ANNA UNIVERSITY
CHENNAI - 600 025

UNIVERSITY DEPARTMENTS

REGULATIONS 2012

CURRICULA AND SYLLABI FOR
I TO VIII SEMESTERS

B.TECH. RUBBER AND PLASTICS TECHNOLOGY (FULL TIME)

Attested

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

ANNA UNIVERSITY:: CHENNAI 600 025

UNIVERSITY DEPARTMENT
R – 2012
B.TECH. RUBBER AND PLASTICS TECHNOLOGY

I – VIII SEMESTERS CURRICULA AND SYLLABI

SEMESTER – I

CODE NO.	COURSE TITLE	L	T	P	C
THEORY					
HS8151	Technical English – I	3	1	0	4
MA8151	Mathematics – I	3	1	0	4
PH8151	Engineering Physics	3	0	0	3
CY8151	Engineering Chemistry	3	0	0	3
GE8151	Computing Techniques	3	0	0	3
GE8152	Engineering Graphics	2	0	3	4
PRACTICAL					
PH8161	Physics Laboratory	0	0	2	1
CY8161	Chemistry Laboratory	0	0	2	1
GE8161	Computer Practice Laboratory	0	0	3	2
GE8162	Engineering Practice Laboratory	0	0	3	2
	Total	**17**	**2**	**13**	**27**

SEMESTER – II

CODE NO	COURSE TITLE	L	T	P	C
THEORY					
HS8251	Technical English – II	3	1	0	4
MA8251	Mathematics – II	3	1	0	4
PH8201	Materials Science for Technologists	3	0	0	3
CY8254	Physical and Organic Chemistry	3	0	0	3

GE8251	Engineering Mechanics	3	1	0	4
PR8251	Conventional Machining Processes	3	0	0	3
PRACTICALS					
CY8261	Applied Chemistry Lab	0	0	2	1
GE8211	Computer Programming Lab	0	0	3	2
	TOTAL	**18**	**3**	**5**	**24**

SEMESTER – III

CODE NO	COURSE TITLE	L	T	P	C
THEORY					
MA8356	Probability and Statistics	3	1	0	4
AE8351	Solid Mechanics	3	0	0	3
EE8252	Principles of Electrical and Electronics Engineering	3	0	0	3
RP8301	Fundamentals of Chemical Engineering Operations	3	0	0	3
RP8302	Polymer Chemistry	3	0	0	3
RP8303	Thermodynamics and Fluid Mechanics	3	1	0	4
PRACTICALS					
AU8312	Mechanical Sciences Laboratory	0	0	3	2
EE8261	Electrical and Electronics Lab	0	0	3	2
	TOTAL	**18**	**2**	**6**	**24**

SEMESTER – IV

CODE NO	COURSE TITLE	L	T	P	C
THEORY					
MA8353	Numerical Methods	3	1	0	4
GE8351	Environmental Science and Engineering	3	0	0	3
RP8401	Physical Properties of Polymers	3	0	0	3
RP8402	Plastics Materials and Properties	4	0	0	4
RP8403	Rubber Materials and Compounding Additives	4	0	0	4

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RP8404	Theory of Machines and Mechanisms	3	1	0	4
PRACTICALS					
RP8411	Computer Aided Parts and Assembly Drawing	0	0	4	2
RP8412	Polymer Synthesis and Identification Lab	0	0	4	2
	TOTAL	**20**	**2**	**8**	**26**

SEMESTER – V

CODE NO	COURSE TITLE	L	T	P	C
THEORY					
RP8501	Engineering and High performance Plastics	3	0	0	3
RP8502	Plastics Processing and Machinery	3	0	0	3
RP8503	Rubber and Plastics Testing	4	0	0	4
RP8504	Rubber Processing and Machinery	3	0	0	3
	Elective – I	3	0	0	3
	Elective – II	3	0	0	3
PRACTICALS					
RP8511	Rubber Materials Lab	0	0	4	2
RP8512	Rubber Processing and Testing Lab	0	0	4	2
	TOTAL	**19**	**0**	**8**	**23**

SEMESTER - VI

CODE NO	COURSE TITLE	L	T	P	C
THEORY					
MG8653	Principles of Management	3	0	0	3
RP8601	Mould Engineering and Manufacture	3	0	0	3
RP8602	Polymer Characterization Techniques	3	0	0	3
RP8603	Rubber Compound and Product Design	3	0	0	3

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	Elective III	3	0	0	3
	Elective IV	3	0	0	3
PRACTICAL					
HS8561	Employabilty Skills	0	0	2	1
RP8611	Computer Aided Mould Design Lab	0	0	4	2
RP8612	Plastics Processing and Testing Lab	0	0	4	2
	TOTAL	**18**	**0**	**10**	**23**

SEMESTER – VII

CODE NO	**COURSE TITLE**	**L**	**T**	**P**	**C**
THEORY					
RP8701	Polymer Composites	3	0	0	3
RP8702	Tyre Technology	3	0	0	3
	Elective V	3	0	0	3
	Elective VI	3	0	0	3
	Elective VII	3	0	0	3
PRACTICALS					
RP8711	Comprehension	0	0	3	2
RP8713	Industrial Training	0	0	0	2
RP8712	Design Project	0	0	4	2
	TOTAL	**15**	**0**	**7**	**21**

* Four weeks of training during 6th semester Vacation

SEMESTER - VIII

CODE NO.	**THEORY**	**L**	**T**	**P**	**C**
THEORY					
	Elective – VIII	3	0	0	3
PRACTICAL					
RP8811	Project Work	-	-	12	6
	TOTAL	**3**	**0**	**12**	**9**

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LIST OF ELECTIVES FOR RUBBER TECHNOLOGY

CODE .NO	COURSE TITLE	L	T	P	C
GE8071	Fundamentals of Nano Science	3	0	0	3
RP8001	Adhesives and Surface Coatings	3	0	0	3
RP8002	Advanced Polymer Processing	3	0	0	3
RP8003	Biopolymers and Polymers from Renewable Resources	3	0	0	3
RP8004	Engineering Statistics and Quality Control	3	0	0	3
RP8005	Fracture behaviour in Polymers	3	0	0	3
RP8006	Latex Science and Technology	3	0	0	3
RP8007	Multiphase Polymer systems	3	0	0	3
RP8008	Plastics Product and Mould Design	3	0	0	3
RP8009	Polymer Recycling	3	0	0	3
RP8010	Polymers in Packaging Technology	3	0	0	3
RP8011	Polyurethane Science and Technology	3	0	0	3
RP8012	Product Design and Cost Estimation	3	0	0	3
RP8013	Rubber Components in Automobiles	3	0	0	3
MG8651	Engineering Management	3	0	0	3
MG8654	Total Quality Management	3	0	0	3
AE8071	Experimental Stress Analysis	3	0	0	3
AU8071	Finite Element Techniques	3	0	0	3
ME8076	Entrepreneurship Development	3	0	0	3
PR8452	Machine Components Design	3	0	0	3
GE8072	Disaster Management	3	0	0	3
GE8073	Human Rights	3	0	0	3

TOTAL NO.OF CREDITS : 177

Attested

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HS8151 **TECHNICAL ENGLISH - I** **L T P C**

(Common to all branches of B.E / B.Tech programmes) **3 1 0 4**

OBJECTIVES:

- To enable all students of engineering and technology develop their basic communication skills in English.
- To give special emphasis to the development of speaking skills amongst the students of engineering and technology students.
- To ensure that students use the electronic media such as interne and supplement the learning materials used in the classroom.
- To inculcate the habit of reading for pleasure.

OUTCOMES:

- Understanding the techniques to develop reading comprehension skills which will help the learners in acquiring knowledge from various reading materials.
- Effectively exploiting Scientific and Technical writing which has a world-wide demand in the corporate and industrial sectors.
- Intensified awareness about the language styles used in the field of Media and Mass communication.
- Improved reading strategies adaptation while reading science and technical texts.
- Ability to speak effectively in English in real life contexts and work-related ambiance.

UNIT I

Listening - Introducing learners to GIE - Types of listening - Listening to audio (verbal & sounds); Speaking - Speaking about one's place, important festivals etc. – Introducing oneself, one's family / friend; Reading - Skimming a reading passage – Scanning for specific information - Note-making; Writing - Free writing on any given topic (My favourite place / Hobbies / School life, etc.) - Sentence completion - Autobiographical writing (writing about one's leisure time activities, hometown, etc.); Grammar - Prepositions - Reference words - Wh-questions - Tenses (Simple); Vocabulary - Word formation - Word expansion (root words / etymology); E-materials - Interactive exercises for Grammar & Vocabulary - Reading comprehension exercises - Listening to audio files and answering questions.

UNIT II

Listening - Listening and responding to video lectures / talks; Speaking - Describing a simple

process (filling a form, etc.) - Asking & answering questions - Telephone skills – Telephone etiquette; Reading – Critical reading - Finding key information in a given text - Sifting facts from opinions; Writing - Biographical writing (place, people) - Lab descriptions (general/specific description of laboratory experiments) - Definitions - Recommendations; Grammar - Use of imperatives - Subject-verb agreement; Vocabulary - Compound words - Word Association; E-materials - Interactive exercises for Grammar and Vocabulary - Listening exercises with sample telephone conversations / lectures – Picture-based activities.

UNIT III

Listening - Listening to specific task - focused audio tracks; Speaking - Role-play – Simulation - Group interaction - Speaking in formal situations (teachers, officials, foreigners); Reading - Reading and interpreting visual material; Writing - Jumbled sentences - Coherence and cohesion in writing - Channel conversion (flowchart into process) - Types of paragraph (cause & effect / compare & contrast / narrative / analytical) - Informal writing (letter/e-mail/blogs) - Paraphrasing; Grammar - Tenses (Past) - Use of sequence words - Adjectives; Vocabulary - Different forms and uses of words, Cause and effect words; E-materials - Interactive exercises for Grammar and Vocabulary - Excerpts from films related to the theme and follow up exercises - Pictures of flow charts and tables for interpretations.

UNIT IV

Listening - Watching videos / documentaries and responding to questions based on them; Speaking - Responding to questions - Different forms of interviews - Speaking at different types of interviews; Reading - Making inference from the reading passage - Predicting the content of a reading passage; Writing - Interpreting visual materials (line graphs, pie charts etc.) - Essay writing – Different types of essays; Grammar - Adverbs – Tenses – future time reference; Vocabulary - Single word substitutes - Use of abbreviations & acronyms; E-materials - Interactive exercises for Grammar and Vocabulary - Sample interviews - film scenes - dialogue writing.

UNIT V

Listening - Listening to different accents, Listening to Speeches/Presentations, Listening to broadcast & telecast from Radio & TV; Speaking - Giving impromptu talks, Making presentations on given topics; Reading - Email communication - Reading the attachment files having a poem/joke/proverb - Sending their responses through email Writing - Creative writing, Poster making; Grammar - Direct and indirect speech; Vocabulary - Lexical items (fixed / semi fixed expressions); E-materials - Interactive exercises for Grammar & Vocabulary - Sending emails with attachment – Audio / video excerpts of different accents, - Interpreting posters.

TOTAL : 60 PERIODS

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TEXT BOOKS

1. Mindscapes: English for Technologists and Engineers, Orient Black Swan, 2012 .
2. S.P. Dhanavel, English and Communication Skills for Students of Science and Engineering, Orient Black Swan, Chennai, 2011.

REFERENCES

1. Pickett, Nell Ann, Ann A.Laster and Katherine E.Staples. Technical English: Writing, Reading and Speaking. New York: Longman, 2001.
2. Bailey, Stephen. Academic Writing: A practical guide for students. New York: Rutledge, 2011.
3. Morgan, David and Nicholas Regan. Take-Off: Technical English for Engineering. Reading: Garnet Publishing Limited, 2008.
4. Thorn, Michael and Alan Badrick, An Introduction to Technical English, Harlow: Prentice Hall Europe, 1993.
5. Rizvi, M.Ashraf., Effective Technical Communication. New Delhi: Tata McGraw-Hill PublishingCompany, 2007.

EXTENSIVE READERS

1. Murthy, Sudha. Wise & Otherwise. New Delhi: Penguin Books India, 2006.
2. Gates, Bill and Collins Hemingway. Business @ the Speed of Thought: Succeeding in the Digital Economy. New York: Warner Business Books, 2000.

Website Resources

1. www.uefap.com
2. www.eslcafe.com
3. www.listen-to-english.com
4. www.owl.english.purdue.edu
5. www.chompchomp.com

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MA 8151 **MATHEMATICS – I** **L T P C**
3 1 0 4

OBJECTIVES

- To develop the use of matrix algebra techniques this is needed by engineers for practical applications.
- To make the student knowledgeable in the area of infinite series and their convergence so that he/ she will be familiar with limitations of using infinite series approximations for solutions arising in mathematical modeling.
- To familiarize the student with functions of several variables. This is needed in many branches of engineering.
- To introduce the concepts of improper integrals, Gamma, Beta and Error functions which are needed in engineering applications.
- To acquaint the student with mathematical tools needed in evaluating multiple integrals and their usage.

OUTCOMES:

- Develops the use of matrix algebra techniques which is needed by engineers for practical applications.
- Able to use the infinite series approximations for solutions arising in mathematical modeling.
- Familiarize the student with functions of several variables which is needed in many branches of engineering.
- Introduces the concepts of improper integrals, Special functions which are needed in engineering applications.
- Acquaints the student with mathematical tools needed in evaluating multiple integrals and their applications.

UNIT I MATRICES **9+3**

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 INFINITE SERIES **9+3**

Sequences – Convergence of series – General properties – Series of positive terms –Tests of convergence (Comparison test, Integral test, Comparison of ratios and D'Alembert's ratio test) – Alternating series – Series of positive and negative terms –Absolute and conditional convergence – Power Series – Convergence of exponential, logarithmic and Binomial Series.

UNIT III FUNCTIONS OF SEVERAL VARIABLES **9+3**

Limits and Continuity – 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 IV IMPROPER INTEGRALS **9+3**

Improper integrals of the first and second kind and their convergence – Evaluation of integrals involving a parameter by Leibnitz rule – Beta and Gamma functions – Properties – Evaluation of integrals using Beta and Gamma functions – Error functions

UNIT V MULTIPLE INTEGRALS **9+3**

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 – Area of a curved surface.

TOTAL: 60 PERIODS

TEXT BOOKS

1. Grewal B.S., "Higher Engineering Mathematics", Khanna Publishers, New Delhi, 40th Edition, 2007.
2. Ramana B.V., "Higher Engineering Mathematics", Tata McGraw Hill Co. Ltd.,New Delhi, 11th Reprint, 2010.

REFERENCES

1. Jain R.K. and Iyengar S.R.K., "Advanced Engineering Mathematics", Narosa Publications, New Delhi, 3rd Edition, 2007.
2. Bali N., Goyal M. and Watkins C., "Advanced Engineering Mathematics", Firewall Media (An imprint of Lakshmi Publications Pvt., Ltd.,), New Delhi, 7th Edition, 2009.
3. Greenberg M.D., "Advanced Engineering Mathematics", Pearson Education, New Delhi, 2nd Edition, 5th Reprint, 2009.

4. Peter V.O'Neil, "Advanced Engineering Mathematics", Cengage Learning India Pvt., Ltd, New Delhi, 2007.

PH 8151 ENGINEERING PHYSICS L T P C

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

OBJECTIVE:

- To introduce the basic physics concepts relevant to different branches of Engineering and Technology.

