speaking** – Speaking about one's place, important festivals etc. – Introducing oneself, one's family/ friend;**Reading** – Skimming a passage– Scanning for specific information;**Writing**- Guided writing - Free writing on any given topic (My favourite place/ Hobbies/ School life, writing about one's leisure time activities, hometown, etc.); **Grammar** – Tenses (present and present continuous) -Question types - Regular and irregular verbs; **Vocabulary** – Synonyms and Antonyms.

UNIT II GIVING INSTRUCTIONS AND DIRECTIONS 12
Listening – Listening and responding to instructions; **Speaking** – Telephone etiquette - Giving oral instructions/ Describing a process – Asking and answering questions; **Reading** – Reading and finding key information in a given text - Critical reading - **Writing –**Process description(non-technical)- **Grammar** – Tense (simple past& past continuous) - Use of imperatives – Subject – verb agreement – Active and passive voice; - **Vocabulary** – Compound words – Word formation – Word expansion (root words).

UNIT III READING AND UNDERSTANDING VISUAL MATERIAL 12
Listening- Listening to lectures/ talks and completing a task; **Speaking** –Role play/ Simulation – Group interaction; **Reading** – Reading and interpreting visual material;**Writing**- Jumbled sentences – Discourse markers and Cohesive devices – Essay writing (cause & effect/ narrative);**Grammar** – Tenses (perfect), Conditional clauses –Modal verbs; **Vocabulary** –Cause and effect words; Phrasal verbs in context.

UNIT IV CRITICAL READING AND WRITING 12
Listening- Watching videos/ documentaries and responding to questions based on them; **Speaking**Informal and formal conversation;**Reading** –Critical reading (prediction & inference);**Writing**–Essay writing (compare & contrast/ analytical) – Interpretation of visual materials;**Grammar** – Tenses (future time reference);**Vocabulary** – One word substitutes (with meanings) – Use of abbreviations & acronyms – Idioms in sentences.

UNIT V LETTER WRITING AND SENDING E-MAILS 12
Listening- Listening to programmes/broadcast/ telecast/ podcast;**Speaking** – Giving impromptu talks, Making presentations on given topics- Discussion on the presentation;**Reading** –Extensive reading;**Writing**- Poster making – Letter writing (Formal and E-mail) ;**Grammar** – Direct and Indirect speech – Combining sentences using connectives;**Vocabulary** –Collocation;

TEACHING METHODS:
Interactive sessions for the speaking module.
Use of audio – visual aids for the various listening activities.
Contextual Grammar Teaching.

EVALUATION PATTERN:
Internals – 50%
End Semester – 50%

TOTAL:60 PERIODS

LEARNING OUTCOMES:
- Students will improve their reading and writing skills
- Students will become fluent and proficient in communicative English
- Students will be able to improve their interpersonal communication

TEXTBOOK:
1. Richards, Jack.C with Jonathan Hull and Susan Proctor **New Interchange : English for International Communication. (level2, Student's Book)** Cambridge University Press,New Delhi: 2010.

REFERENCES:
1. Bailey, Stephen. **Academic Writing: A practical guide for students**. New York: Rutledge,2011.
2. Morgan, David and Nicholas Regan. **Take-Off: Technical English for Engineering**. London: Garnet Publishing Limited, 2008.
3. Redston, Chris & Gillies Cunningham **Face2Face** (Pre-intermediate Student's Book& Workbook) Cambridge University Press, New Delhi: 2005
4. Comfort, Jeremy, et al. **Speaking Effectively : Developing Speaking Skillsfor Business English.** Cambridge University Press, Cambridge: Reprint 2011.

MA7151 MATHEMATICS – I

L	T	P	C
4	0	0	4

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

COURSE OBJECTIVES
- The goal of this course is for students to gain proficiency in calculus computations. In calculus, we use three main tools for analyzing and describing the behavior of functions: limits, derivatives, and integrals. Students will use these tools to solve application problems in a variety of settings ranging from physics and biology to business and economics.
- To make the student acquire sound knowledge of techniques in solving ordinary differential equations that model engineering problems.
- To familiarize the student with functions of several variables. This is needed in many branches of engineering.
- To acquaint the student with mathematical tools needed in evaluating multiple integrals and their usage.

UNIT I DIFFERENTIAL CALCULUS 12

Representation of functions - New functions from old functions - Limit of a function - Limits at infinity - Continuity - Derivatives - Differentiation rules - Polar coordinate system - Differentiation in polar coordinates - Maxima and Minima of functions of one variable.

UNIT II FUNCTIONS OF SEVERAL VARIABLES 12

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

UNIT 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

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

TOTAL : 60 PERIODS

COURSE OUTCOMES

- Understanding of the ideas of limits and continuity and an ability to calculate with them and apply them.
- Improved facility in algebraic manipulation.
- Fluency in differentiation.
- Fluency in integration using standard methods, including the ability to find an appropriate method for a given integral.
- Understanding the ideas of differential equations and facility in solving simple standard examples.

TEXT BOOKS

James Stewart, "Calculus with Early Transcendental Functions", Cengage Learning, New Delhi, 2008.

2. Narayanan S. and Manicavachagom Pillai T. K., "Calculus" Volume I and II, S. Viswanathan Publishers Pvt. Ltd., Chennai, 2007.
3. Erwin Kreyszig, "Advanced Engineering Mathematics", John Wiley and Sons, 9th Edition, New Delhi, 2014.
4. Grewal B.S., "Higher Engineering Mathematics", Khanna Publishers, New Delhi, 43rd Edition, 2014.

REFERENCE BOOKS

1. Ramana B.V., "Higher Engineering Mathematics", Tata McGraw Hill Co. Ltd., New Delhi, 11th Reprint, 2010.
2. Jain R.K. and Iyengar S.R.K., "Advanced Engineering Mathematics", Narosa Publications, New Delhi, 3rd Edition, 2007.
3. Bali N., Goyal M. and Watkins C., "Advanced Engineering Mathematics", Firewall Media (An imprint of Lakshmi Publications Pvt., Ltd.,), New Delhi, 7th Edition, 2009.
4. Greenberg M.D., "Advanced Engineering Mathematics", Pearson Education, New Delhi, 2nd Edition, 5th Reprint, 2009.
5. Peter V.O'Neil, "Advanced Engineering Mathematics", Cengage Learning India Pvt., Ltd, New Delhi, 2007.

PH7151 ENGINEERING PHYSICS L T P C

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

OBJECTIVE:

- To introduce the concept and different ways to determine moduli of elasticity and applications.
- To instill the concept of sound, reverberation, noise cancellation, and ultrasonic generation, detection and applications
- To inculcate an idea of thermal properties of materials, heat flow through materials and quantum physics

- To promote the basic understanding of interferometers, principles and applications of lasers, optical fibers and sensors
- To establish a sound grasp of knowledge on the basics, significance and growth of single crystals

UNIT I PROPERTIES OF MATTER 9

Elasticity – Poisson's ratio and relationship between moduli (qualitative) - stress-strain diagram for ductile and brittle materials, uses - factors affecting elastic modulus and tensile strength - bending of beams - cantilever - bending moment - Young's modulus determination - theory and experiment - uniform and non-uniform bending - I shaped girders - twisting couple - hollow cylinder - shaft - torsion pendulum - determination of rigidity modulus-moment of inertia of a body (regular and irregular).

UNIT II ACOUSTICS AND ULTRASONICS 9

Classification of sound - loudness and intensity - Weber-Fechner Law - standard intensity and intensity level - decibel - reverberation - reverberation time - calculation of reverberation time for different types of buildings – sound absorbing materials - factors affecting acoustics of buildings : focussing, interference, echo, echelon effect, resonance - noise and their remedies. Ultrasonics: production - magnetostriction and piezoelectric methods - detection of ultrasound - acoustic grating – ultrasonic interferometer - industrial applications – Non-destructive testing - ultrasonic method: scan modes and practice.

UNIT III THERMAL AND MODERN PHYSICS 9

Thermal expansion - thermal stress - expansion joints - bimetallic strips - thermal conductivity- heat conductions in solids – flow of heat through compound media - Forbe's and Lee's disc method: theory and experiment- Black body radiation – Planck's theory (derivation) – Compton effect – wave model of radiation and matter – Schrödinger's wave equation – time dependent and independent equations – Physical significance of wave function – particle in a one dimensional box.

UNIT IV APPLIED OPTICS 9

Interference - Michelson interferometer: construction, working, determination of wave length and thickness - anti-reflection coating - air wedge and its applications - Lasers – principle and applications – Einstein's coefficients – CO_2 and Nd:YAG laser - semiconductor lasers: homo junction and hetro junction - construction and working – applications. Optical fibres - classification (index & mode based) - principle and propagation of light in optical fibres - acceptance angle and numerical aperture - fibre optic communication system - active and passive sensors.

UNIT V CRYSTAL PHYSICS 9

Single crystalline, polycrystalline and amorphous materials – Single crystals: unit cell, crystal systems, Bravais lattices, ditections and planes in a crystal, Miller indices - interplanar distance for a cubic crystal - coordination number and packing factor for SC, BCC, FCC, HCP and diamond structures - structure and significance of NaCl, CsCl, ZnS and graphite - crystal imperfections: point defects, line defects – Burger vectors, dislocations and stacking faults – Growth of single crystals: Bridgman and Czochralski methods.

TOTAL: 45 PERIODS

OUTCOME:

- The students will understand different moduli of elasticity, their determination and applications.
- The students will gain knowledge on the properties of sound, noise cancellation, and production, detection and applications of ultrasonics
- The students will acquire sound knowledge on thermal expansion and thermal conductivity of materials. Further they will gain an idea of quantum physics.
- The students will gain knowledge on interferometers, lasers and fiber optics
- The students will secure knowledge on the basics of crystal structures and their significance. Further they gain basic ideas of growing single crystals.

TEXTBOOKS:

1. Gaur R.K. and Gupta S.L., "Engineering Physics", Dhanpat Rai Publications (2013)
2. Palanisamy P.K., "Engineering Physics", Scitech Publications (P) Ltd. (2006).
2. Arumugam M., "Engineering Physics", Anuradha Publications (2000)

REFERENCES:

1. Serway R.A. and Jewett, J.W. "Physics for Scientists and Engineers with Modern Physics". Brooks/cole Publishing Co. (2010).
2. Tipler P.A. and Mosca, G.P., "Physics for Scientists and Engineers with Modern Physics". W.H.Freeman, (2007).
3. Markert J.T.,Ohanian, H. and Ohanian, M. "Physics for Engineers and Scientists". W.W.Norton & Co. (2007).

CY7151 ENGINEERING CHEMISTRY L T P C
3 0 0 3

OBJECTIVES

- To develop an understanding about fundamentals of polymer chemistry.
- Brief elucidation on surface chemistry and catalysis.
- To develop sound knowledge photochemistry and spectroscopy.
- To impart basic knowledge on chemical thermodynamics.
- To understand the basic concepts of nano chemistry.

UNIT I POLYMER CHEMISTRY 9

Introduction: Functionality-degree of polymerization. Classification of polymers- natural and synthetic, thermoplastic and thermosetting. Types and mechanism of polymerization: addition (free radical, cationic, anionic and living); condensation and copolymerization. Properties of polymers: Tg, tacticity, molecular weight-weight average, number average and polydispersity index. Techniques of polymerization: Bulk, emulsion, solution and suspension.

UNIT II SURFACE CHEMISTRYAND CATALYSIS 9

Adsorption-Types of adsorption-adsorption of gases on solids- adsorption from solutions-Types of isotherms–Frendlich adsorption isotherm,Langmuir adsorption isotherm.Industrial applications of adsorption. Catalysis: Characteristics and types of catalysts-homogeneous and heterogeneous, auto catalysis. Enzyme catalysis -factors affecting enzyme catalysis, Michaelis-Menton equation.Industrial applications of catalysts.

UNIT III PHOTOCHEMISTRY AND SPECTROSCOPY 9

Photochemistry: Laws of photochemistry-Grotthuss-Draper law, Stark-Einstein law and Lambert-Beer Law. Photo processes-internal conversion, inter-system crossing, fluorescence, phosphorescence, chemiluminescence and photo-sensitization. Spectroscopy: Electromagnetic spectrum-absorption of radiation-electronic, vibrational and rotational transitions. Width and intensities of spectral lines.Spectrophotometric estimation of iron.UV-Vis and IR spectroscopy- principles, instrumentation (Block diagram) and applications.

UNIT IV CHEMICAL THERMODYNAMICS 9

Second law: Entropy-entropy change for an ideal gas, reversible and irreversible processes; entropy of phase transitions; Free energy and work function: Helmholtzand Gibbs free energy functions; Criteria of spontaneity; Gibbs-Helmholtz equation; Clausius Clapeyron equation; Maxwell relations-Van't Hoff isotherm and isochore. Chemical potential; Gibbs-Duhem equation- variation of chemical potential with temperature and pressure.

UNIT V NANOCHEMISTRY 9

Basics-distinction between molecules, nanoparticles and bulk materials; size-dependent properties.Preparation of nanoparticles – sol-gel and solvothermal.Preparation of carbon nanotube by chemical vapour deposition and laser ablation.Preparation of nanowires by VLS growth, electrochemical deposition and electro spinning.Properties and uses of

nanoparticles, nanoclusters, nanorods, nanotubes and nanowires.

TOTAL : 45 PERIODS

OUTCOMES

- Will be familiar with polymer chemistry, surface chemistry and catalysis.
- Will know the photochemistry, spectroscopy and chemical thermodynamics.
- Will know the fundamentals of nano chemistry.

TEXT BOOKS

1. Jain P. C. & Monica Jain., "Engineering Chemistry", DhanpatRai Publishing Company (P) Ltd, New Delhi, 2014.
2. Kannan P., Ravikrishnan A., "Engineering Chemistry", Sri Krishna Hitech Publishing Company Pvt. Ltd. Chennai, 2014

REFERENCE BOOKS

1. Pahari A., Chauhan B., "Engineering Chemistry", Firewall Media, New Delhi, 2012.
2. Sivasankar B., "Engineering Chemistry", Tata McGraw-Hill Publishing Company Ltd, New Delhi, 2012.
3. AshimaSrivastava. Janhavi N N, Concepts of Engineering Chemistry", ACME Learning Private Limited., New Delhi., 2010.
4. Vairam S., Kalyani P., Suba Ramesh., "Engineering Chemistry", Wiley India Pvt Ltd., New Delhi., 2011.

GE7151	COMPUTING TECHNIQUES (Common to all branches of Engineering and Technology)	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To learn programming using a structured programming language.
- To provide C programming exposure.
- To introduce foundational concepts of computer programming to students of different branches of Engineering and Technology.

UNIT I INTRODUCTION 9

Introduction to Computers – Computer Software – Computer Networks and Internet - Need for logical thinking – Problem formulation and development of simple programs - Pseudo code - Flow Chart and Algorithms.

UNIT II C PROGRAMMING BASICS 9

Introduction to C programming – Fundamentals – Structure of a C program – Compilation and linking processes - Constants, Variables – Data Types – Expressions - Operators – Decision Making and Branching – Looping statements – Solving Simple Scientific and Statistical Problems.

UNIT III ARRAYS AND STRINGS 9

Arrays – Initialization – Declaration – One dimensional and two dimensional arrays - Strings- String operations – String Arrays - simple programs- sorting- searching – matrix operations.

UNIT IV POINTERS 9

Macros - Storage classes –Basic concepts of Pointers– Pointer arithmetic - Example Problems - Basic file operations

UNIT V FUNCTIONS AND USER DEFINED DATA TYPES 9

Function – definition of function – Declaration of function – Pass by value – Pass by reference – Recursion –Enumerators – Structures - Unions

TOTAL : 45 PERIODS

OUTCOMES

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

- Write C program for simple applications
- Formulate algorithm for simple problems
- Analyze different data types and arrays
- Perform simple search and sort**.**
- Use programming language to solve problems.

TEXTBOOKS:

1. Pradip Dey, Manas Ghosh, "Computer Fundamentals and Programming in C", Second Edition, Oxford University Press, 2013
2. Ashok N. Kamthane, "Computer programming", Pearson Education, 2007.
3. Yashavant P. Kanetkar. "Let Us C", BPB Publications, 2011.

REFERENCES:

1. Kernighan,B.W and Ritchie,D.M, "The C Programming language", Second Edition, Pearson Education, 2006
2. Byron S Gottfried, "Programming with C", Schaums Outlines, Second Edition, Tata McGraw-Hill, 2006.
3. R.G. Dromey, "How to Solve it by Computer", Pearson Education, Fourth Reprint, 2007

GE7152	ENGINEERING GRAPHICS	L	T	P	C
		3	2	0	4

OBJECTIVES

• To develop in students, graphic skills for communication of concepts, ideas and design of engineering products and 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 ANDFREE HANDSKETCHING **14**

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- Free hand sketching of multiple views from pictorial views of objects

14

UNIT II PROJECTION OF POINTS, LINES AND PLANE SURFACES

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 trapezoidal 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 **14**

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

UNIT IV PROJECTION OF SECTIONED SOLIDS AND DEVELOPMENT OF SURFACES **14**

Sectioning of 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. Development of lateral surfaces of solids with cut-outs and holes.

