# ANNA UNIVERSITY, CHENNAI
## AFFILIATED INSTITUTIONS
### R - 2008
#### B.TECH. PLASTIC TECHNOLOGY
#### II TO VIII SEMESTERS CURRICULA AND SYLLABI

**SEMESTER II**  
(Common to all B.E. / B.Tech. Degree Programmes except B.E. – Marine Engineering)

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A. CIRCUIT BRANCHES

I Faculty of Electrical Engineering

1. B.E. Electrical and Electronics Engineering
2. B.E. Electronics and Instrumentation Engineering
3. B.E. Instrumentation and Control Engineering

II Faculty of Information and Communication Engineering

1. B.E. Computer Science and Engineering
2. B.E. Electronics and Communication Engineering
3. B.E. Bio Medical Engineering
4. B.Tech. Information Technology

B. NON – CIRCUIT BRANCHES

I Faculty of Civil Engineering

1. B.E. Civil Engineering

II Faculty of Mechanical Engineering

1. B.E. Aeronautical Engineering
2. B.E. Automobile Engineering
3. B.E. Marine Engineering
4. B.E. Mechanical Engineering
5. B.E. Production Engineering

III Faculty of Technology

1. B.Tech. Chemical Engineering
2. B.Tech. Biotechnology
3. B.Tech. Polymer Technology
4. B.Tech. Textile Technology
5. B.Tech. Textile Technology (Fashion Technology)
7. B.Tech. Plastics Technology
## SEMESTER – III
(Applicable to the students admitted from the Academic year 2008 – 2009 onwards)

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Summer Training in the Semester Break
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## Elective – IV

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AIM
To encourage students to actively involve in participative learning of English and to help
them acquire Communication Skills.

OBJECTIVES
• To help students develop listening skills for academic and professional purposes.
• To help students acquire the ability to speak effectively in English in real-life situations.
• To inculcate reading habit and to develop effective reading skills.
• To help students improve their active and passive vocabulary.
• To familiarize students with different rhetorical functions of scientific English.
• To enable students write letters and reports effectively in formal and business situations.

UNIT I
Technical Vocabulary - meanings in context, sequencing words, Articles- Prepositions, intensive reading & predicting content, Reading and interpretation, extended definitions, Process description

Suggested activities:
1. Exercises on word formation using the prefix ‘self’ - Gap filling with preposition.
2. Exercises - Using sequence words.
3. Reading comprehension exercise with questions based on inference – Reading headings
4. and predicting the content – Reading advertisements and interpretation.
5. Writing extended definitions – Writing descriptions of processes – Writing paragraphs based on discussions – Writing paragraphs describing the future.

UNIT II

Suggested activities:
1. Reading comprehension exercises with questions on overall content – Discussions analyzing stylistic features (creative and factual description) - Reading comprehension exercises with texts including graphic communication - Exercises in interpreting non-verbal communication.
2. Listening comprehension exercises to categorise data in tables.
3. Writing formal letters, quotations, clarification, complaint – Letter seeking permission for Industrial visits– Writing analytical paragraphs on different debatable issues.

UNIT III
Cause and effect expressions – Different grammatical forms of the same word - Speaking – stress and intonation, Group Discussions - Reading – Critical reading - Listening, - Writing – using connectives, report writing – types, structure, data collection, content, form, recommendations.

Suggested activities:
1. Exercises combining sentences using cause and effect expressions – Gap filling exercises using the appropriate tense forms – Making sentences using different grammatical forms of the same word. (Eg: object – verb / object – noun)
2. Speaking exercises involving the use of stress and intonation – Group discussions– analysis of problems and offering solutions.
3. Reading comprehension exercises with critical questions, Multiple choice question.
UNIT IV
Numerical adjectives – Oral instructions – Descriptive writing – Argumentative paragraphs – Letter of application - content, format (CV / Bio-data) - Instructions, imperative forms - Checklists, Yes/No question form – E-mail communication.

Suggested Activities:
1. Rewriting exercises using numerical adjectives.
2. Reading comprehension exercises with analytical questions on content – Evaluation of content.
3. Listening comprehension – entering information in tabular form, intensive listening exercise and completing the steps of a process.
4. Speaking - Role play – group discussions – Activities giving oral instructions.

UNIT V
Speaking - Discussion of Problems and solutions - Creative and critical thinking – Writing an essay, Writing a proposal.

Suggested Activities:
1. Case Studies on problems and solutions
2. Brain storming and discussion
3. Writing Critical essays
4. Writing short proposals of 2 pages for starting a project, solving problems, etc.
5. Writing advertisements.

TOTAL: 60 PERIODS

TEXT BOOK

REFERENCES

Extensive Reading:

Note:
The book listed under Extensive Reading is meant for inculcating the reading habit of the students. They need not be used for testing purposes.
UNIT I  ORDINARY DIFFERENTIAL EQUATIONS  12
Higher order linear differential equations with constant coefficients – Method of variation of parameters – Cauchy’s and Legendre’s linear equations – Simultaneous first order linear equations with constant coefficients.

UNIT II  VECTOR CALCULUS  12

UNIT III  ANALYTIC FUNCTIONS  12
Functions of a complex variable – Analytic functions – Necessary conditions, Cauchy – Riemann equation and Sufficient conditions (excluding proofs) – Harmonic and orthogonal properties of analytic function – Harmonic conjugate – Construction of analytic functions – Conformal mapping : \( w = z + c, cz, \frac{1}{z}, \) and bilinear transformation.

UNIT IV  COMPLEX INTEGRATION  12

UNIT V  LAPLACE TRANSFORM  12
Definition of Inverse Laplace transform as contour integral – Convolution theorem (excluding proof) – Initial and Final value theorems – Solution of linear ODE of second order with constant coefficients using Laplace transformation techniques.

TOTAL : 60 PERIODS

TEXT BOOK

REFERENCES
UNIT I CONDUCTING MATERIALS

UNIT II SEMICONDUCTING MATERIALS

UNIT III MAGNETIC AND SUPERCONDUCTING MATERIALS
Superconductivity : properties - Types of super conductors – BCS theory of superconductivity(Qualitative) - High Tc superconductors – Applications of superconductors – SQUID, cryotron, magnetic levitation.

UNIT IV DIELECTRIC MATERIALS

UNIT V MODERN ENGINEERING MATERIALS
Metallic glasses: preparation, properties and applications.
Shape memory alloys (SMA): Characteristics, properties of NiTi alloy, application, advantages and disadvantages of SMA

TOTAL : 45 PERIODS

TEXT BOOKS
2. Charles P. Poole and Frank J.Ownen, 'Introduction to Nanotechnology’, Wiley India(2007) (for Unit V)

REFERENCES
AIM
To impart a sound knowledge on the principles of chemistry involving the different application oriented topics required for all engineering branches.

OBJECTIVES
• The student should be conversant with the principles electrochemistry, electrochemical cells, emf and applications of emf measurements.
• Principles of corrosion control
• Chemistry of Fuels and combustion
• Industrial importance of Phase rule and alloys
• Analytical techniques and their importance.

UNIT I ELECTROCHEMISTRY
Electrochemical cells – reversible and irreversible cells – EMF – measurement of emf – Single electrode potential – Nernst equation (problem) – reference electrodes – Standard Hydrogen electrode - Calomel electrode – Ion selective electrode – glass electrode and measurement of pH – electrochemical series – significance – potentiometer titrations (redox - Fe²⁺ vs dichromate and precipitation – Ag⁺ vs Cl⁻ titrations) and conduct metric titrations (acid-base – HCl vs, NaOH) titrations,

UNIT II CORROSION AND CORROSION CONTROL

UNIT III FUELS AND COMBUSTION

UNIT IV PHASE RULE AND ALLOYS

UNIT V ANALYTICAL TECHNIQUES

TOTAL: 45 PERIODS

TEXT BOOKS

REFERENCES
OBJECTIVE
At the end of this course the student should be able to understand the vectorial and scalar representation of forces and moments, static equilibrium of particles and rigid bodies both in two dimensions and also in three dimensions. Further, he should understand the principle of work and energy. He should be able to comprehend the effect of friction on equilibrium. He should be able to understand the laws of motion, the kinematics of motion and the interrelationship. He should also be able to write the dynamic equilibrium equation. All these should be achieved both conceptually and through solved examples.

UNIT I  BASICS & STATICS OF PARTICLES  12

UNIT II  EQUILIBRIUM OF RIGID BODIES  12

UNIT III  PROPERTIES OF SURFACES AND SOLIDS  12

UNIT IV  DYNAMICS OF PARTICLES  12

UNIT V  FRICTION AND ELEMENTS OF RIGID BODY DYNAMICS  12
Translation and Rotation of Rigid Bodies – Velocity and acceleration – General Plane motion.

TOTAL: 60 PERIODS

TEXT BOOK

REFERENCES

EE2151 CIRCUIT THEORY
(Common to EEE, EIE and ICE Branches) 3 1 0 4

UNIT I BASIC CIRCUITS ANALYSIS 12

UNIT II NETWORK REDUCTION AND NETWORK THEOREMS FOR DC AND AC CIRCUITS: 12
Network reduction: voltage and current division, source transformation – star delta conversion.
Thevenins and Novton & Theorem – Superposition Theorem – Maximum power transfer theorem – Reciprocity Theorem.

UNIT III RESONANCE AND COUPLED CIRCUITS 12
Series and paralled resonance – their frequency response – Quality factor and Bandwidth - Self and mutual inductance – Coefficient of coupling – Tuned circuits – Single tuned circuits.

UNIT IV TRANSIENT RESPONSE FOR DC CIRCUITS 12
Transient response of RL, RC and RLC Circuits using Laplace transform for DC input and A.C. with sinusoidal input.