OUTCOMES:

- Gain the basic knowledge about the elastic nature of materials and fundamentals of structural stability.
- Students will be familiarize with the fundamentals of acoustics and ultrasonics, which provides the basics for the development of acoustics and ultrasonic engineering.
- Good understanding of thermal physics and thermodynamics is achieved for further applications in automobile, structural and electronic industries.
- Acquire knowledge about laser and its applications in communication and information processing and also scientific applications.
- Fundamentals of structural and related properties of solids provide knowledge on the applications of materials in engineering and technology.

UNIT I PROPERTIES OF MATTER 9

Elasticity - Poisson's ratio and relationship between moduli (qualitative) - Stress-strain diagram - factors affecting elasticity - bending of beams - cantilever - bending moment - theory and experiment of Young's modulus determination - 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 - rate of growth and decay of sound intensity - derivation of Sabine's formula - absorption coefficient and its determination - 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 - industrial applications - NDT - Ultrasonic method: scan modes and practice.

UNIT III THERMAL PHYSICS **9**

Thermal expansion - thermal stress - expansion joints - bimetallic strips - thermal conductivity - conductions in solids - Forbe's and Lees' disc methods - Rectilinear flow of heat through a rod - flow of heat through a compound materials - radical flow of heat through a spherical shell - thermal insulation of buildings – Laws of blackbody radiation: Kirchoffs law, Stephens law, Wiens law, Raleigh-Jean law and Planks law (derivation). Laws of thermodynamics - Otto and diesel engines and their efficiency - entropy - entropy of Carnot's cycle - reverse Carnot's cycle - refrigerator.

UNIT IV APPLIED OPTICS **9**

Interference - Michelson interferometer: construction, working, determination of wave length and thickness - anti-reflection coating - air wedge and its application - Lasers - Einstein's coefficients - CO2, Nd:YAG and 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 SOLID STATE PHYSICS **9**

Nature of bonding - growth of single crystals (qualitative) - crystal systems - crystal planes and directions - expressions for interplanar distance - coordination number and packing factor for simple structures: SC, BCC, FCC and HCP - structure and significance of NaCl, ZnS, diamond and graphite - crystal imperfections: point defects, dislocations and stacking faults - unit cell, Bravais space lattices - miller indices.

TOTAL: 45 PERIODS

TEXT BOOKS

1. Gaur R.K., and Gupta, S.L., Engineering Physics, Dhanpat Raj Publications, 2003.
2. Palanisamy, P.K., Engineering Physics, Scitech Publications (P) Ltd, 2006.
3. Arumugam, M., Engineering Physics, Anuradha Publications, 2000.

REFERENCE BOOKS

1. Sankar, B.N., Pillai.S.O., Engineering Physics, New Age International (P) Ltd., 2007.

2. Rajendran.V Engineering Physics, Tata McGraw-Hill, 2009.

CY8151	ENGINEERING CHEMISTRY	L T P C
	(Common to All Branches of Engineering and Technology)	3 0 0 3

OBJECTIVES:

To make the student conversant with the

- Applications of second law of chemical thermodynamics.
- Phase rule and various types of alloys
- Surface chemistry and its importance in adsorption and catalysis.
- Basic principles in organic reaction mechanisms and principles and applications of spectroscopy
- Nanochemistry and its applications

OUTCOMES:

- The key features of thermodynamics enable the students for gaining the knowledge of various thermodynamic properties which affect the feasibility of the reaction.
- Students will be with brief concepts of polymer chemistry provides them the technical applications of polymer in various fields.
- Enable the students to gain knowledge about various factors responsible for velocity of reaction.
- The fundamentals of photochemistry & spectroscopy help them to understand the various changes in atoms/ molecules during the reaction.
- Understand the dimension of nanoparticles and its real time applications.

UNIT I CHEMICAL THERMODYNAMICS 9

Second law: Entropy - entropy change for an ideal gas, reversible and irreversible processes; entropy of phase transitions; Clausius inequality. Free energy and work function: Helmholtz and Gibbs free energy functions; 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 II POLYMER CHEMISTRY 9

Introduction: Classification of polymers – Natural and Synthetic; Thermoplastic and Thermosetting. Functionality – Degree of polymerisation. Types and mechanism of polymerisation: Addition (Free Radical, cationic, anionic and living); condensation and copolymerisation. Properties of polymers: Tg, Tacticity, Molecular weight – weight average, number average and polydispersity index. Techniques of polymerisation: Bulk, emulsion, solution and suspension.

UNIT III KINETICS AND CATALYSIS 9

Introduction – reaction velocity, factors affecting reaction velocity, rate constant, order of reaction, molecularity, pseudo molecular reactions, zero, first, second and third order reactions, reactions of fractional orders, determination of order of reactions. Catalysis: Auto catalysis - Enzyme Catalysis: Michaelis-Menton equation; factors affecting enzyme catalysis. Heterogeneous Catalysis: Types of adsorption isotherms: Langmuir–Hinselwood and Rideal–Eley Mechanism.

UNIT IV PHOTOCHEMISTRY AND SPECTROSCOPY 9

Photochemistry: Laws of photochemistry - Grotthuss–Draper law, Stark–Einstein law and Lambert-Beer Law. Photoprocesses - Internal Conversion, Inter-system crossing, Fluorescence, Phosphorescence, Chemiluminescence and Photo-sensitisation. Spectroscopy: Electromagnetic spectrum - Absorption of radiation – Electronic, Vibrational and rotational transitions. Width and intensities of spectral lines. Spectrophotometric estimation of iron. UV-visible and IR spectroscopy – principles, instrumentation (Block diagram) and applications.

UNIT V NANOCHEMISTRY 9

Basics - distinction between molecules, nanoparticles and bulk materials; size-dependent properties. Nanoparticles: Nanocluster, nanorod, nanotube and nanowire. Synthesis: Precipitation, thermolysis, hydrothermal, solvothermal, electrodeposition, chemical vapour deposition, laser ablation; Properties and Applications. Risk discussion and Future perspectives.

TOTAL: 45 PERIODS

TEXT BOOKS

1. P. Kannan and A. Ravikrishnan, “Engineering Chemistry”, Sri Krishna Hitech Publishing Company Pvt. Ltd. Chennai, 2009.
2. S. Vairam, P. Kalyani and Suba Ramesh, “Engineering Chemistry”, Wiley India, 2011

REFERENCES

1. P.W. Atkins and de Paula Julio, “Physical Chemistry”, Oxford University Press, 8th Ed., (Indian Student Edition) (2009).
2. K. K. Rohatgi-Mukherjee, “Fundamental of Photochemistry” New Age International (P) Ltd., New Delhi, 1986.
3. G.A. Ozin and A.C. Arsenault, “Nanochemistry: A Chemical Approach to Nanomaterials”, RSC Publishing, 2005.
4. V.R.Gowariker, N.V.Viswanathan and Jayadev Sreedhar, “Polymer Science”, New Age International P (Ltd.,), Chennai, 2006.

GE8151 COMPUTING TECHNIQUES L T P C
3 0 0 3

OBJECTIVE

- To impart the basic knowledge of computing and C programming.

OUTCOMES

- To demonstrate of knowledge in fundamentals of computing systems.
- Understand the fundamentals of programming C language.

UNIT I INTRODUCTION 8

Generation and Classification of Computers- Basic Organization of a Computer –Number System – Binary – Decimal – Conversion – Problems. Need for logical analysis and thinking – Algorithm – Pseudo code – Flow Chart.

UNIT II C PROGRAMMING BASICS 10

Problem formulation – Problem Solving - Introduction to ‘ C’ programming –fundamentals

– structure of a ‘C’ program – compilation and linking processes – Constants, Variables – Data Types – Expressions using operators in ‘C’ – Managing Input and Output operations – 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. String- String operations – String Arrays. Simple programs- sorting- searching – matrix operations.

UNIT IV FUNCTIONS AND POINTERS 9

Function – definition of function – Declaration of function – Pass by value – Pass by reference – Recursion – Pointers - Definition – Initialization – Pointers arithmetic – Pointers and arrays- Example Problems.

UNIT V STRUCTURES AND UNIONS 9

Introduction – need for structure data type – structure definition – Structure declaration – Structure within a structure - Union - Programs using structures and Unions – Storage classes, Pre-processor directives.

TOTAL : 45 PERIODS

TEXTBOOKS

1. Pradip Dey, Manas Ghosh, “Fundamentals of Computing and Programming in C”, First Edition, Oxford University Press, 2009
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”, Schaum’s Outlines, Second Edition, Tata McGraw-Hill, 2006.
3. R.G. Dromey, “How to Solve it by Computer”, Pearson Education, Fourth Reprint, 2007

GE 8152 **ENGINEERING GRAPHICS** **L T P C**
2 0 3 4

OBJECTIVES

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

OUTCOMES:

- Understand various projection methods in plotting the 2D and 3D drawing.
- Acquire the drafting practice of orthographic projections.
- Gain the drafting knowledge of projecting a solid object.
- Understand the various solids and their developments.
- Develop the drafting practice of isometric and prospective views of various solids.

CONCEPTS AND CONVENTIONS (Not for Examination) **1**

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

UNIT I PLANE CURVES AND FREE HAND SKETCHING **5+9**

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, Scales: Construction of Diagonal and Vernier scales.

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

UNIT II PROJECTION OF POINTS, LINES AND PLANE SURFACES 5+9

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 5 + 9

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

UNIT IV PROJECTION OF SECTIONED SOLIDS AND DEVELOPMENT OF SURFACES 5+9

Sectioning of above solids in simple vertical position when the cutting plane is inclined to the one of the principal planes and perpendicular to the other – obtaining true shape of section. Development of lateral surfaces of simple and sectioned solids – Prisms, pyramids cylinders and cones. Development of lateral surfaces of solids with cut-outs and holes

UNIT V ISOMETRIC AND PERSPECTIVE PROJECTIONS 6 + 9

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.

TOTAL: 75 PERIODS

TEXT BOOK

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

REFERENCES

1. Gopalakrishna K.R., “Engineering Drawing” (Vol. I&II combined), Subhas Stores, Bangalore, 2007.

2. Luzzader, Warren.J. and Duff,John M., “Fundamentals of Engineering Drawing with an introduction to Interactive Computer Graphics for Design and Production, Eastern Economy Edition, Prentice Hall of India Pvt. Ltd, New Delhi, 2005.
3. Shah M.B., and Rana B.C., “Engineering Drawing”, Pearson, 2nd Edition, 2009.
4. Venugopal K. and Prabhu Raja V., “Engineering Graphics”, New Age International (P) Limited, 2008.
5. Natrajan K.V., “A text book of Engineering Graphics”, Dhanalakshmi Publishers, Chennai, 2009.
6. Basant Agarwal and Agarwal C.M., “Engineering Drawing”, Tata McGraw Hill Publishing Company Limited, New Delhi, 2008.

Publication of Bureau of Indian Standards

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

Special points applicable to University Examinations on Engineering Graphics

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

PH 8161	PHYSICS LABORATORY	L T P C
	(Common to all branches of B.E. / B.Tech. Programmes)	0 0 2 1

OBJECTIVE

To make the students understand and get hands-on in the basic concepts of practical Physics.

OUTCOMES:

- Capable to implement various laboratory exercises in Torsional Pendulum, Non-uniform bending, Lees' disc, Potentiometer, Air wedge, Optical fiber
- Able to solve problems related to engineering physics.

EXPERIMENTS

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. Lee's disc - Determination of thermal conductivity of a bad conductor
4. Potentiometer – Determination of thermo e.m.f. of thermocouple
5. Air wedge – Determination of thickness of a thin sheet of paper
6. i. Optical fibre - Determination of Numerical Aperture and acceptance angle
   ii. Compact disc – Determination of width of the groove using laser
7. Acoustic grating - Determination of velocity of ultrasonic waves in liquids
8. Post office box – Determination of Band gap of a semiconductor
9. Spectrometer – Determination of wavelength using grating
10. Viscosity of liquids – Determination of co-efficient of viscosity of a liquid by Poiseuille's flow

TOTAL : 30 PERIODS

CY 8161	CHEMISTRY LABORATORY	L T P C
	(Common to all branches of Engineering and Technology)	0 0 2 1

OBJECTIVE

To provide hands-on experience in using PH meter, potentiometry, titration methods and estimating the strength of given solutions.

OUTCOMES:

- Ability to solve various problems related to Weighing and preparation, Water Analysis, PH-Meter, Conductometry, Viscometry, Water Pollution.
- Able to solve problems related to engineering chemistry.

EXPERIMENTS

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

REFERENCES

1. A text of quantitative inorganic analysis, A. L.Vogel, ELBS London, 1995.

Attested

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2. Experiments in physical chemistry, D.P. Shoemarker and C.W. Gardad, McGraw Hill, London, 2001.
3. American Public Health Association.

GE8161 COMPUTER PRACTICES LABORATORY L T P C
0 0 3 2

OBJECTIVE

To make the students understand and get hands-on in the basic concepts of practical Physics.

OUTCOMES

- Capability to apply the knowledge on computer applications related to office automation.
- To implement programs in C.

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 and conversion from given program to flow chart.
10. Program using structures and unions.

TOTAL : 45 PERIODS

GE 8162 **ENGINEERING PRACTICES LABORATORY** **L T P C**
0 0 3 2

OBJECTIVE

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

OUTCOMES

- Depict the hands-on experience in plumbing and various joints in plumbing.
- Gain knowledge in basic household wiring system in electrical engineering practice.
- Expose the students to practice basic welded joints and basic machining operations.
- Understand the principle of soldering in a electronic circuit, PCB and various basic electronic items.

GROUP – A (CIVIL & ELECTRICAL)

1. CIVIL ENGINEERING PRACTICE **12**

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 – inlet.

Laying pipe connection to the delivery side of a pump – out let.

Practice in mixed pipe connections: Metal, plastic and flexible pipes used in household appliances.

Wood Work

Sawing, planning and making common joints: T-Joint, Mortise and Tennon joint, Dovetail joint.

Study

Study of joints in door panels, wooden furniture

Study of common industrial trusses using models.

2. ELECTRICAL ENGINEERING PRACTICE **9**

Basic household wiring using switches, fuse, indicator – lamp etc.,

Preparation of wiring diagrams

Stair case light wiring

Tube – light wiring

Study of iron-box, fan with regulator, emergency lamp

GROUP – B (MECHANICAL AND ELECTRONICS) **15**

3. MECHANICAL ENGINEERING PRACTICE

Welding

Arc welding of butt joints, lap joints, tee joints

Gas welding Practice.

Basic Machining

Simple turning, drilling and tapping operations.

Machine assembly Practice.

Study and assembling the following:

Centrifugal pump, mixies and air conditioners.

Demonstration on

(a) Smithy operations like the production of hexagonal bolt.

(b) Foundry operation like mould preparation for grooved pulley.

4. ELECTRONIC ENGINEERING PRACTICE **9**

Soldering simple electronic circuits and checking continuity.

Assembling electronic components on a small PCB and testing.

Study of Telephone, FM radio, low-voltage power supplies.