15

UNIT V ISOMETRIC AND PERSPECTIVE PROJECTIONS

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 and miscellaneous problems.
Perspective projection of simple solids-Prisms, pyramids and cylinders by visual ray method and vanishing point method.

COMPUTER AIDED DRAFTING (DEMONSTRATION ONLY) **3**

Introduction to drafting packages and demonstration of their use.

L=45+T=30, TOTAL: 75 PERIODS

OUTCOMES:

On Completion of the course the student will be able to

- Perform free hand sketching of basic geometrical shapes and multiple views of objects.
- Draw orthographic projections of lines, Planes and Solids
- Obtain development of surfaces.
- Prepare isometric and perspective views of simple solids.

TEXT BOOK:

1. N.D.Bhatt and V.M.Panchal, “Engineering Drawing”, Charotar Publishing House, 50th Edition, 2010.

REFERENCES:

1. K.R.Gopalakrishna., “Engineering Drawing” (Vol I&II combined) SubhasStores, Bangalore, 2007
2. Luzzader, Warren.J., and Duff,John M.,,’’ Fundamentals of Engineering Drawingwith an introduction to Interactive Computer Graphics for Design and Production”,Eastern Economy Edition, Prentice Hall of India Pvt Ltd, New Delhi, 2005
3. M.B.Shah and B.C.Rana, “Engineering Drawing”, Pearson, 2nd Edition, 2009
4. K.Venugopal and V.Prabhu Raja, “Engineering Graphics”, New Age International (P)Limited ,2008.
5. K. V.Natarajan, “A text book of Engineering Graphics”, 28th Edition, Dhanalakshmi Publishers, Chennai, 2015.
6. BasantAgarwal and Agarwal C.M., “Engineering Drawing”, Tata McGraw Hill Publishing Company Limited, New Delhi, 2008.
7. N.S Parthasarathy and Vela Murali, “ Engineering Drawing”, Oxford University Press, 2015

Publication of Bureau of Indian Standards:

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

Special points applicable to University Examinations on Engineering Graphics:

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

BS7161	BASIC SCIENCES LABORATORY	L T P C
	(Common to all branches of B.E. / B.Tech Programmes)	0 0 4 2

PHYSICS LABORATORY: (Any Seven Experiments)

OBJECTIVE:

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

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

TOTAL: 30 PERIODS

OUTCOME:

Upon completion of the course, the students will be able

- To determine various moduli of elasticity and also various thermal and optical properties of materials.
- To determine the velocity of ultrasonic waves, band gap determination and viscosity of liquids.

CHEMISTRY LABORATORY:

(Minimum of 8 experiments to be conducted)

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 poly vinyl 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.

TOTAL: 30 PERIODS

TEXTBOOKS

1. Vogel's Textbook of Quantitative Chemical Analysis (8^{TH} edition, 2014)
2. Laboratory Manual- Department of Chemistry, CEGC, Anna University (2014).

GE7161	COMPUTER PRACTICES LABORATORY	L	T	P	C
		0	0	4	2

OBJECTIVES

- To understand the basic programming constructs and articulate how they are used to develop a program with a desired runtime execution flow.
- To articulate where computer programs fit in the provision of computer-based solutions to real world problems.
- To learn to use user defined data structures.

LIST OF EXPERIMENTS

1. Search, generate, manipulate data using MS office/ Open Office
2. Presentation and Visualization – graphs, charts, 2D, 3D
3. Problem formulation, Problem Solving and Flowcharts
4. C Programming using Simple statements and expressions
5. Scientific problem solving using decision making and looping.
6. Simple programming for one dimensional and two dimensional arrays.
7. Solving problems using String functions
8. Programs with user defined functions
9. Program using Recursive Function
10. Program using structures and unions.

TOTAL: 60 PERIODS

OUTCOMES

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

- Write and compile programs using C programs.
- Write program with the concept of Structured Programming
- Identify suitable data structure for solving a problem
- Demonstrate the use of conditional statement.

LABORATORY REQUIREMENTS FOR BATCH OF 30 STUDENTS

30 Systems with C compiler

HS7251	TECHNICAL ENGLISH	L	T	P	C
		4	0	0	4

OBJECTIVES

- To enable students acquire proficiency in technical communication.
- To enhance their reading and writing skills in a technical context.
- To teach various language learning strategies needed in aprofessional environment.

CONTENTS

UNIT I ANALYTICAL READING **12**

Listening- Listening to informal and formal conversations; **Speaking** – Conversation Skills(opening, turn taking, closing)-explaining how something works-describing technical functions and applications;**Reading** –Analytical reading, Deductive and inductive reasoning; **Writing**- vision statement–structuring paragraphs.

UNIT II SUMMARISING 12

Listening- Listening to lectures/ talks on Science & Technology;**Speaking** –Summarizing/ Oral Reporting, **Reading** – Reading Scientific and Technical articles; **Writing**- Extended definition –Lab Reports – Summary writing.

UNIT III DESCRIBING VISUAL MATERIAL 12

Listening- Listening to a panel discussion; **Speaking** – Speaking at formal situations; **Reading** –Reading journal articles - Speed reading;**Writing**-data commentary-describing visual material-writing problem-process- solution-the structure of problem-solution texts-writing critiques

UNIT IV WRITING/ E-MAILING THE JOB APPLICATION 12

Listening- Listening to/ Viewing model interviews; **Speaking** –Speaking at different types of interviews – Role play practice (mock interview); **Reading** – Reading job advertisements and profile of the company concerned;**Writing**- job application – cover letter –Résumé preparation.

UNIT V REPORT WRITING 12

Listening- Viewing a model group discussion;**Speaking** –Participating in a discussion - Presentation;**Reading** – Case study - analyse -evaluate – arrive at a solution;**Writing**– Recommendations- Types of reports (feasibility report)- designing and reporting surveys- – Report format.- writing discursive essays.

TEACHING METHODS:

Practice writing
Conduct model and mock interview and group discussion.
Use of audio – visual aids to facilitate understanding of various forms of technical communication.
Interactive sessions.

EVALUATION PATTERN:

Internals – 50%
End Semester – 50%

TOTAL:60 PERIODS

LEARNING OUTCOMES

- Students will learn the structure and organization of various forms of technical communication.
- Students will be able to listen and respond to technical content.
- Students will be able to use different forms of communication in their respective fields.

TEXTBOOK:

1. Craig,Thaine**. Cambridge Academic English: An integrated skills course for EAP(Student's Book)Level: Intermediate** Cambridge University Press, New Delhi: 2012

REFERENCES:

1. Laws, Anne. **Presentations.** Hyderabad: Orient Blackswan, 2011.
2. Ibbotson, Mark. **Cambridge English for Engieering**. Cambridge University Press, Cambridge,New Delhi: 2008
3. Naterop, Jean B. and Rod Revell. **Telephoning in English**. Cambridge: Cambridge University Press, 2004.
4. Rutherford, Andrea J. **Basic Communication Skills for Technology**. New Delhi: Pearson Education, 2001.
5. Bailey, Stephen. **Academic Writing A practical Guide for Students**. Routledge, London: 2004.

Attested

DIRECTOR
Centre For Academic Courses
Anna University, Chennai-600 025.

6. Hewings, Martin**. Cambridge Academic English: An integrated skills course for EAP(Student's Book)Level: Intermediate** Cambridge University Press, New Delhi: 2012.

MA7251 MATHEMATICS – II L T P C
4 0 0 4

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

COURSE OBJECTIVES

- To develop the use of matrix algebra techniques this is needed by engineers for practical applications.
- To acquaint the student with the concepts of vector calculus, needed for problems in all engineering disciplines.
- To develop an understanding of the standard techniques of complex variable theory so as to enable the student to apply them with confidence, in application areas such as heat conduction, elasticity, fluid dynamics and flow the of electric current.
- To make the student appreciate the purpose of using transforms to create a new domain in which it is easier to handle the problem that is being investigated.

UNIT I 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 – 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 FUNCTION 12

Analytic functions – Necessary and sufficient conditions for analyticity - Properties – Harmonic conjugates – Construction of analytic function - Conformal mapping – Mapping by functions $w = z + c$, az, $\frac{1}{z}$, 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 with no pole on real axis.

UNIT V LAPLACE TRANSFORMS 12

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

TOTAL : 60 PERIODS

COURSE OUTCOMES

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

- Evaluate real and complex integrals using the Cauchy integral formula and the residue theorem
- Appreciate how complex methods can be used to prove some important theoretical results.
- Evaluate line, surface and volume integrals in simple coordinate systems

- Calculate grad, div and curl in Cartesian and other simple coordinate systems, and establish identities connecting these quantities
- Use Gauss, Stokes and Greens theorems to simplify calculations of integrals and prove simple results.

TEXT BOOKS

1. Erwin Kreyszig, "Advanced Engineering Mathematics", John Wiley and Sons, 9th Edition, New Delhi, 2014.
2. Grewal B.S., "Higher Engineering Mathematics", Khanna Publishers, New Delhi, 43rd Edition, 2014.

REFERENCE BOOKS

1. Ramana, B.V. "Higher Engineering Mathematics", Tata McGraw Hill, New Delhi, 2010.
2. Glyn James, "Advanced Modern Engineering Mathematics", Pearson Education, New Delhi, 2007.
3. Jain R.K. and Iyengar S.R.K., "Advanced Engineering Mathematics", Narosa Publications, New Delhi, 3rd Edition, 2007.
4. Bali N., Goyal M. and Watkins C., "Advanced Engineering Mathematics", Firewall Media (An imprint of Lakshmi Publications Pvt., Ltd.,), New Delhi, 7th Edition, 2009.
5. Peter V. O'Neil , "Advanced Engineering Mathematics", Cengage Learning India Pvt., Ltd, New Delhi, 2007.

PH7252 MATERIALS SCIENCE FOR TECHNOLOGISTS L T P C

(Common to E & I and Rubber and Plastics Technology Branches) **3 0 0 3**

OBJECTIVE:

- To make the students to understand the basics of phase diagrams and various crystal growth techniques
- To equip the students to have a knowledge on different types of electron theory, basics of applied quantum mechanics and about superconductors
- To introduce the importance of semiconducting materials, physics of semiconducting materials and applications of semiconductors in device fabrication
- To familiarize the students to magnetic materials, theory and types of magnetizations, dielectric materials and their application.
- To provide the students a sound platform towards learning about advanced materials and their applications.

UNIT I MATERIALS PREPARATION AND PROCESSING 9

Gibbs phase Rule – Phase Diagram – One component and multi component systems – Eutectic – peritectic – Eutectoid – Peritectoid – Invariant reactions – Lever Rule – Nucleation – homogeneous and heterogeneous nucleation – Free energy of formation of a critical nucleus – Nucleation rate – Experimental techniques of crystal growth – Czochralski, Bridgman, Flux, Solution, Vapour, Sol-gel - Hydrothermal – Epitaxy.

UNIT II CONDUCTING MATERIALS 9

Classical free electron theory of metals – quantum free electron theory - particle in a three dimensional box – degenerate state - electrons in a metal - Fermi distribution function – Density of energy states – effect of temperature on Fermi energy, Superconducting Phenomena, Properties of superconductors – Meissner effect and Isotope effect. Type I and Type II superconductors, High Tc superconductors – Magnetic levitation and SQUIDS.

UNIT III SEMICONDUCTING MATERIALS 9

Origin of band gap in solids (qualitative) - Concept of effective mass of electron and hole – 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 – Compound semiconductors – Hall effect – Determination of Hall coefficient – Solar cells – LED and photodiode.

UNIT IV MAGNETIC AND DIELECTRIC MATERIALS 9

Introduction to magnetic materials - Domain theory of ferromagnetism, Hysteresis, Soft and Hard magnetic materials – Anti-ferromagnetic materials – Ferrites, Giant Magneto Resistance 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.

UNIT V NEW MATERIALS AND APPLICATIONS 9

Introduction to Ceramics and its applications - Ceramic Fibres - Fibre reinforced Plastics – Fibre reinforced Metal – Metallic glasses – Shape memory alloys – Copper base alloys – Nickel – Titanium alloys - Sensors and Actuators – Range - Accuracy Determination –- Photo detectors, Bio-sensors, Scintillation detectors (Position sensitive) – Renogram – Computed Tomography Scan (CT Scan) - Magnetic Resonance Imaging (MRI) - Performance and Reliability testing.

TOTAL: 45 PERIODS

OUTCOME:

Students will be able to

- acquire knowledge of phase diagram and important crystal growing techniques.
- familiarize with conducting materials, and properties and applications of superconductors.
- gain knowledge on semiconducting materials based on energy level diagrams, its types, temperature effect. Also, fabrication methods for semiconductor devices will be understood.
- realize with theories of magnetic materials, understand the dielectric behavior of insulating materials and ferroelectric materials.
- familiarize with ceramics, FRP, shape memory alloys and important technological applications.

REFERENCES:

1. Kumar.J., Moorthy Babu. S and Vasudevan. S., “Engineering Physics”, Vijay Nicole Imprints (2006).
2. Palanisamy, P.K., “Materials Science”, Scitech. (2013).
3. Gaur. R.K. and Gupta. S.L., “Engineering Physics”, Dhanpat Rai Publications (2013).
4. Raghavan V., “Materials Science and Engineering”, Prentice Hall of India (2007).
5. Arumugam M., “Biomedical Instrumentation”, Anuradha Agencies (2003).

GE7153	ENGINEERING MECHANICS	L	T	P	C
		4	0	0	4

OBJECTIVE :

The objective of this course is to inculcate in the student the ability to analyze any problem in a simple and logical manner and to predict the physical phenomena and thus lay the foundation for engineering applications.

UNIT I STATICS OF PARTICLES 12

Fundamental Concepts and Principles, Systems of Units, Method of Problem Solutions, Statics of Particles -Forces in a Plane, Resultant of Forces, Resolution of a Force into Components, Rectangular Components of a Force, Unit Vectors.

Equilibrium of a Particle- Newton’s First Law of Motion, Space and Free-Body Diagrams, Forces in Space, Equilibrium of a Particle in Space.

UNIT II EQUILIBRIUM OF RIGID BODIES 12

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

UNIT III DISTRIBUTED FORCES 16

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

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

UNIT IV FRICTION 8

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

UNIT V DYNAMICS OF PARTICLES 12

Kinematics - Rectilinear Motion and Curvilinear Motion of Particles.

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

L – 45 + T – 15 TOTAL: 60 PERIODS

OUTCOMES:

- Upon completion of this course, students will be able to construct meaningful mathematical models of physical problems and solve them.

TEXT BOOK

1. Beer,F.P and Johnson Jr. E.R, "Vector Mechanics for Engineers", McGraw-Hill Education (India) Pvt. Ltd. 10th Edition, 2013.

REFERENCES

1. Hibbeller, R.C., Engineering Mechanics: Statics, and Engineering Mechanics: Dynamics, 13th edition, Prentice Hall, 2013.
2. J.L. Meriam & L.G. Karige, Engineering Mechanics: Statics (Volume I) and Engineering Mechanics: Dynamics, 7th edition, Wiley student edition, 2013.
3. P. Boresi & J. Schmidt, Engineering Mechanics: Statics and Dynamics, 1/e, Cengage learning, 2008.
4. Irving H. Shames, G. Krishna Mohana Rao, Engineering Mechanics - Statics and Dynamics, Fourth Edition – PHI / Pearson Education Asia Pvt. Ltd., 2006.
5. Vela Murali, "Engineering Mechanics", Oxford University Press (2010)

PR7251	PRODUCTION PROCESSES	L	T	P	C
	(Common to Aero/Auto/Rubber and Plastics)	3	0	0	3

OBJECTIVES:

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

UNIT I CASTING PROCESSES 10

Methods of production processes – comparison – sand casting – mould, pattern, die – pattern allowances – materials – types – 2 and 3 box moulding process – steps involved – core function and core making – runner, riser, gate-purpose – construction, principle, merits, demerits and applications of die casting, shell moulding, investment casting, centrifugal casting, continuous casting squeeze casting.

UNIT II METAL FORMING PROCESSES 8

Definition and companion of hot and cold forming – Principle, construction, types, merits, demerits and application of forging, rolling, extrusion, spinning processes – sheet metal operations – Types of dies used – Principle of powder metallurgy – steps involved – merits, demerits and applications.

UNIT III MACHINING PROCESSES 9

Machine and machine tool – construction, types operations in the following machines with block diagrams – Lathe, Milling, Drilling and Grinding – Concept of NC/CNC machines – Comparison of CNC with conventional machines – sample manual part programming for CNC Lathe and milling.

UNIT IV WELDING PROCESSES 9

Types of joining – soldering, brazing, welding, Chemical and mechanical – Fusion welding process – Gas welding – flame types – applications = Arc welding – types of joint – electrode – power supply – edge preparation – weld symbol – filler material – flux/ shielding gases – arc theory – Construction and applications of types of arc welding – Manual, GTAW, GMAW, SAW, ESW – Thermit welding, Pressure welding – resistance welding – spot, seam, projection and flash butt welding – stud welding – friction stir welding – diffusion bonding.

UNIT V UNCONVENTIONAL MACHINING PROCESSES 9

Need for unconventional – Construction, working principle merits, demerits and applications with block diagram only for AJM, AWJM, USM, CHM, ECM, EDM, EBM, LBM, PAM and IBM.