UNIT V ANALYSING THREE PHASE CIRCUITS 12
Three phase balanced / unbalanced voltage sources – analysis of three phase 3-wire and 4-wire circuits with star and delta connected loads, balanced & un balanced – phasor diagram of voltages and currents – power and power factor measurements in three phase circuits.

TOTAL : 60 PERIODS

TEXT BOOKS

REFERENCES
UNIT I: CIRCUIT ANALYSIS TECHNIQUES 12

UNIT II: TRANSIENT RESONANCE IN RLC CIRCUITS 12

UNIT III: SEMICONDUCTOR DIODES 12

UNIT IV: TRANSISTORS 12
Principle of operation of PNP and NPN transistors – study of CE, CB and CC configurations and comparison of their characteristics – Breakdown in transistors – operation and comparison of N-Channel and P-Channel JFET – drain current equation – MOSFET – Enhancement and depletion types – structure and operation – comparison of BJT with MOSFET – thermal effect on MOSFET.

UNIT V: SPECIAL SEMICONDUCTOR DEVICES (Qualitative Treatment only) 12

TOTAL : 60 PERIODS

TEXT BOOKS

REFERENCES
UNIT I  ELECTRICAL CIRCUITS & MEASUREMENTS  12
Ohm’s Law – Kirchoff’s Laws – Steady State Solution of DC Circuits – Introduction to AC
Circuits – Waveforms and RMS Value – Power and Power factor – Single Phase and Three
Phase Balanced Circuits.
Operating Principles of Moving Coil and Moving Iron Instruments (Ammeters and
Voltmeters), Dynamometer type Watt meters and Energy meters.

UNIT II  ELECTRICAL MECHANICS  12
Construction, Principle of Operation, Basic Equations and Applications of DC Generators,
DC Motors, Single Phase Transformer, single phase induction Motor.

UNIT III  SEMICONDUCTOR DEVICES AND APPLICATIONS  12
Characteristics of PN Junction Diode – Zener Effect – Zener Diode and its Characteristics –
Half wave and Full wave Rectifiers – Voltage Regulation.
Bipolar Junction Transistor – CB, CE, CC Configurations and Characteristics – Elementary
Treatment of Small Signal Amplifier.

UNIT IV  DIGITAL ELECTRONICS  12
Binary Number System – Logic Gates – Boolean Algebra – Half and Full Adders – Flip-Flops
– Registers and Counters – A/D and D/A Conversion (single concepts)

UNIT V  FUNDAMENTALS OF COMMUNICATION ENGINEERING  12
Types of Signals: Analog and Digital Signals – Modulation and Demodulation: Principles of
Amplitude and Frequency Modulations.
Communication Systems: Radio, TV, Fax, Microwave, Satellite and Optical Fibre (Block
Diagram Approach only).

TOTAL : 60 PERIODS

TEXT BOOKS

REFERENCES

UNIT II BUILDING COMPONENTS AND STRUCTURES 15
Foundations: Types, Bearing capacity – Requirement of good foundations.


TOTAL: 30 PERIODS

B – MECHANICAL ENGINEERING

UNIT III POWER PLANT ENGINEERING 10

UNIT IV I C ENGINES 10
Internal combustion engines as automobile power plant – Working principle of Petrol and Diesel Engines – Four stroke and two stroke cycles – Comparison of four stroke and two stroke engines – Boiler as a power plant.

UNIT V REFRIGERATION AND AIR CONDITIONING SYSTEM 10

TOTAL: 30 PERIODS

REFERENCES

GE2155 COMPUTER PRACTICE LABORATORY – II L T P C
0 1 2 2

LIST OF EXPERIMENTS

1. UNIX COMMANDS 15
Study of Unix OS - Basic Shell Commands - Unix Editor

2. SHELL PROGRAMMING 15
Simple Shell program - Conditional Statements - Testing and Loops
3. C PROGRAMMING ON UNIX

Dynamic Storage Allocation-Pointers-Functions-File Handling

TOTAL : 45 PERIODS

HARDWARE / SOFTWARE REQUIREMENTS FOR A BATCH OF 30 STUDENTS

Hardware

. 1 UNIX Clone Server
. 33 Nodes (thin client or PCs)
. Printer – 3 Nos.

Software

. OS – UNIX Clone (33 user license or License free Linux)
. Compiler - C

GS2165
PHYSICS LABORATORY – II
L T P C
0 0 3 2

LIST OF EXPERIMENTS
1. Determination of Young’s modulus of the material – non uniform bending.
2. Determination of Band Gap of a semiconductor material.
3. Determination of specific resistance of a given coil of wire – Carey Foster Bridge.
5. Spectrometer dispersive power of a prism.
6. Determination of Young’s modulus of the material – uniform bending.

• A minimum of FIVE experiments shall be offered.
• Laboratory classes on alternate weeks for Physics and Chemistry.
• The lab examinations will be held only in the second semester.

GS2165
CHEMISTRY LABORATORY – II
L T P C
0 0 3 2

LIST OF EXPERIMENTS
1. Conduct metric titration (Simple acid base)
2. Conduct metric titration (Mixture of weak and strong acids)
3. Conduct metric titration using BaCl₂ vs Na₂SO₄
4. Potentiometric Titration (Fe^{2+} / KMnO₄ or K₂Cr₂O₇)
5. PH titration (acid & base)
6. Determination of water of crystallization of a crystalline salt (Copper sulphate)
7. Estimation of Ferric iron by spectrophotometry.

• A minimum of FIVE experiments shall be offered.
• Laboratory classes on alternate weeks for Physics and Chemistry.
• The lab examinations will be held only in the second semester.
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 Bspline or cubic spline.

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.

TOTAL: 45 PERIODS

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

List of Equipments for a batch of 30 students:

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

EE2155 ELECTRICAL CIRCUIT LABORATORY (Common to EEE, EIE and ICE)

LIST OF EXPERIMENTS

1. Verification of ohm’s laws and kirchoff’s laws.
2. Verification of Thevemin’s and Norton’s Theorem
3. Verification of superposition Theorem
4. Verification of maximum power transfer theorem.
5. Verification of reciprocity theorem
6. Measurement of self inductance of a coil
7. Verification of mesh and nodal analysis.
8. Transient response of RL and RC circuits for DC input.
10. Frequency response of single tuned coupled circuits.

TOTAL: 45 PERIODS
1. Verification of KVL and KCL
2. Verification of Thevenin and Norton Theorems.
3. Verification of superposition Theorem.
4. Verification of Maximum power transfer and reciprocity theorems.
5. Frequency response of series and parallel resonance circuits.
6. Characteristics of PN and Zener diode
7. Characteristics of CE configuration
8. Characteristics of CB configuration
9. Characteristics of UJT and SCR
10. Characteristics of JFET and MOSFET

TOTAL: 45 PERIODS

ENGLISH LANGUAGE LABORATORY (Optional)  L  T  P  C  0  0  2  -

1. Listening: 5
Listening & answering questions – gap filling – Listening and Note taking- Listening to telephone conversations

2. Speaking: 5
Pronouncing words & sentences correctly – word stress – Conversation practice.

Classroom Session 20
1. Speaking: Introducing oneself, Introducing others, Role play, Debate-
Presentations: Body language, gestures, postures.
Group Discussions etc
2. Goal setting – interviews – stress time management – situational reasons

Evaluation
(1) Lab Session – 40 marks
   Listening – 10 marks
   Speaking – 10 marks
   Reading – 10 marks
   Writing – 10 marks

(2) Classroom Session – 60 marks
   Role play activities giving real life context – 30 marks
   Presentation – 30 marks

Note on Evaluation
1. Examples for role play situations:
   a. Marketing engineer convincing a customer to buy his product.
   b. Telephone conversation – Fixing an official appointment / Enquiry on availability of flight or train tickets / placing an order. etc.
2. Presentations could be just a Minute (JAM activity) or an Extempore on simple topics or visuals could be provided and students could be asked to talk about it.

REFERENCES

LAB REQUIREMENTS
1. Teacher – Console and systems for students
2. English Language Lab Software
3. Tape Recorders

MA2211 TRANSFORMS AND PARTIAL DIFFERENTIAL EQUATION (Common to all branches of BE / B.Tech Programmes) L T P C 3 1 0 4

OBJECTIVES
The course objective is to develop the skills of the students in the areas of Transforms and Partial Differential Equations. This will be necessary for their effective studies in a large number of engineering subjects like heat conduction, communication systems, electro-optics and electromagnetic theory. The course will also serve as a prerequisite for post graduate and specialized studies and research.

UNIT I FOURIER SERIES 9 + 3

UNIT II FOURIER TRANSFORMS 9 + 3

UNIT III PARTIAL DIFFERENTIAL EQUATIONS 9 +3
Formation of partial differential equations – Lagrange’s linear equation – Solutions of standard types of first order partial differential equations - Linear partial differential equations of second and higher order with constant coefficients.

UNIT IV APPLICATIONS OF PARTIAL DIFFERENTIAL EQUATIONS 9 + 3
Solutions of one dimensional wave equation – One dimensional equation of heat conduction – Steady state solution of two-dimensional equation of heat conduction (Insulated edges excluded) – Fourier series solutions in cartesian coordinates.

UNIT V Z-TRANSFORMS AND DIFFERENCE EQUATIONS 9 + 3

L : 45  T : 15  TOTAL : 60 PERIODS
TEXT BOOKS

REFERENCES

GE2211 ENVIRONMENTAL SCIENCE AND ENGINEERING L T P C
3 0 0 3

AIM
The aim of this course is to create awareness in every engineering graduate about the importance of environment, the effect of technology on the environment and ecological balance and make him/her sensitive to the environment problems in every professional endeavour that he/she participates.