TOTAL: 45 PERIODS

HS8251 **TECHNICAL ENGLISH - II** **L T P C**

(For all branches of B.E / B.Tech programmes) **3 1 0 4**

OBJECTIVES

- To make the students acquire listening and speaking skills meant for both formal and informal contexts
- To help them develop their reading skills by exposing them to different types of reading strategies
- To equip them with writing skills needed for academic as well as workplace situations
- To make them acquire language skills at their own pace by using e-materials and language lab component

OUTCOMES

- Proficiency in personality development skills and professional skills in getting placed in multi-national companies.
- Dexterous in problem solving skills, thinking skills, and analytical skills to cope themselves in the working environment.
- Ability to build up job application letters and CV-résumés.
- To become eminent in developing interpersonal skills to maintain rapport with their counterparts and higher officials.
- Become proficient in oral and written communication, critical thinking skills, active listening skills and can participate successfully in group discussions

UNIT I **9 + 3**

Listening - Listening to informal conversations and participating; Speaking - Opening a conversation (greetings, comments on something, weather) - Turn taking - Closing a conversation (excuses, general wish, positive comment, thanks); Reading - Developing analytical skills, Deductive and inductive reasoning - Extensive reading; Writing - Effective use of SMS for sending short notes and messages - Using 'emoticons' as symbols in email messages; Grammar - Regular & irregular verbs - Active and passive voice; Vocabulary - Homonyms (e.g. 'can') - Homophones (e.g. 'some', 'sum'); E-materials - Interactive exercise on Grammar and vocabulary – blogging; Language Lab - Listening to different types of conversation and answering questions.

UNIT II **9 + 3**

Listening - Listening to situation based dialogues; Speaking - Conversation practice in real

life situations, asking for directions (using polite expressions), giving directions (using imperative sentences), Purchasing goods from a shop, Discussing various aspects of a film (they have already seen) or a book (they have already read); Reading - Reading a short story or an article from newspaper, Critical reading, Comprehension skills; Writing - Writing a review / summary of a story / article, Personal letter (Inviting your friend to a function, congratulating someone for his success, thanking one's friend / relatives); Grammar - modal verbs, Purpose expressions; Vocabulary - Phrasal verbs and their meanings, Using phrasal verbs in sentences; E-materials - Interactive exercise on Grammar and vocabulary, Extensive reading activity (reading stories / novels from links), Posting reviews in blogs - Language Lab - Dialogues (Fill up exercises), Recording students' dialogues.

UNIT III **9 + 3**

Listening - Listening to the conversation - Understanding the structure of conversations; Speaking - Conversation skills with a sense of stress, intonation, pronunciation and meaning - Seeking information – expressing feelings (affection, anger, regret etc.); Reading - Speed reading – reading passages with the time limit - Skimming; Writing - Minutes of meeting – format and practice in the preparation of minutes - Writing summary after reading the articles from the journals - Format for the journal articles – elements of technical articles (abstract, introduction, methodology, results, discussion, conclusion, appendices, references) - Writing strategies; Grammar - Conditional clauses - Cause and effect expressions; Vocabulary - Words used as nouns and verbs without any change in the spelling (e.g. 'rock', 'train', 'ring'); E-materials - Interactive exercise on Grammar & vocabulary - Speed Reading practice exercises; Language Lab - Intonation practice using EFLU materials – Attending a meeting and writing minutes.

UNIT IV **9 + 3**

Listening - Listening to a telephone conversation, Viewing a model interview (face-to-face, telephonic and video conferencing) and observing the practices; Speaking - Role play practice in telephone skills - listening and responding, -asking questions, -note taking – passing on messages, Role play and mock interview for grasping the interview skills; Reading - Reading the job advertisements and the profile of the company concerned – scanning; Writing - Applying for a job – cover letter - résumé preparation – vision, mission and goals of the candidate; Grammar - Numerical expressions - Connectives (discourse markers); Vocabulary - Idioms and their meanings – using idioms in sentences; E-materials - Interactive exercises on Grammar & Vocabulary - Different forms of résumés- Filling up a résumé / cover letter; Language Lab - Telephonic interview – recording the responses - e-résumé writing.

UNIT V **9 + 3**

Listening - Viewing a model group discussion and reviewing the performance of each

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participant - Identifying the characteristics of a good listener; Speaking - Group discussion skills – initiating the discussion – exchanging suggestions and proposals – expressing dissent/agreement – assertiveness in expressing opinions – mind mapping technique; Reading - Note making skills – making notes from books, or any form of written materials - Intensive reading Writing - Types of reports – Feasibility / Project report – report format – recommendations / suggestions – interpretation of data (using charts for effective presentation); Grammar - Use of clauses; Vocabulary – Collocation; E-materials - Interactive grammar and vocabulary exercises - Sample GD - Pictures for discussion, Interactive grammar and vocabulary exercises - Pictures for discussion; Language Lab - Different models of group discussion

TOTAL: 60 PERIODS

TEXT BOOKS

1. Mindscapes: English for Technologists and Engineers, Orient Black Swan, 2012
2. S.P. Dhanavel, English and Communication Skills for Students of Science and Engineering, Orient Black Swan, Chennai, 2011.

REFERENCES

1. Laws, Anne. Presentations. Hyderabad: Orient BlackSwan, 2000.
2. Lewis, Hedwig. Body Language: A Guide for Professionals. New Delhi: Sage Publications, 1998.
3. Naterop, Jean B. and Rod Revell. Telephoning in English. Cambridge: Cambridge University Press, 1987.
4. Rutherford, Andrea J. Basic Communication Skills for Technology. New Delhi: Pearson Education, 2001.
5. Ur, Penny. Teaching Listening Comprehension. Cambridge: Cambridge University Press, 1984.

EXTENSIVE READERS

1. Abdul Kalam, A P J. Ignited Minds: Unleashing the Power within India. New Delhi: Penguin Books India, 2002.
2. Parameswaran, Uma. C.V.Raman: A Biography. New Delhi: Penguin Books India, 2011.

WEB RESOURCES

1. www.esl-lab.com
2. www.englishgrammar.org

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3. www.englishclub.com
4. www.mindtools.com
5. www.esl.about.com

MA8251 MATHEMATICS II L T P C

(Common to all branches of B.E. / B.Tech. Programmes in II Semester) 3 1 0 4

OBJECTIVES

- To make the student acquire sound knowledge of techniques in solving ordinary differential equations that model engineering problems.
- 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.

OUTCOMES

- Students acquire sound knowledge of techniques in solving ordinary differential equations that model engineering problems.
- Acquaint the student with the concepts of vector calculus, needed for problems in all engineering disciplines.
- Gain knowledge in applications of complex variable in heat conduction, elasticity, fluid dynamics and flow of electric current.
- Enable the student to use different techniques in solving complex integration.
- Able to use using transforms to create a new domain in which it is easier to handle the problem that is being investigated.

UNIT I DIFFERENTIAL EQUATIONS 9+3

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.

UNIT II VECTOR CALCULUS 9+3

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

UNIT III ANALYTIC FUNCTION 9+3

Analytic functions – Necessary and sufficient conditions for analyticity - Properties – Harmonic conjugates – Construction of analytic function - Conformal mapping – Mapping by functions w= z+ c, az, 1/z, z2- Bilinear transformation.

UNIT IV COMPLEX INTEGRATION 9+3

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 9+3

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

TEXT BOOKS

1. Grewal B.S., "Higher Engineering Mathematics", Khanna Publishers, New Delhi, 40th Edition, 2007.
2. Ramana, B.V. "Higher Engineering Mathematics", Tata McGraw Hill, New Delhi, 2010.

REFERENCES

1. Glyn James, “Advanced Modern Engineering Mathematics”, Pearson Education, New Delhi, 2007.
2. Jain R.K. and Iyengar S.R.K., “Advanced Engineering Mathematics”, Narosa Publications, 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. Peter V.O’Neil, Advanced Engineering Mathematics, Cengage Learning India Pvt., Ltd, New Delhi, 2007.

PH8201 MATERIALS SCIENCE FOR TECHNOLOGISTS L T P C

3 0 0 3

OBJECTIVES

- To introduce different types of materials preparation and processing.
- To understand the importance and applications of different materials.

OUTCOMES

Students will able to:

- Acquire the knowledge of materials preparation and processing using phase diagram and various techniques.
- Familiarize with conducting materials based on different functions and properties of superconductors.
- Gain the knowledge on semiconducting materials based on energy level diagram and its types.
- Realize with theories of magnetic materials and understand the dielectric behavior on insulating materials.
- Familiarize with FRP, Ceramic Fibres and Fibre reinforced metals and its characterization techniques.

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 - Schrödinger wave equation - Time independent and time dependent equations. Physical significance of wave function, particle in a box (in one dimension) – 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.

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

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

REFERENCES

1. Kumar.J, Moorthy Babu. S and Vasudevan. S., Engineering Physics, Vijay Nicole Imprints, 2006.

2. Palanisamy. P.K., Materials Science, Scitech., 2003.
3. Gaur. R.K. and Gupta. S.L., Engineering Physics, Dhanpat Rai Publication., 2003.
4. Kumar. J, Moorthy Babu. S and Vasudevan. S., Engineering Physics, Vijay Nicole Imprints., 2004.
5. Raghavan. V. Materials Science and Engineering, Prentice Hall of India, 2002.
6. Arumugam. M - Biomedical Instrumentation, 2nd Edition, Anuradha Agencies, 2003.

CY8254 PHYSICAL AND ORGANIC CHEMISTRY L T P C
3 0 0 3

OBJECTIVE

- To make the student familiarize with chemical kinetics, catalysis, electrochemistry, corrosion and preparation of monomers.

OUTCOMES

- Appreciate the importance of physical chemistry in industrial scenario with respect to chemical kinetics and catalysis.
- Get familiar with the concept of electrochemistry and corrosion.
- Explain the relationship between chemical structure and reactivity and reaction intermediates.
- Utilize the different reaction mechanism which will be useful in polymer preparation.
- Familiar with synthesis and properties of monomers relevant to polymer technology.

UNIT I CHEMICAL KINETICS AND CATALYSIS 9

Chemical Kinetics – Order – Molecularity – Rate of reaction – Activation energy – Polymerization kinetics – Catalysis – Surface science – Application of catalysis – Phase rule - applications.

UNIT II ELECTRO CHEMISTRY / CORROSION 9

Electro Chemistry – Electrochemical series – Transport numbers and ionic mobility – Bufferindicators - Redox reaction – Potentiometric, conductometric, polarographic studies – Galvanic cells – Electrolysis – Thermodynamic parameters.

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, carbo

cations, carbanions, elementary ideas about stereo chemistry.

UNIT IV DETAILS OF REACTION MECHANISMS 9

Free radical substitutions, Electophilic addition, Aromatic Electrophilic substitutions, Nucleophilic additions, condensation reactions, nucleophilic substitutions in aliphatic and aromatic compounds, cyclo additions, rearrangements, uses of these reactions in polymer preparation.

UNIT V ORGANIC SUBSTANCES OF IMPORTANCE TO POLYMER TECHNOLOGY 9

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

TOTAL : 45 PERIODS

REFERENCES

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

GE8251 ENGINEERING MECHANICS L T P C

3 1 0 4

OBJECTIVE

- To develop capacity to predict the effect of force and motion in the course of carrying out the design functions of engineering.

OUTCOMES

- Students will be able to get familiar with various laws of mechanisms and equilibrium conditions.
- Gain knowledge on force and supports developed in 2D surface and 3D objects.
- Able to calculate the centroid and centre of gravity position of various surface and solids.
- To resolve the forces in a particle in dynamic state.
- Understand friction and various elements of rigid body dynamics.

UNIT I BASICS AND STATICS OF PARTICLES 12

Introduction – Units and Dimensions – Laws of Mechanics – Lami's theorem, Parallelogram and triangular Law of forces — Vectorial representation of forces – Vector operations of forces -additions, subtraction, dot product, cross product – Coplanar Forces – rectangular components – Equilibrium of a particle – Forces in space – Equilibrium of a particle in space – Equivalent systems of forces – Principle of transmissibility .

UNIT II EQUILIBRIUM OF RIGID BODIES 12

Free body diagram – Types of supports –Action and reaction forces –stable equilibrium – Moments and Couples – Moment of a force about a point and about an axis – Vectorial representation of moments and couples – Scalar components of a moment – Varignon's theorem – Single equivalent force -Equilibrium of Rigid bodies in two dimensions – Equilibrium of Rigid bodies in three dimensions

UNIT III PROPERTIES OF SURFACES AND SOLIDS 12

Centroids and centre of mass– Centroids of lines and areas - Rectangular, circular, triangular areas by integration – T section, I section, - Angle section, Hollow section by using standard formula –Theorems of Pappus - Area moments of inertia of plane areas – Rectangular, circular, triangular areas by integration – T section, I section, Angle section, Hollow section by using standard formula – Parallel axis theorem and perpendicular axis theorem –Principal moments of inertia of plane areas – Principal axes of inertia-Mass moment of inertia –mass moment of inertia for prismatic, cylindrical and spherical solids from first principle – Relation to area moments of inertia.

UNIT IV DYNAMICS OF PARTICLES 12

Displacements, Velocity and acceleration, their relationship – Relative motion – Curvilinear motion -Newton's laws of motion – Work Energy Equation– Impulse and Momentum – Impact of elastic bodies.

UNIT V FRICTION AND ELEMENTS OF RIGID BODY DYNAMICS 12

Friction force – Laws of sliding friction – equilibrium analysis of simple systems with sliding friction –wedge friction-. Rolling resistance -Translation and Rotation of Rigid Bodies – Velocity and acceleration – General Plane motion of simple rigid bodies such as cylinder, disc/wheel and sphere.

TOTAL : 60 PERIODS

TEXT BOOKS

1. Beer, F.P and Johnston Jr. E.R. “Vector Mechanics for Engineers (In SI Units): Statics and Dynamics”, 8th Edition, Tata McGraw-Hill Publishing company, New Delhi (2004)
2. Vela Murali, “Engineering Mechanics”, Oxford University Press (2010)

REFERENCES

1. Hibbeller, R.C and Ashok Gupta, “Engineering Mechanics: Statics and Dynamics”, 11th Edition, Pearson Education (2010).
2. Irving H. Shames and Krishna Mohana Rao. G., “Engineering Mechanics – Statics and Dynamics”, 4th Edition, Pearson Education (2006)
3. J.L.Meriam and L.G.Kraige, “ Engineering Mechanics- Statics - Volume 1, Dynamics- Volume 2,Third Edition, John Wiley & Sons,(1993)
4. Rajasekaran, S and Sankarasubramanian, G., “Engineering Mechanics Statics and Dynamics”,3rd Edition, Vikas Publishing House Pvt. Ltd., (2005).
5. Bhavikatti, S.S and Rajashekarappa, K.G., “Engineering Mechanics”, New Age International (P) Limited Publishers, (1998).
6. Kumar, K.L., “Engineering Mechanics”, 3rd Revised Edition, Tata McGraw-Hill Publishing company, New Delhi (2008)

PR8251 CONVENTIONAL MACHINING PROCESSES L T P C
3 0 0 3

OBJECTIVES

- To impart the knowledge on basic concepts of various machining Processes and Machine tools.
- Classes to be supported by demonstration in the workshop and screening of video film of the various operations of the machines.

OUTCOMES

- Acquire the knowledge on broad classification of machining processes.
- Able to understand the principle operations in ultrasonic, abrasive and water jet machining.

