1. Program Educational Objectives (PEOs)

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

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

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

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

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

2. Programme Outcomes (POs)

A graduate of this major should be able to:

a. Engineering Knowledge: Select and apply the engineering knowledge, technique and skills in Polymer Science and Technology.

b. Problem Analysis: Select and apply knowledge of mathematics, science, engineering, and technology to Polymer Technology and engineering problems that require the application of principles and applied procedures or methodologies.

c. Design/development of solutions: conduct standard tests and measurements; conduct, analyze, and interpret experiments; and apply experimental results to improve processes.

d. Conduct investigations of complex problems: design systems, components, or processes for broadly defined Polymer Technology problems.

e. Modern Tool Usage: select and apply appropriate techniques, resources and modern tools in Polymer Science and Technology.

f. The Engineer and Society: understand the need for and engage in self-directed continuing professional development.

g. Environment and Sustainability: understand the impact of Polymer Technology solutions in a societal and global context

h. Ethics: demonstrate an understanding of and a commitment to professional and ethical responsibilities, including a respect for diversity

i. Individual and team work: function effectively as a member or leader on a technical team.

j. Communication: communicate effectively regarding broadly defined Polymer Technology and Engineering activities.

k. Project Management and Finance: Demonstrate knowledge and understanding of engineering and management principles which apply to Polymer Engineering areas.

l. Life-long learning: exhibit a commitment to quality, timeliness, and continuous improvement.
3. **Programme Specific Outcomes (PSOs)**

The graduate is expected to:

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

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

4. **PEOs / POs MAPPING**

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OBJECTIVES:

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

UNIT I SHARING INFORMATION RELATED TO ONESELF/FAMILY & FRIENDS 12

UNIT II GENERAL READING AND FREE WRITING 12
Reading - comprehension-pre-reading-post reading- comprehension questions (multiple choice questions and/or short questions/ open-ended questions)-inductive reading- short narratives and descriptions from newspapers including dialogues and conversations (also used as short Listening texts)- register. Writing – paragraph writing- topic sentence- main ideas- free writing, short narrative descriptions using some suggested vocabulary and structures –Listening: telephonic conversations. Speaking – sharing information of a personal kind—greeting – taking leave. Language development – prepositions, conjunctions Vocabulary development: guessing meanings of words in context.

UNIT III GRAMMAR AND LANGUAGE DEVELOPMENT 12
Reading: short texts and longer passages (close reading) Writing: understanding text structure-use of reference words and discourse markers-coherence-jumbled sentences Listening – listening to longer texts and filling up the table- product description- narratives from different sources. Speaking: asking about routine actions and expressing opinions. Language development: degrees of comparison- pronouns- direct vs indirect questions. Vocabulary development – single word substitutes- adverbs.

UNIT IV READING AND LANGUAGE DEVELOPMENT 12
Reading: comprehension-reading longer texts- reading different types of texts- magazines Writing: letter writing, informal or personal letters-e-mails-conventions of personal email. Listening: listening to dialogues or conversations and completing exercises based on them. Speaking: speaking about oneself- speaking about one’s friend. Language development: Tenses- simple present-simple past- present continuous and past continuous. Vocabulary development: synonyms-antonyms- phrasal verbs.

UNIT V EXTENDED WRITING 12
development-modal verbs- present/ past perfect tense - Vocabulary development-collocations-fixed and semi-fixed expressions

TOTAL : 60 PERIODS

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

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

TEXT BOOKS:

REFERENCES

MA8151
ENGINEERING MATHEMATICS I

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

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

UNIT II FUNCTIONS OF SEVERAL VARIABLES
UNIT III     INTEGRAL CALCULUS  12
Definite and Indefinite integrals - Substitution rule - Techniques of Integration - Integration by parts, Trigonometric integrals, Trigonometric substitutions, Integration of rational functions by partial fraction, Integration of irrational functions - Improper integrals.

UNIT IV     MULTIPLE INTEGRALS  12

UNIT V     DIFFERENTIAL EQUATIONS  12

TOTAL : 60 PERIODS

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

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

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

UNIT I  PROPERTIES OF MATTER  9

UNIT II   WAVES AND FIBER OPTICS  9

UNIT III  THERMAL PHYSICS  9

UNIT IV  QUANTUM PHYSICS  9

UNIT V   CRYSTAL PHYSICS  9
Single crystalline, polycrystalline and amorphous materials – single crystals: unit cell, crystal systems, Bravais lattices, directions and planes in a crystal, Miller indices – inter-planar distances - coordination number and packing factor for SC, BCC, FCC, HCP and diamond structures - crystal imperfections: point defects, line defects – Burger vectors, stacking faults – role of imperfections in plastic deformation - growth of single crystals: solution and melt growth techniques.

TOTAL : 45 PERIODS

OUTCOMES:
Upon completion of this course,
- the students will gain knowledge on the basics of properties of matter and its applications,
- the students will acquire knowledge on the concepts of waves and optical devices and their applications in fibre optics,
- the students will have adequate knowledge on the concepts of thermal properties of materials and their applications in expansion joints and heat exchangers,
the students will get knowledge on advanced physics concepts of quantum theory and its applications in tunneling microscopes, and
the students will understand the basics of crystals, their structures and different crystal growth techniques.

**TEXT BOOKS:**

**REFERENCES:**

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

**UNIT I  WATER AND ITS TREATMENT**

**UNIT II  SURFACE CHEMISTRY AND CATALYSIS**

**UNIT III  ALLOYS AND PHASE RULE**
Alloys: Introduction- Definition- properties of alloys- significance of alloying, functions and effect of
alloying elements- Nichrome and stainless steel (18/8) – heat treatment of steel. Phase rule: Introduction, definition of terms with examples, one component system -water system - reduced phase rule - thermal analysis and cooling curves - two component systems - lead-silver system - Pattinson process.

UNIT IV FUELS AND COMBUSTION


UNIT V ENERGY SOURCES AND STORAGE DEVICES

Nuclear fission - controlled nuclear fission - nuclear fusion - differences between nuclear fission and fusion - nuclear chain reactions - nuclear energy - light water nuclear power plant - breeder reactor - solar energy conversion - solar cells - wind energy. Batteries, fuel cells and supercapacitors: Types of batteries – primary battery (dry cell) secondary battery (lead acid battery, lithium-ion-battery) fuel cells – H₂-O₂ fuel cell.

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

TEXT BOOKS:

REFERENCES:

GE8151 PROBLEM SOLVING AND PYTHON PROGRAMMING L T P C

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

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

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

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

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

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

OUTCOMES:
Upon completion of the course, students will be able to
• Develop algorithmic solutions to simple computational problems
• Read, write, execute by hand simple Python programs.
• Structure simple Python programs for solving problems.
• Decompose a Python program into functions.
• Represent compound data using Python lists, tuples, dictionaries.
• Read and write data from/to files in Python Programs.

TEXT BOOKS:

REFERENCES:

GE8152 ENGINEERING GRAPHICS L T P C
2 0 4 4

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

CONCEPTS AND CONVENTIONS (Not for Examination)
Importance of graphics in engineering applications – Use of drafting instruments – BIS conventions and specifications – Size, layout and folding of drawing sheets – Lettering and dimensioning.

UNIT I PLANE CURVES AND FREEHAND SKETCHING 7+12
Basic Geometrical constructions, Curves used in engineering practices: Conics – Construction of ellipse, parabola and hyperbola by eccentricity method – Construction of cycloid – construction of involutes of square and circle – Drawing of tangents and normal to the above curves.

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

UNIT II PROJECTION OF POINTS, LINES AND PLANE SURFACE 6+12
Orthographic projection- principles-Principal planes-First angle projection-projection of points. Projection of straight lines (only First angle projections) inclined to both the principal planes - Determination of true lengths and true inclinations by rotating line method and traces Projection of planes (polygonal and circular surfaces) inclined to both the principal planes by rotating object method.

UNIT III PROJECTION OF SOLIDS 5+12
Projection of simple solids like prisms, pyramids, cylinder, cone and truncated solids when the
axis is inclined to one of the principal planes by rotating object method.

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

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

**UNIT V ISOMETRIC AND PERSPECTIVE PROJECTIONS** 6+12

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

**OUTCOMES:**

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

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

**TEXT BOOK:**


**REFERENCES:**


**Publication of Bureau of Indian Standards:**


**Special points applicable to University Examinations on Engineering Graphics:**
- There will be five questions, each of either or type covering all units of the syllabus.
- All questions will carry equal marks of 20 each making a total of 100.
- The answer paper shall consist of drawing sheets of A3 size only. The students will be permitted to use appropriate scale to fit solution within A3 size. The examination will be conducted in appropriate sessions on the same day.

**GE8161 PROBLEM SOLVING AND PYTHON PROGRAMMING LABORATORY**

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

**LIST OF PROGRAMS**
1. Compute the GCD of two numbers.
2. Find the square root of a number (Newton’s method)
3. Exponentiation (power of a number)
4. Find the maximum of a list of numbers
5. Linear search and Binary search
6. Selection sort, Insertion sort
7. Merge sort
8. First n prime numbers
9. Multiply matrices
10. Programs that take command line arguments (word count)
11. Find the most frequent words in a text read from a file
12. Simulate elliptical orbits in Pygame
13. Simulate bouncing ball using Pygame

**PLATFORM NEEDED**
Python 3 interpreter for Windows/Linux

**OUTCOMES:**
**Upon completion of the course, students will be able to**
- Write, test, and debug simple Python programs.
- Implement Python programs with conditionals and loops.
- Develop Python programs step-wise by defining functions and calling them.
- Use Python lists, tuples, dictionaries for representing compound data.
- Read and write data from/to files in Python.

**TOTAL : 60 PERIODS**
BS8161  PHYSICS AND CHEMISTRY LABORATORY  L  T  P  C
(Common to all branches of B.E. / B.Tech Programmes)  0  0  4  2

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

LIST OF EXPERIMENTS:  PHYSICS LABORATORY (Any 5 Experiments)
1. Determination of rigidity modulus – Torsion pendulum
2. Determination of Young’s modulus by non-uniform bending method
3. (a) Determination of wavelength, and particle size using Laser
   (b) Determination of acceptance angle in an optical fiber.
5. Determination of velocity of sound and compressibility of liquid – Ultrasonic interferometer
6. Determination of wavelength of mercury spectrum – spectrometer grating
7. Determination of band gap of a semiconductor
8. Determination of thickness of a thin wire – Air wedge method

TOTAL: 30 PERIODS

OUTCOMES:
Upon completion of the course, the students will be able to
- apply principles of elasticity, optics and thermal properties for engineering applications.

CHEMISTRY LABORATORY: (Any seven experiments to be conducted)

OBJECTIVES:
- To make the student to acquire practical skills in the determination of water quality parameters through volumetric and instrumental analysis.
- To acquaint the students with the determination of molecular weight of a polymer by viscometry.

1. Estimation of HCl using Na₂CO₃ 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 lodomery.
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.
12. Pseudo first order kinetics-ester hydrolysis.
14. Determination of CMC.
15. Phase change in a solid.
16. Conductometric titration of strong acid vs strong base.