TOTAL: 45 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 BOOKS

1. Serope Kalpakjian, Steven R. Schmid, Manufacturing Engineering and Technology - Anna University, 4/e, Pearson Education, 2014
2. P.C. Sharma, “A Text Book of Production Technology”, S.Chand and Co. Ltd., New Delhi, 2010.

REFERENCE BOOKS:

1. B.H.Amstead, “Manufacturing Processes”, Phillip F.Ostwald, L.Begemon, John Wiley and Sons, 8th Edition, 1998.
2. De Garmo, “Materials and Processes in Manufacturing”, Prentice Hall of India, 8th Edition, 2008.
3. P.N.Rao, “Manufacturing Technology – I and II”, Tata McGraw Hill Publishing Co., New Delhi – 2013.
4. Amitabha Ghosh, Asok Kumar Mallik, Manufacturing Science, EWP Pvt. Ltd, 2007

CY7257 PHYSICAL AND ORGANIC CHEMISTRY L T P C
3 0 0 3

OBJECTIVE

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

OUTCOME

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

UNIT I REACTION MECHANISMS 9

Free radical substitutions, electrophilic 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

TEXT BOOKS

1. Glasstone, S., and D. Lewis. “Elements of Physical Chemistry”.Macmillan, 1995.
2. Maron and C.F. Pruton “Physical Chemistry” Macmillan, 1990.

REFERENCE BOOKS

1. Morrison and Boyd, “Organic Chemistry”. Prentice Hall,1992.
2. Finar I.L., “Textbook of Organic Chemistry”. ELBS,1996.

GE7261 COMPUTER PROGRAMMING LABORATORY L T P C
0 0 4 2

LIST OF EXPERIMENTS:

1. Programs using Functions and Pointers in C
2. Programs using Files in C
3. Programs using Classes and Objects
4. Programs using Operator Overloading

5. Programs using Inheritance, Polymorphism and its types
6. Programs using Arrays and Pointers
7. Programs using Dynamic memory allocation
8. Programs using Templates and Exceptions
9. Programs using Sequential and Random access files

TOTAL : 60 PERIODS

LABORATORY REQUIREMENTS FOR BATCH OF 30 STUDENTS

30 Terminals with C and C++ Compiler

GE7162	ENGINEERING PRACTICES LABORATORY (Common to all Branches of B.E. / B.Tech. Programmes)	L 0	T 0	P 4	C 2

COURSE 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 & ELECTRICAL)

1. CIVIL ENGINEERING PRACTICES 15

PLUMBING

- Basic pipe connections involving the fittings like valves, taps, coupling, unions, reducers, elbows and other components used in household fittings. Preparation of plumbing line sketches.
- Laying pipe connection to the suction side of a pump.
- Laying pipe connection to the delivery side of a pump.
- Practice in connecting pipes of different materials: Metal, plastic and flexible pipes used in householdappliances.

WOOD WORK

- Sawing, planing and making joints like T-Joint, Mortise and Tenon joint and Dovetail joint.

STUDY

- Study of joints in door panels and wooden furniture
- Study of common industrial trusses using models.

2. **ELECTRICAL ENGINEERING PRACTICES** 15

- Basic household wiring using Switches, Fuse, Indicator and Lamp etc.,
- Stair case light wiring
- Tube – light wiring
- Preparation of wiring diagrams for a given situation.
- Study of Iron-Box, Fan Regulator andEmergency Lamp

GROUP – B (MECHANICAL AND ELECTRONICS)

3. **MECHANICAL ENGINEERING PRACTICES** 15

WELDING

- Arc welding of Butt Joints, Lap Joints, and Tee Joints
- Gas welding Practice.
- Basic Machining - Simple turning, drilling and tapping operations..
- Study and assembling of the following:
  a. Centrifugal pump
  b. Mixie
  c. Air Conditioner.

DEMONSTRATION ON FOUNDRY OPERATIONS.

4. **ELECTRONIC ENGINEERING PRACTICES** 15

- Soldering simple electronic circuits and checking continuity.
- Assembling electronic components on a small PCB and Testing.
- Study of Telephone, FM radio andLow Voltage Power supplies.

TOTAL : 60 PERIODS

COURSE OUTCOMES

- Ability to fabricate carpentry components and to lay pipe connections including plumbing works.
- Ability to use welding equipments to join the structures
- Ability to do wiring for electrical connections and to fabricate electronics circuits.

AE7353 SOLID MECHANICS L T P C
3 0 0 3

OBJECTIVE:

- To introduce various behavior of structural components under various loading conditions. Also to introduce about the deflection of beams, stresses and strains in torsional members.

UNIT I STRESS-STRAIN – AXIAL LOADING 9

Definition of stress and strain- Stress-Strain relation- Relation between material constants.- Bar under axial loading- Statically determinate and indeterminate cases – Thermal stress- Impact Loading

UNIT II STRESSES IN BEAMS 9

Types of beams and loadings – Relation between shear force and bending moment - Shear force and bending moment diagrams – Euler beam theory - Bending stress in beams – Shear stress in beam – Composite beam.

UNIT III DEFLECTION OF BEAM 9

Various methods for statically determinate beams - Double integration method – Macaulay's method – Moment area method – Conjucate Beam method – Method of superposition

UNIT IV TORSION – SPRINGS 9

Shear stress and twist relation for circular section – Comparison of hollow shaft and solid shaft – Compound shaft – Power transmission by circular shafts – Springs – Deflection expression for close coiled helical spring – Stress in springs.

UNIT V BIAXIAL STRESS 9

Thin walled cylinder under internal pressure – Principal stresses for general biaxial stress field – Mohr's circle - Stresses in combined loading

TOTAL: 45 PERIODS

OUTCOMES:

At the end of the course

- Students will be familiarizing with the fundamentals of deformation, stresses, and strains in structural elements and pressure vessels.
- Students will be familiarizing the beam of different cross sections for shear force, bending moment, slope and deflection.

TEXT BOOKS:

1. Timoshenko and young, 'Elements of strength of Materials', Vol I & II, Van Nostrand Reinhold Company; 5th Revised edition,1968.
2. William Nash, Strength of Materials, McGraw-Hill Education; 6th edition , 2013.
3. 'Mechanics of Materials' by James M. Gere & Barry J Goodno, cengage Learning Custom Publishing, 8th edition, 2012.

REFERENCES:

1. Clive L. Dym , Irving H. Shames, "Solid Mechanics : A Variational Approach, Augmented Edition", Springer publishers, 2013.
2. Stephen Timoshenko, 'Strength of Materials',Vol I & II, CBS Publishers and Distributors, 3rd edition, 2004.
3. R.K.Rajput, 'Strength of Materials', S Chand; 4th Rev. Edition 2007.

MA7357 PROBABILITY AND STATISTICS L T P C
(Branch specific course) 4 0 0 4

OBJECTIVES:

- To make the students acquire a sound knowledge in statistical techniques that model engineering problems.
- The Students will have a fundamental knowledge of the concepts of probability.

UNIT I RANDOM VARIABLES 12

Discrete and continuous random variables – Moments – Moment generating functions – Binomial, Poisson, Geometric, Uniform, Exponential, Gamma, Weibull and Normal distributions - Functions of a random variable.

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 TESTS OF SIGNIFICANCE 12

Sampling distributions - Tests for single mean, proportion, Difference of means (large and small samples) – Tests for single variance and equality of variances – $\chi 2$- test for goodness of fit – Independence of attributes – Non-parametric tests: Test for Randomness and Rank - sum test (Wilcoxon test).

UNIT IV DESIGN OF EXPERIMENTS 12

Completely randomized design – Randomized block design – Latin square design - 2^2 - factorial design - Taguchi's robust parameter design.

UNIT V STATISTICAL QUALITY CONTROL 12

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

TOTAL : 60 PERIODS

TEXT BOOKS:

1. Milton, J. S. and Arnold, J.C., "Introduction to Probability and Statistics", Tata McGraw Hill, New Delhi, 4th Edition, 3rd Reprint, 2008.
2. Johnson, R.A. and Gupta, C.B., "Miller and Freund's Probability and Statistics for Engineers", Pearson Education, Asia, 8th Edition, 2011.

REFERENCES:

1. Devore, J.L., "Probability and Statistics for Engineering and the Sciences", Thomson Brooks/Cole, International Student Edition, New Delhi, 7th Edition, 2008.
2. 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.
3. Ross, S.M., "Introduction to Probability and Statistics for Engineers and Scientists", Elsevier, New Delhi, 3rd Edition, 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, New Delhi, 2004.

EE7254 PRINCIPLES OF ELECTRICAL AND ELECTRONICS ENGINEERING L T P C
3 0 0 3

OBJECTIVES:

To impart knowledge on

- Electric circuit laws, single and three phase circuits and wiring
- Working principles of Electrical Machines
- Various electronic devices and measuring instruments

UNIT I ELECTRICAL CIRCUITS 9

Basic principles involved in power generation, transmission and distribution, Ohms Law ,Kirchoff's Law , steady state solution of DC circuits , Thevinin's Theorem, Norton's Theorem, Superposition Theorem.

UNIT II AC CIRCUITS 9

Introduction to AC circuits – waveforms and RMS value – power and power factor, single phase and three-phase balanced circuits, housing wiring, industrial wiring, materials of wiring.

UNIT III ELECTRICAL MACHINES 9

Principles of operation and characteristics of DC machines. Transformers (single and three phase) ,Synchronous machines , three phase and single phase induction motors.

UNIT IV ELECTRONIC DEVICES & CIRCUITS 9

Types of Materials –Silicon & Germanium- N type and P type materials – PN Junction – Forward and Reverse Bias –Semiconductor Diodes –Bipolar Junction Transistor – Characteristics – transistor as an Amplifier –Introduction to operational Amplifier –Inverting Amplifier –Non Inverting Amplifier –DAC – ADC .

UNIT V MEASUREMENTS & INSTRUMENTATION 9

Introduction to transducers: pressure, temperature, position, electrical measurements ,Classification of instruments – moving coil and moving iron Ammeter and Voltmeter – multimeters – dynamometer type Wattmeter – three-phase power measurements – energy meter – megger – instrument transformers (CT and PT)

TOTAL : 45 PERIODS

OUTCOMES:

Ability to

- Understand electric circuits and working principles of electrical machines
- Understand the concepts of various electronic devices
- Choose appropriate instruments for electrical measurement for a specific application

REFERENCES

1. Del Toro, "Electrical Engineering Fundamentals", Pearson Education, New Delhi, 2007
2. John Bird, "Electrical Circuit Theory and Technology", Elsevier, First Indian Edition, 2006
3. Allan S Moris, "Measurement and Instrumentation Principles", Elseveir, First Indian Edition, 2006
4. Rajendra Prasad, "Fundamentals of Electrical Engineering", Prentice Hall of India, 2006
5. Thereja .B.L., "Fundamentals of Electrical Engineering and Electronics", S. Chand & Co. Ltd., 2008
6. V.K Mehta and Rohit Mehta, "Principle of Electrical Engineering", S. Chand & Company, 2008

GE7251 ENVIRONMENTAL SCIENCE AND ENGINEERING L T P C
3 0 0 3

OBJECTIVES:

To the study of nature and the facts about environment.

- To find and implement 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– soil waste management: causes, effects and control measures of municipal solid wastes – role of an individual in prevention of pollution – pollution case studies – disaster management: floods, earthquake, cyclone and landslides.

Field study of local polluted site – Urban / Rural / Industrial / Agricultural.

UNIT III NATURAL RESOURCES 10

Forest resources: Use and over-exploitation, deforestation, case studies- timber extraction, mining, dams and their effects on forests and tribal people – Water resources: Use and over- utilization of surface and ground water, floods, drought, conflicts over water, dams-benefits and problems – Mineral resources: Use and exploitation, environmental effects of extracting and using mineral resources, case studies – Food resources: World food problems, changes caused by agriculture and overgrazing, effects of modern agriculture, fertilizer-pesticide problems, water logging, salinity, case studies – Energy resources: Growing energy needs, renewable and non renewable energy sources, use of alternate energy sources. case studies – Land resources: Land as a resource, land 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 environment at infant stage.
- Ignorance and incomplete knowledge has lead to misconceptions.
- Development and improvement in standard of living has lead to serious environmental disasters.

TEXT BOOKS:

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

REFERENCES:

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

RP 7302 THEORY OF MACHINES AND MECHANISMS L T P C
3 1 0 4

OBJECTIVES

- To understand the basic concepts of mechanisms and machinery, its linkages, friction and balancing.

UNIT I MECHANISMS 14

Definition – Machine and Structure – Kinematic link, pair and chain – classification of Kinematic pairs – Constraint & motion – Degrees of freedom - Slider crank – single and double – Crank rocker mechanisms – Inversions, applications – Introduction to Kinematic analysis and synthesis of simple mechanisms – Determination of velocity and acceleration of simple mechanisms.

UNIT II FRICTION 12

Types of friction – friction in screw and nut – screw jack – pivot, collar and thrust bearings – belt (Flat & V) and rope drives – creep in belts – open and crossed belt drives – Ratio of tensions – Effect of centrifugal and initial tensions – condition for maximum power transmission.

UNIT III GEARING AND CAMS 12

Gear – Types and profile – nomenclature of spur & helical gears – laws of gearing – interference – requirement of minimum number of teeth in gears –Cam – Types of cams and followers – Cam design for different follower motions.

UNIT IV BALANCING 11

Static and dynamic balancing – single and several masses in different planes – primary and secondary balancing of reciprocating masses – Balancing of single and multi cylinder engines

UNIT V VIBRATION 11

Free, forced and damped vibrations of single degree of freedom systems – force transmitted to supports – vibration Isolation – vibration absorption – torsional vibration of shafts –geared shafts – critical speed of shafts.

L 45 , T : 15, TOTAL : 60 PERIODS

TEXT BOOKS

1. Bansal Dr.R.K. " Theory of Machines" Laxmi Publications (P) Ltd., New Delhi 2001
2. Rattan S.S."Theory of machines" Tata McGraw Hill publishing Co., New Delhi, 2002.

REFERENCES

1. Rao J.S.and Dukkipati R.V. "Mechanism and Machine Theory" Second Edition, Wiley Eastern Limited, 1992.
2. Malhotra D.R. and Gupta H.C "The Theory of machines" Satya Prakasam, Tech. India Publications, 1989
3. Gosh A and Mallick A.K. "Theory of Machines and Mechanisms" affiliated east west press, 1989
4. Shigley J.E. and Uicker J.J. Theory of Machines and Mechanisms" McGraw Hill, 1986.
5. Burton Paul "Kinematics and Dynamics of Machinery", Prentice Hall, 1979.

RP7301 INTRODUCTION TO POLYMER SCIENCE L T P C
3 0 0 3

UNIT I INTRODUCTION 4

History of Macromolecules – Difference between simple organic molecules and macromolecules-Monomers – Functionality – Classifications of Polymers – Natural and synthetic polymers – Structure of natural rubber and proteins

UNIT II ADDITION POLYMERIZATION 14

Polymerization mechanism- Initiation – Types of initiation – Free radical polymerization – Metallocene polymers - Cationic polymerization – Anionic polymerization – Coordination polymerization – Recent developments-Industrial polymerization – Bulk, emulsion, suspension and solution polymerization techniques – Copolymerization -Kinetics -Copolymer equation-Types of copolymers

UNIT III STEP GROWTH POLYMERIZATION 9

Extension of condensation reactions to polymer synthesis – Polycondensation – Flory's equal reactivity principle – Kinetics of polycondensation - Carother's equation – Linear polymers by polycondensation – Interfacial polymerization – Crosslinked polymers by condensation – Gel point –Examples - Moulding powders

UNIT IV SOLUTION PROPERTIES OF POLYMERS 9

Polymer Dissolution - Difference between simple solutions and polymer solutions – Molecular Weight - Average molecular weight – Degree of polymerization and molecular weight – Molecular weight distribution – Polymer fractionation - Polydispersity – Molecular weight determination. Different methods – Gel Permeation Chromatography – Osmometry, Light Scattering – Basic Principles

UNIT V DIMENSIONS OF MACROMOLECULES 9

Size and shape of the macromolecules – Solubility parameter – Polymer/solvent interaction parameter – Flory Huggins Theory of Polymer Solutions – Thermodynamics of Polymer dissolution - Theta temperature – Size and molecular weight of polymer from the solution properties of polymers

TOTAL : 45 PERIODS

REFERENCES

1. Billmeyer.F.W.,Jr, Text Book of Polymer Science, Ed. Wiley-Interscience, 1984.
2. Seymour.R.B., and Carraher.C.E., Jr., Polymer Chemistry, 2nd Ed., Marcel Dekker, 1988.
3. Gowariker.V.T., Viswanathan.N.V., and Sreedar.J., Polymer Science, 1988.
4. Joel,R.F; Polymer Science and Technology, Eastern Economy Edition, 1999.
5. George Odian , " Principles of Polymerisation", John Wiley& Sons, 2004.
6. Paul . J.Flory, "Principles of Polymer Chemistry" Cornell University Press, 1995.
7. Robert.O.Ebewele, " Polymer Science and Technology," CRC Press, 2000.