OBJECTIVES
At the end of this course the student is expected to understand what constitutes the environment, what are precious resources in the environment, how to conserve these resources, what is the role of a human being in maintaining a clean environment and useful environment for the future generations and how to maintain ecological balance and preserve bio-diversity.

UNIT I INTRODUCTION TO ENVIRONMENTAL STUDIES AND NATURAL RESOURCES

UNIT II ECOSYSTEMS AND BIODIVERSITY
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 and Birds - Field Study of Simple Ecosystems – Pond, River, Hill Slopes, etc.

UNIT III ENVIRONMENTAL POLLUTION 9
Definition – Causes, Effects and Control Measures of: (A) Air Pollution (B) Water Pollution (C) Soil Pollution (D) Marine Pollution (E) Noise Pollution (F) Thermal Pollution (G) Nuclear Hazards – Soil Waste Management: Causes, Effects and Control Measures of Urban and Industrial 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 IV SOCIAL ISSUES AND THE ENVIRONMENT 9

UNIT V HUMAN POPULATION AND THE ENVIRONMENT 9

TOTAL : 45 PERIODS

TEXT BOOKS

REFERENCES
AIM
To learn about the properties and testing of materials.

OBJECTIVES
- To study the mechanical behaviour of materials, types of fractures and testing
- To know the importance of phase diagram
- To understand the various diffusion processes and heat treatment of steel

UNIT I
9 Mechanical Behavior of materials – Stress – Strain curve, Elastic deformation- Characteristics of elastic deformations, atomic mechanism of elastic deformation, Inelastic deformation, Strain-Time curves, Damping capacity, Viscous deformation, Plastic deformation, Mechanism of plastic deformation- slip & twinning, Schmidt’s law, critical resolved shear stress.

UNIT II

UNIT III

UNIT IV

UNIT V

TOTAL : 45 PERIODS
TEXT BOOKS

REFERENCES
3. J. C. Anderson, K. D. Leaver, R. D. Rawlings, J. M. Alexander, Material Science,
5. C. W. Richards, Engineering material Science, Prentice Hall Of India.

PT 2202 ORGANIC CHEMISTRY & TECHNOLOGY
L T P C 3 1 0 4
(/common to Plastic & Polymer Technology)

AIM
To learn about the various basic organic reactions, their mechanisms, preparation, properties and uses of monomers.

OBJECTIVES
To get know about the basics of organic chemistry, mechanism of organic reactions; preparation, properties and uses of majority of the monomers involved in polymer formation.

UNIT I
12

UNIT II
12
Types of reagents- Electrophiles and Nucleophiles, types of reactions – addition (\(>C=C<\), \(>C=O\)) substitution – Electrophilic and Nucleophilic substitution - elimination and rearrangement reactions – Inter and Intra molecular rearrangement – Hoffman , Beckman ,Benzidine rearrangemnts - General conditions and mechanism of each of the above.

UNIT III
12
Natural gas – Synthesis gas – Petroleum and petroleum products – Coal and coal products –Cellulose and cellulose products.

UNIT IV
12

UNIT V
12

TOTAL : 60 PERIODS
TEXT BOOKS

REFERENCES

PT 2203
PHYSICAL CHEMISTRY OF POLYMERS

L T P C
3 0 0 3

(Common to Plastic & Polymer Technology)

AIM
To learn about the structures, conformations and orientation of polymeric materials.

OBJECTIVES
To understand
- Physical and conformational properties of polymeric materials
- Molecular arrangement in polymers and their orientation under the influence of stress.
- Solubility behaviour of polymers

UNIT I
Potential energy and conformational energy of molecules - Staggered and eclipsed states - conformations and configurations, isomeric states and isomerism in polymers - Tacticity, stereoisomerism, geometric isomerism - Unperturbed and Gaussian chains - Random coils and average end to end distance - Freely jointed and freely rotating chain models - Random flight analysis.

UNIT II
Thermodynamics - First and second law of Thermodynamics, Carnot cycle - Entropy and enthalpy - Energy driven and entropy driven elasticity - Thermodynamic treatment of rubbers - entropic and energetic contributions to the elastic force in rubbers - Stastical mechanical theory.

UNIT III
Amorphous State - Transition temperatures - Glass transition temperature - Free volume, kinetic, and thermodynamic views of glass transition - Factors influencing glass transition temperature.
Crystalline State - Crystal systems, unit cells, primitive cell, Bravais lattices, polymorphism - Polymer single crystals, lamellae, spherulites, supermolecular structures, fringed micelle model - Degree of crystallinity, factors affecting crystallinity - X-ray diffraction.

UNIT IV
Chain orientation - Concept of chain orientation - orientation in amorphous and crystalline polymers - Uniaxial and biaxial orientation practical significance - Orientation processes - fibre spinning, blown film extrusion, solid state extrusion, profile extrusion - Properties of oriented polymers - Birefringence.

UNIT V
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) - Concentration regimes in polymer solutions - theta conditions.

TOTAL : 45 PERIODS
PT 2204

POLYMER CHEMISTRY

(Common to Plastic & Polymer Technology)

A I M
To learn the basic concepts of polymers, reactions and kinetics involved in polymerization and characterization.

O B J E C T I V E S
To understand the mechanism of polymerization, various techniques of polymerization, characterization of polymers by molecular weight, reactions and degradation of polymers

U N I T I

U N I T II

U N I T III

U N I T IV
Molecular weight – Molecular weight averages – Molecular weight distribution – Unidispersity, polydispersity, degree of polymerization - Molecular weight determination - Basic concepts of end group analysis, colligative properties, osmometry, light scattering, and gel permeation chromatography - Viscosity of polymers solutions, size of the polymer molecules.

U N I T V

T O T A L : 60 P E R I O D S

T E X T B O O K S
2. George Odian , “Principles of polymerisation”,
3. Seymour Robert
REFERENCES

PT 2207  POLYMER CHEMISTRY LAB  L  T  P  C
0  0  3  2
(Common to Plastic & Polymer Technology)

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

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

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

B. IDENTIFICATION OF RUBBERS BY SIMPLE METHODS
1. Natural Rubber (NR)
2. Polybutylene Rubber (BR)
3. Styrene Butadiene Rubber (SBR)
4. Isoprene Rubber (IR)
5. Isobutene Isoprene Rubber (IIR)
6. Chloroprene Rubber (CR)
7. Acrylonitrile – Butadiene Rubber (NBR)
8. Silicone Rubber

TOTAL : 45 PERIODS

REFERENCE
1. Identification of plastics and rubbers by simple methods , CIPET publications 2002
Lab Requirements
Conical flask 15 No.
Liebig condenser 15 No.
Round bottom flask 15 No.
Burette 15 No.
Pipette 15 No.
Iodine flask 15 No.
Test tubes 01 Gross
Test tube holder 15 No.
Tongs 15 No.
Bunsen burner 15 No.
Chemicals ------

Experiments :

PART A: Identification of Organic compounds of the following types:
1. Alcohols
2. Aldehydes
3. ketones
4. Carboxylic acids
5. Esters
6. Nitro compounds
7. Amines
8. Amides
9. Carbohydrates
10. Halogen compounds
11. Phenols

PART – B: Single step preparation of organic compounds by the following methods
1. Nitration
2. Acetylation
3. Bromination
4. Oxidation
5. Hydrolysis

II. Quantitative Estimation of
1. Phenol
2. Acetone
3. Urea
4. Formaldehyde
5. Methyl Methacrylate
6. Acrylonitrile

REFERENCE
1. A.I. Vogel, Organic Qualitative and Quantitative Analysis.
OBJECTIVES
At the end of the course, the students would

- Acquire skills in handling situations involving more than one random variable and functions of random variables.
- Be introduced to the notion of sampling distributions and have acquired knowledge of statistical techniques useful in making rational decision in management problems.
- Be exposed to statistical methods designed to contribute to the process of making scientific judgments in the face of uncertainty and variation.

UNIT I  RANDOM VARIABLES 9 + 3
Discrete and continuous random variables - Properties - Moments - Moment generating functions and their properties. Binomial, Poisson, Geometric, Negative binomial, Uniform, Exponential, Gamma, and Weibull distributions.

UNIT II  TWO DIMENSIONAL RANDOM VARIABLES 9 + 3
Joint distributions - Marginal and conditional distributions – Covariance - Correlation and Regression – function of a random variable-Transformation of random variables - Central limit theorem.

UNIT III  TESTING OF HYPOTHESIS 9 + 3
Sampling distributions – Testing of hypothesis for mean, variance, proportions and differences using Normal, t, Chi-square and F distributions - Tests for independence of attributes and Goodness of fit.

UNIT IV  DESIGN OF EXPERIMENTS 9 + 3

UNIT V  RELIABILITY AND QUALITY CONTROL 9 + 3
Concepts of reliability-hazard functions-Reliability of series and parallel systems- control charts for measurements (x and R charts) – control charts for attributes (p, c and np charts)

L:  45   T: 15   TOTAL : 60 PERIODS

Note : Use of approved statistical table is permitted in the examination.

TEXT BOOKS

REFERENCES
PT 2251

MOULD ENGINEERING

AIM

To learn the techniques employed in mould making.

OBJECTIVES

- To study the mould making techniques such as metal cutting, metal erosion, metal deposition, metal displacement and mould polishing

UNIT I


UNIT II

Die sinking (copy milling), Pentograph, Profile grinding, Electrical discharge machining – Characteristics, physical processes, special technological features, types of EDM, design consideration & functions and technological planning. Applications of wire cut EDM in mold making.

UNIT III

Electroforming for mold manufacturing – discussion of the process, materials for electroforming, design & materials for models, machining for electroformed blanks, mold cavities, economy & service life.

Hobbing for mold making – Discussion of the hobbing process & its advantages, elements of hobbing like hobbing punch, shape of the hob, materials used for cavity, lubrication, and depth of hobbing, Hobbing presses, Hobbing operations & its economy with examples.