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

TOTAL: 30 PERIODS

TEXTBOOKS:

HS8251 TECHNICAL ENGLISH L T P C
4 0 0 4

OBJECTIVES:
The Course prepares second semester engineering and Technology students to:
- Develop strategies and skills to enhance their ability to read and comprehend engineering and technology texts.
- Foster their ability to write convincing job applications and effective reports.
- Develop their speaking skills to make technical presentations, participate in group discussions.
- Strengthen their listening skill which will help them comprehend lectures and talks in their areas of specialisation.

UNIT I INTRODUCTION TECHNICAL ENGLISH 12

UNIT II READING AND STUDY SKILLS 12
Listening- Listening to longer technical talks and completing exercises based on them-Speaking – describing a process-Reading – reading longer technical texts- identifying the various transitions in a text- paragraphing- Writing- interpreting cgarts, graphs- Vocabulary Development-vocabularyused in formal letters/emails and reports Language Development- impersonal passive voice, numerical adjectives.

UNIT III TECHNICAL WRITING AND GRAMMAR 12
Listening- Listening to classroom lectures/ talks on engineering/technology -Speaking – introduction to technical presentations- Reading – longer texts both general and technical, practice in speed reading; Writing-Describing a process, use of sequence words- Vocabulary Development-sequence words- Misspelled words. Language Development- embedded sentences
UNIT IV  REPORT WRITING  12

UNIT V  GROUP DISCUSSION AND JOB APPLICATIONS  12
Listening- TED/Ink talks; Speaking –participating in a group discussion -Reading– reading and understanding technical articles Writing– Writing reports- minutes of a meeting- accident and survey-Vocabulary Development- verbal analogies Language Development- reported speech .

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

- Read technical texts and write area- specific texts effortlessly.
- Listen and comprehend lectures and talks in their area of specialisation successfully.
- Speak appropriately and effectively in varied formal and informal contexts.
- Write reports and winning job applications.

TEXT BOOKS:

REFERENCES

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

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

OBJECTIVES :
- This course is designed to cover topics such as Matrix Algebra, Vector Calculus, Complex Analysis and Laplace Transform. Matrix Algebra is one of the powerful tools to handle practical problems arising in the field of engineering. Vector calculus can be widely used for modelling the various laws of physics. The various methods of complex analysis and Laplace transforms can be used for efficiently solving the problems that occur in various branches of engineering disciplines.
UNIT I MATRICES 12

UNIT II VECTOR CALCULUS 12
Gradient and directional derivative – Divergence and curl - Vector identities – Irrotational and Solenoidal vector fields – Line integral over a plane curve – Surface integral - Area of a curved surface - Volume integral - Green’s, Gauss divergence and Stoke’s theorems – Verification and application in evaluating line, surface and volume integrals.

UNIT III ANALYTIC FUNCTIONS 12
Analytic functions – Necessary and sufficient conditions for analyticity in Cartesian and polar coordinates - Properties – Harmonic conjugates – Construction of analytic function - Conformal mapping – Mapping by functions $w = z + c$, $cz$, $\frac{1}{z}$, $z^2$ - Bilinear transformation.

UNIT IV COMPLEX INTEGRATION 12

UNIT V LAPLACE TRANSFORMS 12

TOTAL: 60 PERIODS

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

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

TEXT BOOKS:
REFERENCES:

PH8254

PHYSICS OF MATERIALS

(Common to courses offered in Faculty of Technology except Fashion Technology)

L T P C
3 0 0 3

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

UNIT I

PREPARATION OF MATERIALS


UNIT II

CONDUCTING MATERIALS


UNIT III

SEMICONDUCTING MATERIALS


UNIT IV

DIELECTRIC AND MAGNETIC MATERIALS

UNIT V  NEW MATERIALS AND APPLICATIONS  9

TOTAL :  45  PERIODS

OUTCOMES:
At the end of the course, the students will able to
• gain knowledge on phase diagrams and various material processing methods,
• acquire knowledge on basics of conducting materials, superconductors and their applications
• get knowledge on the functioning of semiconducting materials and their applications in LED and solar cells,
• understand the functioning of various dielectric and magnetic materials ,
• have the necessary understanding on various advanced materials.

TEXT BOOKS:

REFERENCES

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

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

UNIT I  REACTION MECHANISMS  9
Free radical substitutions, Electrophilic addition, Aromatic Electrophilic substitutions, Nucleophilic additions, condensation reactions, nucleophilic substitutions in aliphatic and aromatic compounds, cyclo additions, Rearrangements-Beckmann, Curtius, Hofmann, cope and oxy-cope, Fries rearrangement reactions.

UNIT II  HETROCYCLIC COMPOUNDS IN POLYMER TECHNOLOGY  9
Amines, heterocyclic compounds – furan, thiophene, pyrrole, pyridine, quinoline, isoquinoline, imidazoles, thiazoles preparation , properties and uses of simple monomers like ethylene,
propylene, isobutylene, butadiene, styrene, methyl methacrylate, diisocyanates, glycols, polyols, epichlorohydrin, fluoro alkenes, acrylonitrile, vinyl chloride, vinyl acetate.

UNIT III STRUCTURE AND REACTIVITY IN ORGANIC COMPOUNDS 9
Bonding in Organic Compounds- Structure-property relationships - Electronic effects like inductive, mesomeric, electromeric and hyper conjugation effects – Free radicals, carbocations, carbanions, elementary ideas about stereo chemistry RS-nomenclature and EZ- nomenclature- conformational isomers.

UNIT IV PHASE RULE 9

UNIT V ELECTRO CHEMISTRY AND CORROSION 9

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

REFERENCES

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

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

UNIT I ELECTRICAL CIRCUITS & MEASUREMENTS 9
UNIT II ELECTRICAL MACHINES

UNIT III SEMICONDUCTOR DEVICES AND APPLICATIONS

UNIT IV DIGITAL ELECTRONICS

UNIT V FUNDAMENTALS OF COMMUNICATION ENGINEERING

TOTAL: 45 PERIODS

OUTCOMES:
• Ability to identify the electrical components and explain the characteristics of electrical machines.
• Ability to identify electronics components and understand the characteristics

TEXT BOOKS:

REFERENCES:

PR8251 PRODUCTION PROCESSES L T P C
4 0 0 4

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

UNIT I CASTING PROCESSES 12
Principles of metal casting: Pattern materials, types and allowance; Study of moulding, sand moulding, tools, moulding materials, description and operation of cupola: special casting processes e.g. die-casting, permanent mould casting, centrifugal casting, investment casting.

UNIT II SMITHY AND FORGING 12

UNIT III METAL JOINING 12
Welding principles, classification of welding techniques; Oxyacetylene Gas welding, welding, metal arc, Carbon arc, submerged arc and atomic hydrogen welding, Electric resistance welding - composition, properties and function; Electrodes, Types of joints and edge preparation, Brazing and soldering.

UNIT IV SHEET METAL WORK 12
Common processes, tools and equipments; metals used for sheets, standard specification for sheets, spinning, bending, embossing and coining.

UNIT V UNCONVENTIONAL MACHINING PROCESSES 12
Need for unconventional – Construction, working principle merits, demerits and applications only for AJM, USM, ECM, EDM, EBM, LBM and IBM.

TOTAL: 60 PERIODS

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

TEXT BOOK

REFERENCES
1. Hajra Chowdary, Elements of Manufacturing Technology Vol 1 and vol 2

GE8261 ENGINEERING PRACTICES LABORATORY L T P C
0 0 4 2

OBJECTIVES:
• To provide exposure to the students with hands on experience on various basic engineering practices in Civil, Mechanical, Electrical and Electronics Engineering.
GROUP A (CIVIL & MECHANICAL)

I CIVIL ENGINEERING PRACTICE

Buildings:
(a) Study of plumbing and carpentry components of residential and industrial buildings. Safety aspects.

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

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

II MECHANICAL ENGINEERING PRACTICE

Welding:
(a) Preparation of butt joints, lap joints and T-joints by Shielded metal arc welding.
(b) Gas welding practice

Basic Machining:
(a) Simple Turning and Taper turning
(b) Drilling Practice

Sheet Metal Work:
(a) Forming & Bending:
(b) Model making – Trays and funnels.
(c) Different type of joints.

Machine assembly practice:
(a) Study of centrifugal pump
(b) Study of air conditioner

Demonstration on:
(a) Smithy operations, upsetting, swaging, setting down and bending. Example – Exercise – Production of hexagonal headed bolt.
(b) Foundry operations like mould preparation for gear and step cone pulley.
(c) Fitting – Exercises – Preparation of square fitting and V – fitting models.

GROUP B (ELECTRICAL & ELECTRONICS)

III ELECTRICAL ENGINEERING PRACTICE

1. Residential house wiring using switches, fuse, indicator, lamp and energy meter.
2. Fluorescent lamp wiring.
3. Stair case wiring
5. Measurement of energy using single phase energy meter.

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

TOTAL: 60 PERIODS

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

LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS:

CIVIL
1. Assorted components for plumbing consisting of metallic pipes, plastic pipes, flexible pipes, couplings, unions, elbows, plugs and other fittings. 15 Sets.
2. Carpentry vice (fitted to work bench) 15 Nos.
4. Models of industrial trusses, door joints, furniture joints 5 each
5. Power Tools: (a) Rotary Hammer 2 Nos
   (b) Demolition Hammer 2 Nos
   (c) Circular Saw 2 Nos
   (d) Planer 2 Nos
   (e) Hand Drilling Machine 2 Nos
   (f) Jigsaw 2 Nos

MECHANICAL
1. Arc welding transformer with cables and holders 5 Nos.
2. Welding booth with exhaust facility 5 Nos.
3. Welding accessories like welding shield, chipping hammer, wire brush, etc. 5 Sets.
4. Oxygen and acetylene gas cylinders, blow pipe and other welding outfit. 2 Nos.
5. Centre lathe
6. Hearth furnace, anvil and smithy tools
7. Moulding table, foundry tools
8. Power Tool: Angle Grinder
9. Study-purpose items: centrifugal pump, air-conditioner

**ELECTRICAL**

1. Assorted electrical components for house wiring
2. Electrical measuring instruments
3. Study purpose items: Iron box, fan and regulator, emergency lamp
4. Megger (250V/500V)
5. Power Tools: (a) Range Finder  
   (b) Digital Live-wire detector

**ELECTRONICS**

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

**ME8261 COMPUTER AIDED DRAFTING AND MODELING LABORATORY**

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

**LIST OF EXERCISES USING SOFTWARE CAPABLE OF DRAFTING AND MODELING**

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

OUTCOMES:
- ability to use the software packers for drafting and modeling
- ability to create 2D and 3D models of Engineering Components

TOTAL: 60 PERIODS

LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS:

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

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

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

UNIT I PROBABILITY AND RANDOM VARIABLES  12

UNIT II TWO-DIMENSIONAL RANDOM VARIABLES  12
Joint distributions – Marginal and conditional distributions – Covariance – Correlation and linear regression – Transformation of random variables – Central limit theorem (for independent and identically distributed random variables).