- Acquaintance of the principle, process, parameters and various operations in EDM and WEDM.
- Comprehend the principle, process parameters in CHM and ECM.
- Gain the knowledge on principle, operations performed in EBM, LBM and PAM.

UNIT I LATHE 10

Introduction to production processes – types of production (job, batch and mass) – production processes – Casting, Forming, Machining and Welding, Machine and Machine Tool – Lathe – Engine Lathe – block diagram – sketch – functions of each part – work holding devices in lathe – functions – Chuck, Centre, Dogs, Steady Rest and Follower Rest, mechanism of lathe – Apron, Feed, Tumbler Gear, various operations performed in Lathe – facing, turning, chamfering and knurling – relative positions of tool and job – Taper turning operations (three methods_ thread cutting – thread – RH and LH, single start and multi start with application – Method of thread cutting – selection and arrangement of tool and work. Problems in metric and inch thread conversion – Specifications of Lathe – Burnishing.

UNIT II SHAPER, PLANER & SLOTTER 9

Purpose of shaping – block diagram – functions of each part. Purpose of planer – block diagram – functions of each part. Purpose of slotting machine – block diagram – functions and working principle. Operations carried out – horizontal plane, vertical plane, v type with relative position – Comparison of planer with shaper – work holding devices in shaper and planer – Quick return mechanism in shaper – mechanical and hydraulic – cross feed mechanism – Types of planer with application – Comparison of shaping with slotting – tool holding devices in shaper, planer and slotter – specifications of shaper, planer and slotter simple problems to calculate the velocity – speed, feed and depth of cut.

UNIT III DRILLING 8

Purpose of drilling – block diagrm and function – types of drilling machines – portable drilling – bench type – sensitive drilling – radial arm drilling – functions of parts – purpose and operation – gang milling, multiple drill head, upright drilling, relative operations – reaming, boring, tapping, counter boring, courses sinking, trepanning and spot facing (with simple sketch, purpose and application). Work holding devices – specification torque calculation – speed, feed and depth of cut.

UNIT IV MILLING 9

Milling machine purpose – up and down milling – classification of milling machines – slot, keyway machining – methods of milling – single piece, string, rotary, index, gang, progressive, copy. Horizontal milling machine – block diagram – functions of each part- applications –

Vertical milling machine – block diagram – functions of each part applications – Gear cutting using milling machine – procedure with neat sketch – milling cutters – peripheral, face, end T slot, form etc. – attachments and special accessories for milling – rotary, slotting attachment – indexing mechanism – methods of indexing – direct, plain, compound and differential indexing – problems – specifications – cutting conditions and parameters.

UNIT V GRINDING **9**

Purpose – classification – surface finish – applications – grinding wheel – types – specifications – selection – surface grinding machine – block diagram – functions of each part – cylindrical grinding – Centreless grinding – Comparison – infeed, end feed and through feed. Balancing, dressing, loading and Truing of wheel – special grinding machines – specification of machine – cutting condition.

TOTAL: 45 PERIODS

TEXT BOOK

1. HMT Bangalore, "Production Technology", Tata Mc-Graw Hill Publishing Company Limited, New Delhi, 2001.
2. P.C. Sharma, "A Text Book of Production Technology", S.Chand and Company, 2001.

REFERENCES

1. R.K. Jain, "Production Technology", Khanna Publishers, New Delhi, 2001.
2. Hajra Choudhary etal, "Elements of Production Technology –Vol.II", Asia Publishing House, 2000.
3. B.Kumar, "Manufacturing Technology", Khanna Publishers, New Delhi 2000.
4. P.Radhakrishnan, "Manufacturing Technology, Vol.I", Scitech Publications, 2002.
5. Kalpakjain ,"Manufacturing Process for Engineering Material"
6. Jain, "Textbook of Production Engineering".

CY8261 APPLIED CHEMISTRY LABORATORY **L T P C**
0 0 2 1

OBJECTIVE

- To make the student acquire practical skills in the wet chemical and instrumental methods for quantitative estimation of hardness, alkalinity, metal ion content, corrosion in metals and cement analysis.

OUTCOMES:

- Able to solve problems related to engineering chemistry
- Familiarization with equipment like viscometers, flash point apparatus etc
- Familiarization of methods for determining COD, chlorine content, acidity etc
- Familiarisation of a few simple synthetic techniques for soap, dyes, defoamers etc

LIST OF EXPERIMENTS

1. Preparation of solutions with various normality and molarity.
2. Determination of Redwood / Saybolt numbers, kinematic viscosity and viscosity index of lubricating oils
3. Determination of flash point, fire point, cloud and pour point of oils
4. Determination of acid value, saponification number and iodine value of oils
5. Determination of total, temporary, permanent, calcium and magnesium hardness of water samples
6. Determination of chloride, sulphate ,and COD of water samples
7. Determination of purity of washing soda and strength of a commercial acid
8. Estimation of available chlorine in hypochlorite solution
9. Estimation of strength of hydrogen peroxide
10. Synthesis of a dye, preparation of soap and a defoamer

TOTAL : 30 PERIODS

GE8211	COMPUTER PROGRAMMING LABORATORY	L T P C
		0 0 3 2

OBJECTIVES:

The Students should be made to

- Be exposed to Unix shell commands
- Be familiar with an editor on Unix
- Learn to program in Shell script
- Learn to write C programme for Unix platform

OUTCOMES:

At the end of the course the students should be able to:

- Use Shell commands
- Design of Implement Unix shell scripts
- Write and execute C programs on Unix

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

LABORATORY REQUIREMENTS FOR BATCH OF 30 STUDENTS

30 Terminals with C and C++ Compiler

TOTAL : 45 PERIODS

MA8356 PROBABILITY AND STATISTICS L T P C
3 1 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.

OUTCOMES

- To make students acquire a sound knowledge in statistical techniques
- To make students acquire fundamental knowledge about probability concepts
- To make students understand concepts like random variables
- To make students understand concepts like design of experiments
- To make students understand concepts like SQC

UNIT I RANDOM VARIABLES 9+3

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 9+3

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 9+3

Sampling distributions - Tests for single mean, proportion, Difference of means (large and small samples) – Tests for single variance and equality of variances – χ^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 **9+3**

Completely randomized design – Randomized block design – Latin square design - 22 - factorial design - Taguchi's robust parameter design.

UNIT V STATISTICAL QUALITY CONTROL **9+3**

Control charts for measurements (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.

AE8351 SOLID MECHANICS **L T P C**
3 0 0 3

OBJECTIVES:

- To gain knowledge of simple stresses, strains and deformation in components due to external loads.
- To assess stresses and deformations through mathematical models of beams, twisting bars or combinations of both.
- Effect of component dimensions and shape on stresses and deformations are to be

understood.

- The study would provide knowledge for use in the design course.

To provide knowledge on analysis of various structural elements for different loading conditions.

OUTCOMES

- Able to determine stresses and strains due to axial loading.
- Illustrate SF& BM diagrams of various beams and to calculate bending stress in various beams.
- Analyse various methods of deriving beam deflection and strain energy.
- Acquaintance of torsional effect on shafts, spring and the concept of struts and column.
- Understanding the concepts of principle stress and Mohr's circle stresses in thin cylinders.

UNIT I AXIAL LOADING **9**

Stresses and strains – Hooke's law – stress and strain diagrams - elastic constants – statically determinate and indeterminate problems in tension & compression – thermal stresses – impact loading.

UNIT II STRESSES IN BEAMS **9**

Shear force & bending moment diagrams for simply supported and cantilever beam – bending stresses – shear stress variation in beams of symmetric sections – beams of uniform strength.

UNIT III DEFLECTION OF BEAMS **9**

Double integration method – Macaulay's method – moment area method – conjugate beam method – principle of superposition – Strain Energy in axial, bending, torsion and shear loadings. Castigliano's theorems and their applications.

UNIT IV TORSION – SPRINGS **9**

Torsion of solid and hollow circular shafts – shear stress variation – power transmission in shafts – combined bending, torsion and axial loading of circular shafts – open and closed-coiled helical springs – stresses in helical springs – design of close coiled helical spring.

UNIT V BIAXIAL STRESSES **9**

Stresses in thin-walled pressure vessels – Mohr's circle and its construction – determination of principal stresses and principal plane.

TOTAL : 45 PERIODS

TEXTBOOKS

1. Gere & Timoshenko, 'Mechanics of Materials', McGraw Hill, 1993
2. William Nash, Strength of Materials, Tata McGraw Hill, 2004

REFERENCES

1. Dym,C.L., and Shames,I.H., 'Solid Mechanics', McGraw Hill, Kogakusha, Tokyo, 1973.
2. Stephen Timoshenko, 'Strength of Materials', Vol I & II, CBS Publishers and Distributors, Third Edition.
3. R.K.Rajput, 'Strength of Materials', S. Chand and Co., 1999.
4. Timoshenko,S. and Young,D.H., Elements of Strength of Materials, T.Van Nostrand Co. Inc., Princeton, N.J., 1977.

EE8252 PRINCIPLES OF ELECTRICAL AND ELECTRONICS ENGINEERING L T P C

3 0 0 3

OBJECTIVE

- To introduce the fundamental concept of electrical and electronics engineering such as electronic components, circuits, logic gates and digital circuits etc.

OUTCOMES

- Familiarize with different electronic components and its devices.
- Acquaint the knowledge of various circuits and amplifiers.
- Understand the concepts of logic gates and digital circuits.
- Impart knowledge in measurements and instruments.
- Able to understand various parameters of microprocessors and its applications.

UNIT I ELECTRICAL CIRCUITS 9

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

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 – (op. Principles).

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 –Rectification – 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 transformer (CT and PT)

TOTAL : 45 PERIODS

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. Sanjeev Sharma, “Basics of Electrical Engineering”, S.K International Publishers, New Delhi, 2007
7. V.K Mehta and Rohit Mehta, “Principle of Electrical Engineering”, S. Chand & Company, 2008

RP8301 FUNDAMENTALS OF CHEMICAL ENGINEERING OPERATIONS L T P C
3 0 0 3

OBJECTIVES

- To highlight on basics of heat and mass transfer processes.
- To enlighten the students with fundamentals related to mixing, separation and drying processes.

OUTCOMES

- Students introduced to various types of unit operation in chemical industries.
- Exhibit an indulgent in the basics of heat and mass transfer mechanism and to demonstrate the ability to apply the principle of heat and mass transfer in rubber and plastics processing
- Students will able to comprehend the agitation of liquids, absorption and adsorption and machinery used for the process.
- Students will acquire the knowledge on principles and process for drying and humidification.
- Students will recognizable with membrane separation process, size reduction and mechanical separation process.

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 – methods of solution- fuels and combustion – stoichiometry

UNIT II MASS TRANSFER 9

Heat exchange equipment – double pipe and shell and tube heat exchangers, condensers Mass Transfer – 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 III AGITATION AND MIXING 9

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 IV DRYING **9**

Drying – Principles and definitions, Rate of batch drying, Equipments for drying. Humidification – Humidity and saturation, dry bulb and wet bulb temperatures, percentage saturation, dew point, humid volume, humid heat, enthalpy, Equipment — cooling towers, spray chambers-Water technology.

UNIT V SEPARATION PROCESSES **9**

Membrane Separation Processes - Separation of gases and liquids, Dialysis, Membrane 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.

RP8302 POLYMER CHEMISTRY **L T P C**

3 0 0 3

OBJECTIVES

- To make the students understand, analyze and apply the mechanisms of polymerization in various industrial polymerization techniques.
- To enlighten the students with the solution properties, molecular weight and molecular weight distribution of polymers.

OUTCOMES

- Students become recognizable with basic classification of polymers
- Analyze the mechanism of polymerization in the synthesis of various polymers and polymerization techniques.

Attested

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- Demonstrate the ability to relate the structure – property relationship in arriving at a decided property
- Able to calculate the molecular weight of polymers
- Able to realize the various transition in polymers.

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 – Industrial polymerization – Bulk, emulsion, suspension and solution polymerization techniques – Copolymerization -Kinetics -Copolymer equation-Types of copolymers

UNIT III STEP GROWTH POLYMERIZATION **9**

Flory's equal reactivity principle – Extension of condensation reactions to polymer synthesis – Polycondensation – 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.

RP8303 THERMODYNAMICS AND FLUID MECHANICS L T P C
3 1 0 4

OBJECTIVES

To make the students understand

- the basic thermodynamic concepts and various cycles and steam in a thermodynamic system.
- the basic fluid mechanic concepts
- the basic equations and fluid flow analysis
- the incompressible inviscid flow.

OUTCOMES

- Familiarize with energy transfer in thermodynamic systems and entropy changes.
- Will able to determine output and efficiency for different air standard cycles.
- Able to understand the forces due to fluids and to predict the prototype performance from the model.
- Acquire the knowledge about fundamental laws on fluid motion.
- Able to measure fluid flow properties and mathematical representation of the same.

UNIT I BASIC THERMODYNAMICS 16

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 II AIR CYCLE AND STEAM **12**

Otto, Diesel, Dual combustion cycles. Air standard efficiency - Mean effective pressure. Properties of steam – Rankine cycle – Steam Nozzles

UNIT III BASIC CONCEPTS OF FLUID MECHANICS **12**

Introduction – Fluid properties – Newton's viscosity law – Classification of fluids and fluid motion – Fluid statics – Hydrostatic force on submerged surfaces – stability of floating bodies – Dimensional analysis – The Buckingham-Pi theorem – Significant dimensionless groups – Flow similarity and model studies

UNIT IV BASIC EQUATIONS OF FLUID FLOW ANALYSIS **12**

Basic laws for a system in integral form – Conservation of mass – Newton's Second law – Laws of thermodynamics – Application of the basic laws for a control volume – Kinematics – Motion of a fluid particle – Fluid deformation – Differential analysis of fluid motion – Continuity equation – Differential momentum equation – The Navier Stokes equations

UNIT V INCOMPRESSIBLE INVISCID FLOW **8**

Euler's equations of motion – Bernoulli's equations – Applications – Methods of pressure measurement – Flow measurement – Orifice plate – Venturi meter – Irrotational flow – Stream function and velocity potential – Laplace equation – Elementary plane flows

TOTAL : 60 PERIODS

REFERENCES

1. Nag.P.K., "Engineering Thermodynamics", Tata McGraw-Hill, New Delhi, 2007.
2. Shames I H, 'Mechanics of Fluids', Kogakusha, Tokyo, 1998.
3. Venwylen and Sontag, "Classical Thermodynamics", Wiley Eastern, 1987
4. Arora C.P, " Thermodynamics", Tata McGraw-Hill, New Delhi, 2003.
5. Robert W Fox & Alan T Mc.Donald, 'Introduction to fluid Mechanics', John Wiley and Sons, 1995
6. Yuan S W, 'Foundations of fluid Mechanics', Prentice-Hall, 1987.
7. Rathakrishnan, E, 'Fundamentals of Fluid Mechanics', Prentice-Hall, 2007.

AU8312 **MECHANICAL SCIENCES LABORATORY** **L T P C**
0 0 3 2

OBJECTIVE

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

OUTCOME

- Students were trained in testing and quantifying the mechanical properties of Materials, Engines and Heat Exchanger.