UNIT IV

Polishing technology in mold making: Definition of surface roughness, basis of polishing technology, Effect of mold materials on polishability, Types of polishing tools, Methods of polishing - Basic information on Electro sonic polishing – Principles of Electro deposition in damaged molding surfaces.

Surface Texturing of molds – Process description, types of molds, types of patterns and mold shapes, metals that can be etched, mold preparation, limitations of chemical texturing.

UNIT V

Metrology and inspection: Scope of inspection, Procedures, Choices of basic measuring instruments, Vernier, Micrometer, Surface Plates, Angle plates, Squares, Vernier height gauges, Depth gauges, Slip gauges, Dial gauges, Surface roughness measurement, Hardness testing, Comparators, Optical profiles projectors, Tool makers microscope, Optical flats – types and uses.

TOTAL : 60 PERIODS

TEXT BOOKS

2. HMT Production Technology, TMH (India), 1992

REFERENCES

AIM
To emphasize the relationship between the structure and properties of polymers.

OBJECTIVES
To understand
- The structure of polymers and prediction of polymer properties
- The relationship between polymer structure and properties such as mechanical, thermal, electrical, optical and chemical properties

UNIT I
Structure of polymers - Linear, branched, crosslinked, and network polymers - Homochain and hetero atomic chain polymers - Copolymers - Linear and cyclic arrangement - Prediction of polymer properties, group contribution techniques, topological techniques - Volumetric properties - molar volume, density, Van der Waals volume - Coefficient of linear thermal expansion and volumetric thermal expansion - Pressure volume temperature (PVT) relationship.

UNIT II
Mechanical properties - Stress-strain properties of polymers - Effect of polymer structure on modulus of elasticity, tensile strength, flexural strength, impact strength, yield strength, fracture toughness - Crazing in glassy polymers - Ductile brittle transition. Effect of additives on mechanical properties of polymers - Creep, stress relaxation, and fatigue.

UNIT III
Thermodynamic and transition properties - Transition temperature in polymers, glass transition ($T_g$), melt transition ($T_m$), relationship between $T_g$ and $T_m$ - other transitions like $\beta$-transitions, upper and lower glass transition temperatures - Prediction of $T_g$ and $T_m$ of polymers by group contributions.
Calorimetric properties - Heat capacity, specific heat, latent heat of crystallization and fusion, enthalpy and entropy - Calculation of heat capacities of polymers.

UNIT IV
Electrical and optical properties - Effect of polymer structure on dielectric constant, power factor, dissipation factor, and loss factor - effect of frequency of voltage and temperature on dielectric properties - Prediction of molar polarization and effective dipole moment. Effect of additives on electrical properties of polymers.
Optical properties - Effect of polymer structure on optical properties - clarity, transparency, haze, transmittance, reflectance, and gloss - Prediction of refractive indices of polymers by group contributions, Static charges, volume & surface resistivity, arc resistance.

UNIT V
Chemical Properties - Cohesive energy, cohesive energy density, solubility parameter, determination of solubility parameter of polymers - Prediction of solubility parameter -Effect of polymer structure on solubility in solvents and oils - Influence of structure in prediction of flame retardancy, water repellency - Chemical resistance of polymers - Polymer toxicity.

TOTAL : 45 PERIODS

TEXT BOOKS
REFERENCES

PT 2253 PRINCIPLES OF CHEMICAL ENGINEERING L T P C
(Common to Plastic & Polymer Technology) 3 0 0 3

UNIT I Classification of Unit Operations
Fluid flow - Types of fluids – Newton’s law of viscosity; Reynolds number regimes, internal flow - flow through pipes – pressure drop under laminar and turbulent flow conditions Mixing and agitation – types of impellers, power requirement for mixing.

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, sedimentation, cyclones and hydro cyclones and filtration

UNIT III Heat transfer

UNIT IV Mass transfer

UNIT V Absorption – Principle and equipment (packed towers and plate columns).
Extraction - Principle and equipment for adsorption.

TOTAL : 45 PERIODS
TEXT BOOKS

REFERENCES
2. Chemical Engineer’s handbook - Perry and Chilton.

PT 2254 STRENGTH OF MATERIALS L T P C
3 0 0 3
(Common to Plastic & Polymer Technology)

AIM
To acquire knowledge on behaviour of materials on application of load.

OBJECTIVES
• To study the behavior and failure pattern of different materials under different loading conditions
• Design of structural member under given loading conditions

UNIT I
Elasticity: Stress and strain, compressive, tensile, shear and bearing stress – Stress – strain diagram, Hooks law, modulus of elasticity, modulus of rigidity, bulk modulus of rigidity, bulk modulus, Poisson’s ratio. Relationship between elastic constants and temperature stresses, composite bars.

UNIT II
Properties of section, calculation of areas, centroid, neutral axis, moment of inertia, modulus of section, radius of gyration with reference to structural shapes.

UNIT III

UNIT IV
Principal stresses and strains - Thin cylinders and shells subjected to internal pressures.

UNIT V
Deflection – deflection of beams in simple cases column and struts – long and short columns – axial loading – effect of end conditions – equivalent length and slenderness ratio – Euler and Rankine formulae.

TOTAL : 45 PERIODS

TEXT BOOKS
PL 2251  RUBBER MATERIALS  L T P C  4 0 0 4
UNIT I  10
Structure-Property Relationships in Rubbers: Rubber Elasticity – Requirements for rubber elasticity – Effect of chemical structure on the performance properties of rubbers – Effect of structure on processing properties of elastomers

UNIT II  10
Natural Rubber: Origin – Natural Rubber Latex, tapping, processing, properties and applications – Conversion of Latex into dry rubber – Properties of dry rubber – Classification based on technical specifications – Modifications of Natural Rubber–Applications – Synthetic polyisoprene.

UNIT III  16

UNIT IV  8
High Performance Elastomers: – Fluoroelastomers and silicone elastomers, Manufacture, structure, Properties and applications

UNIT V  16

TOTAL : 60 PERIODS

REFERENCES
4. Blackely, D.C., Synthetic Rubbers – their Chemistry and Technology.

PT 2257  CHEMICAL ENGINEERING LAB  L T P C  0 0 3 2
(Common to Plastic & Polymer Technology)

AIM:
LAB REQUIREMENTS
Fluidized bed  1 No.
Packed bed  1 No.
Stop watch  2 No.
Measuring cylinder (1 Lit)  2 No.
Sieve shaker and sieve set  1 No.
Ball mill  1 No.
Jaw crusher  1 No.
Electronic balance  1 No.
Plastics tray  2 No.
Friction pipe apparatus 1 No.
Single speed centrifugal pump 1 No.
Venturi meter apparatus 1 No.
Orifice/mouth piece apparatus 1 No.
Stop watch 4 No.
Meter scale 4 No.
Vernier caliper 2 No.
Flow measuring meters 3 No.
Stop watch 2 No.
Thermometer 5 No.
Tacho meter 1 No.
Measuring jar (2 lit and 1 Lit each one) 2 No.
Air compressor 1 No.
Parallel and counter flow heat exchanger 1 No.
Stephen Boltzman apparatus 1 No.
Thermal conductivity Apparatus 1 No.

Experiments:
1. Flow through rough and smooth pipes.
2. Centrifugal pump.
3. Calibration of orifice meter.
4. Air compressor
5. Calibration of rotameter
6. Pressure drop in packed bed
7. Fluidization
8. Flow through weirs
10. Open orifice and drainage time
11. Thermal conductivity of solids.
12. Heat exchanger
13. Stefan-Boltzman constant
14. Jaw crusher
15. Ball Mill
16. Screening efficiency.
17. Simple distillation
18. Steam distillation
(Any Nine Experiments)

TOTAL : 45 PERIODS

REFERENCES
AIM
To learn the techniques employed in mould making.

OBJECTIVES
To study the mould making techniques such as metal cutting, metal erosion, metal deposition, metal displacement and mould polishing.

**LAB REQUIREMENTS**

<table>
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<tr>
<td>Shaping machine</td>
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<tr>
<td>Vertical milling machine</td>
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<tr>
<td>Horizontal milling machine</td>
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<tr>
<td>Lathe</td>
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<tr>
<td>Plain surface grinding machine</td>
<td>1 No.</td>
</tr>
<tr>
<td>Bench grinder</td>
<td>2 No.</td>
</tr>
<tr>
<td>Vernier caliper</td>
<td>2 No.</td>
</tr>
<tr>
<td>Vernier height gauge</td>
<td>2 No.</td>
</tr>
<tr>
<td>Sine bar</td>
<td>2 No.</td>
</tr>
<tr>
<td>Sine center</td>
<td>1 No.</td>
</tr>
<tr>
<td>Gear tooth vernier caliper</td>
<td>1 No.</td>
</tr>
</tbody>
</table>

**Experiments**

1) Exercise on Shaping machine – making square rod from round rod and cutting V-groove.
2) Exercise on Plain Milling.
3) Exercise on Vertical Milling.
4) Screw Cutting on lathe – external thread.
5) Exercise on Surface Grinding.
6) Exercise on Slotting Machine.
7) Grinding of Cutting tools.
8) Study of different types of Cutting tools.
9) Measurements using Micrometer, vernier, Height gauge and Slip gauge.
10) Measurement of angles and tapers.
11) Checking of straightness using auto collimeter.
12) Application of Dial gauge.

(Any 8 experiments from the above)

**Demonstration Experiment** : To make a simple mold for hand molding machine

TOTAL : 45 PERIODS

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**MA2264**

**NUMERICAL METHODS**

AIM
With the present development of the computer technology, it is necessary to develop efficient algorithms for solving problems in science and engineering. This course gives a complete procedure for solving different kinds of problems occur in Engineering numerically.