UNIT III TESTING OF HYPOTHESIS  12
Sampling distributions - Estimation of parameters - Statistical hypothesis - Large sample tests based on Normal distribution for single mean and difference of means -Tests based on t, Chi-square and F distributions for mean, variance and proportion - Contingency table (test for independent) - Goodness of fit.

UNIT IV DESIGN OF EXPERIMENTS  12
One way and Two way classifications - Completely randomized design – Randomized block design – Latin square design - 2² factorial design.
UNIT V  

STATISTICAL QUALITY CONTROL

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

TOTAL: 60 PERIODS

OUTCOMES:

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

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

TEXT BOOKS:


REFERENCES:


PT8351  

FUNDAMENTALS OF POLYMER SCIENCE  

L T P C  

3 0 0 3

OBJECTIVE:

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

UNIT I   

BASIC CONCEPTS OF POLYMER

UNIT II POLYMERIZATION MECHANISM

UNIT III COPOLYMERIZATION MECHANISM

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

UNIT V REACTIONS OF POLYMERS

TOTAL: 45 PERIODS

OUTCOME:
Upon completion of this course,

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

TEXT BOOKS:

REFERENCES:
1. JM.G. Cowie, “Polymers: Chemistry and Physics of Modern Materials”, Blackie, and
GE8291 ENVIRONMENTAL SCIENCE AND ENGINEERING

OBJECTIVES:

- To study the nature and facts about environment.
- To finding and implementing scientific, technological, economic and political solutions to environmental problems.
- To study the interrelationship between living organism and environment.
- To appreciate the importance of environment by assessing its impact on the human world; envision the surrounding environment, its functions and its value.
- To study the dynamic processes and understand the features of the earth’s interior and surface.
- To study the integrated themes and biodiversity, natural resources, pollution control and waste management.

UNIT I ENVIRONMENT, ECOSYSTEMS AND BIODIVERSITY

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

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

UNIT III NATURAL RESOURCES

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

UNIT V HUMAN POPULATION AND THE ENVIRONMENT

TOTAL: 45 PERIODS

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

TEXT BOOKS:

REFERENCES:
PT8353 MECHANICS OF SOLIDS L T P C
3 0 0 3

OBJECTIVES:

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

UNIT I STRESS AND STRAIN


UNIT II SHEAR AND BENDING IN BEAMS

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

UNIT III DEFLECTION OF BEAMS


UNIT IV TORSION

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

UNIT V THIN CYLINDERS AND THEORIES OF FAILURE

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

TOTAL: 45 PERIODS

OUTCOMES

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

TEXT BOOKS:

REFERENCES:

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

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

UNIT I FLUID FLOW

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

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

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

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

TOTAL: 45 PERIODS
OUTCOMES
On completion of the course, students

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

TEXT BOOKS:

REFERENCES:

PT8354 POLYMER PHYSICS L T P C
3 0 0 3

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

UNIT I FUNDAMENTALS OF POLYMER PHYSICS 9
Potential energy and conformational energy of molecules - conformations and configurations, Tactility, isomeric states and isomerism in polymers, stereoisomerism, geometric isomerism - Random coils and average end to end distance - (Derivation only)

UNIT II THERMODYNAMIC PROPERTIES 9
Laws of Thermodynamics - Freely jointed and freely rotating chain models - Entropy and enthalpy- Energy driven and entropy driven elasticity - Thermo elasticity -Thermodynamic treatment - entropic and energetic contributions (Derivation only).

UNIT III POLYMER CRYSTAL FORMATION 9

UNIT IV CHAIN ORIENTATION 9
UNIT V  POLYMER SOLUTIONS

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

OUTCOMES:
Upon completing this course, the students
- Will understand molecular arrangement in polymers.
- Will able to demonstrate the orientation processes in polymer.
- Will acquire the knowledge in solubility behavior of polymers.

TEXT BOOKS:

PT8361  CHEMICAL ENGINEERING LABORATORY L T P C O BJECTIVE:
- To train on various techniques for reducing and separating of particles, flow properties of fluids.

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

OUTCOMES:
Upon completing this course, the students
- Will be able to apply the different technique for size reduction
- Will attain skill in function of fluid pressure apparatus.
LIST OF EQUIPMENT FOR BATCH OF 30 STUDENTS

<table>
<thead>
<tr>
<th>Equipment</th>
<th>Quantity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fluidized bed</td>
<td>1 No.</td>
</tr>
<tr>
<td>Packed bed</td>
<td>1 No.</td>
</tr>
<tr>
<td>Stop watch</td>
<td>2 Nos.</td>
</tr>
<tr>
<td>Measuring cylinder (1 Lit)</td>
<td>2 Nos.</td>
</tr>
<tr>
<td>Sieve shaker and sieve set</td>
<td>1 No.</td>
</tr>
<tr>
<td>Ball mill</td>
<td>1 No.</td>
</tr>
<tr>
<td>Jaw crusher</td>
<td>1 No.</td>
</tr>
<tr>
<td>Electronic balance</td>
<td>1 No.</td>
</tr>
<tr>
<td>Plastics tray</td>
<td>2 Nos.</td>
</tr>
<tr>
<td>Friction pipe apparatus</td>
<td>1 No.</td>
</tr>
<tr>
<td>Single speed centrifugal pump</td>
<td>1 No.</td>
</tr>
<tr>
<td>Venturi meter apparatus</td>
<td>1 No.</td>
</tr>
<tr>
<td>Orifice/mouth piece apparatus</td>
<td>1 No.</td>
</tr>
<tr>
<td>Meter scale</td>
<td>2 Nos.</td>
</tr>
<tr>
<td>Vernier caliper</td>
<td>2 Nos.</td>
</tr>
<tr>
<td>Flow measuring meters</td>
<td>3 Nos.</td>
</tr>
<tr>
<td>Thermometer</td>
<td>5 Nos.</td>
</tr>
<tr>
<td>Tacho meter</td>
<td>1 No.</td>
</tr>
<tr>
<td>Measuring jar (2 lit and 1 Lit each one)</td>
<td>2 Nos.</td>
</tr>
<tr>
<td>Air compressor</td>
<td>1 No.</td>
</tr>
<tr>
<td>Parallel and counter flow heat exchanger</td>
<td>1 No.</td>
</tr>
<tr>
<td>Stephen Boltzman apparatus</td>
<td>1 No.</td>
</tr>
<tr>
<td>Thermal conductivity Apparatus</td>
<td>1 No.</td>
</tr>
</tbody>
</table>

REFERENCES:

PT8311 POLYMER IDENTIFICATION AND ANALYSIS LABORATORY

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

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

Part A Identification of Polymers

A. PLASTICS
1. Polyethylene
2. Polypropylene
3. Polystyrene
4. Polyvinyl Chloride
5. Polyamide
6. Polyethylene terephthalate
7. Polybutylene terephthalate
8. Polycarbonate
9. Polyacetel

(Any Four of the above)

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

(Any Four of the above)

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

(Any Four of the above)

OUTCOMES: 
Upon completion of this course, students
• will be able to identify different types of plastics and rubber by their characteristics
• will able to characterize the polymer by different techniques.

LIST OF EQUIPMENT FOR BATCH OF 30 STUDENTS
Bunsen Burner 15 Nos.
Electronic Balance 1 No.
Thermostatic Water bath 2 Nos.
Melting Point Apparatus 1 No.
Retort Stand 15 Nos.
Polymer Samples and Glassware 15 Nos.
Burette 15 Nos.
Pipette 15 Nos.
REFERENCES:

HS8381 INTERPERSONAL SKILLS/LISTENING AND SPEAKING

OBJECTIVES: The Course will enable learners to:
- Equip students with the English language skills required for the successful undertaking of academic studies with primary emphasis on academic speaking and listening skills.
- Provide guidance and practice in basic general and classroom conversation and to engage in specific academic speaking activities.
- Improve general and academic listening skills.
- Make effective presentations.

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

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

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

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

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

TOTAL: 30 PERIODS
OUTCOMES: At the end of the course Learners will be able to:

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

TEXT BOOKS:

REFERENCES:

MA8491  NUMERICAL METHODS  L T P C
4 0 0 4

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

UNIT I  SOLUTION OF EQUATIONS AND EIGENVALUE PROBLEMS  12

UNIT II  INTERPOLATION AND APPROXIMATION  12
Interpolation with unequal intervals - Lagrange’s interpolation – Newton’s divided difference interpolation – Cubic Splines - Difference operators and relations - Interpolation with equal intervals - Newton’s forward and backward difference formulae.
UNIT III NUMERICAL DIFFERENTIATION AND INTEGRATION 12

UNIT IV INITIAL VALUE PROBLEMS FOR ORDINARY DIFFERENTIAL EQUATIONS 12

UNIT V BOUNDARY VALUE PROBLEMS IN ORDINARY AND PARTIAL DIFFERENTIAL EQUATIONS 12
Finite difference methods for solving second order two - point linear boundary value problems - Finite difference techniques for the solution of two dimensional Laplace’s and Poisson’s equations on rectangular domain – One dimensional heat flow equation by explicit and implicit (Crank Nicholson) methods – One dimensional wave equation by explicit method.

TOTAL: 60 PERIODS

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

- Understand the basic concepts and techniques of solving algebraic and transcendental equations.
- Appreciate the numerical techniques of interpolation and error approximations in various intervals in real life situations.
- Apply the numerical techniques of differentiation and integration for engineering problems.
- Understand the knowledge of various techniques and methods for solving first and second order ordinary differential equations.
- Solve the partial and ordinary differential equations with initial and boundary conditions by using certain techniques with engineering applications.

TEXT BOOKS:

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

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

UNIT II  FLUID FRICTION AND FLOW MEASUREMENT
Bernoulli’s equation–kinetic energy correction factor; head loss; friction factor; major and Minor losses- Flow measurement: Introduction; Orifice meter; Venturi meter; concept of area meters: rotameter; Local velocity measurement: Pitot tube

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

UNIT IV  POLYMER RHEOLOGY

UNIT V  MEASUREMENT OF POLYMER VISCOSITY

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

TEXT BOOKS:
REFERENCES:

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

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

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

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

UNIT III COMMODITY THERMOPLASTICS-II
Preparation - properties and applications of Vinyl plastics - Polyvinyl chloride, C-PVC, Polyvinyl Acetate, Polyvinylidene chloride, Polyvinyl alcohol. Polystyrene

UNIT IV GENERAL PURPOSE THERMOSETS
Preparation - properties - and applications of: Phenol formaldehyde (PF) ,Amino plastics: Urea formaldehyde (UF) - Melamine formaldehyde (MF), Unsaturated polyesters, Alkyd resins

UNIT V ENGINEERING AND SPECIALITY THERMOSETS
Preparation - properties - and applications of: Epoxy Plastics, Polyurethane (PU) Silicones

OUTCOMES:
Upon completing this course, the students
- Will familiarize in natural polymer properties and its applications
• Will acquire skills in selecting additives for plastic materials for specific applications
• Will have knowledge of manufacturing, properties and applications of poly olefins.
• Will have knowledge of manufacturing, properties and applications of vinyl halogenated olein based plastic materials
• Will have knowledge of manufacturing, properties and applications of special purpose plastics

TEXT BOOKS:

REFERENCES:
1. V.R. Gawariker, “Polymer Science” – New Age International (P) Ltd, Publishers
5. Charles Gebelein, Biotechnological Polymers: Medical, pharmaceutical and industrial applications, CRC press,1993

PT8401
RUBBER MATERIALS

L T P C
3 0 0 3

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

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

UNIT II    GENERAL PURPOSE ELASTOMERS
Manufacturing, structure, properties, curing and applications of- Polyisoprene, Polybutadiene, SBR, EPDM, Nitrile rubber.