EE7261 ELECTRICAL AND ELECTRONICS ENGINEERING LABORATORY L T P C 0 0 4 2

OBJECTIVE:

- To train the students in performing various tests on electrical drives, sensors and circuits.

LIST OF EXPERIMENTS:

1. Load test on separately excited DC shunt generator
2. Load test on DC shunt moor
3. Load test on S Transformer
4. Load test on Induction motor
5. Regulation of 3 Alternator
6. Study of CRO
7. Logic gates
8. Operational amplifiers
9. Time constant of RC circuit
10. Characteristics of LVDT
11. Calibration of Rotometer
12. RTD and Thermistor
13. Flapper Nozzle system

TOTAL : 60 PERIODS

ME7362 MECHANICAL SCIENECS LABORATORY L T P C 0 0 4 2

OBJECTIVE:

- To train the students in testing and quantifying the mechanical properties of Engineering Materials, Engines.

LIST OF EXPERIMENTS:

Material Testing Lab

- Tension Test
- Torsion Test
- Testing of springs
- Impact test i) Izod, ii) Charpy
- Hardness test i) Vickers, ii) Brinell, iii) Rockwell, iv) Shore
- Deflection of Beams
- Dye Penetrant Test

- Tensile testing of polymers.
- Flex Fatigue test for Elastomers.
- Injection moulding machine operation.

IC Engines Lab

- Performance test on a 4 stroke engine
- Viscosity determination of the given fluid
- Moment of inertia of connecting rod
- Determination of Effectiveness of a parallel and counter flow heat exchangers.
- Valve timing of a 4 stroke engine and port timing of a 2 stroke engine.
- Determination of Flash point and Fire point of the given oil.

TOTAL : 60 PERIODS

OUTCOME:

- Upon completion of this course, the students can able to apply determine the strength materials and thermal properties.

MA 7354 NUMERICAL METHODS L T P C
4 0 0 4

OBJECTIVES:

- To provide the mathematical foundations of numerical techniques for solving linear system, eigenvalue problems, interpolation, numerical differentiation and integration and the errors associated with them;
- To demonstrate the utility of numerical techniques of ordinary and partial differential equations in solving engineering problems where analytical solutions are not readily available.

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 methods – Iterative methods of Gauss-Jacobi and Gauss-Seidel - Matrix Inversion by Gauss-Jordan method - Eigenvalues of a matrix by Power method and by Jacobi's method.

UNIT II INTERPOLATION AND APPROXIMATION 12

Interpolation with unequal intervals - Lagrange interpolation – Newton's divided difference interpolation – Cubic Splines - Interpolation with equal intervals - Newton's forward and backward difference formulae – Least square method - Linear curve fitting.

UNIT III NUMERICAL DIFFERENTATION AND INTEGRATION 12

Approximation of derivatives using interpolation polynomials - Numerical integration using Trapezoidal, Simpson's 1/3 and Simpson's 3/8 rules – Romberg's method - Two point and three point Gaussian quadrature formulae – Evaluation of double integrals by Trapezoidal and Simpson's 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 and second order equations - Multi-step methods - Milne's and Adams-Bashforth 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 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:

- Demonstrate understanding of common numerical methods and how they are used to obtain approximate solutions.
- Apply numerical methods to obtain approximate solutions to mathematical problems.
- Derive numerical methods for various mathematical operations and tasks, such as interpolation, differentiation, integration, the solution of linear and nonlinear equations, and the solution of differential equations.
- Analyse and evaluate the accuracy of common numerical methods.

TEXT BOOKS:

1. Grewal, B.S. and Grewal,J.S., "Numerical methods in Engineering and Science", Khanna Publishers, New Delhi, 9th Edition, 2007.
2. Sankara Rao . K, " Numerical Methods for Scientists and Engineers" PHI Learning Pvt Ltd. New Delhi, 2007.

REFERENCES:

1. Brian Bradie, "A Friendly Introduction to Numerical Analysis", Pearson Education Asia, New Delhi, 1st Edition, 2007.
2. Gerald, C.F. and Wheatley, P.O., "Applied Numerical Analysis", Pearson Education Asia, New Delhi, 6th Edition, 2006.
3. Laurene V. Fausett, "Applied Numerical Analysis using MATLAB", Pearson Education, New Delhi, 1st print, 2nd Edition, 2009.
4. S. R. K. Iyengar, R. K. Jain, Mahinder Kumar Jain, "Numerical Methods for Scientific and Engineering Computation", 6th Edition, New Age International Publishers, New Delhi, 2012.

RP7402 FUNDAMENTALS OF CHEMICAL ENGINEERING OPERATIONS **L T P C**
3 0 0 3

UNIT I HEAT TRANSFER **9**

Classification of Unit Operations - Heat transfer – steady state – Fourier law – thermal conductivity – conduction through plane wall – cylindrical wall – convection – forced and natural convection – radiation – unsteady state heat transfer - exchange equipment – double pipe and shell and tube heat exchangers, condensers

UNIT II BASIC THERMODYNAMICS **9**

Systems, Zeroth law, First law. Steady flow energy equation. Heat and work transfer in flow and non-flow processes. Second law, Kelvin-Planck statement - Clausius statement - Concept of Entropy, Clausius inequality, Entropy change in non-flow processes. Properties of gases and vapours.

UNIT III MASS TRANSFER **9**

Mass Transfer –Material Balance - Principles of diffusion, Fick's law – theory of diffusion, Mass transfer coefficients and film theory Penetration theory. Distillation – Vapour liquid equilibria, Simple distillation, Steam distillation, Continuous binary distillation, Industrial equipment for distillation- industrial boilers

UNIT IV AGITATION AND DRYING **9**

Drying – Principles and definitions, Rate of batch drying, Equipments for drying. Humidification –dry bulb and wet bulb temperatures, Equipment –— cooling towers, spray chambers

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Centre For Academic Courses
Anna University, Chennai-600 025.

Agitation of liquids – Types of impellers, Selection criteria, Power consumption calculations for agitated vessel Absorption – Principle and equipment (packed towers and plate columns). Adsorption – Principles and equipment for adsorption

UNIT V SEPARATION PROCESSES 9

Membrane Separation Processes - Separation of gases and liquids, Dialysis, Membranes, liquid – liquid extraction, Pervaporation and reverse osmosis. Size reduction Laws of crushing, Equipment – Classification, Crushers and grinders.

Mechanical separations – Screening and screening equipments, Filtration – Principle and filtration equipment, filter media, filter aids, Gravity settlers, Cyclones and hydro cyclones.

TOTAL : 45 PERIODS

REFERENCES

1. Mc. Cabe, W.L., Smith, J.C., Unit Operations of Chemical Engineering, Mc.Graw Hill. 1993.
2. Badger, W.L., Banchero, J.T., Introduction to Chemical Engineering, Mc.Graw Hill, UK, 1997.
3. Richardson and Coulson, Chemical Engineering, Vol. 1 & vol.2, Asian Books Pvt. Ltd., India. 1996.
4. Chattopadhyay, P., Unit Operations of Chemical Engineering Vol. I and Vol. II, Khanna Publishers, Delhi, 1998.

RP 7403 PHYSICAL PROPERTIES OF POLYMERS

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UNIT I STATES OF AGGREGATION IN POLYMERS 12

Transitions and segmental mobility in polymers – Glass transition, T_g, and flexibility – Multiple transitions in polymers - Significance of transition temperatures – Semi crystalline polymers – Effect of crystallization on properties of polymers – Factors affecting crystallization crystal nucleation and growth – relationship between T_g and T_m – Relationship between properties and crystalline structure- Melting of polymers – Rheology of Polymer melts.

UNIT II DEFORMATION & STRENGTH PROPERTIES OF POLYMERS 12

Polymer structure and Stress – Strain properties – Tensile properties – Flexural strength – impact strength – Fatigue endurance – Hardness tests – Mechanical relaxations in polymers –Effect of temperature on mechanical behaviour of polymers–Visco-elastic properties– Damping characteristics – Crazing in glassy polymers – Role of crazing in fracture – Macroscopical fracture theory – Fracture and microstructure

UNIT III FRICTION AND WEAR IN POLYMERS 8

Elastic deformation – Single contacts – Multiple contacts – Static and Dynamic Coefficient of friction -Rolling friction – Sliding friction of rubbers and rigid polymers – lubrication by fluids and solids – Wear –Wear testing – Abrasive wear.

UNIT IV ELECTRICAL PROPERTIES OF POLYMERS 8

Structure-Property relationships – Polar and Non-polar polymers - charge carriers – Electronic and Orientation Polarization-carrier mobility – Dielectric properties of polymers - Anti static and conductive of polymers –Volume resistivity measurements Molecular theories of dielectric relaxation in polymers – Dielectric breakdown.

UNIT V OPTICAL AND BARRIER PROPERTIES OF POLYMERS 5

Introduction – Isotropic polymers – Anisotropic polymers – Dichroism – Optical applications of polymers – Transmission – Haze - Rheoptical properties and application-Birefringence-Photoelastic effects and Analysis in Polymers, Permeation properties – diffusion coefficient – barrier properties in packaging application

TOTAL : 45 PERIODS

REFERENCES

1. Ulrich Eisele, "Introduction to Polymer Physics" Springer – Verlag, New York, 1990.
2. Bill Meyer.F.W. "Text Book of Polymer Science," Wiley Interscience Publications, 1994.
3. Sperling L.H., "Introduction to Physical Polymer Science," 4th Edition, Wiley Interscience, 2006
4. Brown.R.P., "Physical Testing of Rubber" Elsevier, 1986.
5. Gert Strobl, "The Physics of Polymers, 3rd Edition, Springer-Verlag, 2010.

RP 7404 PLASTICS MATERIALS – I L T P C
4 0 0 4

UNIT I INTRODUCTION TO PLASTICS 12

Plastics – Classification – Structure – Property relationship (effect on thermal, mechanical, optical, chemical, electrical properties)

UNIT II OLEFINIC PLASTICS 12

Manufacturing methods – structure / property relationships, processing & applications of PE, PP & Copolymers of PE & PP – Metallocene polymers

UNIT III STYRENICS & ACRYLICS 12

Styrenics: Manufacturing methods – Structure - property relationship, processing & applications of PS, SAN, ABS, HIPS & EPS.

Acrylics: Manufacturing Methods – Structure - property relationship processing & applications of PAN, PMMA & their copolymers

UNIT IV PVC TECHNOLOGY 9

Manufacturing, Structure - property relationship, additives for PVC - Processing applications of pPVC, uPVC,, PVC pastes, co polymers of PVC, blends & alloys of PVC, Testing of PVC resin, PVC compounds & Products

UNIT V ADDITIVES FOR PLASTICS 15

Fillers – Antioxidants – Stabilizers – Lubricants – Plasticizers – Toughening Agents – Colourants – Fire Retardants – Coupling Agents – Blowing Agents – UV Stabilizers – Anti Static Agents – Anti blocking Agents – Slip and Anti slip agents – processing aids – mould releasing agents – miscellaneous additives – environmental regulations

TOTAL : 60 PERIODS

REFERENCES

1. Brydson.J.A., Plastics Materials, 7th edition Elsevier Publication, 1999
2. Athalye & Prakash Trivedi, PVC Tech, Multitech Publishing Co, Bombay,1994.
3. Geoffrey Pritchard, "Plastics Additives", Rapra Technology Ltd, UK, 2005.
4. Olagoke Olabisi, "Hand Book of Thermoplastics", Marcel Decker, inc., 1997
5. Irvin.I. Rubin, "Hand Book of Plastic Materials and Technology", Wiley Interscience, NY, 1990

RP7405 RUBBER MATERIALS L T P C
3 0 0 3

UNIT I STRUCTURE-PROPERTY RELATIONSHIPS IN RUBBERS 12

Rubber Elasticity – Requirements for rubber elasticity – Effect of chemical structure on the performance properties of rubbers – Effect of structure on processing properties of elastomers

UNIT II NATURAL RUBBER AND OTHER GENERAL PURPOSE RUBBERS 12

Origin – Natural Rubber Latex, tapping, processing, properties and applications – Conversion of Latex into dry rubber – Properties of dry rubber – Classification based on

technical specifications – Modifications of Natural Rubber–Applications – Synthetic polyisoprene- SBR-BR-Polyalkenamers and polynorbornene

UNIT III SPECIAL PURPOSE ELASTOMERS 12

Nitrile Rubber and its modified forms, Butyl Rubber, Polychloprene Rubbers – Ethylene Propylene Rubber and Ethylene – Vinyl acetate copolymers – Elastomers based on modified polyethylene – Acrylate rubbers Polysulphide rubbers- polyether rubbers – Polyurethane elastomers

UNIT IV HIGH PERFORMANCE ELASTOMERS 4

Fluoroelastomers and silicone elastomers- Preparation, structure, properties and applications

UNIT V THERMOPLASTIC ELASTOMERS 5

Requirements for thermoplastic elastomeric behaviour – SBS and SIS Block copolymers – Thermoplastic Polyurethane elastomers – Thermoplastic-co-polyesters – Thermoplastic elastomers based on Plastics – Rubber Blends – Dynamic Vulcanization.

TOTAL : 45 PERIODS

TEXT BOOK

1. Kothandaraman B, Rubber Materials, Ane Books, New Delhi, 2007

REFERENCES

1. Brydson, J.A., Rubber Chemistry, Allied science Publishers, London, 1978.
2. Morton.M., Rubber Technology, Chapman Hall, 1995.
3. Franta, Elastomers and Rubber Compounding materials, Elsevier, 1989.
4. Blackely, D.C., Synthetic Rubbers – Their Chemistry and Technology, Applied Science Publishers Ltd, 1983.

RP 7401 FLUID MECHANICS AND POLYMER RHEOLOGY L T P C
3 0 0 3

UNIT I FLUID FLOW PHENOMENA 9

Fluid as a continuum, Terminologies of fluid flow, velocity – local, average, maximum, flow rate – mass, volumetric, velocity field; flow visualization – streamline, path line- laminar and turbulent flows of Newtonian fluids - power law – general treatment of isothermal viscous flow in tubes – Reynolds number—its significance

UNIT II FLOW MEASUREMENT 9

Bernoulli's equation–kinetic energy correction factor; head loss; friction factor; major and Minor losses- Flow Meters - general equation for internal flow meters; Orifice meter; Venturimeter;concept of area meters: rotameter; Local velocity measurement: Pitot tube

UNIT III INTRODUCTION TO RHEOLOGY 9

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, shear rate fluid through channel- Viscoelasticity - effect of rate of strain, temperature and time on mechanical behaviour of polymeric materials

UNIT IV MECHANICAL MODELS 9

- stress strain response of spring and dashpot – viscoelastic models Maxwell element - Voigt kelvin element - response to creep and stress relaxation -four-parameter model - dynamic mechanical properties - Boltzman principle - time temperature super position principle - WLF equation.

UNIT V MEASUREMENT OF RHEOLOGICAL PROPERTIES 9

Viscosity of polymer melts - die- swell and melt fracture - Weissenberg effect - Elongational viscosity. capillary rheometers – cone and plate viscometer - torque rheometers - Mooney viscometer - Applications of rheology to polymer processing (injection moulding, extrusion and blow moulding)

TOTAL : 45 PERIODS

TEXT BOOKS

1. Brydson J.A., "Flow properties of polymer melts", Life books, London, 1978.
2. Crawford R.J., "Plastics Engineering", Butterworth - Heinemann, Oxford, 1998

REFERENCES

1. Richard C. Progelhof and James L. Throne, "Polymer Engineering Principles", Hanser Publishers, New York, 1993.
2. John M. Dealy and Kurt F. Wissburn, "Melt Rheology and its Role in Plastics Processing,"
3. Chapman, London, 1995.
4. Lenk R.S., "Polymer Rheology," Applied Science, London, 1978.
5. Ferry, J.D."Viscoelastic Properties of Polymers," John Wiley & Sons, New York, 1986.
6. Chang Dae Han. "Rheology in Polymer Processing," Academic Press, New York, 1976

RP7412 POLYMER CHEMISTRY LABORATORY L T P C
0 0 4 2

OUTCOMES

- Capability to identify plastics materials
- Able to synthesize various types of polymers

Able to measure viscosity of polymer solutions.

LIST OF EXPERIMENTS

1. Synthesis of Plastics materials.
2. Bulk polymerization - Preparation of Polymethyl methacrylate.
3. Solution Polymerization - Preparation of polyacrylamide
4. Preparation of Phenol-Formaldehyde, UF and MF resins.
5. Density Determination
6. Identification of Polymers
7. Measurement of viscosity of polymer solutions and determination of molecular weight of the polymer.
8. Determination of K value of PVC
9. Determination of acid value of a Polyester resin.
10. Determination of EEW
11. Study of Molecular weight distribution (GPC).
12. Study of Thermal Stability of polymers

TOTAL : 60 PERIODS

REFERENCES

1 ASTM Standards, Vol. 8 & 9, ASTM International, 1995.
2 Ashraf S.M, Sharif Ahamed, Ufana Riaz, " A Laboratory Manual of Polymers", I.K International Publishing House Pvt Ltd, 2009
3 Stanley R. Sandler, Wolf Karo, JoAnne Bonesteel, Eli M. Pearce," Polymer Synthesisand Characterization: A Laboratory Manual," Academic Press, 1998.