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 : 45 PERIODS

EE8261 **ELECTRICAL AND ELECTRONICS LAB** **L T P C**
0 0 3 2

OBJECTIVES:

To impart hands on experience in verification of circuit laws and theorems, measurement of circuit parameters, study of circuit characteristics and simulation of time response. To expose the students to the basic operation of electrical machines and help them to develop experimental skills.

OUTCOMES

- Able to do the test on AC and DC machines and electronic circuits.
- Able to handle CRO for various applications.
- Able to know the characteristics and applications of transducers.

LIST OF EXPERIMENTS

1. Study of DC & AC Starters
2. Wheatstone Bridge and Schering Bridge
3. Speed Control of DC Shunt Motor
4. Load Test on DC Shunt Motor
5. OCC & Load Characteristics of DC Shunt Generator
6. Load Test on Single-Phase Transformer
7. Load Test on Three-Phase Induction Motor
8. Load Test on Single-Phase Induction Motor
9. Study of Transducers
10. ADC and DAC Converters

TOTAL : 45 PERIODS

MA8352 **NUMERICAL METHODS** **L T P C**
3 1 0 4

OBJECTIVE

- To impart knowledge on numerical methods that will come in handy to solve numerically the problems that arise in engineering and technology. This will also serve as a precursor for future research.

OUTCOMES

- Demonstrate various methods of solving system of equations.
- Acquire knowledge on fitting polynomials
- Examining the approximate solution for numerical integration and differentiation.
- Able to formulate and solve initial value and boundary value problems.

UNIT I SOLUTION OF EQUATIONS AND EIGENVALUE PROBLEMS 9+3

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 andGauss-Seidel - Matrix Inversion by Gauss-Jordan method - Eigen values of a matrix by Power method and by Jacobi's method.

UNIT II INTERPOLATION AND APPROXIMATION 9+3

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 9+3

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 9+3

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

UNIT V BOUNDARY VALUE P ROBLEMS IN ORDINARY AND PARTIAL DIFFERENTIAL EQUATIONS **9+3**

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

REFERENCES

1. Grewal, B.S. and Grewal,J.S.," Numerical methods in Engineering and Science" , Khanna Publishers, New Delhi, 9 thEdition, 2011.
2. Sankara Rao, K. "Numerical methods for Scientists and Engineers', PrenticeHall of India Private Ltd., New Delhi, 3 rdEdition,2007
3. Brian Bradie, "A Friendly Introduction to Numerical Analysis", Pearson Education Asia, New Delhi, 1st Edition, 2007.
4. Gerald, C.F. and Wheatley, P.O., "Applied Numerical Analysis", PearsonEducation Asia, New Delhi, 6 thEdition, 2006.
5. Laurene V. Fausett, "Applied Numerical Analysis using MATLAB",Pear sonEducation, New Delhi,print, 2nd Edition, 2009.

GE8351 ENVIRONMENTAL SCIENCE AND ENGINEERING **L T P C**
3 0 0 3

OBJECTIVE

- The student is expected to understand what constitutes the environment, what are precious resources in the environment, how to conserve these resources, what is the role of a human being in maintaining a clean environment and useful environment for the future generations and how to maintain ecological balance and preserve bio-diversity. The role of government and non-government organization in environment managements.

OUTCOMES

- Demonstrate the understanding about the constitutes of the environment, precious resources in the environment, conservation of resources.

- Gain the knowledge on causes, effects and control measures of environmental pollutions.
- Understand the role of a human being in maintaining a clean environment and useful environment for the future generations.
- Able to know the importance of ecological balance and preservation of bio-diversity.
- Understand the importance of sustainable development, social issues and different pollution control acts.
- Up to date knowledge on the human population growth and its related environmental issues.

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

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).

REFERENCE BOOKS

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)

RP8401 PHYSICAL PROPERTIES OF POLYMERS L T P C

3 0 0 3

OBJECTIVE

- To impart fundamental knowledge on flow behaviour of polymers, structure property relationship of polymers.

OUTCOMES

- Realize the solution and the flow behavior of polymers.
- Comprehend the mechanical behavior of polymers and its test methods.
- Acquire the awareness of Frictional and wear properties of polymers.
- Obtain the facts of electrical properties of polymers and its applications.
- Learn the optical properties of polymers and ability to use them for design applications.

UNIT I STATES OF AGGREGATION IN POLYMERS 12

Transitions and segmental mobility in polymers – Glass transition, Tg, and flexibility – Multiple transitions in polymers - Significance of transition temperatures – Semicrystalline polymers – Effect of crystallization on properties of polymers – Factors affecting crystallization crystal nucleation and growth – relationship between Tg and Tm – 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 – Iimpact 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 7

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 POLYMER 5

Structure-Property relationships – Polar and Nonpolar 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 PROPERTIES OF POLYMERS 9

Introduction – Isotropic polymers – Anisotropic polymers – Dichroism – Optical applications of polymers – Transmission – Rheoptical properties and application-Birefringence-Photoelastic effects and Analysis in Polymers

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. L.H.Sperling, 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.

RP8402 PLASTICS MATERIALS AND PROPERTIES L T P C
4 0 0 4

OBJECTIVES

- To make them understand the structure property relationship of various plastics.
- To make them understand the importance of structure property relationship to choose the materials for various applications.

OUTCOMES

- Classify the different types of plastics
- Demonstrate an idea about structure property relation of different plastics and its uses.
- Be familiar with the preparation, properties and application of various commodity plastics.
- Acquire the knowledge of preparation, properties and application of thermosets and engineering plastics and speciality polymers.
- Ability to select the plastics for various end uses in industry.

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.

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 12

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 THERMOSETS & NATURAL POLYMERS 12

Natural Polymers – Cellulose, starch, proteins, RNA,DNA – Properties & applications.PF, UF & MF resins – preparation, properties & uses moulding powders – additives , epoxy, unsaturated polyester resins

TOTAL : 60 PERIODS

REFERENCES

1. J.A.Brydson, Plastics Materials, 7th edition Elsevier Publication, 1999
2. Athalye & Prakash Trivedi, PVC Tech, Multitech Publishing Co, Bombay 1994.
3. Engg. Materials Hand Book, Vol.2, Engg. Plastics, ASM Internation, 1997.

RP8403 RUBBER MATERIALS AND COMPOUNDING ADDITIVES L T P C
4 0 0 4

OBJECTIVES

- To enable the students understand the importance of chemical structural features in determining the properties of the rubbers.
- To make the students aware of various rubbers – their preparations, properties and uses.
- To make the students understand the importance of compounding ingredients in a rubber and get detailed knowledge about the ingredients.

OUTCOMES

- Understand the concepts of flexible polymer chains and its influence in properties of rubber.
- Appreciate the influence of chemical structure in various properties of elastomer.
- Acquire basic knowledge on Natural Rubber, properties and its applications.
- Familiar with preparation, properties and application of various synthetic rubbers, TPEs.
- Familiarize about rubber additive.

UNIT I STRUCTURE-PROPERTY RELATIONSHIPS IN RUBBERS 9

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 GENERAL PURPOSE RUBBERS 9

Natural Rubber- 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– Synthetic polyisoprene-Polybutadiene and SBR-Their manufacture, structure-property considerations- processing

and curing of these rubbers-uses of these rubbers

UNIT III SPECIAL PURPOSE RUBBERS 20

Preparation, properties and uses of: Nitrile Rubber, Butyl Rubber and Polychloprene Rubbers – Ethylene Propylene Rubber and Ethylene – Vinyl acetate copolymers – Elastomers based on modified polyethylene – Acrylate rubbers Polysulphide rubbers– Polyalkenamers and poly norbornene -Hydrin rubbers-polysulphide rubber-Silicones and poly urethanes-Polyurethanes - Reactions of di isocyanates – Polyols -chain extenders-types of urethane elastomers – Properties and uses - 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

UNIT IV COMPOUNDING AND ADDITIVES FOR VULCANIZATION 8

Order of mixing- vulcanization agents-Their mechanisms of action-Accelerators and activators-Other cure systems

UNIT V FILLERS AND OTHER ADDITIVES 14

Carbon black -Its preparation, structure, properties and their effect on rubber properties-silica fillers-coupling agents- other fillers-Processing aids-Anti oxidants and antiozonants-Other additives like colourants, blowing agents, factice, reclaimed rubbers.

TOTAL : 60 PERIODS

REFERENCES

1. Brydson J, Rubber Chemistry, Butterworths, 1978
2. Franta, I; Elastomers and Rubber Compounding materials, Elsevier, 1989.
3. Kothandaraman B, Rubber Materials, Ane Books, 2008.
4. Morton, M.; Rubber Technology, Chapman Hall, 1995.
5. Dick. J.S., Rubber Technology Compounding and testing for Performance, Hanser Publisher, 2001.

RP8404 THEORY OF MACHINES AND MECHANISMS L T P C
3 1 0 4

OBJECTIVES

To make the student to understand the

- Various mechanism and its kinematic analysis.
- Various frictional force in mechanical devices.
- Various profile of gear and its mechanisms.
- Balancing in mechanical systems and various vibrations

OUTCOMES

- Analyze the practice of forming different mechanism using link
- Be familiar with friction force and its importance in mechanical devices
- Understanding the analysis of gear and cam power transmission
- Scrutinize the effect of unbalance and balancing techniques
- Acquire the knowledge of different vibration and to analyze the transmission of vibration

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 – Plate and cone clutch – belt (flat & vee) 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 – Gear trains – simple, compound and reverted gear trains – Determination of speed and torque in Epicyclic gear trains – Cams different types of followers – 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 – Governors and Gyroscopic effects.

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 –Single and multi rotor systems – Geared shafts – Critical speed of shafts.

TOTAL : 60 PERIODSREFERENCES

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

RP8411 COMPUTER AIDED PARTS & ASSEMBLY DRAWING **L T P C**
0 0 4 2

OBJECTIVE

- To make the students to understand the CAD concepts and assembly of various mechanical elements.

OUTCOMES

- Students will be trained in construction of machine elements and assembly drawing.
- Students will able to allocate geometrical tolerances and to develop part drawing.

DRAWING

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

COMPUTER AIDED PRODUCTION DRAWING AND MODELING

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

1. Screw jack
2. Plummer block
3. Machine vice
4. Four jaw chuck of lathe
5. Universal coupling
6. Hydraulic & Pneumatic Assembly

COMPUTER AIDED ANALYSIS

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

TOTAL : 45 PERIODS

REFERENCES

1. Narayana K.L., Kannaiah P and Venkata Reddy – "Production Drawing" New age International Limited, Delhi 2004.
2. Bhat N.D., "Machine Drawing", Charotar Publishing House, Anand 2000
3. Nagtal G.R., "Machine Drawing", Khanna Publishers, New Delhi 1994.
4. Joseph Gordon r., M., Industrial Design of Plastics Products, Wiley Interscience Publication 2003.

RP8412 POLYMER SYNTHESIS AND IDENTIFICATION LABORATORY L T P C
0 0 4 2

OBJECTIVES

- To provide hands on experience on various polymerization techniques.
- To make the student understand simple experimental procedures to determine

molecular weight and molecular weight distribution of polymers.
- To make the student familiarize with the thermal properties of polymers.
- To make the student understand simple techniques to identify the plastic materials.

OUTCOMES
- Capability to identify plastics materials.
- Able to synthesize various types of polymers.
- Able to measure viscosity of polymer solutions.

LIST OF EXPERIMENTS

1. Identification of Plastics materials.
2. Density determination.
3. Bulk polymerization - Preparation of Polymethyl methacrylate.
4. Solution Polymerization - Preparation of polyacrylamide.
5. Preparation of Phenol-Formaldehyde, UF and MF resins.
6. Measurement of viscosity of polymer solutions and determination of molecular weight of the polymer.
7. End group analysis.
8. Determination of acid value of a resin.
9. Study of Molecular weight distribution (GPC).
10. Determination of cure of a phenolic moulding (percentage acetone soluble matter).
11. Study of Thermal Stability of polymers.

TOTAL : 60 PERIODS

RP8501 ENGINEERING AND HIGH PERFORMANCE PLASTICS L T P C
3 0 0 3

OBJECTIVES

- To emphasize the importance of additives for plastics.
- To make them understand the structure property relationship and applications of engineering plastics and high performance polymers.
- To highlight the applications of specialty polymers.

OUTCOMES

- Students understand the importance of additives in plastics.
- Students understand the uses of surface modifiers, stabiilsers etc used in plastics.

- Students acquire fundamental knowledge about preparation and uses of engineering plastics like polyesters, LCP etc.
- Students acquire knowledge about hign temperature plastics like fluoropolymers, polyimides, poly heterocyclics etc.
- To introduce specialty polymers like those with piezoelectric, ferroelectrics, biomedical polymers etc.

UNIT I ADDITIVES FOR PLASTICS-I 9

Additives for plastics – Fillers – Antioxidants – Stabilizers – Lubricants – plasticizers, toughening agents, colourants – Fire retardants – Coupling agents.

UNIT II ADDITIVES FOR PLASTICS – II 9

Blowing agents, UV stabilizer, antistatic agents, anti blocking agents – Slip & antislip agents – Processing aids, mould releasing agents

UNIT III ENGINEERING PLASTICS 9

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

UNIT IV HIGH TEMPERATURE PLASTICS 9

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 V SPECIALITY POLYMERS 9

Polymers for electronic applications, conducting polymers – Photoresists, polymers in optoelectronics polymers with piezoelectric, pyroelectric & ferroelectric properties – Polymers in bio medical applications.

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.

RP8502 PLASTICS PROCESSING AND MACHINERY L T P C
3 0 0 3

OBJECTIVE

- To study the flow behaviour of plastics and its processing techniques.

OUTCOMES

- Familiarize with various types of additives used for plastics and its mixing machinery.
- Acquaint of various parameters to operate injection molding machine.
- Realize the application of different types of injection molds.
- Gain knowledge of principle and process of extrusion, calendaring and blow molding operations.
- Aware of thermoforming, rotational molding and finishing, machining and welding of plastics.

UNIT I MELT PROCESSING OF PLASTICS 9

Flow behavior – 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; pipe extrusion – Profile extrusion – Sheet extrusion, flat sheet extrusion – Blown film extrusion – Monofilament & fiber extrusion - Trouble shooting in extrusion operations Blow molding-Extrusion blow molding – Injection Blow moulding – Stretch Blow moulding – Co extrusion Blow moulding – Wall thickness and parison thickness relationship.

UNIT III INJECTION MOULDING OF PLASTICS-I 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.

Co-injection moulding – RIM – Gas- assisted injection moulding – Soluble core technology – Push-pull moulding systems, Injection moulding for thermosetting plastics.

UNIT IV INJECTION MOULDING OF PLASTICS-II 9

Basic mould constructions, two plate, three plate mold – Runnerless, stack moulds, mould designs – Sprue, runner, gate systems, venting, mould cooling, estimation of mould filling and mold cooling- Orientation arising in moulding – Shrinkage in injection moulding.

UNIT V THERMOFORMING, ROTATIONAL MOLDING AND FINISHING OF PLASTICS **9**

. Forming process – Vacuum forming, pressure forming, plug – assisted vacuum forming – Billow forming – Rotational moulding – Casting 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.