OBJECTIVES
At the end of the course, the students would be acquainted with the basic concepts in numerical methods. The uses of numerical methods are summarized as follows:
• The roots of nonlinear (algebraic or transcendental) equations which arise in engineering applications can be obtained numerically where analytical methods fail to give solution. Solutions of large system of linear equations are also obtainable using the different numerical techniques discussed. The Eigen value problem is one of the important concepts in dynamic study of structures.
• When huge amounts of experimental data are involved in some engineering application, the methods discussed on interpolation will be useful in constructing approximate polynomial to represent the data and to find the intermediate values.
• The numerical differentiation and integration find application when the function in the analytical form is too complicated or the huge amounts of data are given such as series of measurements, observations or some other empirical information.
• Many physical laws are couched in terms of rate of change of quantity. Therefore most of the engineering problems are characterized in the form of nonlinear ordinary differential equations. The methods introduced in the solution of ordinary differential equations will be useful in attempting any engineering problem.
• When the behavior of a physical quantity is expressed in terms of rate of change with respect to two or more independent variables, the problem is characterized as a partial differential equation. The knowledge gained may be used in solving any problem that has been modeled in the form of partial differential equation.

UNIT I SOLUTION OF EQUATIONS AND EIGENVALUE PROBLEMS 9+3

UNIT II INTERPOLATION AND APPROXIMATION 9+ 3
Lagrangian Polynomials – Divided differences – Interpolating with a cubic spline – Newton’s forward and backward difference formulas.

UNIT III NUMERICAL DIFFERENTIATION AND INTEGRATION 9+ 3

UNIT IV INITIAL VALUE PROBLEMS FOR ORDINARY DIFFERENTIAL EQUATIONS 9+ 3

UNIT V BOUNDARY VALUE PROBLEMS IN ORDINARY AND PARTIAL DIFFERENTIAL EQUATIONS 9+ 3
Finite difference solution of second order ordinary differential equation – Finite difference solution of one dimensional heat equation by explicit and implicit methods – One dimensional wave equation and two dimensional Laplace and Poisson equations.

L : 45  T :15 TOTAL : 60 PERIODS

TEXT BOOKS

REFERENCES
UNIT I 3
State of Aggregation and phase states of matter Molecular motion in Polymers Transition relaxation processes in Polymers.

UNIT II 6
Glass Transition, Theories to determine the glass transition i.e. Dillatometric, Heat capacity, measurement, Thermomechanical, Measurement of modulus of elasticity, effect of Tg on molecular mass, kinetic chain flexibility and chemical constituent, Importance of Tg and Tm, HDT.

UNIT III 9
Viscoelastic behavior of Polymer solution and melts stress-strain curves for Polymers, creep of Polymeric material, elastic deformation, irrecoverable follow deformation. Rubber like deformation, Time-temp superposition (WLF Equation) Models of viscollastity such as Maxwell and kelvin model. Types of viscosity, stress relaxation.

UNIT IV 9
Introduction and Basic concept of Rheology, classification of fluids, Newtonian and non Newtonian fluids, shear stress, shear strain and shear rate, shear modulus, bulk modulus, Zero shear viscosity, Dependance of viscosity with temp, shear stress, shear rate fluid through channel, characteristic parameter during shear deformation.

UNIT V 9
Methods to determine shear viscosity by capillary Rheometer, cone and plate viscometer, Cup and bob viscometer, Measurement of normal stresses. Theories of viscosities of dilute (Debye Bueche theory) and conc. Solutions (Grasselley’s entanglement theory), (Entanglement concern)

UNIT VI 9

REFERENCES
6. Physical Chemistry of Polymers - Tager.
7. Polymer Sc. and Tech. of Plastics and Rubber ; D.Ghosh.
11. May; Clayton A. (Ed.), Chemorheology of Thermosetting Polymers, ACS Symposium.
PL2302  POLYMERIZATION ENGINEERING  L T P C  3 0 0 3

UNIT I  9
Industrial methods of polymerization such as a bulk, solution, emulsion, suspension. Layout and arrangement of polymer plant. Stereochemistry of polymers and stereo-specific polymerization. Catalysts-their utility in polymers and stereo-specific polymerizations.

UNIT II  9
Catalysts-their utility in polymer manufacture, Zieglar-Natta, Metallocene and others.

UNIT III  9
Manufacturing processes of basic raw materials and intermediates of synthetic polymers. Production technology, properties and application of important plastics such as polyethylene, polypropylene, polystyrene and polyvinyl chloride.

UNIT IV  9
Brief introduction of copolymers based on the common monomers such as ethylene, vinyl chloride, styrene, acrylates and methacrylates etc.

UNIT V  9
Formaldehyde and its reaction products with phenol, urea and melamine. Preparation of moulding powders.

TOTAL : 45 PERIODS

REFERENCES
1. Principles of Polymerization by George Odian.
4. Polymer Science by Gowriker-Viswanathan-Sreedhar.

PL2303  CAD/CAM/CAE FOR PLASTICS ENGINEERING  L T P C  3 0 0 3

UNIT I  COMPUTER AIDED DESIGNING  9
Fundamentals: Output primitives (points, lines, curves, etc.) 2-D Transformation, Translation, Scaling, Rotation, windowing, View ports clipping transformation.
CAD Software: Interactive programs w.r.t design problems and production of drawing using any languages like Autocad, Auto LISP/C/C+++, creation of surface, solids etc., using solid modeling package (prismatic and revolved parts), Data exchange, customizing.

UNIT II  VISUAL REALISM  9
Hidden – Line – Surface – sold removal algorithms shading – coloring. Introduction to parametric and variation geometry based on soft wares and their principles creation of prismatic and lofted parts using these packages. Graphics and computing standards
UNIT III  COMPUTER AIDED MANUFACTURING


UNIT IV  CAD / CAM INTERFACE FUNDAMENTALS OF CNC MACHINES


UNIT V  COMPUTER AIDED ENGINEERING

Computer modeling for polymer processing: Models of Material Behaviour, Model simplifications, Finite difference, Finite element techniques for field problems, Simulation of viscoelastic fluid flow, computer implementation of Process models. Advanced computational techniques, Supercomputing and Visualization of Results.

Concept of A.I. and knowledge based systems in selection and processing of polymers.
CAE in Mould Manufacture: Computerized numerical control. Flexible manufacturing.

TOTAL : 45 PERIODS

REFERENCES

UNIT I  HISTORY
Basic chemistry of polymers-nomenclature of polymers sources for raw materials- Natural Polymers - Shellac resin and natural rubber - Cellulosics -Cellulose nitrate, cellulose acetate, cellulose acetate butyrate, Ethyl cellulose & others.

UNIT II  COMMODITY THERMOPLASTICS & ITS APPLICATIONS
Methods of manufacturing - general properties - processing behavior and applications of the following:

UNIT III  ENGINEERING PLASTICS & ITS APPLICATIONS
UHMHDPE -EPDM – EVA - Polyamides - Nylons 6, 66, 6 10, 11, 12 etc. Acrylic plastics - Polymethyl Methacrylate, Polycrylonitrile - Polyesters - Polyethylene terephthalate, polybutylene terephthalate - Polycarbonate - Polycetals

UNIT IV  HIGH PERFORMANCE PLASTICS
Aromatic ether - Polypheylene oxide, Aromatic thioether - Polyphenylene sulphide, Polysulfone, Polimidazoles – Polyimide - Polyurethane, luoropolymers - Polyvinyl fluoride, Polyvinylidene fluoride, Polytetrafluoroethylene, Polychlorotrifluoroethylene.

UNIT V  THERMOSET MATERIALS & ITS APPLICATIONS
Phenol formaldehyde - Urea formaldehyde - Melamine formaldehyde – Unsaturated polyesters, Alkyd resins - Epoxides - Polyurethane – Silicones - End use applications - case studies on applications – Moulding Powders

TOTAL : 45 PERIODS

TEXT BOOKS
1. Plastic Materials Ed 7 - By Brydson, J A.
2. Hand Book of Plastics Materials & Technology - By Rubin, Irwin, J
3. Plastics Materials Hand Book - By Athalye, A.S
4. Polymer Science - By Gowariker, V.R & Others
5. Text Book of Polymer Science-By Billmeyer, F.W.

REFERENCES
1. Plastics Engineering Hand Book Ed. 5 & Society of the Plastic Industry Inc - By SPI.
UNIT I  INTRODUCTION
Basic principles of processing - shape and size – Effect of polymer property and processing
– Newtonian ands Non-Newtonian fluids - Rheology of polymer melts

UNIT II  COMPRESSION MOULDING & TRANSFER MOULDING
Fundamental principles-Meaning of terms-Bulk factor and flow properties as applied to
moulding materials-The methods adopted for estimating these properties and their
limitations Process variables-Inter relation between flow properties-Curing time-Mould
temperature and Pressure requirements-Preforms and preheating-Techniques of preheating-
Machines used-Common moulding faults and their correction-Finishing of mouldings.
Fundamental principles of transfer moulding-advantages over compression moulding-
Equipment used-Press capacity-Integral moulds and auxiliary ram moulds-Moulding cycles-
Tool costs-Moulding tolerances-Materials Theoretical calculation of pressures-Line
pressures- Injection ram pressure-clamping-Heating requirements-Finishing of moulded
parts—Moulding faults - causes and remedies.