RP 7411 COMPUTER AIDED PARTS AND ASSEMBLY DRAWING L T P C
0 0 4 2

OBJECTIVE

- To make the students to understand the concepts of drawing and construction of machine elements and assembly drawing by computer drafting.

- Train the students to allocate geometrical tolerances and to develop part drawing

INTRODUCTION

Introduction to machine drawing & production drawing- classification of drawing- Standardization – Orthographic and isometric projections- Conversion of orthographic to isometric drawing and vice versa- sectional views. Reviews of the concepts of limits, tolerance, fits, surface roughness, and symbols terminology used in Production drawing.

COMPUTER AIDED PRODUCTION DRAFTING

Detailed part drawing and assembly drawings (with suitable tolerances, machine symbols, specification of fit).

1. Screw jack
2. Shaper tool head
3. Plummer block
4. Machine vice
5. Four jaw chuck of lathe
6. Lathe tail stock
7. Universal coupling and knuckle joint
8. Hydraulic & Pneumatic Assembly
9. Injection moulding toggle type clamping
10. Snap fit and ribbed plate

TOTAL : 60 PERIODS

TEXT BOOK

1. Narayana K.L., Kannaiah P and Venkata Reddy – "Production Drawing" New age International Limited, Delhi 2004.

REFERENCES

1. Bhat N.D., "Machine Drawing", Charotar Publishing House, Anand 2000
2. Nagtal G.R., "Machine Drawing", Khanna Publishers, New Delhi 1994.
3. Sache Singh & P.L. Shah – Fundamentals of Machine Drawing, Prentice Hall India, 2003.

RP7504 RUBBER COMPOUNDING L T P C
3 0 0 3

UNIT I STANDARDS AND PRACTICES 6

Need for standardized rubber formulation - Specification data – Line call out - Mix Design – essentials and auxiliaries – order of addition, handling, storage - Compounding ingredients, physical form, viscosity, dispersive quality - Process safety, rate, state, stability

UNIT II CROSSLINKERS: MATERIALS AND MECHANISM 9

Cross linking of rubber, methods, materials & Mechanisms - Sulphur based systems - Classification of systems, activators, accelerators - Cure inhibitors, incipient cross linking - Organic peroxides as curatives – additives - Organic peroxides – mechanisms and applications - Metal oxides (ZnO, MgO) and activators - Curing of butyl by phenolic resins – materials, method and mechanism - Self cross linking systems - Blends of accelerators – synergism - Role of semi EV, modified EV - Crosslink density, optimization, role of cross link density on properties

UNIT III REINFORCERS, DILUENTS AND PROCESS ENABLERS 12

Filler reinforcement – need, materials, bound rubber – particle size, structure - Carbon black – furnace process – feed stock – ASTM grades – D1765 properties effect on extrusion mixing - Carbon black – low structure, Silica - coupling agent - Comparison of reinforcing and extending fillers – clay, whiting - Short fibre – L/D ratio, orientation, surface coating, short glass fibre - Non black fillers and oils – implication price, properties, performance – PNA content - Vulcanized vegetable oil – effect on viscosity – extrusion – calendaring - Substituted amines and hindered phenols – types – efficiency and mechanism - Hydro

carbon resin, synthetic resin as tackifiers, inorg, org, blowing agent, types – efficiency, pigments and organic dyes for coloration.

UNIT IV FORMULATION FOR PERFORMANCE REQUIREMENTS 12

Hardness requirements – low compression set – For damping application – Compounding to meet bonding requirements with metals – Compounding to meet processing – Economics of compounding – Cost estimation.

UNIT V FORMULATIONS: EXAMPLES AND JUSTIFICATION 9

NR formulation low hardness for automotive, non-automotive applications - NR for moderate hardness (50 – 30) for tyre carcass, tread, engine mounting, diaphragms, - NR for conveyor cover compound, bridge bearing - SBR BR for tyre tread - NBR for processing and performance - CR, CSM and FKM for weather, ozone, solvent, resistance application – ACM and HNBR Food and Drug contact, amine free additives - REACH regulations, PAH, synthetic process aids - TLV, LD50, environmental regulations.

TOTAL : 45 PERIODS

REFERENCES

1. Brendon Rodgers, “Rubber Compounding- Chemistry and Applications”, Marcel Dekker Inc 2004.
2. John S Dick, “Rubber Technology- Compounding and Testing for Performance” Hanser Publishers, 2001.
3. Smith, Len, “Language of Rubber,” Butterworth- Heinemann Ltd, 1993.
4. Hepburn. C., “Rubber Compounding Ingredients - Need, Theory and Innovation,”Part I and Part II, , RAPRA Review Reports Vol (9), 1997

RP 7503 POLYMER CHARACTÉRISATION TECHNIQUES L T P C
3 0 0 3

UNIT I CHEMICAL METHODS 6

Identification of Olefins, Dienes and other vinyl Polymers by Chemical Methods – preliminary examination – Polymer identification through functional group reactions- Analysis of Natural rubber, synthetic rubber and different plastic materials-Microstructural characterization using X-ray diffraction, SEM, TEM and AFM

UNIT II SPECTROSCOPIC CHARACTERIZATION OF POLYMERS 12

Vibrational Spectroscopy –Principles - Characterization of Specific functional groups - Group frequencies and Finger Print Regions– Applications in Polymer Blends and alloys - UV – Visible Spectroscopy - Spectrophotometer – Analysis of Cu, Mn, Fe in NR – NMR, Mass Spectroscopy, XPS and its applications in Polymer Characterization

UNIT III RHEOLOGICAL CHARACTERIZATION 9

Viscosity Characterization – Brookfield Viscosity – Characterization through Dilute solution viscosity – Characterization of Polymer melts – Characterization of Shear and Elongational flow – Rotational and Capillary Rheometers – Rheological Characterization of filled and unfilled Polymers – Rheological Characterization of Rubbers and Thermosets

UNIT IV THERMAL ANALYSIS 12

Thermal analysis – Instrumentation – Polymer Identification using Thermal Analysis - Compositional analysis – volatile matter, Rubber, Polymer blends, C-black & ash – estimation – Glass transition – Heat capacity – Thermal history of polymers – Degradation – State of cure studies-Characterization of Mechanical & Dielectric Relaxations in Polymers.

UNIT V CHROMATOGRAPHIC CHARACTERIZATION 6

Molecular weight distribution using GPC, HPLC– Biological Separations - Analysis of antioxidant, process oil and additives in Polymer Compounds –Analysis of Decomposition products using GC – Pyrolysis Gas Chromatography

TOTAL : 45 PERIODS

REFERENCES

1. Hummel D.O.and Scholl F., "Atlas of Polymer and Plastics Analysis", Vol.2, Carl Hanser Verlag, 1988
2. Craver, C.D. and Provder T., "Polymer Characterization", ACS Advances in chemistry Series, Volume 227, 1990
3. Vishu Shaw, "Hand Book of Plastics Technology", 2nd Edition, Wiley Interscience, 1998
4. Ottenbrite, Utracki, L.A., and Inoue, "Current Topics in Polymer Science", Vol. I & II, Hanser, 1987.

RP7502 PLASTICS PROCESSING AND MACHINERY L T P C
3 0 0 3

UNIT I MELT PROCESSING OF PLASTICS 9

Flow behavior – Viscosity and polymer processing, Newtonian and non newtonian flow, Melt flow index, capillary rheometer -thermal behaviour, crystallization, orientation.

UNIT II EXTRUSION PROCESS & BLOW MOULDING 9

Extruder components and their functions – Geometry & various types of extruder screws-Barrier screws, flow analysis with extruder, two stage, vented extruders; – Plastics compounding and its machinery. Pipe Extrusion Profile extrusion – Sheet extrusion, flat sheet extrusion –trouble shooting

Blow molding-Extrusion blow molding – Injection Blow moulding – Stretch Blow moulding – Co extrusion Blow moulding – Wall thickness and parison thickness relationship-causes and remedies

UNIT III INJECTION MOULDING OF PLASTICS 9

Cycle of operation – Machine construction details – Injection unit, clamping unit – Machine control – Specification for an injection moulding machine – Injection Machine ratings –Trouble shooting in injection moulding of Thermoplastics- process capability-total quality-SQC.

UNIT IV COMPRESSION, TRANSFER AND ROTATIONAL MOULDING OF PLASTICS 9

Thermosetting compounds-properties and uses; compression molding-perform and preheating-curing-process control; transfer molding-intergal and auxiliary mould-process control-mould; Rotational molding –materials , process control and troubleshooting - Sintering

UNIT V THERMOFORMING, CALENDARING AND FINISHINGOF PLASTICS 9

Thermo Forming process – Vacuum forming, pressure forming, plug – assisted vacuum forming– Billow forming – Calendaring process –PVC sheeting process– Powder coating processes – Welding of plastics – Heated tool welding – Hot gas welding – Frictional welding – Radiation based welding – Induction welding – Adhesive bonding of plastics – Machining of plastics– Laser marking – pad printing–painting

TOTAL : 45 PERIODS

REFERENCES

1. Harold Belofsky, "Plastics product design and process engineering" Hanser publishers, 1995
2. Tin A. Osswald, "Polymer Processing Fundamentals ", Hanser publishers, 1998.
3. Walter – Michaeli, "Plastics Processing An Introduction", Hanser, 1995.
4. Rubin I. "Hand book of Plastics Materials & Technology," Wiley, Interscience, 1999.

Attested

DIRECTOR
Centre For Academic Courses
Anna University, Chennai-600 025.

5. Crawford R.J, "Plastics Engineering," 3 rd Edition, Elsevier publications, 2005.

RP 7501 PLASTICS MATERIALS - II L T P C
3 0 0 3

UNIT I ENGINEERING PLASTICS 10

Polyamides, (nylons), modified polyamides, polyesters – PET, PBT, Polyacetals, PC and its blends – Preparation, properties & applications, LCP's, IPN's

UNIT II HIGH TEMPERATURE PLASTICS 10

Fluorine containing Plastics – Preparation, properties & uses of PTFE, PCTFE, PVDF, other high performance plastics like PPO, PPS, polysulphones, PEEK, Polyimides, Polybenzimidazoles, aromatic polyamides – Kevlar, Nomex – Preparation, properties & applications.

UNIT III SPECIALITY POLYMERS 10

Polymers for electronic applications, conducting polymers – Photoresists, polymers in optoelectronics polymers with piezoelectric, pyroelectric & ferroelectric properties, Polymers in telecommunications and power transmission

UNIT IV THERMOSETS 9

PF, UF and MF Resins – Preparation properties and uses – Moulding powders – Additives, Epoxy, Unsaturated Polyster, Vinyl Ester, Cyanate Ester – Preparation properties and applications

UNIT V POLYMERS FOR BIO MEDICAL APPLICATIONS 6

Bio- compatible and bio degradable polymers, Controlled drug release, tissue engineering, orthopaedic application, dentistry.

TOTAL : 45 PERIODS

REFERENCES

1. R.W. Dyson "Specialty Plastics" 2nd edition, Blackie Academic & Professional,1988.
2. James M. Margolis " Engineering. Plastics Handbook" McGraw – Hill, 2006.
3. "Engineering Plastics", Vol.2, ASM International, 1988.
4. Manas Chanda, Salil.K.Roy, "Plastics Technology Hand book", 2nd edition, Marcel Dekker, New York, 1993.
5. Matrin.T.Goosey, "Plastics for Electronics", Elsevier, Applied Science, 1985.

RP 7512 RUBBER MATERIALS LABORATORY L T P C
0 0 4 2

LIST OF EXPERIMENTS

1. Determination of T.S., D.R.C., V.F.A number of Latex
2. Estimation of total alkalinity of the latex
3. Determination of volatile matter, dirt, ash content in Rubber from Natural sources
4. Estimation of Cu, Fe and Mn in rubber by colorimetry
5. Rubber identification pyrolysis and spot test by specific reagents
6. Soxhlet extraction – determination of total extractables
7. Rapid reflux extract
8. Chemical analysis of synthetic rubber components and vulcanisates
9. Determination of structure of carbon black
   (i) DBP absorption
   (ii) IAN
   (iii) Surface area Calculation

10. Estimation of total and free sulphur in rubber products
11. Estimation of process oils
    (i) Aniline point
    (ii) Flash point
    (iii) Viscosity
    (iv)Density
12. Characterization of accelerator, insoluble methanol.
13. Knowledge about Spectroscopy – UV – Vis and FTIR
14. TGA / DSC analysis of Rubber Compounds.
15. TLC Analysis

TOTAL : 60 PERIODS

RP 7511 PLASTICS PROCESSING AND TESTING LABORATORY L T P C
0 0 4 2

LIST OF EXPERIMENTS

PLASTICS PROCESSING
1. Compounding and Mixing of plastic and their characteristics.
2. Semi and Fully Automatic Injection Molding-Piston Type.
3. Injection moulding
4. Extrusion of plastics-Single screw and Twin screw extruder
5. Compression moulding
6. Composites-Hand lay-up technique Gelation
7. Study of Injection and Compression molds.
8. Study of machining of plastics
9. Study of Adhesive materials
10. Determination of gel point

PLASTICS TESTING
1. Tensile Testing of Plastics
2. Flexural Testing of Plastics
3. Compressive Testing of Plastics
4. Impact Testing of Plastics
5. Falling Dart Impact testing for films
6. Arc Testing of Plastics
7. Melt flow index

TOTAL : 60 PERIODS

RP 7603 RUBBER PROCESSING AND MACHINERY L T P C
3 0 0 3

UNIT I COMPOUNDING AND MIXING OPERATIONS 8

Rubber mixing mechanism, mixing machinery - Open mill mixing – Internal mixers – Continuous mixers – Factors affecting mixing – Flow behaviour of rubber compound, processiblity test, Latex compounding and mixing.

UNIT II FORMING OPERATIONS 9

Calendering: Sheeting –Skim coating – Frictioning – Topping – Doubling – Profiling – Spreading – Roll configurations – Control of thickness. Extrusion; Ram type – Screw type – L/D ratio and its influence – Hot, cold feed extruders – Pin barrel extruder – Twin screw extruder – Criteria for machine selection.

UNIT III MOULDING AND OTHER VULCANISING TECHNIQUES 8

Compression, transfer and injection moulding – Blanks & pre-heating techniques, preparation of surfaces for bonding. Curing: Autoclaves, Hot air chambers, curing of built up

articles, continuous vulcanization, L.C.M. (Liquid Curing Media), Fluidized Bed, microwave curing. Hand building and forming equipment for tank, pipe lining, roller covering.

UNIT IV PROCESSING METHODS FOR VARIOUS RUBBER PRODUCTS 15

Belting and hoses – Cables – Footwear – Sports goods – Moulded products – Miscellaneous products – Latex products – Rubber – To-Metal bonding – Coated fabric.

UNIT V FINISHING OF RUBBER COMPONENTS – SAFETY IN RUBBER MACHINERY 5

Equipment's for flash and spew removal – Cryogenic techniques – Hand trimming – roller trim, buffing, tumbling, punching, grinding, shot blasting, painting, lacquering – Guards, Trip devices, Photoelectric and pressure sensitive devices – Maintenance of guards.

TOTAL : 45 PERIODS

REFERENCES

1. Blow.C.M. and Hepburn.C. Rubber Technology and manufacture, Butterworths, 1982.
2. Evans.C.W., Practical Rubber Compounding and processing, Applied Science Publishers, London, 1981.
3. Whelan.A., Injection Moulding Machines, Elsevier, 1989.
4. Stevens.M.J., Extruder Principles and Operations, Elsevier Applied Science, New York, 1985.
5. White.J.L., Rubber Processing Technology Materials, Principles, Hanser Publication, New York, 1995.
6. Richard F.Grossman,The Mixing of Rubber, Chapman & Hall,1997.
7. Kleemann, Weber, Elastomer Procesing, Hansar, 2005.

RP 7601 PLASTICS PRODUCT AND MOULD DESIGN L T P C
3 0 0 3

UNIT I CONCEPTS OF PLASTIC PRODUCT DESIGN 9

Introduction to DFMA, PFMA, Plastics for designer- Selection of Plastics - Product Design, Development and Manufacture – Checklist forms – Versatility of Design and assembly with Polymers – Property considerations in Designing of Plastics parts –Mechanical properties of plastics – Creep curves of Plastics. Product design consideration—Stress strain curves.

UNIT II DESIGNING STRUCTURAL PRODUCTS 9

Structural Requirements – Structural Analysis – Beams, Pressure vessels and tubes – Buckling of columns, Rings and arches – Flat Plates – Ribbed Plate Design – Plastics Springs – Snap Fit Designs – Design of Plastics gears and bearings-Design of plastic pipes .

UNIT III DESIGN OF INJECTION MOLDS 9

Principles of mould design-Standard mould system -Determination of mould size-design for core, cavity, runner, gates, guide pillar, venting, Ejection-simple mould design-Simple case study.

UNIT IV DESIGN OF COMPRESSION AND TRANSFER MOLDS 9

Types of compression moulding process-Determination of number of cavities - flash thickness allowances, design of mould cavity, design of loading chamber-Transfer mould design- Design calculations: Pot calculation, runner & gate dimensions.