UNIT III   SPECIAL PURPOSE ELASTOMERS -I
Manufacturing, structure, properties, curing and applications of- Butyl rubber, Halobutyl, Neoprene – CSM, Fluoro elastomer (FKM), Epichlorohydrin, Polysulphide.

UNIT IV    SPECIAL PURPOSE ELASTOMERS-II
Manufacturing, structure, properties, curing, and applications of-Polyurethane Elastomers, Acrylic rubber, Ethylene Vinyl Acetate, Silicone rubber.

UNIT V     THERMOPLASTIC ELASTOMERS AND RECLAIMED RUBBERS
Basic structure, Manufacture, Morphology, Commercial grades and Applications – Thermoplastic styrene block copolymers, Polyester thermoplastic elastomers, polyamide thermoplastic
elastomer, Polyurethane thermoplastic elastomers. Reclaimed rubber - process of reclamation – applications.

**TOTAL: 45 PERIODS**

**OUTCOMES:**

Upon completion of this course students,

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

**TEXT BOOKS:**


**REFERENCES:**


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

**OBJECTIVE:**

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

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

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

**UNIT III FLOW AND MISCELLANEOUS MEASUREMENTS**  
Venturi, Orifice & nozzle meters, Pitot tube, turbine type meters, hot wire anemometer, magnetic flow meters. Level measurement: float level meters & electrical conductivity meters.
UNIT IV  INDICATING AND RECORDING INSTRUMENTS  9

UNIT V  INSTRUMENTATION IN ANALYTICAL TECHNIQUE  9
IR spectroscopy, Gas chromatography, X-ray spectrometer, Thermoanalytical method, Thermal conductivity analyzer, Measurement of color.

TOTAL: 45 PERIODS

OUTCOMES:
Upon completing this course, the students

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

TEXT BOOKS:

REFERENCES:

PT8452  MOULD MANUFACTURING TECHNOLOGY  L T P C

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

UNIT I  FUNDAMENTALS OF MOLD MAKING  9

UNIT II  ELECTRICAL DISCHARGE MECHANISMS  9
Electrical discharge machining – Principle, Types of EDM - Die Sinking & Wire Cut EDM, Machining Process, Requirements of dielectric fluid, Applications of EDM in mold making.

UNIT III  ELECTRO FORMING PROCESS  9
Electroforming for mold manufacturing - discussion of the process, materials for electroforming,
design & materials for models, machining for electroformed mold cavities, Advantages, Disadvantages.

**UNIT IV  HOBBING AND CHEMICAL TEXTURING**

Hobbing for mold cavity making - Discussion of the hobbing process, elements of hobbing, materials used for cavity, lubrication, and depth of hobbing, advantages and disadvantages.

Surface Texturing of molds – Chemical Texturing, Process description, Advantages- Limitations of chemical texturing.

**UNIT V  METROLOGY AND INSPECTION**

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

**TOTAL: 45 PERIODS**

**OUTCOMES:**

Upon completing this course, the students

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

**TEXT BOOKS:**

2. HMT Production Technology, Tata Mc Graw Hill (India), 1992

**REFERENCES:**


**PT8461  MOULD MANUFACTURING TECHNOLOGY LABORATORY**

**OBJECTIVE:**

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

**LIST OF EXPERIMENTS**

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

(Any 8 experiments from the above)

TOTAL: 60 PERIODS

OUTCOMES:
Upon completing this course, the students
- Will understand the mould parts manufacturing technique
- Will attain knowledge in turning operations
- Will attain knowledge in slotting and milling operations
- Will know about the grinding methods
- Will understand the measuring instruments

DEMOGRAPHIC EXPERIMENT:
To make a simple mold for hand molding machine

LIST OF EQUIPMENT FOR BATCH OF 30 STUDENTS

<table>
<thead>
<tr>
<th>Equipment</th>
<th>Quantity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Shaping machine</td>
<td>2 Nos.</td>
</tr>
<tr>
<td>Vertical milling machine</td>
<td>1 No.</td>
</tr>
<tr>
<td>Horizontal milling machine</td>
<td>1 No.</td>
</tr>
<tr>
<td>Lathe</td>
<td>10 Nos.</td>
</tr>
<tr>
<td>Plain surface grinding machine</td>
<td>1 No.</td>
</tr>
<tr>
<td>Bench grinder</td>
<td>2 Nos.</td>
</tr>
<tr>
<td>Vernier caliper</td>
<td>2 Nos.</td>
</tr>
<tr>
<td>Vernier height gauge</td>
<td>2 Nos.</td>
</tr>
<tr>
<td>Vernier Depth Gauge</td>
<td>1 No.</td>
</tr>
<tr>
<td>Micrometer</td>
<td>2 Nos.</td>
</tr>
<tr>
<td>Sine bar</td>
<td>1 No.</td>
</tr>
</tbody>
</table>

HS8461  ADVANCED READING AND WRITING  

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

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

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

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

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

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

TOTAL: 30 PERIODS

OUTCOMES: At the end of the course Learners will be able to:
- Write different types of essays.
- Write winning job applications.
- Read and evaluate texts critically.
- Display critical thinking in various professional contexts.

TEXT BOOKS:

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

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

UNIT II  BLOW MOLDING & THERMOFORMING

UNIT III  COMPRESSION AND TRANSFER MOLDING
Compression moulding - Types, Advantages & Limitations, Type of compression mould, - Transfer moulding – Types- Pot Type Transfer Mold- Plunger type transfer mold - Advantages -Limitations.

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

UNIT V  UNCONVENTIONAL PROCESSES
Unconventional processes – rotational molding, casting, machining, joining

TOTAL: 45 PERIODS

OUTCOMES:
Upon completing this course, the students
- Will familiarize injection molding method employed for Plastics.
- Will attain knowledge in Blow molding process.
- Will know about the compression molding and transfer molding process
- Will have the knowledge in extrusion of plastics
- Will familiarize in thermoforming process

TEXT BOOKS:

REFERENCES:
OBJECTIVES:

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

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

UNIT II  SPECTRAL ANALYSIS OF POLYMERS
Principle, experimental technique and applications of UV, FTIR spectroscopy & NMR spectroscopy –¹H and ¹³C – Instruments

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

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

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

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

TOTAL: 45 PERIODS
TEXT BOOKS:

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

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

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

UNIT I  ENGINEERING PLASTICS & ITS APPLICATIONS - I  9
Preparation- properties - and applications: Styrene copolymers – High Impact Polystyrene (HIPS), Acrylonitrile Butadiene Styrene (ABS), Styrene acrylonitrile (SAN), Acrylic plastics - Polymethyl Methacrylate, Polyacrylonitrile , Ethylene Vinyl Alcohol (EVA).

UNIT II  ENGINEERING PLASTICS & ITS APPLICATIONS – II  9
Preparation- properties - and applications: Polyamides - Nylons 6, (6,6), (6,10), 11, 12,
Polyesters – Polyethylene terephthalate, polybutylene terephthalate, Polycarbonate, Polymidetsals.

UNIT III  HIGH PERFORMANCE PLASTICS - I  9
Preparation - properties - and applications: Aromatic ether - Polyphenylenoxide (PPO), Aromatic thioether - Polyphenylenesulphide (PPS), Polysulfone, Aromatic polyamides

UNIT IV  HIGH PERFORMANCE PLASTICS - II  9
Preparation - properties - and applications: Polymides (PI) Polyamideimide (PAI), Polyimidazoles, Fluropolymers – Polyvinyl fluoride (PVF), Polyvinylidene fluoride (PVDF), Polytetrafluoroethylene (PTFE), Polychlorotrifluoroethylene (PCTFE).

UNIT V  WATER SOLUBLE POLYMERS AND BIO DEGRADABLE POLYMERS  9
Preparation- properties and applications of Biodegradable polymers - poly \( \xi \)-caprolactone - polylactic acid- Bacterial polyhydroxyalkonates.– polyvinylpyrrolidone – polyacrylic acid and its homolog’s – polyacrylamide –polyethylene oxide – polyethylene amine-Polyvinyl alcohol

TOTAL: 45 PERIODS

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

TEXT BOOKS:

REFERENCES:
5. Birley; Arthur W. and Scott; Martyn J., Plastics Materials: Properties and Applications,

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

UNIT I PRINCIPLES OF COMPOUNDING
Introduction- The ingredients and formulation of a mix: Design of compounding experiments and evaluation of data – Compounding to meet processing requirements – Compounding for Vulcanize properties

UNIT II FILLERS AND PROCESSING AIDS
Fillers: Carbon black, Non carbon black – Colors & Pigments - Plasticizers, Process aids, Softeners and Extenders.
UNIT III ANTIDEGRADATION AND MISCELLEOUS


UNIT IV ADDITIVES FOR VULCANIZATION

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

UNIT V TESTING


OUTCOMES:
After completing the course, the students
- Will understand concept of rubber compounding.
- Will modify the properties of rubber by incorporation of additives.
- Will develop rubber compound for required end use application.
- Will modify the strength by varying vulcanizing agents.
- Will do testing of rubber and assess’ quality of rubber compound.

REFERENCES:

PT8561 POLYMER PREPARATION LABORATORY

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

LIST OF EXPERIMENTS
Preparation
1. Preparation of phenol - formaldehyde (Novalac) resin.
2. Preparation of phenol - formaldehyde (Resol) resin.
3. Preparation of Urea formaldehyde resin.
5. Bulk polymerization of styrene.
7. Solution Polymerization of acrylonitrile.
8. Bulk Polymerization of Methyl methacrylate.
9. Copolymerization of styrene and methyl methacrylate.
10. Ring opening polymerization of Caprolactone
11. Solution Polymerization of Vinyl acetate.

(Any Nine of the above)

TOTAL: 60 PERIODS

OUTCOMES:
Upon completing this course, the students
• Will acquire skills in preparation of polymers using various polymerization techniques.
• Will develop the conversion of polymeric materials into product.