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

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

UNIT V  BLOW MOULDING
Basic principles and definitions- Processer – viz, Injection Blow moulding, extrusion blow
moulding, Accumulation blow moulding, Merits & Demerits - Development of blow moulding
industry Processing Parameters-Temperature-Pressure and cycle time Components –
Materials requirements related to process and product performance-Materials used-
Limitations in product design presented by process characteristics-Design guide lines for
optimum product performance and appearance-Equipment used-Hand and power operated
equipment.  Screw and Plunger Systems-Cross head and die design-Blow moulding
machine features and operation including hydraulic and electrical control systems-faults,
causes and remedies.
Parison programming, blow mould construction, cooling methods, mould venting, blow
moulding of difficult articles like fuel tanks, odd shaped containers with handles, limitation in
blow moulding, decoration of blow moulding products, hot stamping-multi colour printing-
faults, causes and remedies.

TOTAL : 45 PERIODS

TEXT BOOKS
1. Allen; W. S. and Baker; P. N., Hand Book of Plastic Technology, Volume-1, Plastic
Processing Operations [Injection, Compression, Transfer, Blow Molding], CBS
Publishers and Distributors, New Delhi (2004).Injection Molding Theory & Practice By
Rubin, Irvin.
Globalisation has brought in numerous opportunities for the teeming millions, with more focus on the students’ overall capability apart from academic competence. Many students, particularly those from non-English medium schools, find that they are not preferred due to their inadequacy of communication skills and soft skills, despite possessing sound knowledge in their subject area along with technical capability. Keeping in view their pre-employment needs and career requirements, this course on Communication Skills Laboratory will prepare students to adapt themselves with ease to the industry environment, thus rendering them as prospective assets to industries. The course will equip the students with the necessary communication skills that would go a long way in helping them in their profession.
OBJECTIVES

- To equip students of engineering and technology with effective speaking and listening skills in English.
- To help them develop their soft skills and interpersonal skills, which will make the transition from college to workplace smoother and help them excel in their job.
- To enhance the performance of students at Placement Interviews, Group Discussions and other recruitment exercises.

I. PC based session (Weightage 40%) 24 periods

A. ENGLISH LANGUAGE LAB (18 Periods)

1. LISTENING COMPREHENSION: (6)
   - Listening and typing – Listening and sequencing of sentences – Filling in the blanks - Listening and answering questions.

2. READING COMPREHENSION: (6)
   - Filling in the blanks - Close exercises – Vocabulary building - Reading and answering questions.

3. SPEAKING: (6)
   - Conversations: Face to Face Conversation – Telephone conversation – Role play activities (Students take on roles and engage in conversation)

B. DISCUSSION OF AUDIO-VISUAL MATERIALS (6 PERIODS)

   (Samples are available to learn and practice)

1. RESUME / REPORT PREPARATION / LETTER WRITING (1)
   - Structuring the resume / report - Letter writing / Email Communication - Samples.

2. PRESENTATION SKILLS: (1)
   - Elements of effective presentation – Structure of presentation - Presentation tools – Voice Modulation – Audience analysis - Body language – Video samples

3. SOFT SKILLS: (2)
   - Time management – Articulateness – Assertiveness – Psychometrics – Innovation and Creativity - Stress Management & Poise - Video Samples

4. GROUP DISCUSSION: (1)
   - Why is GD part of selection process ? - Structure of GD – Moderator – led and other GDs - Strategies in GD – Team work - Body Language - Mock GD -Video samples

5. INTERVIEW SKILLS: (1)
   - Kinds of interviews – Required Key Skills – Corporate culture – Mock interviews-Video samples.

II. Practice Session (Weightage – 60%) 24 periods

1. Resume / Report Preparation / Letter writing: Students prepare their own resume and report.
2. **Presentation Skills**: Students make presentations on given topics. (8)
3. **Group Discussion**: Students participate in group discussions. (6)
4. **Interview Skills**: Students participate in Mock Interviews (8)

REFERENCES

**Requirement for a batch of 60 students**

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<thead>
<tr>
<th>Sl.No.</th>
<th>Description of Equipment</th>
<th>Quantity required</th>
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<tr>
<td>1. <strong>Server</strong></td>
<td></td>
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<tr>
<td>o PIV system</td>
<td></td>
<td></td>
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<tr>
<td>o 1 GB RAM / 40 GB HDD</td>
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<td>o OS: Win 2000 server</td>
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<tr>
<td>o Audio card with headphones (with mike)</td>
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<td>o JRE 1.3</td>
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<td>2. <strong>Client Systems</strong></td>
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<td>o PIII or above</td>
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<tr>
<td>o 256 or 512 MB RAM / 40 GB HDD</td>
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<tr>
<td>o OS: Win 2000</td>
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<tr>
<td>3. <strong>Handicam Video Camera</strong> (with video lights and mic input)</td>
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<td>4. <strong>Television - 29”</strong></td>
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<td>5. Collar mike</td>
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<td>6. Cordless mikes</td>
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<tr>
<td>7. Audio Mixer</td>
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<td></td>
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<tr>
<td>8. DVD Recorder / Player</td>
<td>1 No.</td>
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</table>
I. A) Injection mould design using CAD

Design calculations: No. of cavities, Selection of injection moulding machine, shot capacity, plasticizing rate, Clamping force, Injection pressure & Tool strength calculations related to -
1. Two - plate mould.
2. Three - plate mould.

B) CNC Programme for the Machining of Core & Cavity using CNC Lathe and CNC Milling of simple profiles

II. Semi - Automatic Compression Mould.

Design calculations: Economic determination of no. of cavities, flash thickness allowances, design of mould cavity, design of loading chamber, bulk factor, loading chamber depth & heat requirement for heating the mould related to -
1. Open-flash type compression mould.
2. Semi-positive horizontal and vertical type.
3. Fully positive type compression mould.

III. Transfer mould design using CAD.

Design calculations: Pot calculation, runner & gate dimensions, bulk factor & shrinkage allowances for thermo set plastics & Minimum moulding pressure related to -
1. Pot transfer mould.
2. Plunger transfer mould.

IV. Blow mould Design using CAD.

Design calculations: Clamping force, pinch-off, head die design and parison diameter calculations.

V. Extrusion Die Design using CAD.

1. For pipes.
2. For profiles.

VI. Part design for an Injection Moulded Component-using MOULDFLOW.

1. 3D Modeling using MOULD – FLOW / view, Flow analysis, Cooling analysis, Shrink / Wrap analysis, Stress analysis.

TOTAL: 60 HOURS

<table>
<thead>
<tr>
<th>S.No.</th>
<th>Description of Equipment</th>
<th>Quantity required</th>
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<tbody>
<tr>
<td>2.</td>
<td>Softwares for C++ and Java</td>
<td></td>
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</tbody>
</table>
REFERENCES
5. Design calculations for Compression moulds, Machinery publications, Yellow series, U.K.

PL2308 POLYMER ENGINEERING LAB

LIST OF EXPERIMENTS
1. To study kinetics of reaction by differential / integral method of analysis / IR N UV
2. To find activation energy and frequency factor
3. Performance of batch reactor
4. Performance of C.S.T.R.
5. Performance of tubular reactor
6. Bulk Polymerisation technique
7. Emulsion Polymerisation technique
8. Suspension Polymerisation technique
9. R.T.D. Studies in mixed vessel
10 R.T.D. Studies in tubular flow
11 To study kinetics of Polycondensation
12 To study kinetics of Addition Polymerisation by dilatometer.

TOTAL: 60 PERIODS

<table>
<thead>
<tr>
<th>S.No.</th>
<th>Description of Equipment</th>
<th>Quantity required</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Magnetic stirrer</td>
<td>10 Nos.</td>
</tr>
<tr>
<td>2.</td>
<td>Thermostatic water bath</td>
<td>2 Nos.</td>
</tr>
<tr>
<td>3.</td>
<td>Vacuum pump</td>
<td>1 No.</td>
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<tr>
<td>5.</td>
<td>Water distillation set up</td>
<td>1 No.</td>
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<td>8.</td>
<td>Air Oven</td>
<td>1 No.</td>
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<tr>
<td>9.</td>
<td>Melting point apparatus</td>
<td>1 No.</td>
</tr>
<tr>
<td>10.</td>
<td>Retard stand</td>
<td>15 Nos.</td>
</tr>
</tbody>
</table>
UNIT I
Orthographic projection—Projection of solids—vertical and horizontal surfaces—Inclined Surfaces—Curved Surfaces—Sectional views and assembly drawing.

UNIT II

UNIT III
Parting line—Construction of core and cavity—types of gate—types of ejection—Mould temperature control - cooling - Mould alignment—Mould ancillary parts.

UNIT IV

UNIT V
Extrusion -- extruder parts - extrusion screw - design features - design variables. Injection Moulds for threaded components -- automatic unscrewing -- various unscrewing methods

REFERENCES
2. Plastics Moulds & Dies - By Sors, & Others.
4. Injection Mould - By VDI.
5. Injection Mould Design for Thermoplastic - By Pye, R.G.W.
7. Injection Moulds – 130 Proven Design - By Gastrow, H.
8. Plastics Product Design Engineering Hand Book - By Dubois, H.

TOTAL: 45 PERIODS

PL2352 PLASTICS MATERIALS & APPLICATIONS – II LT P C
4 0 0 4

UNIT I
Thermoplastic Elastomers
Speciality polymers viz.PEEK, polyimides, PAI & Ionomer
Liquid Crystalline Polymers
Metalloocene Polymers

UNIT II
Reinforced Plastics – principles of composite reinforcement, effect of reinforcement on strength of plastics. Role and nature of binders and coupling agents, properties and applications of fibres in reinforcement (glass and carbon). Properties and applications of FRP’s (Thermoset & Thermoplastics: un-saturated polyesters, epoxies, PU, nylon) End use applications - case studies on applications
UNIT III 12
Definition, advantages of polymers, blends and alloys, role of composition, properties and applications of parameters for compatibility, PVC – Nitrile rubber, ABS-PVC and PP-EPDM

UNIT IV 12
Polyolephines, Nylons & Polycarbonates with fillers like Glass, Mica, Talc, Caco, etc
Polymer Concretes & Advanced ceramics.