TOTAL : 45 PERIODS

REFERENCES

1. Plastics product design and process engineering – Harold Belofsky – Hanser publishers, 1995.
2. Tin A. Osswald, Polymer Processing Fundamentals – Hanse publishers, 1998.
3. Walter – Michaeli, Plastics Processing An Introduction – Henser, publishers, 1995.
4. Rubin I. Hand book of Plastics Materials & Technology, Wiley, Interscience, 1999.
5. The role of additives in plastics – L. MASCIA, Edward Arnold publication.

RP8503 RUBBER AND PLASTICS TESTING **L T P C**
4 0 0 4

OBJECTIVES

To make the student familiarize with

- Various standards, specifications and principles of rubber and plastics testing.
- Various mechanical testing of polymers.
- Thermal, optical and electrical studies of rubber and plastics.
- Various durability studies in elastomers.

OUTCOMES

- Understand the importance of standards and specifications.
- Familiarization about various test methods on Rubber and Plastics used in industry.
- Access and analyze the properties and performance of the rubber and plastic products in service condition.
- Understand the techniques and instruments used to measure vulcanization of rubbers.
- Carry out the destructive and durability tests of elastomers.

UNIT I INTRODUCTION **8**

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

UNIT II PLASTICS TESTING- I **15**

Tests on raw materials – Melt flow index - Spiral flow tests – Tests on thermosets – Viscosity - Bulk factor – Gelation tests – Molecular weight distribution – Flame resistance tests – Tensile strength – Modulus – Hardness of plastics – Flexural strength – Impact strength – Creep – Isochronous and isometric curve – Tests for fatigue loading – Tests on low temperature properties.

UNIT III PLASTICS TESTING- II **12**

Heat deflection temperature – Softening point – Thermal expansion – Coefficient of friction – Static and dynamic – Thermal conductivity – Resistivity measurements – Dielectric properties - Tracking index – Arc resistance – Refractive index - Gloss – Transmittance – Reflectance.

UNIT IV TESTS FOR RUBBER PROPERTIES **13**

Testing of Natural rubber Principles of NR specification – Scorch and cure parameters – Techniques and instruments – Types of curemeters – Principles applications of cure data. Cured properties – Mechanical: Static properties –Hardness, tear, tensile application of test data and abrasion.

UNIT V DESTRUCTIVE AND DURABILITY TESTS IN ELASTOMER **12**

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

TOTAL : 60 PERIODS

REFERENCES

1. Brown.R.P. Physical Testing of Rubber, Elsevier, 1986.
2. Testing and Evaluation of Plastics, Mathur A B., Allied Publishers (P) Ltd., 2003
3. Language of Rubber, Smith, Len, Butterworth- Heinemann Ltd., 1993.
4. Schaefer.R. Dynamic Properties of Rubber (1-8) Series, rubber World, Vol.211, 1995.
5. ASTM Standards Volumes 8 and 9, 2003.

RP8504 RUBBER PROCESSING AND MACHINERY L T P C
3 0 0 3

OBJECTIVES

To study the mixing mechanism of rubber, machinery and process.

- To study the manufacture of different rubber products.

OUTCOMES

- Appreciative the different rubber processing techniques and safety aspects of machineries.
- Significance of compounding and mixing mechanism of rubber and its machinery.
- Acquire the knowledge of calendaring and extrusion process and its machinery.
- Realizing the different molding and vulcanization techniques.
- Manufacturing of various rubber components.

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 – Fractioning – 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 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.

UNIT V PROCESSING METHODS FOR VARIOUS RUBBER PRODUCTS 15

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

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.

RP8511 RUBBER MATERIALS LABORATORY L T P C
0 0 4 2

OBJECTIVES

- To make the familiarize with simple quality control test for the given rubber latex.
- To perform simple tests for identification of elastomers.
- To carry out tests related to properties of rubber and its additives.

OUTCOMES

- Identification of rubber
- Analyze the physical properties of NR latex.
- Chemical analysis of synthetic rubber
- Able to carry out the specifications test and interpretation of data's of various rubbers.

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 etc.
12. Characterisation of accelerator, insoluble methanol.
13. Knowledge about Spectroscopy – UV – VIS – IR
14. TGA / DSC analysis of Rubber Compounds.

TOTAL: 60 PERIODS

RP8512 RUBBER PROCESSING AND TESTING LABORATORY L T P C
0 0 4 2

OBJECTIVES

To make the student to familiarize with

- Mixing studies of various rubbers
- Processing and curing studies of various rubbers.
- Preparation of samples for different testing of rubbers and its hands on experience.

OUTCOMES

- Operate and mix rubber compound using 2-roll mixing mill.
- Optimize the cure parameters of various rubber compounds.
- Mold rubber compounds using molds such as tensile, flex, buttons.
- Demonstration of the skill acquired to operate and analyze the problems in various rubbers processing equipment.
- Capability to carry out testing of rubber compounds and observe the behavior of the material under the test conditions.
- To perform the cure characteristics and mechanical testing of rubbers

LIST OF EXPERIMENTS

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

RUBBER TESTING:

1. 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.
2. 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

MG8653 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

OUTCOMES

- Understand the principles of management.
- Familiarize with inventory management and its cost analysis.
- To understand the different principles and techniques of management in planning, organizing, directing and controlling.
- Gain the knowledge of methods of operation management.
- Gain the knowledge on 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

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

RP8601 MOULD ENGINEERING AND MANUFACTURE L T P C
3 0 0 3

OBJECTIVES

To make the student to familiarize with

- Theory of metal cutting and lathe operations
- Principles of special machine tools and its application in making a mould.
- Various materials, properties and heat treatment process for mould.
- Various unconventional machining and CNC process to make a mould.

OUTCOMES

- Ability to understand different components of mould and die.
- Able to design and draw moulds and dies.
- Able to understand mould design concepts.
- Gain the knowledge on various mould manufacturing techniques.
- To gain idea on mould materials and machining processes.

UNIT I THEORY OF METAL CUTTING & LATHE MACHINES 9

Introduction: material removal processes, types of machine tools –Theory of metal Cutting-Chip formation, cutting tool materials, tool wear, tool life, surface finish, cutting fluids. Centre lathe- Various operations Capstan and turret lathes - Special attachments

UNIT II SPECIAL MACHINE TOOLS 9

Reciprocating machine tools: shaper, planer, slotter - Milling : types, milling cutters, operations - Hole making : drilling, Reaming, Boring, Tapping -Broaching machines: broach construction – Push, pull, surface and continuous broaching machines. Grinding process – Cylindrical grinding, surface grinding

UNIT III MOULD ENGINEERING AND MATERIALS FOR MOULD MANUFACTURING 9

Mould –function-requirement-mechanical properties- tolerance-basic mould types-Mould construction nomenclature .Steel – Stress releving -Heat treatment-mould steel requirements-Selection of steel for mould-Surface treatments- Alloy steels-Non Ferrous materials for moulds. Mould making techniques.

UNIT IV UNCONVENTIONAL MACHINING PROCESSES 9

Electric Discharge Machining (EDM)- working Principle. Parameters-Surface Finish and MRR- electrode - Wire cut EDM – Applications. Chemical machining and Electro-Chemical

machining - Etchants- Maskant- Techniques of applying maskants-Process Parameters – Surface finish and MRR-Applications. Principles of ECM-Equipment's-Surface Roughness and MRR-Electrical circuit-Process Parameter.

UNIT V CNC MACHINE TOOLS AND PART PROGRAMMING 9

Numerical control (NC) machine tools – CNC: types, constructional details, special features – Design considerations of CNC machines for improving machining accuracy – Structural members – Slide ways –Linear bearings – Ball screws – Spindle drives and feed drives. Part programming fundamentals – Manual programming – Computer assisted part programming.

TOTAL : 45 PERIODS

REFERENCES

1. Hajra Choudry, "Elements of Work Shop Technology – Vol. II", Media Promoters.2002.
2. Herbert Rees, Mould Engineering, 2nd edition, Hanser Publishers.
3. Benedict. G.F. "Nontraditional Manufacturing Processes" Marcel Dekker Inc., New York (1987).
4. P.N.Rao, CAD/CAM principles and Applications , Tata McGraw-Hill,2007.
5. HMT – "Production Technology", Tata McGraw-Hill, 1998.
6. Mikell p.Groover, ' Fundamentals of modern Manufacturing, Materials, Processess and systems' John Wiley and Sons, 9th Edition,2007.
7. Shrawat N.S and Narang J.S, 'CNC Machines' , Dhanpat Rai & CO., 2002.
8. Milton C. Shaw, ' Metal Cutting Principles' , Oxford university Press, second Edition 2005.

RP8602 POLYMER CHARACTERISATION TECHNIQUES L T P C

3 0 0 3

OBJECTIVES

- To impart the knowledge on chemical analysis of different polymers.
- To enlighten the students with various instrumental techniques for the analysis.
- To highlight methods used for the study of thermal and physical properties of polymers.

OUTCOMES

- Chemical analysis of different polymers.
- Physical characteristics of polymers.
- The polymers using instrumental methods for analysis.
- The thermal properties of polymers and molecular weight of polymers.
- And interpret and analyze the given data of any polymeric material.

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. D.O.Hummel and F.Scholl, Atlas of Polymer and Plastics Analysis, Vol.2, Carl Hanser Verlag, 1988
2. Craver, C.D. and T.Provder, 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.

RP8603 RUBBER COMPOUND AND PRODUCT DESIGN L T P C
3 0 0 3

OBJECTIVES
- To impart the knowledge to design rubber compound and product.
- To estimate the compound cost.

OUTCOMES
- Understanding the principle of compounding, mixing and compound design.
- Understanding the cure mechanism of various rubber and its vulcanizing agents.
- Acquire the knowledge of functions and applications of reinforcing fillers and other rubber additives.
- Ability to apply the concept of science in various additives, design a formulation for a specific requirement.a
- Demonstrate the role of rubber elasticity in product application
- Understand rubber application in load bearing, sealing and vibration control

UNIT I DESIGNING WITH RUBBER – FUNDAMENTALS 9

Elastic properties at small strains – Large deformations – Dynamic Mechanical properties – Heat generation in Rubber components – Vibration isolation – Shock absorbers – Mechanical Fatigue – Fatigue in rubber composites.

UNIT II SERVICE CONDITIONS 9

Dynamic mechanical properties- viscoelasticity- heat generation- Strength- ozone attack, effect of oxygen- Effect of temperature and frequency- Special environments- Solvents and other media

UNIT III DESIGN OF RUBBER COMPONENTS 9

Introduction – Viscoelasticity and its implication – Creep and stress relaxation and inter relationship, Payne and Mullins - Shear and compression bearings – Planar sandwich forms – Laminate bearings – Shape factors – Vibration and noise control - Design requirements – Design of seals and O-rings – V-belts.

UNIT IV INDIVIDUAL RUBBER FORMULATIONS 9

Formulating for natural and synthetic rubbers and typical recipes for a few rubber products, Implications of FDA Regulations - Toxicity and environmental issues.

UNIT V FORMULATION FOR PERFORMANCE REQUIREMENTS 9

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

TOTAL : 45 PERIODS

REFERENCES

1. Alan N Gent, Engineering with Rubber, 2nd Edition, Carl Hanser Verlag,Munich 2001.
2. Miller, E., Plastics Product Design Hand Book, Part A & B, Marcl Dekker, 1982.
3. Theory and Practice of Engineering with Rubber by Freakley and Payne, Dynamic Mechanical Analysis- A practical introduction, Kevin Menard, CRC Press, 1999.
4. Khairi Nagdi, Rubber as an Engineering Material: Gudieline for Uses, Hanser Publishers, 1993.
5. Elastomers: Criteria for Engineering Design, C Hepburn & R J W Reynolds, Applied Science Publishers, London, 1979.
6. Natural Rubber Science and Technology (ed.) A D Roberts, OUP, 1988
7. Rubber Springs Design, Gobel E F., Translated and ed by Brichta A M., Newnes-Butterworths, 1974.

HS8561 EMPLOYABILITY SKILLS L T P C

(LAB / PRACTICAL COURSE) 0 0 2 1

(Common to all branches of Fifth or Sixth Semester B.E / B.Tech programmes)

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 soft skills, including report writing, necessary for the workplace Situations.

OUTCOMES

- Development in soft skills and interpersonal skills, which will make the transition from college to workplace smoother and help them excel in their job
- Enhancement in the performance of students at placement, interviews, group discussion and other recruitment exercises.

1. Making presentations – introducing oneself – introducing a topic – answering questions – individual presentation practice
2. Creating effective PPTs – presenting the visuals effectively
3. Using body language with awareness – gestures, facial expressions, etc.
4. Preparing job applications - writing covering letter and résumé
5. Applying for jobs online - email etiquette
6. Participating in group discussions – understanding group dynamics - brainstorming the topic
7. Training in soft skills - persuasive skills – sociability skills - questioning and clarifying skills – mock GD
8. Writing reports – collecting, analyzing and interpreting data – drafting the report
9. Attending job interviews – answering questions confidently
10. Interview etiquette – dress code – body language – mock interview

TOTAL: 30 PERIODS

Requirements for a class of 30 students

1. A PC or a lap top with one or two speakers
2. A Collar mike and a speaker
3. An LCD projector and a screen
4. CD's and DVD's on relevant topics
5. Individual chairs for conducting group discussions

REFERENCE BOOKS

1. Dhanavel, S.P. 2010. English and Soft Skills. Hyderabad: Orient BlackSwan Ltd.
2. Corneilssen, Joep. How to Prepare for Group Discussion and Interview. New Delhi: Tata-McGraw-Hill, 2009.
3. D'Abreo, Desmond A. Group Discussion and Team Building. Mumbai: Better Yourself Books, 2004.
4. Ramesh, Gopalswamy, and Mahadevan Ramesh. The ACE of Soft Skills. New Delhi: Pearson, 2010.
5. Gulati, Sarvesh. Corporate Soft Skills. New Delhi: Rupa and Co. 2006.

Attested

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

6. Van Emden, Joan, and Lucinda Becker. Presentation Skills for Students. New York: Palgrave Macmillan, 2004.

EXTENSIVE READERS

1. Covey, Stephen R. The 7 Habits of Highly Effective People. New York: Free Press, 1989.
2. Bagchi, Subroto. The Professional. New Delhi: Penguin Books India, 2009.

WEB RESOURCES

1. www.humanresources.about.com
2. www.careerride.com

RP8611 COMPUTER AIDED MOULD DESIGN LABORATORY L T P C
0 0 4 2

OBJECTIVE

- To make the students to familiarize in mould design softwares, construction and design of mould and dies.

OUTCOMES

- Ability to use Mould design softwares.
- Ability to understand different components of mould and die.
- Able to design and draw molds and dies.

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. Collapsable core – Mechanism
10. Gear Core – Mechanism
11. Compression Mould
12. Transfer Mould

1. DESIGN AND DRAWING OF DIES FOR

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

RP8612 PLASTICS PROCESSING AND TESTING LABORATORY L T P C
0 0 4 2

OBJECTIVE

- To provide hands on experience in various plastics processing equipments, sample preparation and testing.

OUTCOMES

- Apply practical skills in handling various plastic processing equipments
- To prepare and characterize the product for testing
- Understand the importance of standards and specifications.
- Familiarization about various test methods on Plastics used in industry.
- Access and analyze the properties and performance of the plastic products in service condition.