UNIT V EXTRUSION DIES AND MAINTENANCE OF MOLDS 9

Mono extrusion dies for thermoplastics – Design and applications, dies with slit exit, annular exit, pipes dies. Co extrusion dies for thermoplastics - Adapters, blown film dies. Mechanical design of extrusion dies. Causes of wear and damage, preventive maintenance. Repair of moulds.

TOTAL : 45 PERIODS

REFERENCES

1. Joseph Gordon r., M., Industrial Design of Plastics Products, Wiley Interscience Publication 2003.
2. Crawford R.J Plastics Engineering, 3 rd Edition, Elsevier publications, 2005.
3. Ronald George William Pye, "Injection Mould Design" Published for The Plastics Institute [by] Iliffe, 2011.
4. Walteir Michaleli, "Extrusion dies for plastic and rubbers", 3rd edition, Hanser Publishers, 2003.
5. Gunter Mennig, Klaus Stoeckhert , "Mould making hand book" 2nd edition, Hanser Publishers, 2013.
6. Herbert Rees, Mould Engineering, 2nd edition, Hanser Publishers, 2002.

RP 7604 RUBBER PRODUCT DESIGN L T P C
3 0 0 3

UNIT I DEFORMATION, LOADING AND RESPONSE 9

Spring rates- creep- stress relaxation- rubber in compression- simple geometries- blocks- geometry and materials on spring characteristics- metal bonded rubber assemblies- design for spring rates.

UNIT II DESIGN FOR COMBINED DEFORMATION 9

Rubber product in simple shear- axial shear- rotary shear- sleeves- bush for torsion loads- shear spring rates- compression and shear in combination- material selection.

UNIT III RUBBER DESIGN FOR DAMPING AND DYNAMIC CONDITION 9

Dynamic mechanical properties and media- hysteresis- heat generation- vibration control- damping- engine mounts, bearings and earthquake resistant bearings- compound design.

UNIT IV SEALS AND SEALABILITY OF RUBBER AND PRODUCT DESIGN 9

Rubber in fluid sealings- type of seals- static seals, gaskets- couplings, hose- profile- beltings- conveyor and power transmission- failure mechanism and remedial measures.

UNIT V DESIGN FOR THERMAL, SHEAR AND FLOW DEPENDENT REQUIREMENTS 9

Moulds for rubber products- compression molds- transfer molds- injection molds- rubber products for specialty applications- nuclear- aerospace- naval fields.

TOTAL : 45 PERIODS

REFERENCES

1. Alan N Gent, "Engineering with Rubber", Hanser Verlag, Munich, 2001.
2. Freakley P R and Payne A R, "Theory and Practice of Engineering with Rubber," Applied Science Publishers, London, 1970.
3. Lindley P B, "Engineering Design with Natural Rubber", RAPRA, London, 1974.
4. Gobel E F & Brichta A M, Newnes, "Rubber Springs Design," Butterworths, London 1974.
5. A D Roberts, "Natural Rubber Science and Technology", OUP, London, 1998.

RP 7602 RUBBER AND PLASTICS TESTING L T P C
4 0 0 4

UNIT I PRINCIPLES OF SPECIFICATION 6

Principles of Testing- Standards and specification –Line Call- out– Nomenclature- ISO and other standards- Working Groups- Rubber & Plastics.

UNIT II TESTS ON RUBBER COMPOUNDS 15

Testing of Rubber Principles of specification – Scorch and cure parameters – Techniques and instruments – Types of curemeters – Principles, applications of cure data. Processability Testing, Principle and Application, Construction of TTS Curves, application.

UNIT III TESTS ON RUBBER VULCANISATES 15

Cured properties – Mechanical: Static properties –Hardness, tear, tensile application of test data and abrasion.

Fatigue – Flex cracking and cut growth – Heat build up – Principle and applications. Effect of environment – Oxygen, heat, ozone, low temperature and swelling media; Rubber to non-rubber substrate adhesions – Product and standard methods of testing.

UNIT IV PLASTICS TESTING - I 12

Tests on raw materials – Melting Point - Melt flow index – Density – Moisture analysis – Water absorption – K value of PVC - - Tests on thermosets – Spiral flow tests - Bulk factor – Gelation tests – Tensile strength – Modulus – Hardness of plastics – Flexural strength – Impact strength – Shear strength – Creep – Isochronous and isometric curve – Tests for fatigue loading – Abrasion resistance and wear rate - Coefficient of friction – Static and dynamic - Flammability test - Heat deflection temperature – Vicat softening point - Brittleness temperature test.

UNIT V PLASTICS TESTING- II 12

Thermal expansion — Thermal conductivity –- Resistivity measurements – Dielectric properties - Tracking index – Arc resistance – Refractive index - Gloss – Transmittance – Reflectance – Colour measurement - Gas and Water vapour permeability test – Stain resistance – ESCR – Salt spray test - Accelerated weathering test – Outdoor weathering test –Fungi and Bacteria resistance.

TOTAL : 60 PERIODS

REFERENCES

1. Brown R P, “Physical Testing of Rubber,” Elsevier, 1986.
2. Mathur A B, “Testing and Evaluation of Plastics” Allied Publishers (P) Ltd., 2003.
3. Smith, Len, “Language of Rubber,” Butterworth- Heinemann Ltd., 1993.
4. Schaefer R, “Dynamic Properties of Rubber (1-8) Series,” Rubber World, Vol.211, 1995.
5. Handbook of Plastics Testing Technology, Wiley Publication, 2007 (e-book)
6. ASTM Standards Volumes 8 and 9, 2015.
7. Vishu Shaw, Hand Book of Plastics Technology, 2nd Edition, Wiley Interscience, 1998

HS7551 EMPLOYABILITY SKILLS L T P C

3 0 0 3

COURSE DESCRIPTION

This course aims to help the students acquire the employability skills necessary for the workplace situations. It also attempts to meet the expectations of the employers by giving special attention to language skills, presentation skills, group discussion skills and soft skills. This will be achieved through expert guidance and teaching activities focusing on employability skills.

COURSE OBJECTIVES

- To enhance the employability skills of students with a special focus on presentation skills, group discussion skills and interview skills
- To help them improve their reading skills, writing skills, and soft skills necessary for the workplace situations
- To make them employable graduates

CONTENTS

UNIT I READING AND WRITING SKILLS 9

Reading: skimming & scanning strategies – note making skills – interpreting visual material (charts & tables) – critical reading – fast reading necessary for reading letters & files - preparing job applications - writing covering letter and résumé - applying for jobs online - email etiquette – writing official letters (placing an order, letters to consumers, etc.) writing reports – collecting, analyzing and interpreting data

UNIT II SOFT SKILLS 9

Hard skills & soft skills – soft skills: self-management skills & people skills - training in soft skills - persuasive skills – sociability skills –interpersonal skills – team building skills – leadership skills – problem solving skills – adaptability - stress management – motivation techniques – life skills -

UNIT III PRESENTATION SKILLS 9

Preparing slides with animation related to the topic – organizing the material - Introducing oneself to the audience – introducing the topic – answering questions – individual presentation practice— presenting the visuals effectively – 5 minute presentation

UNIT IV GROUP DISCUSSION SKILLS 9

Participating in group discussions – understanding group dynamics - brainstorming the topic -– questioning and clarifying –GD strategies (expressing opinions, accepting or refusing others opinions, turn taking) – activities to improve GD skills – viewing recorded GD - mock GD

UNIT V INTERVIEW SKILLS 9

Interview etiquette – dress code – body language – mock interview -–attending job interviews – answering questions confidently – technical interview – telephone/Skype interview - practice in different types of questions – one to one interview &panel interview – FAQs related to job interview- Emotional and cultural intelligence.

LEARNING OUTCOMES

- Students will be able to make presentations and participate in group discussions with high level of self-confidence.
- Students will be able to perform well in the interviews
- They will have adequate reading and writing skills needed for workplace situations

TOTAL : 45 PERIODS

REFERENCES:

1. Corneilssen, Joep. How to Prepare for Group Discussion and Interview. New Delhi: Tata-McGraw-Hill, 2009.
2. Dabreo, Desmond A. Group Discussion and Team Building. Mumbai: Better Yourself Books, 2004.
3. Ramesh, Gopalswamy, and Mahadevan Ramesh. The ACE of Soft Skills. New Delhi: Pearson, 2010.
4. Gulati, Sarvesh. Corporate Soft Skills. New Delhi: Rupa and Co. 2006.
5. Van Emden, Joan, and Lucinda Becker. Presentation Skills for Students. New York: Palgrave Macmillan, 2004.

EXTENSIVE READING

1. Covey, Stephen R. The 7 Habits of Highly Effective People. New York: Free Press, 2013.
2. Bagchi, Subroto. The Professional. New Delhi: Penguin Books India, 2009.

WEB RESOURCES

1. www.humanresources.about.com
2. www.careerride.com
3. https://bemycareercoach.com/softskills

RP 7611 RUBBER PROCESSING AND TESTING LABORATORY L T P C
0 0 4 2

The students will prepare using the rubber & rubber materials as appropriate using the process machinery and perform the tests for the properties as suggested in the following titles

Ex No:1 Mixing behaviour of NR on two roll mill
Ex No :2 Mixing study of carbon black filled NR
Ex No: 3 Mixing study of carbon black filled SBR
Ex No: 4 Mixing study of carbon black filled SBR & NR blend
Ex No: 5 Mixing study of carbon black filled EPDM
Ex No: 6 Mixing study of carbon black filled NBR
Ex No: 7 Extrusion characteristics of a filled rubber mix- NR
Ex No: 8 Extrusion characteristics of a filled rubber mix- SBR
Ex No: 9 Extrusion characteristics of a filled rubber mix- NBR
Ex No: 10 Extrusion characteristics of a filled rubber mix- EPDM
Ex No: 11 Curing Process of Rubber Compound- NR filled
Ex No: 12 Curing Process of Rubber Compound- SBR filled
Ex No 13 Curing Process of Rubber Compound- NBR filled
Ex no: 14 Curing Process of Rubber Compound- EPDM filled

Note: 1. The students will be required to perform at least 12 experiments as listed above to qualify for practical examination.
2. The cured specimens prepared will be tested for hardness, resilience, tensile properties, tear strength, fatigue (crack initiation and propagation), abrasion resistance and hot air aging.
3. In the testing, the students will be required to perform at least one set of testing for NR and a synthetic rubber.

TOTAL : 60 PERIODS

RP 7701 POLYMER COMPOSITES L T P C
3 0 0 3

UNIT I INTRODUCTION AND MATERIALS USED IN PMCs 9

Composites – Matrix-Reinforcements-Classification- Glass fibres – forms of reinforcements – carbon and Kevlar fibres – other fibres – polyester resins – epoxy resins – phenolic resins – curing of the resins – other ingredients in FRP – carbon – carbon composites.

UNIT II PROCESSING METHODS FOR FRPs 12

Hand lay up – spray up – Resin injection moulding – bulk moulding compounds – compounding of polyester machines – machinery and equipment – SMC, BMC compression and injection moulding, filament winding – pultrusion – autoclave moulding, matched die moulding – injection moulding and forming of thermoplastic composites.

UNIT III MECHANICS OF COMPOSITES 10

Theory of composites- Macromolecular behavior of Laminates- stress strain relationships- Analysis of Laminate - Longitudinal and transverse loading - Semi empirical approach - short fibre analysis.

UNIT IV TESTING AND CHARACTERISATION OF COMPOSITES 9

Mechanical properties- General test methods for tension, flexural, interlaminates shear stress, compression tests – elevated temperature tests – shear modulus, void content, resin content, fibre content, impact strength tests- Fractography

UNIT V APPLICATIONS OF COMPOSITES 5

Applications in aerospace, automotive, marine, civil engineering and electrical industry- Composite tooling - Rapid prototyping and Tooling.

TOTAL : 45 PERIODS

REFERENCES

1. Burns,R., “Polyester Moulding Compounds”, Marcel Dekker Inc., 1982.
2. Mathews F.L., and Rawlings, “Composite Material Engg. Science”, Chapman and Hall, London, 1994.
3. Weatherhead, R.G., “FRP Technology”, Applied science Publishers Ltd., 2000.
4. Riew, K., “Rubber Toughened Plastics”, ACS, 1989.

RP 7703 TECHNOLOGY OF TYRES AND TUBES L T P C
3 0 0 3

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 tyre behaviour 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 tyre behaviour.

UNIT III STRUCTURE OF THE PNEUMATIC TYRE 9

Tread design – Principles and materials. Abrasion – Concepts and recent understanding. Design of tyre moulds 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

REFERENCES

1. Setright J.K., “ Automobile Tyres”, Champan & Hall, 1972.
2. Woods, E.C.” Pnuematic Tyre 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,

RP 7702 POLYMER RECYCLING L T P C
3 0 0 3

UNIT I INTRODUCTION TO RECYCLING 6

Need for recycling –Source of Plastic waste – Life cycle analysis – Legislations related to polymer recycling - depolymerization - Thermal depolymerization – Ceiling temperature and its importance – Degradation – Biodegradation, Primary, Secondary, Tertiary recycling and Quaternary recycling

UNIT II SORTING TECHNIQUES 8

Density based – Optical sorting – Electrostatic sorting – Sorting by melting temperature – Sorting by selective dissolution- sorting of metal contaminants, size reduction - cutting – Densification – Pulverization – Chemical methods, melt filtration of contamination in recycled plastics – screen changers – filtration requirements of different recycled plastics.

UNIT III RECYCLING MATERIALS- I 12

Recycling of PET – PET separation – Melt reprocessing – Chemical reprocessing – Energy recovery – application.

HDPE recycling – Application of HDPE recyclate – LDPE recycling – Application of LDPE recycle LDPE – film recycling – Polypropylene recycling – Application of recycled PP – Recycling of polystyrene - Application of Recycled EPS.

Nylon recycling – Chemical recycling – Mechanical recycling – applications Depolymerization-case studies (PMMA, PS, polyacetals)

UNIT IV RECYCLING MATERIALS- II 11

Recycling of Engineering Thermoplastics – PC – ABS Mechanical and chemical recycling of polyacetals – Uses, recycling of polyurethanes – Physical methods – Chemical methods, Feed stock recycling and energy recovery.

Recycling of Thermoset composites – grinding of SMC – selective chemical degradation of SMC scrap – solvent recycling – pyrolysis – Energy recovery from SMC scrap – Recycling of thermoplastics composites.

Recycling of PVC - Separation techniques for PVC and PET – size reduction – melt filtration – Mechanical recycling – chemical recycling – Energy recovery – applications. Feed Stock Recycling – Pyrolysis – kiln / Retort – Fluidized bed – application – Hydrogenation of plastics waste – Gasification – different gasification process – economic aspects – Incineration of plastic waste with energy recovery.

UNIT V RUBBER RECYCLING 8

Tyre size reduction – Application of ground Rubber crumb – Filler – Bound Rubber products – Thermoplastics binder – Civil engineering applications – Surface treated crumb rubber – applications – Rubber reclaiming and devulcanization scrap rubber and fuel source (Tyre derived fuel TDF) – Pyrolysis.

TOTAL : 45 PERIODS

REFERENCES

1. John Scheirs, “Polymer Recycling Science, Technology and Applications,” JohnWiley & Sons, 1998.
2. Ann Christine Albertson and Samuel J Huang, “Degradable Polymers, Recycling and Plastics,” Marcel Dekker Inc, 1995.
3. Randall Curlec, T. and Sujit Das, “Plastics Wastes: Management Control, Recycling and Disposal,” US Environmental Protection Agency, Noyes Data Corporation, 1991.
4. Gerald D Andrews and Pallatheri M Subramanian, “Emerging Technologies in Plastics Recycling,” ACS Symposium Series, 513, 1992.
5. Mustafa.N. “Plastics Waste Management Disposal Recycling and Reuse,” Marcel Dekker Inc, 1993.

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RP 7713 **INDUSTRIAL TRAINING** **L T P C**
0 0 2 1

All the students have to undergo practical industrial training of **Two weeks** duration in recognized establishments, at the end of which they have to submit a report. The internal assessment will be based on the report and presentation and the examination marks, on viva voce examination.

TOTAL : 30 PERIODS

RP 7712 **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.

TOTAL : 30 PERIODS

RP 7711 **MOULD AND PRODUCT DESIGN LABORATORY** **L T P C**
0 0 4 2

LIST OF EXPERIMENTS

I DESIGN AND DRAWING OF MOULDS

1. Hand Mould
2. Semi – Injection Mould
3. Automatic Mould – with working area calculations
4. Multi Cavity – Multiday Light Mould
5. Split Cavity – Finger Cam Mechanism
6. Split Cavity – Dog Leg Cam Mechanism
7. Split Cavity – Cam tract Actuation
8. Side Core – Hydraulic Actuation
9. Collapsible core – Mechanism
10. Gear Core – Mechanism
11. Compression Mould
12. Transfer Mould

1.DESIGN AND DRAWING OF EXTRUSION DIES

1) Hot and Cold Extrusions
2) Extrusion of Tubes and profiles

II. ANALYSIS OF INJECTION MOULDING OF SIMPLE PRODUCTS USING MOULD ANAYSIS SOFTWARES

Product mould design considerations – Mould filling and cooling analysis – Control of product tolerances – Increasing product strength and stiffness – Designing for assemblies- Design for assembly and service.