UNIT V 12
Preleminary concepts of new materials such as electrically active polymers, Optoelectronic plastics, Bio-polymers, membrane plastics in bio medical applications.

L : 45 , T : 15 , TOTAL: 60 PERIODS

REFERENCES
1. Plastics Engineering Hand Book Ed. 5 & Society of the Plastic Industry Inc - By SPI.
6. Plastic Materials Ed 7 - By Brydson, J.A.
10. Text Book of Polymer Science-By Billmeyer, F.W.

PL2353 PLASTICS TESTING TECHNIQUES – I L T P C
UNIT I 9
Consideration of importance of testing for identification of plastics-Determination of necessary manufacturing conditions-Assessment of properties of finished products in relation to service requirements.

UNIT II 9
Standard and specifications-National and International standards-BIS, ASTM, ISO & NABL.

UNIT III 9
Identification of common plastics materials by simple tests e.g., visual inspection, density, effects of heat, combustion and solvents, analysis with common solvents.

UNIT IV 9
Preconditioning and test atmosphere - Testing of Mechanical properties.
Thermal properties,Optical properties.

UNIT V 9
Testing of Electrical properties, Permeability Properties and Rheological properties.

TOTAL: 45 PERIODS

REFERENCES
PL2354 PROCESS CONTROL & INSTRUMENTATION

UNIT I
Elements of measurement, functions and general classifications of measuring instruments. Indicating and recording type of instruments. Elements of measuring instruments, static and dynamic characteristics of measuring instruments.

UNIT II
Principle of operation, construction and application of important industrial instruments for the measurement of temperature, flow, liquid level and composition.

UNIT III
Dynamic behavior of first order, second order and two or more first order systems in series.

UNIT IV
Block and physical diagrams of control system. Open and closed loop control systems. Characteristics of measuring elements, controllers and final control elements. Modes of control actions.

UNIT V
Response of closed loop control systems for various kind of control actions and measurement lag.

TOTAL: 45 PERIODS

REFERENCES
UNIT I

UNIT II
Antistatic agents-Anti blocking agents-Slip and antislip agents-processing aids-mould releasing agents.

UNIT III
Compounding - Selection of polymers and compounding-ingredients-general objectives-possibilities and limitation of additives into polymer matrices. Mixing and mixing equipments.

UNIT IV
Machine construction - specifications - temperature control system - operating characteristics - house keeping and maintenance of compounding machines.

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

REFERENCES

UNIT I
Thermoforming
Basic principles & types of thermoforming processes, Thermoforming moulds-processing parameters—faults, causes and remedies.

Calendering
Principle and process description, types of calender units 2, 3 and 4 rolled calenders, Design of calender roll, Heating and temp control, roll crown, roll crossing and roll bending, materials for calendering, calendering sheets and films, embossing, coating and lamination by calender, comparison between calendering and extrusion.

UNIT II
FRP & Laminates - Introduction, FRP Processing methods-contact moulding-hand lay up, Spray up method-vacuum bag & pressure bag moulding, filament welding Centrifugal casting, pultrusion, pulforming matched die moulding – Laminates, definition of terms-high, medium and low pressure laminating process, types of machinery, impregnation systems – decorative and industrial laminates, continuous high pressure laminating process, application.

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

UNIT IV
Machining & Joining of Plastics (10 hours) - Introduction-Importance of machining – methods viz; cutting, drilling, blending, filling etc., joining-principles-cohesion principle, adhesion principle – solvent cementing. Dop cementing, welding of plastics-viz high frequency welding thermal sealing, spin welding, vibration welding, hot plate welding, ultrasonic welding, Adhesive ponding-examples: Mechanical fasteners.

UNIT V
Other Secondary Processes
Printing, painting, Hot slamping, In mould decoration, Electro plating and vacuum metallising.

REFERENCES
3. Technician's Hand Book & Plastics - By Grandilli, P.A.
5. Injection Molding - By Athalye, A.S.
6. Injection Molding Technology - By V.D.I.
9. Compression Molding - By Iyesew, A.I.
11. Thermoforming - By James & Throne.
14. Basic Principle of Thermoforming - By Brycle, D.M
15. Plastics Injection Molding - By Brycle, D.M.
17. Plastics Mold Design Vol.1 Compression & Transfer Moulds - By Bebb.

TOTAL: 45 PERIODS
# Plastic Extrusion Technology
- By Hensen.

# Hand Book of Plastics Technology 2 Vol.
- By Allen, W.S & Baker, P.H.

# Extrusion of Plastics
- By Fisher.

# Plastics Extrusion Technology
- By Grief.

# Extrusion of Plastics
- By Fisher.

# Plastic Engineering Hand Book
- By S P I..

# Lecture Notes for Risk Assessment.

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## PL2358  PLASTICS PROCESSING LAB – I  L T P C  0 0 4 2

<table>
<thead>
<tr>
<th>Sl. No</th>
<th>Name of M/c/Equipment/ Mould</th>
<th>Description of Practical Exercise to be done*</th>
</tr>
</thead>
</table>
(ii) Operation practice to produce moulding on different hand injection moulds. Recording the observation and results in practical record books. |
(ii) Operation of Pneumatic & Hydraulic type of Semi automatic Injection moulding M/cs, to produce components in different moulds. Cycle-time analysis, observations of Process-Parameters & Procedure to be recorded. |
| 3.     | Extrusion Processes on Extruders | (i) Study of Extruders in IRO, Free sketch of machines, their parts and parts-function, List of products manufactured by Extrusion-Process. Study of different types of extrusion process.  
(ii) Operation-Practice by Trainee on setting up of Process-parameter to produce Blown-Film on Film-plant, observations on extruder output, size of film produced and technical specifications of machines to be recorded. |
(ii) Operating Principle of Hand Compression Press, mould setting-procedure & parameter setting, operation practice on different compression moulds, M/c specification observations and recording. |
(ii) Die-centering practice by Trainees, operation of Hand Blow Machines, to produce components observations, cycle-time analysis Procedure of operation and observations. |
<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>Experiment/Exercise</th>
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</thead>
<tbody>
<tr>
<td>1)</td>
<td>Determination of Melt flow index of plastics materials</td>
</tr>
<tr>
<td>2)</td>
<td>Study of Mechanical properties of plastics &amp; test methods</td>
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<tr>
<td>3)</td>
<td>Study of Weathering properties.</td>
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<tr>
<td>4)</td>
<td>Determination of Burst strength &amp; tear strength of films</td>
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<tr>
<td>5)</td>
<td>Determination of Hardness (rockwell, shore A&amp;D, Barcol)</td>
</tr>
<tr>
<td>6)</td>
<td>Specimen preparation by Injection moulding, contour cutting, compression moulding, contour punching, etc.</td>
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<tr>
<td>7)</td>
<td>Testing of Electrical and Optical properties of Plastics materials</td>
</tr>
<tr>
<td>8)</td>
<td>Introduction to product testing</td>
</tr>
</tbody>
</table>

**TOTAL: 60 PERIODS**
PL2401  POLYMER COMPOSITE TECHNOLOGY  L T P C  3 0 0 3

UNIT I  9

UNIT II  9
Types of reinforcement such as natural, glass, carbon/graphite, aramid fibers, high strength and high modulus fibers. Surface treatment and various forms of fibers.

UNIT III  9
Thermosetting and thermoplastic materials for the composites and their selection for a particular application

UNIT IV  9
Processing and production techniques like hand-lay-up, spray-up, bag moldings, filament winding and pultrusion.

UNIT V  9
Preparing their manufacture and characterization. Sheet moulding and dough moulding compounds and their processing, perform and resin transfer moldings. Hybrid and sandwich type composites.

TOTAL: 45 PERIODS

REFERENCES

PL2402  PLASTICS TESTING TECHNIQUES – II  L T P C  3 0 0 3

UNIT I  9
Consideration of the importance of testing-Identification of plastics-Determination of necessary manufacturing conditions-Assessment of properties of finished products in relation to service requirements-Standard and specification-National and International standards-Test specimen preparation-Preconditioning and test atmosphere.

UNIT II  9

UNIT III  9
Thermal Properties: Specific heat and thermal conductivity thermal dependant properties-thermal endurance-glass transition temperature-thermal yield tests-Heat deflection
temperature-Vicat softening temperature-Marten’s heat resistance test-low temperature brittle point and flexibility test-coefficient of thermal expansion-shrinkage-Thermal stability-Thermal ageing and flammability.

UNIT IV
Optical Properties -Refractive index-light transmission-haze-clarity-gloss-colour guard and microscope.
Application of national and international standards (BIS-ASTM-ISO) for testing and their significance, Knowledge and exposure on Sectorial Testing Standards.

UNIT V
Product testing-Pipe and fittings-film and sheets-container testing and FRP based products.
Factors for designing tests for newer products
Factors affecting the quality of materials and products
Analysis of failure and its measurements
Techniques of characterisation-Principles and application of DSC- TGA AND FTIR
Concepts of non-destructive testing

REFERENCES
1. Simple Methods for Identification of Plastics By Brawn, R.B.
2. Analysis of Plastics By Crompton, J.
3. Plastic Engineering Hand Book & D-5 By Society of Plastics Industry Inc Identification & Analysis of PlasticsBy Haslam & Others..
11. Testing and Evaluation of Plastics By Mathur, A.A & Bhardwaj, I.S.
UNIT III ENTREPRENEURSHIP

UNIT IV TOTAL QUALITY MANAGEMENT
- TQM concepts – overview
- Quality tools & techniques used in TQM
- TQM Principles
Six sigma
- Concepts & Terminology of Six Sigma
- Tool Kit to Deploy
- Six Sigma improvement process using DMAIC
- Tools for Six Sigma

UNIT V COSTING
Basic principles of costing-direct cost-indirect cost-labour costing-stores organisation-factory overhead costs-Costing methods.
Standard and marginal costing-break-even-point control functions-cost reduction-value analysis-cost audit-costing as related to mould and mouldings-capital expenditure-reports and statistics.
Proforma for cost estimation – product cost-mould cost-Processing cost-project costing-direct cost-indirect cost-break even point.