LIST OF EQUIPMENT FOR BATCH OF 30 STUDENTS

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

PT8511 PLASTICS PROCESSING LABORATORY

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

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

TOTAL: 60 PERIODS
OUTCOMES:
Upon completing this course, the students
- Will be able to operate the automatic injection, blow moulding machine
- Will be able to prepare the blow mould, thermoformed products
- Will be able to demonstrate the plastic sealing & welding and preparation of polymer films by casting method
- Will be able to describe the mould maintenance and manufacturing practices
- Will be able to dramatize the scrap grinder by using the recycling of plastics

LIST OF EQUIPMENT FOR BATCH OF 30 STUDENTS

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

HS8581 PROFESSIONAL COMMUNICATION

OBJECTIVES:
The course aims to:
- Enhance the Employability and Career Skills of students
- Orient the students towards grooming as a professional
- Make them Employable Graduates
- Develop their confidence and help them attend interviews successfully

UNIT I
Introduction to Soft Skills—Hard skills & soft skills—employability and career Skills—Grooming as a professional with values—Time Management—General awareness of Current Affairs

UNIT II
Self-Introduction-organizing the material - Introducing oneself to the audience – introducing the topic – answering questions – individual presentation practice— presenting the visuals effectively— 5 minute presentations
UNIT III
Introduction to Group Discussion— Participating in group discussions – understanding group dynamics - brainstorming the topic — questioning and clarifying – GD strategies- activities to improve GD skills

UNIT IV
Interview etiquette – dress code – body language – attending job interviews— telephone/skype interview – one to one interview & panel interview – FAQs related to job interviews

UNIT V
Recognizing differences between groups and teams- managing time-managing stress- networking professionally- respecting social protocols-understanding career management-developing a long-term career plan-making career changes

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

• Make effective presentations
• Participate confidently in Group Discussions.
• Attend job interviews and be successful in them.
• Develop adequate Soft Skills required for the workplace

Recommended Software
1. Open Source Software
2. Win English

REFERENCES:

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

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

UNIT I INJECTION MOULDS 9

UNIT II COMPRESSION MOULDS 9
Classification of Compression Moulds - Factors that Influence Thermoset Moulding -Materials
Selection in Relation to Moulding Conditions- Calculation related to-Number of Cavities, Clamping force, shot weight- Advantages and Disadvantages of Compression moulds. Mould maintenance.

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

UNIT IV BLOW MOULDS

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

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

TEXT BOOKS:

REFERENCES:

PT8602 RUBBER PROCESSING AND MACHINERY

OBJECTIVES:
- To understand knowledge on internal mixer.
• To enable the students about calendaring process and mechanism.
• To understand on different types of extrusion process.
• To enrich knowledge on different molding process.
• To understand principle and process of different vulcanization methods.

UNIT I MIXING AND INTERNAL MIXER 12

UNIT II CALENDERING PROCESS 12

UNIT III EXTRUSION PROCESS 12
Extrusion; Construction of single screw and twin screw extruder - Ram type – Screw type – Function of ancillary equipment for standard extrusion operation - Different types of rubber extruder: Hot, cold feed extruders, Pin barrel extruder – Criteria for machine selection.

UNIT IV MOULDING PROCESS 12
Construction, Principle and Types of - Compression moulding– Transfer moulding- Injection molding of rubber articles.

UNIT V VULCANIZATION METHODS 12
Principles and Process of - Batch vulcanization: Hot air oven, Autoclave and Press - Continuous vulcanization: Liquid curing method (LCM), Hot air, Microwave, Drum, fluidized beds, Microwave, Electron beam, High pressure steam tube and roto cure.

TOTAL: 60 PERIODS

OUTCOMES
On completion of the course, students
• Will understand on milling and internal mixer.
• Will understand mechanism and operation of calendaring process.
• Will know the mechanism involved in different types of extrusion process.
• Will get knowledge on various molding process.

TEXT BOOKS:

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

OBJECTIVES:
• To familiarize the students with standards and methodology in preparing various polymers
specimen
• To enable the students to understand the testing of raw materials and components for evaluating various properties; testing the products for predicting product performance

UNIT I STANDARDS AND SPECIMEN PREPARATION 9
Standards - BIS, ASTM, ISO, SPE, SPI, UL. Preparation of test specimen by various techniques for thermoplastics, thermo sets, and elastomers, conditioning and test atmospheres- Analytical tests: determination of specific gravity, water absorption.

UNIT II MECHANICAL PROPERTIES 9
Tensile, compression, flexural, shear, impact, abrasion, hardness, permanent set, rebound resilience, Demattia flex and cut growth. fatigue.

UNIT III THERMAL AND FLAMMABILITY PROPERTIES 9
Vicat softening temperature, heat distortion temperature, coefficient of expansion, thermal conductivity, brittleness temperature, flammability- non rigid solid plastics self-supporting plastics in horizontal position solid plastics in vertical position- oxygen index test

UNIT IV ELECTRICAL, OPTICAL AND OTHER PROPERTIES 9
Volume and surface resistivity, dielectric constant and dielectric strength, arc resistance, tracking resistance, Refractive index, transparency, haze, gloss, Environmental stress crack resistance (ESCR) - weathering and chemical resistance, aging, ozone resistance, permeability- adhesion.

UNIT V TESTING OF PRODUCTS 9
Plastic films, pipes, foams, containers, and Rubber hose, tyres and tubes. Non-destructive testing: ultrasonic testing, X-ray fluorescence, Acoustic emission (AE) testing

TOTAL: 45 PERIODS

OUTCOMES:
Upon completing this course, the students
• Will have the knowledge of standard and specification for polymer testing.
• Will be able to demonstrate the mechanical testing of polymer
• Will be know the flammability and thermal properties of polymers
• Will get knowledge on electrical and optical properties of polymers.
• Will develop the skills in testing of polymer products.

TEXT BOOKS:
2. ASTM: 8.01 & 8.04; 9.01 & 9.02,2000

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

UNIT I  CLASSIFICATION OF POLYMER BLENDS AND ALLOYS  9

UNIT II  PREPARATION OF POLYMER BLENDS AND ALLOYS  9

UNIT III  TYPES OF POLYMER BLENDS  9
Liquid Crystalline Polymer, Blends-Ternary Polymer – Elastomer, Blends-Polymer blends containing block copolymers— Biodegradable polymer blends- Recycled polymer blends

UNIT IV  TOUGHENED THERMOPLASTICS AND THERMOSETS  9
Toughened polymers- Specific examples for toughened thermoplastics and thermosets - specific interaction - hydrogen bonding interaction, dipole-dipole interaction, ion–dipole & ion-ion interaction and additional specific interaction

UNIT V  APPLICATION OF BLENDS AND ALLOYS  9
Application of Blends in Emerging technology - Photovoltaic, Light Emitting Diode, Electro chromic, Electric conductivity polymer and blends, Lithium battery & Fuel cells Applications

TOTAL: 45 PERIODS

OUTCOMES:
Upon completing this course, the students
- Able to express the basic concepts of polymer blend
- Able to infer the thermodynamic of polymer -polymer miscibility
- Able to classify the types of polymer blends
- Able to interpret the characterized polymer blends
- Able to discover the application of polymer blends

TEXT BOOKS:

REFERENCES:
2. Utracki, “Polymer Blends and Alloys”, Hanser Publisher.

<table>
<thead>
<tr>
<th>PT8611</th>
<th>RUBBER PROCESSING LABORATORY</th>
</tr>
</thead>
<tbody>
<tr>
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<td></td>
</tr>
</tbody>
</table>

OBJECTIVE:

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

LIST OF EXPERIMENTS

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

TOTAL: 60 PERIODS

OUTCOMES:

Upon completing this course, the students

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

LIST OF EQUIPMENT FOR BATCH OF 30 STUDENTS

**Equipment for Rubber processing:**

<table>
<thead>
<tr>
<th>Equipment</th>
<th>Quantity</th>
<th>No.</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Two roll mill for rubber mixing</td>
<td>1</td>
<td>No.</td>
</tr>
<tr>
<td>2. Ball mill</td>
<td>1</td>
<td>No</td>
</tr>
<tr>
<td>3. Compression moulding machine</td>
<td>1</td>
<td>No</td>
</tr>
<tr>
<td>4. Sheet cutter</td>
<td>1</td>
<td>No</td>
</tr>
</tbody>
</table>

**Moulds for rubber processing:**

<table>
<thead>
<tr>
<th>Moulds</th>
<th>Quantity</th>
<th>No.</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Moulds for sheet moulding</td>
<td>1</td>
<td>No</td>
</tr>
<tr>
<td>2. Moulds for M/C sheet moulding</td>
<td>1</td>
<td>No</td>
</tr>
<tr>
<td>3. Moulds for play ball</td>
<td>1</td>
<td>No</td>
</tr>
<tr>
<td>4. Moulds for Hand gloves</td>
<td>1</td>
<td>No</td>
</tr>
<tr>
<td>5. Moulds for Balloon</td>
<td>1</td>
<td>No</td>
</tr>
<tr>
<td>6. Moulds for Rubber band</td>
<td>1</td>
<td>No</td>
</tr>
<tr>
<td>7. Moulds for play thread</td>
<td>1</td>
<td>No</td>
</tr>
<tr>
<td>8. Moulds for flex specimen moulding</td>
<td>1</td>
<td>No</td>
</tr>
<tr>
<td>9. Electronic balance</td>
<td>1</td>
<td>No</td>
</tr>
</tbody>
</table>
OBJECTIVES:
- To familiarize the students with standard and methodology in preparing various polymers specimen
- Testing raw materials and components for evaluating various properties

LIST OF EXPERIMENTS

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

2. Testing of Mechanical Properties

3. Testing of Thermal properties
   Vicat softening point, Heat Distortion Temperature

4. Testing of Electrical & Optical properties
   Volume & Surface resistivity, Dielectric strength, Arc resistance, opacity

5. Testing of weathering properties
   Chemical resistance, ESCR, Thermal ageing resistance
   (Any Ten from the above all experiments)

OUTCOMES:
Upon completion of this course, the students
- Will be able to prepare the test sample for various polymer test
- Will have knowledge on latex testing
- Will acquire skills in polymer testing
- Will be able to measure the polymer properties

LIST OF EQUIPMENT FOR BATCH OF 30 STUDENTS
1. Universal tensile testing machine (UTM) 1 No.
2. Shore - A hardness tester 1 No.
3. Shore - D hardness tester 1 No.
4. Izod and charpy impact tester 1 No.
5. Falling dart impact tester 1 No.
6. Din Abrader 1 No.
7. Rebound Resilience tester 1 No.
9. Vicat softening point tester (VSP) 1 No.
10. HDT Tester 1 No.
11. Environmental stress crack resistance tester (ESCR) 1 No.
12. Volume and surface resistivity tester 1 No.
13. Arc resistance tester 1 No.
14. Dielectric Strength tester 1 No.
TEXT BOOKS:

REFERENCE:

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

UNIT I  STRUCTURAL DESIGN OF BEAMS AND MEMBERS  12
Introduction to structure and physical properties of polymers, stress-strain behaviour of polymers, effect of fillers on properties of polymers, stress analysis of polymers, structural design of beams, plates and other structural members

UNIT II  DYNAMIC LOADING ON PLASTIC PARTS  12
Dynamic load response of polymers, effects of cyclic loading, other forms of stress applied to polymer parts, design for stiffness, processing limitations on polymers product design. Material and process interaction and the effects on the performance of plastic parts and the resulting design limitations, performance in service and environmental exposure

UNIT III  DESIGN PROCEDURE FOR PLASTIC PARTS  12
Design procedure for plastic parts- Tolerance-Moulded holes-threads-radius- moulded hinges-integral hinge-snap fits Design of plastic structural parts for static loads, design of dynamically loaded plastic parts, design of plastic parts for electrical applications, design of plastic parts for optical applications.