TOTAL : 60 PERIODS

RP 7811 **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 Rubber and Plastics 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.

TOTAL : 300

RP 7009 POLYMERS FOR ENERGY STORAGE APPLICATIONS L T P C
3 0 0 3

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 – electroanalytical 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

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.

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RP 7001 ADHESIVES AND SURFACE COATINGS L T P C
3 0 0 3

UNIT I FUNDAMENTALS OF ADHESION 8

Adhesives – Fundamentals – types of substrates –mechanisms of setting, adhesive strength – thermodynamics of adhesives – concepts of surface energy, contact angle etc – types of joints – joint selection

UNIT II NON REACTIVE ADHESIVES 10

Natural adhesives like animal glue, casein, starch – rubber based adhesives – NR, SBR, NBR, CR, IIR adhesives – Latex based & solution based – principles behind formulations – Pressure sensitive & hot melt adhesives based on SBS, EVA – polyvinyl acetate & polyvinyl alcohol based adhesives.

UNIT III REACTIVE ADHESIVES 10

Phenolics, epoxies, acrylics, anaerobics, cyanoacrylates – uses of adhesives in civil Engineering, automobile, aerospace, electrical & electronic industries.

UNIT IV SURFACE COATINGS 9

Components of Paints – Preparations formulations, pigment dispersion, drying & film formation mechanisms, types of paints – based on emulsion, oil, alkyds, epoxies, PF, UF etc, Urethanes, Silicones – Primers like chlorinated rubber – applications, powder coatings.

UNIT V SURFACE PREPARATION 8

Surface preparation for adhesion & painting, powder coatings, factors affecting coating properties, barrier properties – rheology & its importance, paint & adhesion performance testing.

TOTAL : 45 PERIODS

REFERENCES

1. Skiest I ," Hand book of Adhesives ", Van Nostrand Reinhold, 1990.
2. Shields, "Adhesives Hand Book," Elsevier, 2008.
3. Malshe V.C, Sikchi M, "Basics of Paint Technology", Vol 1, Colour Publicatons Pvt Ltd, Mumbai, 2002
4. Phillipe Cognard "Handbook of Adhesives and Sealants: Basic Concepts and High Tech Bonding", Elsevier, 2005.

RP7002 ADVANCED PLASTICS PROCESSING L T P C
3 0 0 3

OBJECTIVES

To familiarize students with the latest plastics processing technologies.

UNIT I ADVANCED 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 - ProcessControls – Merits.

UNIT II ADVANCED INJECTION MOULDING PROCESS – II 9

Multi-layer Moulding, Counter flow moulding, Liquid Injection Moulding processes. Thin walled moulding, 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 optimisation - Cooling Profile applications. Process, downstream equipments - dies and application. Multi-layer film extrusion, co-extruded sheets, Corrugated pipes, profiles.

TOTAL : 45 PERIODS

OUTCOMES

At the end of the course, the students able to analysis the advance processing technique, end product application & it's importance

REFERENCES

1. James F. Stenvension, "Innovation in Polymer Processing Moulding," Hanser Publishers, New York, 1996.
2. Donald V. Rosato, "Injection Moulding Handbook," International Thomson Publishing Company, 1985.
3. Friedhelm Henson, "Plastics Extrusion Technology," Hanser Publishers, New York,1988.
4. Brunt Strong, "Plastics: Materials and Processing," Prentice-Hall, New Jersey,1996

RP 7003	BIOPOLYMERS AND POLYMERS FROM RENEWABLE RESOURCES	L	T	P	C
		3	0	0	3

UNIT I GREEN CHEMISTRY FOR POLYMERS 9

Raw materials for polymers – Sustainability of Petroleum resources - Need for Alternate Sources for Polymers –Polymer Recycling and Environmental Issues – Bio derived Polymers - Biodegradation and its Evaluation techniques – Standards for biodegradation – Need for biodegradation of packaging materials – Introduction to Life Cycle Assessment – Monomers from biosources.

UNIT II RESOURCES FOR BIOPOLYMERS 9

Polysaccharide based polymers – Gelatinization – Starch based blends - Biodegradation of Starch based Polymers - Production of Lactic acid and Polylactide - Properties and applications of Polylactides – Introduction to Polyhydroxyalkanoates and their derivatives – Applications – Chitin & Chitosan and its derivatives as biopolymers

UNIT III PROTEINS, HEMICELLULOSE AND CELLULOSE BASED POLYMERS 9

Plant and animal based Proteins – Solution casting of proteins – Processing of proteins as plastics – preparation and properties of hemicellulose – Cellulose based Composites – Surface and Chemical modifications of Cellulose fibers

UNIT IV PACKAGING APPLICATIONS OF BIOPOLYMERS 9

Food Packaging – Functional Properties – safety and Environmental aspects – Shelf life – Films and coatings in Food Applications – Materials for edible films and coatings – Biopolymer coatings for paper and paperboard – Bio-nano composite films and coatings

UNIT V BIOPOLYMER APPLICATIONS FOR AGRICULTURE 9

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Biopolymer Films – Biodegradable mulching – Advantages and Disadvantages - Chemical sensors – Biosensors - Functionalized Biopolymer Coatings and Films – Applications of biopolymers in horticulture

TOTAL : 45 PERIODS

REFERENCES

1. David Plackett, "Biopolymers – New Materials for Sustainable films and Coatings", John Wiley & Sons Ltd, 2011
2. David Kaplan, "Biopolymers from Renewable resources", Springer, 1998
3. Carmen Scholz, Richard A Gross, "Polymers from Renewable Resources: Biopolymers and Biocatalysis", American Chemical Society, 2001.

PR7551 STATISTICAL QUALITY CONTROL AND RELIABILITY ENGINEERING L T P C
3 0 0 3

OBJECTIVES:

- To impart the knowledge of the quality control, control charts and application and construction of various quality control charts and the selection.
- To study the significance of design of experiments and its application.
- To train the students in the field of reliability and its estimation.

UNIT I STATISTICAL PROCESS CONTROL 9

Quality control – Definition – Quality Assurance Variation in process – Factors – control charts – variables X_R and X_σ, - Attributes P, C and U-Chart Establishing and interpreting control charts process capability – Quality rating – Short run SPC.

UNIT II ACCEPTANCE SAMPLING 9

Lot by lot sampling types – probability of acceptance in single, double, multiple sampling plans – OC curves – Producer's risk and consumer's risk. AQL, LTPD, AOQ, AOQL, Concepts Design of sampling plan – single, double, multiple- standard sampling plans for AQL and LTPD – Use of standard sampling plans – Sequential sampling plan.

UNIT III EXPERIMENTAL DESIGN AND TAGUCHI METHOD 9

Fundamentals – fractional, factorial experiments – random design, Latin square design – Taguchi method –Quality Loss function – experiments – S/N ratio and performance measure – Orthogonal array.

UNIT IV RELIABILITY AND ITS PREDICTION 9

Life testing – Failure characteristics – Meantime to failure – maintainability and availability – reliability – system reliability – OC curves – reliability improvement techniques – Reliability testing techniques – Pareto analysis. MTBF, MTTF, MTTR – System reliability – OC curve Availability and Maintainability – Reliability Improvement techniques.

UNIT V FAILURE DATA ANALYSIS 9

Real time distribution, exponential,normal, log normal, gamma and weibull – reliability data requirements – Graphical evaluation.

TOTAL: 45 PERIODS

OUTCOME:

- Enable student to apply tools of statistics in analysis of experiments and data of industrial management interest.

TEXT BOOKS:

1. Amitava Mitra, "Fundamentals of Quality Control and Improvement", Pearson Education Asia, Delhi 2002.
2. Modares, "Reliability and Risk Analysis", Marcel Decker Inc. 4th edition 2014.

REFERENCES:

1. Besterfield D.H., "Quality Control", Prentice Hall, 3rd edition 2011.
2. Manohar Mahajan, "Statistical Quality Control", Dhanpat Rai and Sons, 2007.

3. Sharma S.C., “Inspection Quality Control and Reliability”, Khanna Publishers, 1998.

RP 7007 FRACTURE MECHANICS L T P C
3 0 0 3

UNIT I FATIGUE OF STRUCTURES 7

S.N. curves - Endurance limits - Effect of mean stress, Goodman, Gerber and Soderberg relations and diagrams - Notches and stress concentrations - Neuber’s stress concentration factors - Plastic stress concentration factors - Notched S.N. curves.

UNIT II STATISTICAL ASPECTS OF FATIGUE BEHAVIOUR 10

Low cycle and high cycle fatigue - Coffin - Manson’s relation - Transition life - cyclic strain hardening and softening - Analysis of load histories - Cycle counting techniques -Cumulative damage - Miner’s theory - Other theories.

UNIT III PHYSICAL ASPECTS OF FATIGUE 10

Phase in fatigue life - Crack initiation - Crack growth - Final Fracture - Dislocations - fatigue fracture surfaces.

UNIT IV FRACTURE MECHANICS 10

Strength of cracked bodies - Potential energy and surface energy - Griffith’s theory - Irwin - Orwin extension of Griffith’s theory to ductile materials - Stress analysis of “cracked bodies - Effect of thickness on fracture toughness” - Stress intensity factors for typical ‘geometries.

UNIT V FATIGUE DESIGN AND TESTING 8

Safe life and Fail-safe design philosophies - Importance of Fracture Mechanics in aerospace structures - Application to composite materials and structures.

TOTAL : 45 PERIODS

REFERENCES

1. Prasanth Kumar ,”Elements of fracture mechanics”, Wheeter publication, 1999.
2. Barrois W, Ripely, E.L., “Fatigue of aircraft structure,” Pergamon press. Oxford, 1983.
3. Sih C.G., “Mechanics of fracture.” Vol - I, Sijthoff and w Noordhoff International Publishing Co., Netherlands, 1989.
4. Knott, J.F., “Fundamentals of Fracture Mechanics,” - Buterworth & Co., Ltd., London, 1983.
5. Kare Hellan ,’Introduction to Fracture Mechanics’, McGraw Hill, Singapore,1985

RP 7008 LATEX SCIENCE AND TECHNOLOGY L T P C
3 0 0 3

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

REFERENCES

1. Blackley, D.C., "High Polymer Latices", Vol 1 and 2, Chapman & Hall, 1997
2. Mausser,R.F., "The Vanderbilt Latex Hand book" 3rd edn. R.T. Vanderbilt Company, 1987.
3. Calvert, "Polymer Latex and Applications", Applied Science Publishing Ltd, 1985.

RP 7015 TECHNOLOGY OF POLYMER BLEND

L	T	P	C
3	0	0	3

UNIT I THEORY OF POLYMER BLENDS 9

Flory – Huggins treatment of polymer mixtures –Phase diagrams and Miscibility gaps - Effect of temperature on the miscibility of polymer solutions and blends - Criteria for Blend miscibility – Polymer – Polymer Interaction Energies – Hydrogen boding systems – Crystalline polymer blends-Block Copolymers

UNIT II MELT PROCESSING OF POLYMER BLENDS 9

Factors influencing Morphology – Influence of Processing methods on Morphology Chemistry of compatibilization –Compatibilizers - Reactive compatibilization – Commercially important Blends: Structure – Property relationships

UNIT III MORPHOLOGY OF POLYMER BLENDS 9

Continuous & discontinuous phases – Microscopic Phase visualization methods – Optical Microscopy, TEM, SEM and AFM – Dispersed phase size and Dispersion Uniformity – Glass transition in Polymers blends and copolymers – Applications of thermal analysis in crystalline polymer blends – Interpenetrating Polymer networks

UNIT IV PROPERTIES OF POLYMER BLENDS 9

Thermo-mechanical Performance of amorphous – Amorphous and Amorphous- Crystalline blends – Permeability of miscible blends – Barrier materials through control of Blend morphology – Reinforced polymer blends

UNIT V ELASTOMER BLENDS 9

Miscible and immiscible elastomers blends – Thermoplastic vulcanizates – Thermoset – Thermoplastic Blends – Properties of cured Blends – Rubber Toughening of thermosets – Toughening of semi-crystalline plastics – Recycling of polymer blends.

TOTAL : 45 PERIODS

REFERENCES

1. Paul, D.R. and Bucknall, C.B., “Polymer Blends”, Volumes I and II, Wiley Interscience, 2000.
2. Utracki, L.A., “Polymer Blends Handbook”, Volumes I and II, Kluwer Academic Publishers, 2002.
3. Riew, C.K. and Kinloch, A.J., “Toughened Plastics I – Science and Engineering”, ACS, Advance in Chemistry Series 233, 1993
4. L.H.Sperling, “Introduction to Physical Polymer Science”, Wiley Interscience, 2006

RP 7010 POLYMERS IN PACKAGING TECHNOLOGY L T P C
3 0 0 3

UNIT I INTRODUCTION TO PACKAGING 9

Definition, functions of packaging, types and selection of package, packaging hazards, interaction of package and contents, materials and machine interface, environmental and recycling considerations-Life cycle assessment; Package design-Fundamentals, factors influencing design, stages in package development.

UNIT II DIFFUSION AND PERMEABILITY 9

Diffusion-Types of diffusion, Fick’s law of diffusion and applications; Diffusion coefficients of gas, liquid and vapour in polymers and packaging films, techniques to measure diffusion coefficient in polymer interface; Polymer permeability, gaseous transport in polymers, permeability measurement.

UNIT III VARIOUS PACKAGING TECHNIQUES 9

PE,PP,EVA,EVOH,PVC,PVDC,PS,ABS,EPS,Polyester,Polyamide,PC,PPE,,Cellulosics,PEEK,TPE and PEN,PEI and LCP ;Biodegradable polymers- PLA,PGA,PCL,PHA and PHB and Foam based on PE,PP & PU -Properties and applications.

Flexible and Rigid Packaging-Extrusion- Blown film, cast film, multi-layer film and sheet, lamination; Injection moulding; Blow moulding ;Thermoforming; Surface treatment for printing and printing processes.

UNIT IV SPECIALITY PACKAGING 9

Aerosol packaging, shrink and stretch wrapping, blister packaging, antistatic packaging, aseptic packaging, active packaging, modified atmospheric packaging, ovenable package, cosmetic package, hardware packaging, food packaging, textile packaging, health care packaging, export packaging.

UNIT V TESTING OF PACKAGING MATERIALS 9

Package Testing- Mechanical properties – Tensile and tear properties, Impact properties, Burst strength, Stiffness, Crease or flex resistance; Co-efficient of friction, Blocking Orientation and Shrinkage; Optical Properties – Clarity, Haze and gloss; Barrier Properties – Oxygen transmission, Water vapour transmission rate migration; Chemical resistance tests

TOTAL: 45 PERIODS

REFERENCES

1. Aaron L Brody Kenneth S Marsh, “Encyclopedia of Packaging Technology”, Wiley, 1997.
2. A.S. Athayle, “Handbook of Packaging Plastics”, Multi Tech publishing Co, First edition, 1999
3. Selke, S. E. M., Culter, J. D. and Hernandez, R. J., “Plastics Packaging: Properties, Processing, Applications and Regulations”, Carl Hanser Verlag, USA, 2004

RP 7011 POLYURETHANE SCIENCE AND TECHNOLOGY L T P C
3 0 0 3

UNIT I PRINCIPLES OF PU CHEMISTRY AND SPECIAL 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

Flexible foams-Their production-Equipment and process, properties and uses
Rigid foams-Production and properties-Relationship between production methods and properties, uses – Integral skin foams- RIM

UNIT IV SOLID PU MATERIALS 9

Casting of PUs, TPUs- Chemistry, manufacturing, processing, compounding and uses, millable PUs-preparation, properties and uses

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

REFERENCES

1. Oertel G(Ed), “PU Handbook”, II Edition, Hanser, 1993.
2. Hepburn C, “PU Elastomers II” Edition, Springer Science, 1992.

MG7451 PRINCIPLES OF MANAGEMENT L T P C
3 0 0 3

OBJECTIVES:

- To study the Evolution of Management
- To study the functions and principles of management
- To learn the application of the principles in an organization

UNIT I INTRODUCTION TO MANAGEMENT AND ORGANIZATIONS 9

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

UNIT II PLANNING 9

Nature and purpose of planning – planning process – types of planning – objectives – setting objectives – policies – Planning premises – Strategic Management – Planning Tools and Techniques – Decision making steps and process.

UNIT III ORGANISING 9

Nature and purpose – Formal and informal organization – organization chart–organization structure – types – Line and staff authority – departmentalization – delegation of authority – centralization and decentralization –Job Design - Human Resource Management –HR Planning, Recruitment, selection, Training and Development, Performance Management ,

Career planning and management.

UNIT IV DIRECTING 9

Foundations of individual and group behaviour– motivation – motivation theories – motivational techniques – job satisfaction – job enrichment – leadership – types and theories of leadership –communication – process of communication – barrier in communication – effective communication –communication and IT.

UNIT V CONTROLLING 9

System and process of controlling –budgetary and non-budgetary control techniques – use of computers and IT in Management control – Productivity problems and management – control and performance – direct and preventive control – reporting.