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.
7. Study of Injection and Compression molds.
8. Study of machining of plastics
9. Study of Adhesive materials

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

RP8701 **POLYMER COMPOSITES** **L T P C**
3 0 0 3

OBJECTIVES

- To impart the fundamentals of polymer composites and its applications.
- To know about manufacture, properties and application of polymer and fibre.

OUTCOMES

- Classify the different type of polymeric composites and its applications.
- Select different types of matrix and reinforcement materials.
- Ability to select the process for fabrication of polymer composites.
- Relate theoretical knowledge with typical products and its stress –strain behavior.
- Aware of different testing and characterization of polymer composites.

UNIT I INTRODUCTION TO COMPOSITES 9

Composites-Definition, classification, general characteristics– Theory of composites – Mechanical behavior of laminates – Stress strain relationships – Fiber-matrix interactions in a unidirectional lamina.

UNIT II MATERIALS USED IN POLYMER COMPOSITES 9

Thermoplastics and Thermosetting Matrix; Reinforcements-fibers- Classification, properties and applications, fiber orientation, fiber surface treatments, fillers and other additives used for composites processing, curing of the resins.

UNIT III PROCESSING METHODS FOR FRP'S 9

Open and closed mould process-Hand lay up – Spray up –Vacuum and pressure bag moulding, resin injection moulding, vacuum impregnation and injection; bulk molding compounds – SMC, DMC,BMC compression, transfer and injection moulding, filament winding, pultrusion; centrifugal casting; common faults and troubleshooting.

UNIT IV TESTING AND CHARACTERISATION OF COMPOSITES 9

General test methods for tensile, flexural, inter laminar shear strength, compression tests , impact strength tests; elevated temperature tests; void content, resin content, fiber content, gel time.

UNIT V FINISHING AND APPLICATIONS OF COMPOSITES 9

Adhesive and mechanical joining, finishing; repairing- Surface damage, small impact failures,

holes; Application of composites in aerospace, automotive industry, marine industry, civil engineering applications, electrical industry etc.

TOTAL : 45 PERIODS

REFERENCES

1. R.G.Weatherhead,"FRP Technology", Applied Science Publishers Ltd, 1990.
2. P.K.Mallick," Fiber reinforced plastics",Marckel Dekkar Inc,1998.
3. Autar Kaw,"Mechanics of composite materials", CRC Press, 1997.
4. Dominick V.Rosato,"Designing with Reinforced Composites", Hanser Publishers, 1997.
5. Stuart M Lee,"Composites Technology", Vol 1 & 2, Technomic Pub., 1989.
6. Leonard Hollaway, "Handbook of Polymer Composites for Engineers", Woodhead Publishers.

RP8702 TYRE TECHNOLOGY L T P C

3 0 0 3

OBJECTIVES

- To impart the knowledge of pneumatic tyre, tyre components and their functions.
- To make the students aware of tyre cords and its reinforce mechanism, tyre building and tyre properties.

OUTCOMES

- Understand the materials and methods of various tyre components and their properties.
- Gain the knowledge of the science behind pneumatic tyre of various sizes and end use.
- Know the tyre cords and its reinforcement mechanism.
- Identify the tyre stress, deformation, traction and wear.
- Evaluate the tyre properties.

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. Carcass 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 MEASUREMENT AND ANALYSIS OF TYRE PROPERTIES 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 – Testing of tyres and tubes – Defects and remedial measures. 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, 1955.
3. Tire Technology, Frederick J Kovac, The Goodyear Tire Company, 1973.
4. Clark, S.K. Mechanics of Pneumatic Tyres.
5. Wake W.C. and Wootton, D.B. Textiles in Reinforcement of Elastomers, 1982.
6. The Pneumatic Tire, (ed) A N Gent & J D Walter, The University of Akron, August. 2005, published by NHTSA, DOT, USA

RP8711 **COMPREHENSION** **L T P C**
0 0 3 2

OUTCOMES

- Helps the faculty members to assess the students' level of interest in career planning in rubber, plastics, composites, management or in entrepreneurship.
- Recall and judge the depth of understanding in various subjects which had been taught in the previous semesters.

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.

TOTAL: 45 PERIODS

RP8713 **INDUSTRIAL TRAINING (6WEEKS)** **L T P C**
0 0 4 2

OUTCOMES

- Understanding the importance of getting hands on experience by industrial training.
- Able to visualize and get trained in the real time applications in industry.
- Capable to prepare a technical report and present cogently
- Demonstrate an understanding about industrial practice related to rubber, plastics and related fields (like tyre industry

All the students have to undergo practical industrial training of six week 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 be based on viva voce examination.

TOTAL: 60 PERIODS

RP8712 **DESIGN PROJECT** **L T P C**
0 0 4 2

OBJECTIVE

- Capability to think and work independently towards conceptualizing a process, a product or a fabrication.

OUTCOME

The students are expected to carryout one design project in the following fields of Rubber/ Plastics Technology:

1. Computer aided Drafting and Design
2. Product Development and Analysis
3. Development of Machines for Rubber Processing
4. Development of machines / apparatus for rubber / plastics testing.
5. Mould / Die Design
6. Process Control / Modification
7. Plant Layout

TOTAL: 60 PERIODS

RP8811 **PROJECT WORK** **L T P C**
00126

OUTCOMES

- Demonstrate an ability to think and work independently towards conceptualizing a process, a product or a fabrication
- Acquire confidence in giving a technical presentation to an expertise or professional from industry

Each student will be assigned a project involving some design and fabrication work as well as theoretical and experimental studies on some problem 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 talk about the work done. End semester examination mark will be based on viva voce examination.

TOTAL: 180 PERIODS

GE8071 **FUNDAMENTALS OF NANOSCIENCE** **L T P C**
3 0 0 3

OBJECTIVES

- Study the basic nano technology and nano science.
- Understand interdisciplinary nature of this field.
- Understand the importance role of physics, chemistry, biology.
- Recognize that the rules of nano science are fundamentally different than those we experience.
- Study the basic fabrication strategies of nano science.

OUTCOMES

Students will able to:

- Acquire the knowledge of basics of nanotechnology, nanoscience and its inter-disciplinary nature.
- Understand the different preparation methods for nanomaterials.
- Knowledge on patterning and lithography of nanoscale devices.
- Knowledge of clean room environment, specification and design.
- Enable to know characterization techniques of nano materials.

UNIT I INTRODUCTION **10**

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 PREPARATION METHODS **10**

Bottom-up Synthesis-Top-down Approach: Precipitation, Mechanical Milling, Colloidal routes, Self-assembly, Vapour phase deposition, MOCVD, Sputtering, Evaporation, Molecular Beam Epitaxy, Atomic Layer Epitaxy, MOMBE.

UNIT III PATTERNING AND LITHOGRAPHY FOR NANOSCALE DEVICES **5**

Introduction to optical/UV electron beam and X-ray Lithography systems and processes, Wet etching, dry (Plasma /reactive ion) etching, Etch resists-dip pen lithography

UNIT IV PREPARATION ENVIRONMENTS 10

Clean rooms: specifications and design, air and water purity, requirements for particular processes, Vibration free environments: Services and facilities required. Working practices, sample cleaning, Chemical purification, chemical and biological contamination, Safety issues, flammable and toxic hazards, biohazards.

UNIT V CHARECTERISATION TECHNIQUES 10

X-ray diffraction technique, Scanning Electron Microscopy - environmental techniques, Transmission Electron Microscopy including high-resolution imaging, Surface Analysis techniques- AFM, SPM, STM, SNOM, ESCA, SIMS-Nanoindentation

TOTAL : 45 PERIODS

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, Second 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.

RP8001 ADHESIVES AND SURFACE COATINGS L T P C

3 0 0 3

OBJECTIVES

- Students become aware of the importance of adhesive and coatings.
- Student gets detailed knowledge about adhesive types, dormulation principles and their uses.
- Students get detailed about preparation and uses of paints and coatings.

OUTCOMES

- Understand the fundamentals of adhesives, adhesion mechanism and thermodynamics of adhesion and types of substrates.
- Acquire the knowledge of natural and rubber based adhesives.
- Acquaint of uses of adhesives in civil, automobile, aerospace, electrical & electronics industries.
- Ability to the select adhesives and adhesion process and its applications
- Realize the importance of surface preparation, composition of paints and surface coating applications.

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 – 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 10

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 AND TESTING 7

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 (ed), Hand book of Adhesives – Van Nostrand Reinhold, 1990.
2. Shields, Hand Book of Adhesives, Butterworths, 1984.
3. Paul,S. Surface Coatings, John Wiley & Sons, 1985.

RP8002 ADVANCED POLYMER PROCESSING L T P C
3 0 0 3

OBJECTIVE

- To impart the knowledge on advanced polymer processing techniques.

OUTCOME

- Able to demonstrate the ability to process advanced injection moulding, extrusion and blow moulding process.

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 - Process Controls – Merits.

UNIT II ADVANCED INJECTION MOULDING PROCESS – II 9

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

UNIT III ADVANCED EXTRUSION PROCESSES 9

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

UNIT IV 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 V 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.

TOTAL : 45 PERIODS

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.

RP8003 BIOPOLYMERS AND POLYMERS FROM RENEWABLE RESOURCES **L T P C**
3 0 0 3

OBJECTIVE

- To impart the fundamentals of biopolymers and biocomposites.

OUTCOMES

- Able to prepare biopolymers.
- Able to use biopolymers for various applications.

UNIT I POLYMERS & SUSTAINABILITY **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 BIOPOLYMERS 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-nanocomposite films and coatings

UNIT V BIOPOLYMER APPLICATIONS FOR AGRICULTURE 9

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

RP8004 ENGINEERING STATISTICS AND QUALITY CONTROL L T P C
3 0 0 3

OBJECTIVES

- To impart the knowledge of statistical process control, sampling procedures and failure data analysis.

OUTCOMES

- Able to use different quality control procedures.
- Able to use experimental design, reliability and failure data analysis

UNIT I STATISTICAL PROCESS CONTROL 9

Quality control – Definition – Quality Assurance Variation in process – Factors – control charts – variables XR and Xσ, - 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, AOQL, Concepts Designof single sampling plan – Standard sampling plans for AQL and LTPD – Use of standard sampling plans – Sequential sampling plan.

UNIT III EXPERIMENTAL DESIGN AND TAGUCHI METHOD 9

Fundamentals – Factorial experiments – Meantime to failure – Maintainability and availability – Reliability – System reliability – OC curves – Reliability improvement techniques – Reliability testing techniques – Pareto analysis.

UNIT IV RELIABILITY AND ITS PREDICTION 9

Life testing – Failure characteristics – MTBA MTTF – 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

REFERENCES

1. Amita Mitra “Fundamentals of Quality Control and Improvement” Pearson Education 2002
2 Modares: Reliability & Risk Analysis Marcel Decker Inc. 1993.
3 Bester field D.H., “Quality Control” Prentice Hall, 7th edition 2003
4 Manohar Mahajan, “Statistical Quality Control” Dhanpal Rai & Sons, 2001
5 Sharma S.C., “Inspection Quality Control and Reliability”, Khanna Publications, 2004.

RP8005 FRACTURE BEHAVIOUR IN POLYMERS L T P C
3 0 0 3

OBJECTIVES

- To impart the knowledge of fracture behaviour in polymers

OUTCOMES

- Understand the fatigue behaviour and fracture mechanism.
- Able to do fatigue design and testing of composite materials and structures.

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

RP8006 LATEX SCIENCE AND TECHNOLOGY L T P C

3 0 0 3

OBJECTIVES

- To understand the characteristics of latex, its classification and source.
- To impart the fundamentals of latex compounding and processing.
- To study about the manufacture, properties and applications of synthetic latex.

OUTCOMES

Able to perform compounding and processing of latex.

- Able to understand the properties and application of synthetic latex.

UNIT I LATEX XHARACTERISTICS 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, Maclaren & Sons
2. Mausser,R.F., The Vanderbilt Latex Hand book 3rd edn.,
3. Waterman,R., Mausser R.F., & Miller,E.E., Vanderbilt Latex Book on Process and Compounding Ingredients, Publ. By R T Vanderbilt.
4. Calvert, Polymer Latex and Applications,1985

RP8007 **MULTIPHASE POLYMER SYSTEMS** **L T P C**
3 0 0 3

OBJECTIVE

- To impart the fundamentals of polymer blends and its properties,

OUTCOMES

- Able to prepare polymer blends using compatibilizers.
- Able to understand the morphology and microstructure of the blends.
- Able to understand the applications of the polymers blends.

UNIT I THERMODYNAMICS **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

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& MICROSTRUCTURE **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

RP8008 PLASTICS PRODUCT AND MOULD DESIGN L T P C
3 0 0 3

OBJECTIVE

- To make the student to understand the design factors involved in plastic products and mould design

OUTCOME

Students able to design plastic products, injection mould and extruder die.

UNIT I CONCEPT OF PLASTIC PRODUCT DESIGN 9

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 COMPOSITES AND TOOLING DESIGN 9

Deformation behavior-reinforcement, matrix types – Fiber reinforcement, analysis- laminates – Deformation behavior. Multilayered materials. Product mould design consideration-type, material, mould base, cavity tolerance, calculations.

UNIT IV 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 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. R.J Crawford Plastics Engineering, 3 rd Edition, Elsevier publications. Pye 'Injection Moulding'
3. Walteir Michaleli, Extrusion dies for plastic and rubbers, 3rd edition, Hanser Publishers.
4. Stoeckhert/ Mennig,Mould making hand book. 2nd edition, Hanser Publishers
5. Ronald George William Pye, Injection mould design , Godwin for the Plastics and Rubber Institute, 1978.
6. J. Harry Dubois and Wayne and I. Pribbles Plastics mold engineering hand book, 4th edition, Van Nostrand reinhold company, new York.
7. Herbert Rees, Mould Engineering, 2nd edition, Hanser Publishers.

RP8009 **POLYMER RECYCLING** **L T P C**
3 0 0 3

OBJECTIVES

- To emphasize the fundamentals and importance of plastics recycling.
- To impart the knowledge on various sorting and separation techniques.
- To highlight recycling procedures for commodity and engineering plastics.
- To familiarize rubber recycling procedures.

OUTCOMES

Students will able to:

- Apply the principles of various methods of recycling and to relate the methods to various polymeric materials.
- Understand the need for recycling and classification of recycling methods.
- Sort and separate mixed plastics.
- Recycle domestic and engineering thermoplastics.
- Acquire the knowledge of various techniques for rubber recycling.

UNIT I FUNDAMENTALS OF PLASTICS RECYCLING **6**

Need for recycling –Source of Plastic waste – depolymerization - Thermal depolymerization – Ceiling temperature and its importance – Degradation – Biodegradation, Primary, Secondary and Tertiary recycling.

UNIT II RECYCLING OPERTIONS **8**

Sorting and separation techniques – 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 rquirements 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 of PMMA.

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.

RP8010 **POLYMERS IN PACKAGING TECHNOLOGY** **L T P C**
3 0 0 3

OBJECTIVES

- To understand the different types of packaging.
- To select polymers for packaging applications.
- To impart the knowledge of testing of packaging materials.

OUTCOMES

- Able to understand the functions and design of packaging.
- Able to manufacture packaging materials.

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 POLYMERS & MANUFACTURING OF PACKAGING MATERIALS **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 7 Kenneth S Marsh, Encyclopedia of Packaging Technology, 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

RP8011 POLYURETHANE SCIENCE AND TECHNOLOGY L T P C
3 0 0 3

OBJECTIVE:

To enable the students to understand the basic variation between the raw materials used for polyurethane production, methods of polyurethane production and analysis of the raw materials products.