UNIT IV  DESIGN OF GEAR,BEARINGS AND PIPE  12
Gear Design: materials, strength and durability, moulded V/s cut plastic gearing inspection assembly and operation. Bearings: Self lubricated plastic materials rubber bearing, type of bearings, designers check list. PVC piping: Raw materials, pipe design, specification and test procedure, manufacturing process.

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

TOTAL: 60 PERIODS
OUTCOMES:
On completion of the course, students
- Will explain the terminology involved in product design
- Will discriminate the moulded hole, insert and undercut
- Will describe the processing limitation of product design and stress analysis for product
- Will demonstrate the plastic products for load bearing applications
- Will paraphrase the elastomeric products for load bearing applications

TEXT BOOKS:
2. Plastics Product Design Engineering Hand Book- By Dubois, H.

REFERENCES:

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

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

UNIT I TYRE MANUFACTURING

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

UNIT III FOOTWEAR AND SPORTS GOODS MANUFACTURING

UNIT IV OIL SEALS AND ENGINE MOUNT MANUFACTURING
Manufacturing, curing of Oil Seals, Gaskets, Engine Mounts, Bridge and railway pads- Rubber to Metal bonding - Good manufacturing practices - Effluent- Control and Treatment- Safety in rubber industry
UNIT V LATEX PRODUCTS MANUFACTURING 9

TOTAL: 45 PERIODS

OUTCOMES:
Upon completing this course, the students
• Will have the knowledge of tyre manufacturing technique.
• Will understand about manufacturing of belts and hoses
• Will familiarize in latex product manufacturing process
• Will attain knowledge in production of Footwear and sports Goods
• Will acquire skills in manufacturing of Latex Products

TEXT BOOKS:

REFERENCE:

PT8751 POLYMER COMPOSITES L T P C 3 0 0 3

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

UNIT I REINFORCEMENTS FOR COMPOSITES 9
Composites- classifications - metal matrix composites, ceramic matrix composites, Polymer Composites- general properties and applications- Reinforcements: Properties and applications of - various types of glass fiber, carbon fibers, aramid fibers, boron fibers, natural fibers.

UNIT II GENERAL PURPOSE RESINS 9
Methods of manufacturing- properties, curing characteristics and applications of unsaturated polyesters - vinyl ester -phenol formaldehyde resin-urea formaldehyde resin-melamine formaldehyde resin.

UNIT III SPECIAL PURPOSE THERMOSETS 9
Methods of manufacturing, properties, curing characteristic and applications of epoxy resins, Polyimide, Thermoset polyurethanes and Cyanate esters resins.

UNIT IV PROCESSING OF COMPOSITES 9
Composites Processing techniques - Hand Lay-Up, Spray- Up, Bag Molding, Resin Transfer
UNIT V LAMINATES & TESTING OF COMPOSITES

OUTCOMES:
Upon completing this course, the students
- Will familiarize about the resins used in FRP system
- Will attain the knowledge of reinforcement mechanism
- Will able to understand the processing methods of composites
- Will attain the knowledge post processing operations of composites
- Will develop the knowledge in testing of composites

TEXT BOOKS:

REFERENCES:

PT8711 COMPUTER AIDED POLYMER PRODUCT DESIGN LABORATORY

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

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

(Total: Any Five)

OUTCOMES:
Upon completing this course, the students
- Will develop the knowledge on designing the polymer products.
- Will evaluate the various polymer processing parameters.
- Will design the injection, compression and transfer mould for polymer products.
Will design the blow and extrusion molding die for polymer products.
Will develop new polymer products.

LIST OF EQUIPMENT FOR BATCH OF 30 STUDENTS
2. Software packages
   Pro-E - 1 No
3. Printer - 1 No.

TEXT BOOKS:

REFERENCES:
3. Design calculations for Compression moulds, Machinery publications, Yellow series, U.K.

PT 8712 COMPREHENSION
L T P C
0 0 2 1
In the VII Semester a comprehension test will be conducted with at least one written test in the middle of the Semester with Objective type of questions and a terminal viva-voce test in order to evaluate the comprehension of the students in all the subjects covered in the all previous semester subjects.

PT8811 PROJECT WORK
L T P C
0 0 2 0 1 0
Each student will be assigned a project involving some design and fabrication work as well as theoretical and experimental studies on issues related to Polymer Technology. Continuous internal assessment marks for the project will be given during project review meeting. The student has to prepare and present a detailed project report at the end of the semester and give a presentation about the work done. End semester examination mark will be based on viva voce examination.

PT8001 DESIGN OF MACHINE ELEMENTS
L T P C
3 0 0 3
OBJECTIVES
- To familiarize the various steps involved in design process
- To design the different types of joints, bolts and keys
- To design the shafts, couplings & brakes
- To design the different types of drives, belt drives
- To design the springs and bearings
UNIT I  INTRODUCTION

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

UNIT III  DESIGN OF SHAFTS, COUPLINGS AND BRAKES
Design of shaft – for static and varying loads, for strength and rigidity – Design of Coupling – types- flange, Muff - Design of Brakes - Block and Band brakes.

UNIT IV  DESIGN OF TRANSMISSION ELEMENTS
Design of Spur, Helical, Bevel and Worm gear drives – Design of belt drives – flat and V belts

UNIT V  DESIGN OF SPRINGS AND BEARINGS

TOTAL: 45 PERIODS

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

TEXT BOOK

REFERENCES

PT8072  FIBER TECHNOLOGY

OBJECTIVES:
To enable the students
- To learn about the production technologies of synthetic fibres such as melt spinning, wet spinning, dry spinning, texturing and stretching methods; colouration techniques of fibres.
- To learn about modification and testing fibre
UNIT I  CRITERIA FOR FIBRE FORMING POLYMERS
Development of synthetic - commercial synthetic fibres, Raw materials manufacture. DMT, TPA, MEG, caprolactum, adipic acid, hexamethylene diamine, acrylonitrile, polymerisation - types of polymers - criteria for fibre forming polymers - production of polyethylene terephthalate polymer - polyamides - production of nylon 66 polymer - nylon 6 polymer.

UNIT II  FIBRE PRODUCTION METHODS-1

UNIT III  FIBRE DRAWING PROCESSES

UNIT IV  MODIFIED SYNTHETIC FIBRES
Modified synthetic fibres - modified polyester, Nylon, PP, acrylics - Hydrophilic -Hollow -Low pilling - flame retardant- bicomponent fibres - Dyeability of synthetic fibres

UNIT V  TESTING OF YARN AND FIBRES

TOTAL: 45 PERIODS

OUTCOMES:
Upon completing this course, the students
- Will have knowledge of polymer used in fiber formation.
- Will demonstrate the processing techniques for fiber formation.
- Will able to prepare a fiber forming polymers
- Will able fiber stretching polymers
- Will attain the knowledge of testing of fiber.

TEXT BOOK:

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

UNIT I  SELECTION CRITERIA FOR PACKAGING MATERIALS  9

UNIT II  CONVERSION PROCESS FOR PACKAGING MATERIALS  9
Conversion process - Compression & transfer for moulding, Injection moulding, Blow moulding, Extrusion, roto moulding, thermoforming, Lamination, metallizing, decoration process, Shrink wrapping, Pallet & stretch wrapping

UNIT III  PROCESS FOR FLEXIBLE PACKAGING  9

UNIT IV  PROCESSES FOR RIGID PACKAGING  9
Thermoformed, moulded and rigid packages, Thermoforming packages: Position & thermoforming & wrap forming, solid phase pressure forming, scrabbles, twin sheet & melt - to- mold thermoforming, skin packaging, Polystyrene & other foams systems cushioning, plastic pallets, drums, shipping containers.

UNIT V  TESTING OF PLASTIC PACKAGING  9

TOTAL: 45 PERIODS

OUTCOMES:
Upon completing this course, the students
- will Apply and examine the knowledge of properties for selection of packaging materials
- will Select between different techniques of packaging
- Will familiarize in testing of plastic packaging

TEXT BOOKS:
REFERENCES:

GE8071 DISASTER MANAGEMENT L T P C 3 0 0 3

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

UNIT I INTRODUCTION TO DISASTERS 9
Definition: Disaster, Hazard, Vulnerability, Resilience, Risks – Disasters: Types of disasters – Earthquake, Landslide, Flood, Drought, Fire etc - Classification, Causes, Impacts including social, economic, political, environmental, health, psychosocial, etc.- Differential impacts- in terms of caste, class, gender, age, location, disability - Global trends in disasters: urban disasters, pandemics, complex emergencies, Climate change- Dos and Don’ts during various types of Disasters.

UNIT II APPROACHES TO DISASTER RISK REDUCTION (DRR) 9
Disaster cycle - Phases, Culture of safety, prevention, mitigation and preparedness community based DRR, Structural- nonstructural measures, Roles and responsibilities of- community, Panchayati Raj

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

UNIT III INTER-RELATIONSHIP BETWEEN DISASTERS AND DEVELOPMENT 9
Factors affecting Vulnerabilities, differential impacts, impact of Development projects such as dams, embankments, changes in Land-use etc.- Climate Change Adaptation- IPCC Scenario and Scenarios in the context of India - Relevance of indigenous knowledge, appropriate technology and local resources.

UNIT IV DISASTER RISK MANAGEMENT IN INDIA 9
Hazard and Vulnerability profile of India, Components of Disaster Relief: Water, Food, Sanitation, Shelter, Health, Waste Management, Institutional arrangements (Mitigation, Response and Preparedness, Disaster Management Act and Policy - Other related policies, plans, programmes and legislation – Role of GIS and Information Technology Components in Preparedness, Risk Assessment, Response and Recovery Phases of Disaster – Disaster Damage Assessment.
UNIT V  DISASTER MANAGEMENT: APPLICATIONS AND CASE STUDIES AND FIELD WORKS

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, Scenarios in the Indian context, Disaster damage assessment and management.

TEXT BOOKS:


REFERENCES:

1. Govt. of India: Disaster Management Act, Government of India, New Delhi, 2005

GE8075  INTELLECTUAL PROPERTY RIGHTS

OBJECTIVE:

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

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

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

UNIT III  AGREEMENTS AND LEGISLATIONS
UNIT IV DIGITAL PRODUCTS AND LAW

UNIT V ENFORCEMENT OF IPRs
Infringement of IPRs, Enforcement Measures, Emerging issues – Case Studies.

OUTCOMES:
Upon completing this course, the students
• Ability to manage Intellectual Property portfolio to enhance the value of the firm.