TOTAL: 45 PERIODS

OUTCOMES:

- The student would have gained the ability to learn the different principles and techniques of management in planning, organizing, directing and controlling.

TEXT BOOKS:

1. Stephen P. Robbins & Mary Coulter, " Management", Prentice Hall (India)Pvt. Ltd., 10th Edition, 2009.
2. JAF Stoner, Freeman R.E and Daniel R Gilbert "Management", Pearson Education, 6th Edition, 2004.

REFERENCES:

1. Stephen A. Robbins & David A. Decenzo & Mary Coulter, "Fundamentals of Management" Pearson Education, 7th Edition, 2011.
2. Robert Kreitner & Mamata Mohapatra, " Management", Biztantra, 2008.
3. Harold Koontz & Heinz Weihrich "Essentials of management" Tata McGraw Hill,1998.
4. Tripathy PC & Reddy PN, "Principles of Management", Tata Mcgraw Hill, 1999

RP 7013 RUBBER COMPONENTS IN AUTOMOBILES L T P C
3 0 0 3

UNIT I INTRODUCTION 6

Identification of plastics / rubber components in automobiles – Function – Selection criteria.

UNIT II STRUCTURE-PROPERTY RELATIONSHIPS IN RUBBERS 10

Resilience, creep, hysteresis and damping, stability, set and stress relaxation, behaviour in dynamic applications.

UNIT III VIBRATION AND RUBBER SPRING 10

Principles of vibration isolation – Rubber mounts – Spring design – Comparison with metallic springs – Shape factor and its effect – Forced and free vibrations with damping – Typical mounts, compounding and manufacture.

UNIT IV FLUID SEALINGS AND FLEXIBLE COUPLINGS AND HOSES 10

Seals for static and dynamic applications – Effect of heat / oil ageing – Frictional behaviour – Fundamental of sealability.

UNIT V COMPOUNDING AND MANUFACTURE 9

Types of couplings – Specification and selection – Torque vs deflection relationship – Brake fluid / hydraulic hoses, materials and manufacture.

TOTAL : 45 PERIODS

REFERENCES

1. Freakley.P.K., and Payne A.R., "Theory and Practice of Engineering with Rubber", Applied Science Publishers Ltd., 1978.
2. Gobel.E.F., "Rubber Springs Design", Newnes-Butterworths, Guildford, UK 1974.
3. Blow.C.M. and Hepburn C., "Rubber Technology and Manufacture", Butterworth-Heinemann, 1982.

The scope of the subject will include studies on the following components:

Cylinder head gasket	:	ACM, Silicon
Oil Pan gasket	:	ACM
Blow-by Circuit hose	:	NBR / PVC, CM, FKM/EVA, FKM/VMQ
Vacuum Hose	:	CR, CM, AEM
Oil Circuit and blow-by seals	:	AEM, FPM, HNBR
Oil hose	:	AEM
Oil filter base gasket	:	NBR, AEM and ACM
Dipstick guide	:	HNBR
Dipstick seal	:	NBR ,FPM
Drain plug seal	:	NBR, ACM
Air filter intake duct	:	TPV-(EPDM+PP)
Throttle valve intake duct	:	TPV-(EPDM+PP), EPDM, NBR/PVC, CM, ECO
Throttle valve seals	:	NBR
Air intake manifold seals	:	NBR
Cooling Hose	:	EPDM
Cooling Seals	:	EPDM

GE7652 TOTAL QUALITY MANAGEMENT L T P C
3 0 0 3

AIM

To provide comprehensive knowledge about the principles, practices, tools and techniques of Total quality management.

OBJECTIVES

- To understand the need for quality, its evolution, basic concepts, contribution of quality gurus, TQM framework, Barriers and Benefits of TQM.
- To understand the TQM Principles.
- To learn and apply the various tools and techniques of TQM.
- To understand and apply QMS and EMS in any organization.

UNIT I INTRODUCTION 9

Introduction - Need for quality - Evolution of quality - Definition of quality - Dimensions of product and service quality –Definition of TQM-- Basic concepts of TQM –-Gurus of TQM (Brief introduction) -- TQM Framework- Barriers to TQM –Benefits of TQM.

UNIT II TQM PRINCIPLES 9

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

UNIT III TQM TOOLS & TECHNIQUES I 9

The seven traditional tools of quality – New management tools – Six-sigma Process Capability– Bench marking – Reasons to bench mark, Bench marking process, What to Bench Mark, Understanding Current Performance, Planning, Studying Others, Learning from the data, Using the findings, Pitfalls and Criticisms of Bench Marking – FMEA – Intent of FMEA, FMEA Documentation, Stages, Design FMEA and Process FMEA.

UNIT IV TQM TOOLS & TECHNIQUES II 9

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

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

OUTCOMES:

Ability to apply TQM concepts in a selected enterprise.
Ability to apply TQM principles in a selected enterprise.
Ability to apply the various tools and techniques of TQM.
Ability to apply QMS and EMS in any organization.

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.

REFERENCE BOOKS:

1. James R. Evans and William M. Lindsay, "The Management and Control of Quality", (6th Edition), South-Western (Thomson Learning), 2005.
2. Oakland, J.S. "TQM – Text with Cases", Butterworth – Heinemann Ltd., Oxford, Third Edition, 2003.
3. Suganthi,L and Anand Samuel, "Total Quality Management", Prentice Hall (India) Pvt. Ltd., 2006 .
4. Janakiraman,B and Gopal, R.K, "Total Quality Management – Text and Cases",Prentice Hall (India) Pvt. Ltd., 2006.

AE7071 EXPERIMENTAL STRESS ANALYSIS L T P C
3 0 0 3

OBJECTIVE:

- To study the various experimental techniques involved for measuring displacements, stresses, strains in structural components.

UNIT I EXTENSOMETERS AND DISPLACEMENT SENSORS 8

Principles of measurements, Accuracy, Sensitivity and range of measurements, Mechanical, Optical, Acoustical and Electrical extensometers and their uses, Advantages and disadvantages**,** Capacitance gauges, Laser displacement sensors.

UNIT II ELECTRICAL RESISTANCE STRAIN GAUGES 12

Principle of operation and requirements, Types and their uses, Materials for strain gauges, Calibration and temperature compensation, cross sensitivity, Wheatstone bridge and potentiometer circuits for static and dynamic strain measurements, strain indicators, Rosette analysis, stress gauges, load cells, Data acquisition, six component balance.

UNIT III PHOTOELASTICITY 11

Two dimensional photo elasticity, Photo elastic materials, Concept of light - photoelastic effects, stress optic law, Transmission photoelasticity, Jones calculus, plane and circular polariscopes, Interpretation of fringe pattern, Calibration of photoelastic materials, Compensation and separation techniques, Introduction to three dimensional photo elasticity.

UNIT IV BRITTLE COATING AND MOIRE TECHNIQUES 7

Relation between stresses in coating and specimen, use of failure theories in brittle coating, Moire method of strain analysis.

Attested

DIRECTOR
Centre For Academic Courses
Anna University, Chennai-600 025.

UNIT V NON – DESTRUCTIVE TESTING 7

Fundamentals of NDT, Acoustic Emission Technique, Radiography, Thermography, Ultrasonics, Eddy Current testing, Fluorescent Penetrant Testing,

TOTAL: 45 PERIODS

OUTCOMES:

- Knowledge of stress and strain measurements in loaded components.
- Acquiring information's the usage of strain gauges and photo elastic techniques of measurement.
- Knowledge in NDT in stress analysis.

TEXT BOOKS:

1. Dally, J.W., and Riley, W.F., Experimental Stress Analysis, McGraw Hill Inc., New York 1998.
2. Srinath, L.S., Raghava, M.R., Lingaiah, K., Garagesha, G., Pant B., and Ramachandra, K., Experimental Stress Analysis, Tata McGraw Hill, New Delhi, 1984.
3. Sadhu Singh, Experimental Stress Analysis, Khanna Publishers, New Delhi, 2009.

REFERENCES:

1. Hetenyi, M., Hand book of Experimental Stress Analysis, John Wiley and Sons Inc., New York, 1972.
2. Pollock A.A., Acoustic Emission in Acoustics and Vibration Progress, Ed. Stephens R.W.B., Chapman and Hall, 1993.
3. Max Mark Frocht, Photo Elasticity, John Wiley and Sons Inc., New York, 1968
4. A.J.Durelli, Applied Stress Analysis, Prentice Hall of India Pvt Ltd., New Delhi, 1970
5. Ramesh, K., Digital Photoelasticity, Springer, New York, 2000.

RP 7006 FINITE ELEMENT ANALYSIS FOR POLYMERS L T P C
3 0 0 3

UNIT I INTRODUCTION 8

Review of various approximate methods – Raleigh Ritz's, Galerkin and finite difference methods- Governing equation and convergence criteria of finite element method.

UNIT II DISCRETE ELEMENTS 10

Bar elements, uniform sections, mechanical and thermal loading, varying section, truss analysis, Beam element- problems for various loadings and boundary conditions – longitudinal and lateral vibration – use of local and natural coordinates

UNIT III CONTINUUM ELEMENTS 8

Plane stress, plane strain and axisymmetric problems. Derivation of element matrices for constant and linear strain triangular elements and axisymmetric elements

UNIT IV ISOPARAMETRIC ELEMENTS & FIELD PROBLEM 10

Definitions, shape function for 4,8 nodal quadrilateral elements, stiffness matrix and consistent load vector, Gaussian integration Heat transfer problems, steady state fin problems

UNIT V NON LINEAR ANALYSIS 9

Elastomers- Elastic material model correlation-Terminology-Types of FEA models-Model building- Non linear material behavior- Boundary conditions-Applications-case studies

TOTAL : 45 PERIODS

REFERENCES

1. Tirupathi.R. Chandrapatha and Ashok D. Belegundu,"Introduction to Finite Elements in Engineering", Printice Hall India, Third Edition, 2003.

2. Rao S.S, “Finite Element Methods in Engineering”, Butterworth and Heinemann, 2001
3 Reddy J.N. “An Introduction to Finite Element Method “, McGraw Hill, 2000.
4 Krishnamurthy, C.S., “Finite Element Analysis”, Tata McGraw Hill, 2000.
5 Bathe, K.J. and Wilson, E.L., “Numerical Methods in Finite Elements Analysis”, Prentice Hall of India, 1985.
6 Alan N Gent, “Engineering with Rubber”, 2nd Edition, Carl Hanser Verlag, Munich 2001.
7 Robert D Cook, David S malkus, Michael E Plesha, “Concepts and Applications of Finite Element Analysis”, 4th edition, John Wiley and Sons, Inc., 2003.

RP 7005 ENTREPRENEURSHIP DEVELOPMENT L T P C
3 0 0 3

UNIT I INTRODUCTION 10
Design Process – Morphology of design – Role of a technocrat – Trade cycle – Production – Consumption cycle – Industrial Policies – Design of an Industrial Project – Stages of development of the project – Preparation of project report.

UNIT II FEASIBILITY STUDY 10
Information and Needs analysis –Input/output analysis – Translation needs into goals – Physical reliability – Economic viability – Market survey demand forecasting – Predicting share in the market.

UNIT III PRODUCT DESIGN AND DEVELOPMENT 8
Physical reliability – Functional aesthetic, production and economic cost aspect value analysis – Product analysis and specifications.

UNIT IV DISTRIBUTION 8
Sales strategies – Sales organization – Distribution channels – After sales service.

UNIT V FINANCE AND CAPITAL REQUIREMENTS 9
Price fixation – Cash flow statement – Return on investment – Sources of finance – Execution of project and commencement of production – Organization and institutions promoting entrepreneurship in India.

TOTAL : 45 PERIODS

REFERENCES
1. Mossis Asimow, Engineering Design.
2. Woodson,T.T., Introduction to Engineering.
3. Wilson,A., The Assessment of Industrial Markets.
4. Guideline for Preparation of feasibility reports for Industrial Projects: Project Appraisal Division of Planning Commission.

RP7014 TECHNOLOGY OF FOOTWEAR L T P C
3 0 0 3

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 theatre) and oil refinery shoes.

TOTAL : 45 PERIODS

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. Ravindra Goontilleke, " Science of Footwear" CRC Press, 2013.

GE7073 FUNDAMENTALS OF NANOSCIENCE L T P C
3 0 0 3

OBJECTIVES:

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, 92 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, TiO_2,MgO, ZrO_2, NiO, nanoalumina, CaO, $AgTiO_2$, Ferrites, Nanoclays-functionalization and applications-Quantum wires, Quantum dotspreparation, 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

Attested

DIRECTOR
Centre For Academic Courses
Anna University, Chennai-600 025.

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

RP 7004 DESIGN OF MACHINE ELEMENTS L T P C
3 0 0 3

OBJECTIVE

- To expose the students to the design and theory of common machine elements and to practice the students in solving design problems involving various machine elements.

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, Design for finite and infinite life, Soderberg and Goodman Criteria-Eccentric loading.

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 and flexible rubber bushed coupling – 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 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

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

RP 7012 PRODUCT DESIGN AND COST ESTIMATION L T P C
3 0 0 3

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

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.

GE7071 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.

TEXTBOOKS:

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.

GE7074 HUMAN RIGHTS L T P C
3 0 0 3

OBJECTIVES :

- 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.

GE7072 FOUNDATION SKILLS IN INTEGRATED PRODUCT DEVELOPMENT L T P C
3 0 0 3

OBJECTIVES:

- To understand the global trends and development methodologies of various types of products and services
- To conceptualize, prototype and develop product management plan for a new product based on the type of the new product and development methodology integrating the hardware, software, controls, electronics and mechanical systems
- To understand requirement engineering and know how to collect, analyze and arrive at requirements for new product development and convert them in to design specification
- To understand system modeling for system, sub-system and their interfaces and arrive at the optimum system specification and characteristics
- To develop documentation, test specifications and coordinate with various teams to validate and sustain up to the EoL (End of Life) support activities for engineering customer

UNIT I FUNDAMENTALS OF PRODUCT DEVELOPMENT 9

Global Trends Analysis and Product decision - Social Trends - Technical Trends- Economical Trends - Environmental Trends - Political/Policy Trends **- Introduction to Product Development Methodologies and Management -** Overview of Products and Services - Types of Product Development - Overview of Product Development methodologies **-** Product Life Cycle – Product Development Planning and Management.

UNIT II REQUIREMENTS AND SYSTEM DESIGN 9

Requirement Engineering - Types of Requirements - Requirement Engineering - traceability Matrix and Analysis - Requirement Management - **System Design & Modeling -** Introduction to System Modeling - System Optimization - System Specification - Sub-System Design - Interface Design.

UNIT III DESIGN AND TESTING 9

Conceptualization - Industrial Design and User Interface Design - Introduction to Concept generation Techniques – **Challenges in Integration of Engineering Disciplines** - Concept Screening & Evaluation - **Detailed Design -** Component Design and Verification – **Mechanical, Electronics and Software Subsystems** - High Level Design/Low Level Design of S/W Program **-** Types of Prototypes, S/W Testing- Hardware Schematic, Component design, Layout and Hardware Testing – **Prototyping -** Introduction to Rapid Prototyping and Rapid Manufacturing - **System Integration, Testing, Certification and Documentation**

UNIT IV SUSTENANCE ENGINEERING AND END-OF-LIFE (EOL) SUPPORT 9

Introduction to Product verification processes and stages - Introduction to Product Validation processes and stages - Product Testing Standards and Certification - Product Documentation - **Sustenance -**Maintenance and Repair – Enhancements - **Product EoL -** Obsolescence Management – Configuration Management - EoL Disposal

UNIT V BUSINESS DYNAMICS – ENGINEERING SERVICES INDUSTRY 9

The Industry - Engineering Services Industry - Product Development in Industry versus Academia –**The IPD Essentials -** Introduction to Vertical Specific Product Development processes -Manufacturing/Purchase and Assembly of Systems - Integration of Mechanical, Embedded and Software Systems – Product Development Trade-offs - Intellectual Property Rights and Confidentiality – Security and Configuration Management.

TOTAL: 45 PERIODS

OUTCOMES:

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

- Define, formulate and analyze a problem
- Solve specific problems independently or as part of a team
- Gain knowledge of the Innovation & Product Development process in the Business Context
- Work independently as well as in teams
- Manage a project from start to finish

TEXTBOOKS:

1. Book specially prepared by NASSCOM as per the MoU.
2. Karl T Ulrich and Stephen D Eppinger, "Product Design and Development", Tata McGraw Hill, Fifth Edition, 2011.
3. John W Newstorm and Keith Davis, "Organizational Behavior", Tata McGraw Hill, Eleventh Edition, 2005.

REFERENCES:

1. Hiriyappa B, “Corporate Strategy – Managing the Business”, Author House, 2013.
2. Peter F Drucker, “People and Performance”, Butterworth – Heinemann [Elsevier], Oxford, 2004.

3. Vinod Kumar Garg and Venkita Krishnan N K, “Enterprise Resource Planning – Concepts”, Second Edition, Prentice Hall, 2003.
4. Mark S Sanders and Ernest J McCormick, "Human Factors in Engineering and Design", McGraw Hill Education, Seventh Edition, 2013