OUTCOMES:

Upon completing this course, the students

- Will understand the importance of poly urethane in engineering application
- Will familarize about manufacturing techniques for poly urethane
- Will attain the knowledge of qualitative and quantitative analysis of polyurethane

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, TPEs-Production, processing 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, Elsevier, 1992

RP8012 PRODUCT DESIGN AND COST ESTIMATION L T P C
3 0 0 3

OBJECTIVE

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

OUTCOMES

Upon completing this course, the students

- Will have the knowledge of rubber product manufacturing technique.
- Will understand about processing of rubbers
- Will familiarize in latex product manufacturing process

UNIT I INTRODUCTION **8**

The design process – Selection of the right product – Market survey and research – factors to be studied preparatory to design – market development – product life cycle.

UNIT II CRITERIA FOR PRODUCT SUCCESS **8**

Functional design – aesthetic design – Incorporating – quality, durability and reliability into design – design for case of manufacture and maintenance – design optimization.

UNIT III PROCESS PLANNING **8**

Process Planning – Definition – Aims – Information required – Process Sheet – Information required – Process sheet – primary process selection rules – Steps to prepare detailed process sheets – case studies – Break even analysis – Applications.

UNIT IV ESTIMATING, COSTING AND ELEMENTS OF COST **12**

Importance and aims of Cost estimation – Functions of estimation – costing – importance and aims 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 direct Labour Cost – Expenses – Cost of Product (Ladder of cost) – Illustrative examples.

UNIT V 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 and value enhancement of typical products.

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. Adithan. M. and Pabla,B.S.,Estimating and Costing, Konark Publishers.Pvt.Ltd.,1989
4. Khanna, O.P. Mechanical Estimating and Costing, Dhanpat Rai Publications, 1999.

RP8013 RUBBER COMPONENTS IN AUTOMOBILES L T P C

3 0 0 3

OBJECTIVES

To provide the plastics / rubber components in automobiles.

OUTCOMES:

Upon completing this course, the students

- Will attain the knowledge in role of additives at rubber.
- Will demonstrate the mixing methods
- Will have knowledge in selection of compounding ingredients

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.
2. Gobel.E.F., Rubber Springs Design.
3. Blow.C.M. and Hepburn C., Rubber Technology and Manufacture, 1982.

4. The scope of the subject will include studies on the following components:Cylinder head gasket: ACM, Silicon
5. Oil Pan gasket : ACM
6. Blow-by Circuit hose : NBR / PVC, CM, FKM/EVA, FKM/VMQ
7. Vacuum Hose : CR, CM, AEM
8. Oil Circuit and blow-by seals : AEM, FPM, HNBR
9. Oil hose : AEM
10. Oil filter base gasket : NBR, AEM and ACM
11. Dipstick guide : HNBR
12. Dipstick seal : NBR ,FPM
13. Drain plug seal : NBR, ACM
14. Air filter intake duct : TPV-(EPDM+PP)
15. Throttle valve intake duct : TPV-(EPDM+PP), EPDM, NBR/PVC, CM, ECO
16. Throttle valve seals : NBR
17. Air intake manifold seals : NBR
18. Cooling Hose : EPDM
19. Cooling Seals : EPDM

MG8651 ENGINEERING MANAGEMENT L T P C

3 0 0 3

OBJECTIVE

To provide the principles of management and its cost analysis.

OUTCOMES

- Understand the principles of management.

- Familiarize with inventory management and its cost analysis.
- Gain the knowledge of methods of operation management.
- Comprehend the methods of financial management.

UNIT I PRINCIPLES OF MANAGEMENT & PERSONNEL MANAGEMENT 7

General Principles of Management – Management Functions – Organization – Types – Comparison – Functions of Personnel Management – Recruitment – Training Leadership/ Motivation – Communication – Conflict- Industrial Relations – Trade unions.

UNIT II INVENTORY MANAGEMENT 11

Purpose of Inventory – Cost Related to inventory – Basic EOQ Model – Variations in EOQ Model – Finite Production – Quality Discounts – ABC Analysis – MRP

UNIT III OPERATIONS MANAGEMENT 10

Plant Location – Layout – Materials Handling – Method Study – Time Study Ergonomics – Aggregate Planning – Value Analysis

UNIT IV FINANCIAL MANAGEMENT 10

Capital – Types – Sources – Break Even Analysis – Financial Statements – Income Statement – Balance Sheet – Capital Budgeting – Working Capital Management – Inventory Pricing.

UNIT V MARKETING MANAGEMENT 7

Functions of Marketing – Sales Promotion Methods – Advertising – Product Packaging – Marketing Variables – Distribution Channels – Organisation – Market research – Market Research Techniques.

TOTAL : 45 PERIODS

REFERENCES

1. R.Panneerselvam – Production and Operations Management –Prentice Hall of India, 2003
2. Koontz and Weihrich-Essentials of Management, Mc Graw Hill 1992.
3. Philips Kotler – Principles of Marketing, Prentice Hall of India, 1995.
4. Pandey, I.M. – Financial Management, Vikas Publishing house, 1995.
5. Ahuja, K.K. – Personal Management, Kalyane Publication, 1992.

MG8654 **TOTAL QUALITY MANAGEMENT** **LT 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 various principles, practices of TQM to achieve quality.
- To learn the various statistical approaches for Quality control.
- To understand the TQM tools for continuous process improvement.
- To learn the importance of ISO and Quality systems

OUTCOMES

Students will able to:

- Understand the different principle, practices of TQM to achieve quality.
- Apply the various TQM tools and techniques for continuous improvement.
- Enable to gain knowledge about modern tools of management, various data collection methods, statistical analysis and interpretation.
- Understand the importance of ISO and quality systems.
- Implement TQM in manufacturing and service sectors to achieve quality.

UNIT I INTRODUCTION **9**

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

UNIT II TQM PRINCIPLES **9**

Quality statements - Customer focus –Customer orientation, Customer satisfaction, Customer complaints, Customer retention - Continuous process improvement – PDCA cycle, 5s, Kaizen - Supplier partnership – Partnering, Supplier selection, Supplier Rating.

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

The seven traditional tools of quality – New management tools – Six-sigma: Concepts, methodology, applications to manufacturing, service sector including IT – Bench marking–

Reason to bench mark, Bench marking process – FMEA – Stages, Types.

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

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

UNIT V QUALITY SYSTEMS **9**

Need for ISO 9000- ISO 9000-2000 Quality System – Elements, Documentation, Qualityauditing-QS 9000 – ISO 14000 – Concepts, Requirements and Benefits –Quality Council – Leadership, Employee involvement – Motivation, Empowerment, Team and Teamwork, Recognition and Reward.

TOTAL : 45 PERIODS

TEXT BOOK

1. Dale H.Besterfiled, et al., “Total Quality Management”, Pearson Education Asia, Third Edition, Indian Reprint , 2006.

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.

AE8071 EXPERIMENTAL STRESS ANALYSIS **L T P C**
3 0 0 3

OBJECTIVE

To study the various experiments techniques involving the measurements of displacements, stresses, stains, in structural components

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

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 PHOTO ELASTICITY 11

Two dimensional photo elasticity, Photo elastic materials, Concept of light - photoelastic effects, stress optic law, Transmission photo elasticity, 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.

UNIT V NON – DESTRUCTIVE TESTING 7

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

TOTAL : 45 PERIODS

REFERENCES

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, 1996.
4. Hetenyi, M., Hand book of Experimental Stress Analysis, John Wiley and Sons Inc., New York, 1972.
5. Pollock A.A., Acoustic Emission in Acoustics and Vibration Progress, Ed. Stephens R.W.B., Chapman and Hall,1993.
6. Max Mark Frocht, Photo Elasticity, John Wiley and Sons Inc., New York, 1968
7. A.J.Durelli, Applied Stress Analysis, Prentice Hall of India Pvt Ltd., New Delhi, 1970
8. Ramesh, K., Digital Photoelasticity, Springer, New York, 2000.

AU8071 FINITE ELEMENT TECHNIQUES L T P C
3 0 0 3

OBJECTIVES:

- To introduce the concepts of Mathematical Modeling of Engineering Problems.
- To appreciate the use of FEM to a range of Engineering Problems.

OUTCOMES:

- Upon completion of this course, the students can able to understand different mathematical Techniques used in FEM analysis and use of them in Structural and thermal problem

UNIT I INTRODUCTION 8

Engineering design analysis-meaning and purpose. Basic concepts of FEM. Advantages and limitations of FEM. Test for convergence. Element choice. Commercial finite element packages-organization-advantages and limitations. Raleigh Ritz's, Galerkin and finite difference methods- Governing equation and convergence criteria of finite element method.

UNIT II STATIC ANALYSIS 10

Formulation of element stiffness matrices-1D bar and beam elements. Plane stress, Plane strain and axisymmetric problems, constant and linear strain triangular elements, stiffness matrix, axisymmetric load vector, quadrilateral elements, Isoparametric elements. Treatment of boundary condition. Numerical Integration.

UNIT III DYNAMICS ANALYSIS 8

Equations of motion for dynamic problems. Consistent and lumped mass matrices. Formulation of element mass matrices. Free vibration problem formulation. Torsion problems.

UNIT IV HEAT TRANSFER AND FLUID FLOW ANALYSIS 10

Basic equations of heat transfer and fluid flow problems. Finite element formulation. One dimensional heat transfer and fluid flow problems. Derivation of element matrices for two dimensional problems.

UNIT V AUTOMOTIVE APPLICATION 9

Force distribution on different parts of automotive structure, design of the parts, static, dynamic and thermal analysis of the parts using finite element method. Material redistribution to minimize stresses and deflection. Optimization of location of ribs to maximize rigidity.

TOTAL : 45 PERIODS

TEXT BOOK

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

REFERENCES

1. Reddy J.N. – An Introduction to Finite Element Method – McGraw Hill – 2000.
2. Krishnamurthy, C.S., Finite Element Analysis, Tata McGraw Hill, 2000.
3. Bathe, K.J. and Wilson, E.L., Numerical Methods in Finite Elements Analysis, Prentice Hall of India, 1985.
4. Robert D Cook, David S Malkus, Michael E Plesha, 'Concepts and Applications of Finite Element Analysis', 4th edition, John Wiley and Sons, Inc., 2003.
5. Larry J Segerlind, 'Applied Finite Element Analysis', Second Edition, John Wiley and Sons, Inc. 1984.

ME8076 **ENTREPRENEURSHIP DEVELOPMENT** **L T P C**
3 0 0 3

OBJECTIVE

Study of this subject provides an understanding of the scope of an entrepreneur, key areas of development, financial assistance by the institutions, methods of taxation and tax benefits, etc.

OUTCOMES

Able to gain knowledge on entrepreneurship.

- Able to manage financing and accounting techniques.

UNIT I ENTREPRENEURSHIP **9**

Entrepreneur – Types of Entrepreneurs – Difference between Entrepreneur and Intrapreneur – Entrepreneurship in Economic Growth, Factors Affecting Entrepreneurial Growth.

UNIT II MOTIVATION **9**

Major Motives Influencing an Entrepreneur – Achievement Motivation Training, self Rating, Business Game, Thematic Apperception Test – Stress management, Entrepreneurship Development Programs – Need, Objectives.

UNIT III BUSINESS **9**

Small Enterprises – Definition, Classification – Characteristics, Ownership Structures – Project Formulation – Steps involved in setting up a Business – identifying, selecting a Good Business opportunity, Market Survey and Research, Techno Economic Feasibility Assessment

Preparation of Preliminary Project Reports – Project Appraisal – Sources of Information – Classification of Needs and Agencies.

UNIT IV FINANCING AND ACCOUNTING **9**

Need – Sources of Finance, Term Loans, Capital Structure, Financial Institution, management of working Capital, Costing, Break Even Analysis, Network Analysis Techniques of PERT/ CPM – Taxation – Income Tax, Excise Duty – Sales Tax.

UNIT V SUPPORT TO ENTREPRENEURS **9**

Sickness in small Business – Concept, Magnitude, causes and consequences, Corrective

Measures – Government Policy for Small Scale Enterprises – Growth Strategies in small industry – Expansion, Diversification, Joint Venture, Merger and Sub Contracting.

TOTAL : 45 PERIODS

TEXT BOOKS

1. S.S.Khanka "Entrepreneurial Development" S.Chand & Co. Ltd. Ram Nagar New Delhi, 1999.
2. Kuratko & Hodgetts, "Enterprenuership – Theory, process and practices", Thomson learning 6th edition.

REFERENCES

1. Hisrich R D and Peters M P, "Entrepreneurship" 5th Edition Tata McGraw-Hill, 2002.
2. Mathew J Manimala," Enterprenuership theory at cross roads: paradigms and praxis" Dream tech 2nd edition 2006.
3. Rabindra N. Kanungo "Entrepreneurship and innovation", Sage Publications, New Delhi, 1998.
4. EDII " Faulty and External Experts – A Hand Book for New Entrepreneurs Publishers: Entrepreneurship Development" Institute of India, Ahmadabad, 1986.

PR8451 MACHINE COMPONENTS DESIGN L T P C
3 0 0 3

OBJECTIVE

- To introduce the students the design and theory of common machine elements and to give experience in solving design problems.

OUTCOMES

- Get an idea about gradual and variable stress induced in various machine elements.
- Familiarize with design practice of detachable and permanent joints in machines.
- Understanding the design process of shaft, coupling and brakes in machines.
- Realize with the design of gears and belt drives in power transmission.
- Gain the knowledge of design of springs and bearings in machines.

UNIT I INTRODUCTION 12

Fundamentals of Machine Design-Engineering Design, Phases of Design, Design

Consideration - Standards and Codes - Selection of Materials –Design against Static and Dynamic Load –Modes of Failure, Factor of Safety, Principal Stresses, Theories of Failure-Stress Concentration, Stress Concentration Factors, Variable Stress, Fatigue Failure, Endurance Limit, Design for Finite and Infinite Life, Soderberg and Goodman Criteria.

UNIT II DETACHABLE AND PERMANENT JOINTS 12

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 SHAFTS, COUPLING AND BRAKES 12

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 GEARS AND BELT DRIVES 12

Design of Spur, Helical, Bevel and Worm Gear drives-Design of Belt drives-Flat and V Belts.

UNIT V SPRINGS AND BEARINGS 12

Design of Helical Spring-Types, Materials, Static and Variable Loads-Design of Leaf Spring-Design of Journal Bearing -Antifriction Bearing-Types-Life of Bearing, Reliability Consideration, Selection of Ball and Roller Bearings.

TOTAL: 60 PERIODS

TEXT BOOK

1. Joseph Edward Shigley, Charles R. Mischke " Mechanical Engineering Design", McGraw Hill, International Edition, 1992.

REFERENCES

1. V.B.Bhandari, " Design of Machine Elements", Tata McGraw-Hill Publishing Company Limited, 2003.
2. C.S.Sharma and Kamlesh Purohit, "Design of Machine Elements", Prentice Hall of India Private Limited, 2003.
3. Robert L.Norton, "Machin Design – An Integrated Approach", Prentice Hall International Edition, 2000.

GE8072 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.

GE8073 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.

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