TEXT BOOKS:

REFERENCES:

PL8075 POLYURETHANE TECHNOLOGY L T P C
3 0 0 3

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

UNIT I PRINCIPLES OF PU CHEMISTRY AND APPLICATIONS
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
Polyols, isocyanates – Their preparation and characteristics, conversion products of the raw materials – Additives – Industrial hygiene –Principles of PU processing
UNIT III  
**PU FOAMS**


UNIT IV  
**SOLID PU MATERIALS**

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

UNIT V  
**PU COATINGS AND ADHESIVES**

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

**TOTAL: 45 PERIODS**

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

**TEXT BOOK:**

**REFERENCES:**

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**PL8074  
PLASTICS WASTE MANAGEMENT AND RECYCLING TECHNIQUES**

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

UNIT I  PLASTIC WASTE GENERATION & SEPARATION TECHNIQUES

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

UNIT III  RECYCLING OF POLYOLEFIN, PET & PVC

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

UNIT V  RECYCLING OF THERMOSET COMPOSITES

TOTAL: 45 PERIODS

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

TEXT BOOKS:

REFERENCES:
2. John Schiles, Polymer Recycling.
OBJECTIVES:
To enable the students
- To understand the basics and chemistry of nano size materials and their synthesis, characterization and applications.
- To know the manufacturing and processing of clay/polymer nanocomposites.
- To learn about the flow behavior of nanofiller/polymer systems and their processing and applications.

UNIT I  INORGANIC AND ORGANIC POLYMER NANOMATERIALS  

UNIT II  POLYMER/GRAPHENE NANOCOMPOSITES  

UNIT III  POLYMER/CLAY NANOCOMPOSITES  
Clay/Polymer Nanocomposites: Physical and chemical properties of clay nanoparticles; Synthesis; Potential Applications

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

UNIT V  POLYMER NANOCOMPOSITES APPLICATIONS  
Rheology and processing, Applications and economics of polymer nanocomposites.

OUTCOMES:
Upon completing this course, the students
- will have a clear understanding of nanocomposites
- will demonstrate clay/polymer nanocomposites, carbon nanotube polymer composites and metal/polymer nanocomposites
- will correlate the processing and economics of polymer nanocomposites compared to conventional polymer composites.

TEXT BOOKS:

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

UNIT I CHEMISTRY AND BIOCHEMISTRY OF POLYMER DEGRADATION
Introduction, enzymes - enzyme nomenclature - enzyme specificity - physical factors affecting the activity of enzymes - enzyme mechanism, Chemical degradation initiates biodegradation, Hydrolysis of synthetic biodegradable polymers.

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

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

UNIT IV RECYCLING TECHNOLOGY FOR BIODEGRADABLE PLASTICS

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

OUTCOMES:
Upon completing this course, the students
- Will develop biodegradable polymer by various methods.
- Will understand mechanism of degradation of rubber compounds.
- Will assess bio-degradability of polymers.
- Will do recycle of biodegradable polymer.
- Will understand standards for biodegradable polymer.

TEXT BOOKS:
OBJECTIVES:
To enable the students
- To know various sources of materials used in automobiles.
- To know polymeric materials importance in automobiles structural and mechanical components.
- To know the rubber components in automobiles.

UNIT I  INTRODUCTION  9

UNIT II  POLYMERS IN THE INTERIOR OF THE VEHICLE  9
Interiors – Dominance of Plastic – Fashion and function – Plastics surfaces: Texture and fogging – Plastic structure and panel application: Sandwich concept, Instrumental panel, other sensitive panels – Structural and mechanical components: Seating, Door and window furniture, steering wheel, airbags, seat belts, pedals, instrumental and others.

UNIT III  POLYMERS IN THE EXTERIOR OF THE VEHICLE  9
Exteriors: Body panels and structure – Painting problems – Bumpers – Other exteriors: Grills, Spoilers, Mirrors, Door handles, Wheel trim, Road wheels, Sun roof components, Windscreen wiper assemblies.

UNIT IV  ENGINE, POWERTRAIN AND CHASSIS  9

UNIT V  RUBBER PRODUCTS  9

TOTAL: 45 PERIODS

OUTCOMES:
Upon completing this course, the students
- Will have knowledge about needs of automobile industry.
- Will explain the plastic components used in automobile interior and exterior parts.
- Will specify the composites used in automobile engines.
- Will understand the rubber components used in automobile parts.
TEXT BOOK:

REFERENCES:

PT8003 TYRES AND TUBES TECHNOLOGY

OBJECTIVES:

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

UNIT I INTRODUCTION

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

UNIT II TYRE CORD AND CORD REINFORCED RUBBER


UNIT III STRUCTURE OF THE PNEUMATIC TYRE


UNIT IV TYRE STRESS, DEFORMATION, TYRE TRACTION AND WEAR


UNIT V MANUFACTURING AND TESTING OF TYRES


OUTCOMES:

Upon completing this course, the students

- Will classify different types of tyre and its application.
- Will develop tubeless tyre and assess its quality.

TOTAL: 45 PERIODS
• Will assemble tyre for various applications.
• Will develop the skill on testing of tyre.
• Will identify defects and assess quality of tyre.

REFERENCES:

PT8004 POLYMER REACTION ENGINEERING L T P C

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

UNIT I KINETICS OF HOMOGENOUS REACTIONS
Introduction to chemical kinetics – Classification of chemical reactions – Rate of Reaction - Temperature dependent term of a rate equation - Concentration dependent of a rate equation.

UNIT II INTERPRETATION OF BATCH REACTOR DATA
Interpretation of Batch Reactor data for irreversible reactions taking place in constant volume and variable volume batch reactors – Integral and Differential method of Analysis.

UNIT III DESIGN FOR SINGLE IDEAL REACTORS
Chemical Reactors - Performance equations for Batch Reactor – Stirred Tank Reactor - MFR/CSTR - Plug flow reactors (PFR).

UNIT IV DESIGN FOR SINGLE REACTIONS
Multiple reactor system – CSTR in series (Equal & Unequal Size) - PFR in series - Residence time distribution in non-ideal flow reactors.

UNIT V POLYMERIZATION REACTORS
Polymerization reactors - Free radical polymerization - stepwise addition and condensation polymerization and copolymerization

OUTCOMES:
Upon completing this course, the students
• Will attain the knowledge in reaction kinetics.
• Will understand the knowledge in reaction mechanisms.
• Will understand the batch and continuous flow reactors.
Will understand the Design of reactors.
Will increase the ability to design polymerization reactors

TEXT BOOKS:

REFERENCES:

GE8076 PROFESSIONAL ETHICS IN ENGINEERING L T P C

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

UNIT I HUMAN VALUES 10

UNIT II ENGINEERING ETHICS 9

UNIT III ENGINEERING AS SOCIAL EXPERIMENTATION 9
Engineering as Experimentation – Engineers as responsible Experimenters – Codes of Ethics – A Balanced Outlook on Law.

UNIT IV SAFETY, RESPONSIBILITIES AND RIGHTS 9

UNIT V GLOBAL ISSUES 8

TOTAL: 45 PERIODS
OUTCOME:
• Upon completion of the course, the student should be able to apply ethics in society, discuss the ethical issues related to engineering and realize the responsibilities and rights in the society.

TEXT BOOKS:

REFERENCES:

Web sources:
1. www.onlineethics.org
2. www.nspe.org
3. www.globalethics.org
4. www.ethics.org

GE8073 FUNDAMENTALS OF NANOSCIENCE L T P C
3 0 0 3

OBJECTIVE:
• To learn about basis of nanomaterial science, preparation method, types and application

UNIT I INTRODUCTION
Nanoscale Science and Technology- Implications for Physics, Chemistry, Biology and Engineering-Classifications of nanostructured materials- nano particles- quantum dots, nanowires-ultra-thinfilms-multilayered materials. Length Scales involved and effect on properties: Mechanical, Electronic, Optical, Magnetic and Thermal properties. Introduction to properties and motivation for study (qualitative only).

UNIT II GENERAL METHODS OF PREPARATION
Bottom-up Synthesis-Top-down Approach: Co-Precipitation, Ultrasonication, Mechanical Milling, Colloidal routes, Self-assembly, Vapour phase deposition, MOCVD, Sputtering, Evaporation, Molecular Beam Epitaxy, Atomic Layer Epitaxy, MOMBE.
UNIT III   NANOMATERIALS

UNIT IV   CHARACTERIZATION TECHNIQUES

UNIT V   APPLICATIONS

OUTCOMES:
Upon completing this course, the students
- Will familiarize about the science of nanomaterials
- Will demonstrate the preparation of nanomaterials
- Will develop knowledge in characteristic nanomaterial

TEXT BOOKS:

REFERENCES:

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

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

UNIT II  LATEX COMPOUNDING  9
Latex compounding-Ingredients, Preparation of Dispersions, Emulsion, Slurries; Machineries- Ball mill, Pearl mill; Preparation of latex compound and maturation; Prevulcanized latex, MG Latex, - Preparation, properties and application; Evaluation of the latex compound- Chloroform number, swelling index test; Design for latex products formulation.

UNIT III  LATEX DIPPING PROCESS  9
Principle and types of dipping process, Dipping plant design, formers, sequence of operation, post processing; Manufacture of Condoms, Gloves, Catheters, Balloons-formulations, process, specification, testing and troubleshooting.

UNIT IV  LATEX FOAM, SHEETING AND SPRAYING  9
Principle and Manufacture of Foam-Dunlop and Talalay process, Compound design-Process details, Foam properties, testing and defects, foam applications;Latex sheeting; latex binders and carpet backing- Basics and process.

UNIT V  EXTRUSION AND PRODUCTS BASED ON SYNTHETIC LATEX  9
Principle and Manufacture of latex elastic threads; latex tubing; latex casting process specification and testing, defects.
Synthetic latex- Types, properties, and application- surface coatings, adhesives, paper industries.

TOTAL: 45 PERIODS

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

TEXT BOOKS:

REFERENCES:
OBJECTIVE:

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

UNIT I ELECTROCHEMISTRY OF CONDUCTING POLYMERS
Introduction to conducting polymers - discovery of polyacetylene - concept of doing and n-type - polarons and bipolarons - conduction mechanism - redox type polymers (electro - active polymers)

UNIT II GENERAL SYNTHESIS OF CONDUCTING POLYMERS
Synthesis of conducting polymers - Chemical synthesis - electrochemical synthesis -template synthesis - precursor synthesis - soluble polymers (colloids and dispersions) -advantages and disadvantages of various synthesis methods.

UNIT III CHARACTERIZATION OF CONDUCTING POLYMERS
Characterization methods - elemental analysis for dopants - IR - UV (electro chemical) scanning electro microscopy (SEM) - electro chemical characterization - cyclic voltometry- electrochemical quartz crystal microbalance (EQCM) - probe beam deflection (PBD) -Langmuir - blodgett technique.

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

UNIT V APPLICATIONS OF CONDUCTING POLYMERS
Recent trends in conducting polymers - functionalised conducting polymers (second generation polymers) - super conductors (inorganic - organic hybrid structures) - conducting polymers based on nano composites.

TOTAL: 45 PERIODS

OUTCOMES:

Upon completing this course, the students

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

TEXT BOOKS:

REFERENCES:
1. Hari Singh Nalwa (ed.), Hand Book of Organic conductive molecules and polymers, 4 -
OBJECTIVE:

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

UNIT I ELECTROCHEMISTRY OF CONDUCTING POLYMERS

UNIT II GENERAL SYNTHESIS OF CONDUCTING POLYMERS

UNIT III CHARACTERIZATION OF CONDUCTING POLYMERS
Characterization of conducting polymers – electro analytical techniques – cyclic voltammetry, chronoaaperometry and chronocoulometry, spectral methods - use of UV-vis, Raman, XRD and NMR.

UNIT IV SYNTHESIS, PROCESSABILITY AND APPLICATIONS
Synthesis, processability and applications of acetylene, aniline, pyrrole, thiophene and para – phenylene based conducting polymers.

UNIT V APPLICATIONS OF CONDUCTING POLYMERS

TOTAL: 45 PERIODS

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

REFERENCES
PL8073 BIOMEDICAL PLASTICS

OBJECTIVES:

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

UNIT I BIOMATERIALS

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

UNIT III BIOMEDICAL APPLICATIONS OF POLYMERS

UNIT IV POLYMERIC LENSES

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

TOTAL: 45 PERIODS

OUTCOMES:

- Able to describe the criteria for selection of bio medical polymers
- Able to explain the biomedical applications of polymers
- Able be familiarized with the polymers used in dental applications
- Able to attain the skill on polymeric lenses used in medical applications
TEXT BOOKS:
2. J S Brydson, Plastics Materials –.

REFERENCES:
3. Chiellini; Emo, Sunamoto; Junzo, Migliaesi; Claudio, Ottebrite; Raphael and Cohn; Daniel (Eds.), Biomedical Polymers and Polymer Therapeutics, Kluwer Academic/Plenum Publishers, New York (2001).
4. Galaev; Igor and Mattiasson; Bo (Eds.), Smart Polymers; Applications in Biotechnology and Biomedicine, CRC Press, Boca Raton (2008).

GE8074 HUMAN RIGHTS L T P C
3 0 0 3

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

UNIT I

UNIT II

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

UNIT IV
Human Rights in India – Constitutional Provisions / Guarantees.

UNIT V

TOTAL: 45 PERIODS

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

REFERENCES:
PT8007 PAINTS AND SURFACE COATINGS

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

UNIT I ORGANIC FILM FORMERS 9

UNIT II PIGMENTS FOR PAINTS 9

UNIT III ADDITIVES FOR PAINTS 9

UNIT IV APPLICATIONS OF PAINTS AND COATINGS 9
Application of coating – Coating for building – Automotive parts – Automotive refinish paints - General industrial paints – Painting of ships.

UNIT V MECHANICAL PROPERTIES OF PAINTS AND COATINGS 9

TOTAL: 45 PERIODS

OUTCOMES:
Upon completing this course, the students
- Will understand the various polymerization techniques for different resins
- Will specify the effects of pigments in paints
- Will classify the additives in paints
- Will mention the impact of the particle sizing methods and various application of coatings
- Will explain the mechanical properties of paints and coating

TEXT BOOK:

REFERENCES:

PL8091

THERMOPLASTIC ELASTOMERS

L T P C
3 0 0 3

OBJECTIVES:

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

UNIT I  THERMOPLASTIC STYRENIC BLOCK COPOLYMER

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

UNIT II  THERMOPLASTIC POLYURETHANE


UNIT III  THERMOPLASTIC POLYAMIDES AND POLYESTERS


UNIT IV  THERMOPLASTIC POLYOLEFIN AND BLENDS


UNIT V  THERMOPLASTIC ELASTOMERS PROCESSING


TOTAL: 45 PERIODS

OUTCOMES:

Upon completing this course, the students

- Will be able to understand the synthesis methods of various thermoplastic elastomers.
- Will be able to analyze the properties of elastomers based on their morphology and structure.
- Will be able to understand the properties and applications of blends of thermoplastic elastomers.
- Will be able to recognize the processing methods for different thermoplastic elastomers.

TEXT BOOKS:

REFERENCES:

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

UNIT I SPECIALIZED INJECTION MOULDING PROCESS - I

UNIT II SPECIALISED INJECTION MOULDING PROCESS – II
Multi-layer Moulding, Counter flow moulding, Liquid Injection Moulding processes. Structural foam moulding - Low pressure and high pressure processes - Merits &demerits.

UNIT III ADVANCED BLOW MOULDING - I

UNIT IV ADVANCED BLOW MOULDING – II

UNIT V ADVANCED EXTRUSION PROCESSES

TOTAL:45 PERIODS

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

REFERENCES:
11. Schar, J., Press blowing option for tough to blow parts, SPE ANTEC April'87.

GE8077 TOTAL QUALITY MANAGEMENT
L T P C
3 0 0 3

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

UNIT I INTRODUCTION

UNIT II TQM PRINCIPLES
Leadership - Quality Statements, Strategic quality planning, Quality Councils - Employee involvement - Motivation, Empowerment, Team and Teamwork, Recognition and Reward, Performance appraisal - Continuous process improvement - PDCA cycle, 5S, Kaizen - Supplier partnership - Partnering, Supplier selection, Supplier Rating.
UNIT III TQM TOOLS AND TECHNIQUES I
The seven traditional tools of quality - New management tools - Six sigma: Concepts, Methodology, applications to manufacturing, service sector including IT - Bench marking - Reason to bench mark, Bench marking process - FMEA - Stages, Types.

UNIT IV TQM TOOLS AND TECHNIQUES II
Quality Circles - Cost of Quality - Quality Function Deployment (QFD) - Taguchi quality loss function - TPM - Concepts, improvement needs - Performance measures.

UNIT V QUALITY MANAGEMENT SYSTEM

TOTAL: 45 PERIODS

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

TEXT BOOK:

REFERENCES:
4. ISO9001-2015 standards

GE8072 FOUNDATION SKILLS IN INTEGRATED PRODUCT DEVELOPMENT

OBJECTIVES:
- To understand the global trends and development methodologies of various types of products and services
- To conceptualize, prototype and develop product management plan for a new product based on the type of the new product and development methodology integrating the hardware, software, controls, electronics and mechanical systems
- To understand requirement engineering and know how to collect, analyze and arrive at requirements for new product development and convert them in to design specification
- To understand system modeling for system, sub-system and their interfaces and arrive at the optimum system specification and characteristics
- To develop documentation, test specifications and coordinate with various teams to validate and sustain up to the EoL (End of Life) support activities for engineering customer
UNIT I  FUNDAMENTALS OF PRODUCT DEVELOPMENT 9

UNIT II  REQUIREMENTS AND SYSTEM DESIGN 9

UNIT III  DESIGN AND TESTING 9

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

UNIT V  BUSINESS DYNAMICS – ENGINEERING SERVICES INDUSTRY 9

TOTAL: 45 PERIODS

OUTCOMES:
Upon completion of the course, the students will be able to:
• Define, formulate and analyze a problem
• Solve specific problems independently or as part of a team
• Gain knowledge of the Innovation & Product Development process in the Business Context
• Work independently as well as in teams
• Manage a project from start to finish

TEXTBOOKS:
1. Book specially prepared by NASSCOM as per the MoU.

REFERENCES:

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

UNIT I HIGH PERFORMANCE POLYMERS
High temperature and fire resistant polymers –Requirement for heat resistance- polymers, for low fire hazards - polymers for high temperature Resistance - applications of heat resistant polymers like, polyimides, polyquinolines, polyguinoxalines, PBO, PBI, PPS, PPO, PEEK

UNIT II CONDUCTING POLYMERS
Conducting polymers preparation and applications, conducting mechanisms, requirements for polymer to work as conductor, types of conducting polymers - doping of polymeric systems, polyaniline, polyyacetylene, poly paraphenylene, polypyrrole, organometallic polymers, Photosensitive polymers

UNIT III OPTOELECTRONIC POLYMERS
Polymers with electrical and electronic properties, polymers in non-linear optics, polymers with piezoelectric, pyroelectric and ferroelectric properties, photoresists for semiconductor fabrication - Polymers in telecommunications and power transmission - liquid crystalline polymers

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

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

TOTAL: 45 PERIODS

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

TEXT BOOKS:

REFERENCE:

PT8008

SPECIALITY ELASTOMERS

L T P C
3 0 0 3

OBJECTIVE:
• To impart knowledge on manufacturing, compounding, processing and curing of specialty elastomers

UNIT I
SPECIALITY RUBBER AND THEIR COPOLYMERS

UNIT II
CHLORO AND FLUORO ELASTOMERS

UNIT III
POLYSULPHIDE AND TPU

UNIT IV
ACM and THEIR COPOLYMERS

UNIT V
CHLORONATED PE AND EPDM
Chlorinated Polyethylene - Introduction - Manufacture - Structure and its influence on Properties - Compounding - Curing - Properties and applications. EPM, EDPM - Introduction, Manufacture -
Structure and its influence on Properties - Compounding - Curing - Properties and applications.

**OUTCOMES:**
Upon completing this course, the students
- will describe the fabrication, curing and properties of speciality polymers
- will familiarize the elastomer used in special application
- will demonstrate the manufacturing and applications of speciality polymer
- will attain the skill on compounding and curing characteristics for speciality rubbers

**TEXT BOOKS:**

**PT8009 PRODUCT DESIGN AND COST ESTIMATION**

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

**UNIT I INTRODUCTION TO PRODUCT DEVELOPMENT 9**

**UNIT II PROCESS PLANNING 9**

**UNIT III ESTIMATING, COSTING AND ELEMENTS OF COST 9**

**UNIT IV ANALYSIS OF OVERHEAD EXPENSES 9**

**UNIT V AN OVERVIEW ON INTELLECTUAL PROPERTY RIGHTS 9**

**TOTAL: 45 PERIODS**
OUTCOMES
Upon completing this course, the students
- Will understand the concepts to develop a new product and its selection criteria.
- Will have thorough knowledge in the preparation of process planning sheets.
- Will know the techniques of cost estimation and will be able to estimate the product costs.
- Will be able to analyze the various expenses of a typical product.
- Will understand the basic and significance of intellectual property rights.

REFERENCES

PT8010 FOOTWEAR TECHNOLOGY L T P C
3 0 0 3

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

UNIT I PRODUCTION OF FOOTWEAR 10
Operations involved in making footwear – ‘Built-up’ footwear – DVP/DIP (Direct Vulcanising / Direct injection Moulding) process – Materials used in manufactures of footwear (Other than rubber)

UNIT II ADHESIVES AND SYNTHETIC FABRICS IN FOOTWEAR 9
Fabrics used – Cotton, Rayon, Nylon, Polyester – treatment of textiles for combining with rubber – types of adhesives water, chloroprene, NBR, PU passed adhesives – NR and synthetic rubber latex based adhesives.

UNIT III CELLULAR AND MICROCELLULAR MATERIALS 10
Natural and Synthetic Rubber based microcellular materials – PU, PVC, EVA in microcellular soling – Direct vulcanizing / injection processes.

UNIT IV MANUFACTURE OF FOOTWEAR COMPONENTS 8
Process manufacture of different footwear – traditional and modern methods.

UNIT V SPECIALITY SHOES 8
Sports / athletics shoes, mountaineering / hiking shoes, fireman, hospital (operating theatre) and oil refinery shoes.

TOTAL: 45 PERIODS
OUTCOMES:
Upon completing this course, the students

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

REFERENCES