TOTAL: 45 PERIODS

REFERENCES
1. Management By Koontz, Herold & Others.
2. Essentials of Management By Koontz, Herold & Weihrich.
3. Industrial Engineering and Management By Ravi Shankar.
5. Cost Accounting By Bhar, B.K.
6. Personnel Management and Industrial Relations By Davor, R.S.
8. Cost and Management Accountancy for Students By Batty J.
11. Organizational Behaviour By Khanna.
12. Industrial Engineering &Management By Khanna, O.P.
PL2404  PLASTICS PRODUCT DESIGN  L T P C

UNIT I


UNIT II

Moulded threads—thread pieces—threaded holes
Inserts-Materials-Selection of metal for inserts-minimum wall thickness of material around inserts-anchorage-relieving moulding stresses around inserts-location of inserts in the part-moulded in inserts-pressed in inserts

UNIT III

Quality and economy-tooling aspects on product design-process variables vs product design-product design appraisal. Product design limitations-shrinkage vs tolerance-minimum wall thickness-mechanical properties-creep properties-end use requirements with case studies. Prototype development – rapid prototyping techniques – stereolithography.

UNIT IV


UNIT V


TOTAL: 45 PERIODS

REFERENCES
5. Plastics Product Design Engineering Hand Book- By Dubois, H.
<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>Name of M/c/ Equipment/ Mould</th>
<th>Description of Practical Exercise to be done*</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Automatic Injection Moulding M/C</td>
<td>Idle-run observation (IRO) &amp; study of Injection Unit, Clamping Unit, Process- Control knobs, safety precautions, start-up Procedure, Shut-down Procedure, Sketch of Machine Platens, Clamping system, type of nozzle used in M/c etc., study of Hydraulic System used in the M/c. M/c Operation-Practice, Process parameter setting for a particular mould on the Machine, Operation of Machine in Hand, Semi Automatic &amp; Automatic-mode to produce components, observations of all parameters, cycle-time analysis, use of different plastics material for moulding &amp; comparison, Moulding faults analysis for causes and remedies.</td>
</tr>
<tr>
<td>2.</td>
<td>MICRO-PROCESSOR Controlled Injection Moulding M/C</td>
<td>Study of Basic concepts of Micro processor control, Comparison of Micro Processor- Controlled M/cs with Conventional M/Cs, Machine Setting Procedure, Procedure for Process-Parameter-setting on monitor or control Panel. Operation of M/c with Mould fixing &amp; setting on the M/c with different plastics materials, cycle-time analysis, Analysis of Product defects, causes &amp; remedies during M/c operation, listing of important operating procedure points, safety precautions through M/C Instruction/Manual operating.</td>
</tr>
<tr>
<td>3.</td>
<td>EXTRUSION-PROCESS on Blown Film Extruder</td>
<td>Procedure for setting up of Process-parameters eg. Temperature on different zones, Screw-Speed, Nip-roller speed, Winder Speed, Blow-ratio, control of cooling-Air on bubble, Methodology &amp; practice by trainees to fix the Blown Film die on M/C familiarization of Die-parts &amp; their function, Technical specification of M/cs, defects, causes &amp; remedies, Practice of operating M/c to produce different sizes of Blown Film. Study of the Machine-parts &amp; function from Screw drive to the Cater pillar. Practice of Die setting on the machine, SIZING TECHNIQUES, Procedure for setting up of parameters &amp; operation practice in running the Machine to produce pipe/ Tube/ film.</td>
</tr>
<tr>
<td>4.</td>
<td>Compression &amp; Transfer Moulding(Semi-Automatic)</td>
<td>Setting up procedure for operation of M/c, safety precautions, Type of Mould Clamping arrangement available on M/c-Platen, Mould Clamping procedure on M/c, Operation of M/c by setting the optimum Temperature, curing time, clamping force, ejector-stroke etc. on continuous basis, Analysis of Product defects &amp; remedies, Analysis of Cycle-time, Practice on operation of compression &amp; Transfer moulds with thermoset materials.</td>
</tr>
<tr>
<td>5.</td>
<td>Automatic Blow Moulding Machine</td>
<td>Machine-setting Procedure, Parameter-setting Procedure, Method of Mould fixing &amp; parison-die setting on the M/c, Practice by trainees to remove &amp; fix the parison die to produce on appropriate Parison for blowing, type of blowing systems, operation-practice on different moulds, cycle-time analysis, process-faults &amp; remedies.</td>
</tr>
<tr>
<td>6.</td>
<td>Thermoforming (Vacuum forming)</td>
<td>Study of Process Principle, type of moulds &amp; material used, Familiarisation with the M/c controls for operation, Operation Practice by trainee, observation on Cycle-time, processing-defects &amp; remedies.</td>
</tr>
<tr>
<td>7.</td>
<td>Rotational Moulding</td>
<td>Machine-study in IRO, Process Principle &amp; sequence of operation, Raw materials used, Mould-clamping practice on the M/c, operation practice to produce Roto moulded components, Cycle-time analysis, Comparison of process with other processing processes.</td>
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<tr>
<td>Sl. No.</td>
<td>Experiment/Exercise</td>
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<tr>
<td>1)</td>
<td>Compounding, Blending using Two Roll Mill and Specimen preparation</td>
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<td>2)</td>
<td>Determinations of Carbon Black Content and Dispersion of Olefinic Plastics</td>
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<td>3)</td>
<td>Determination of environmental stress cracking resistance for Polyethylene</td>
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<td>4)</td>
<td>Testing of HDPE/RPVC Pipes</td>
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<td>5)</td>
<td>Testing of Water Storage Tanks/Containers</td>
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<td>6)</td>
<td>Testing of Films/Sheets</td>
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<td>7)</td>
<td>Testing of HDPE/PP Woven Sacks/Tapes</td>
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<td>8)</td>
<td>Testing of Bottles/Vanaspati, Ghee, Milk Packing</td>
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<td>9)</td>
<td>Testing of Plastics Products for Determination of Mechanical,</td>
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</tbody>
</table>

**TOTAL: 60 PERIODS**
UNIT I  INJECTION MOULDING  
Thin wall product moulding, multi material and multi colour moulding, sandwich moulding, thermost set injection moulding. Micro Processor Controlled Injection moulding operation. Statistical quality control and process control. All electric injection moulding - Merits & Demerits

UNIT II  SPECIALISED PROCESSES  
Gas Assist Moulding, Water Assist molding, Reaction Injection molding, Liquid Injection Molding, Lost Core molding, Thermoset Injection molding,

UNIT III  STRUCTURAL FOAM MOLDING  
Structural foam molding: a) Low pressure Foam b) High pressure Foam, In – mold Decoration/ Reaction Transfer Molding, Filament Winding, Metal/Ceramic Powder Molding,

UNIT IV  ADVANCED BLOW MOULDING  

UNIT V  ADVANCED EXTRUSION  

TOTAL: 45 PERIODS

REFERENCE
UNIT V

REFERENCES

PL2023  PLASTICS PACKAGING TECHNOLOGY

UNIT I
Introduction to plastics packaging: functions of packaging, advantages of plastic packaging, distribution hazards, special requirements of food and medical packaging, packaging legislation and regulation.
Packaging as a system: Elements, approach, package, design, relation criteria for packaging materials, packaging equipment checklist, case histories
Major packaging plastics
Introduction – PE, PP, PS, PVC, polyesters, PVDE, vinyl acetate, PVA, EVA , PV Alcohol, PA, PC ionomers & fluoro polymers.

UNIT II

UNIT III

UNIT IV
Thermoformed, molded and rigid packages, Thermoforming packages: Position & thermoforming & wrap forming, variations in thermoforming and solid phase pressure forming, scrabbles, twin sheet & melt – to- mold thermoforming, skin packaging, thermoforming moulds, thermoforming fill- real, Aseptic thermoforming, advantages & disadvantages of moulding foams, other cushioning materials & distribution packaging – Polystyrene & other foams systems cushioning, Design of molded cushioning systems, plastic pallets, drums & other shipping containers.

UNIT V
Testing plastic packages, Barrier, Migration & compatibility, Printing, labeling & pigmenting, Sterilisation systems and health care products.
Packaging hazards and their controls. Environmental considerations.

TOTAL: 45 PERIODS
REFERENCES

PL2024              FIBRE TECHNOLOGY      L T P C
UNIT I 9
Introduction to natural and synthetic polymers. Essential characteristics and molecular architecture of fibre forming polymers.

UNIT II 9
Concept of order in polymers, crystallinity, orientation, physical structure of natural and man-made fibers.

UNIT III 9
Physical methods for investigating fiber structure. Optical properties of oriented polymers and fibres, refractive index and birefringence.

UNIT IV 9
Melt spinning, dry and wet spinning of fibers. Fiber drawing, heat setting, texturing and mechanical properties of fibers based on viscose, cellulose acetate, polyamides.

UNIT V 9
Fiber drawing, heat setting, texturing and mechanical properties of fibers based on polyesters, acrylics, polypropylene, glass and carbon-fibres. General principles of finishing and dying of fibers. Common types of finishes applied to textile fibers.

TOTAL: 45 PERIODS

REFERENCES

PL2026              BIODEGRADABLE POLYMERS      L T P C
UNIT I 9
CHEMISTRY AND BIOCHEMISTRY OF POLYMER DEGRADATION

UNIT II 9
PARTICULATE STARCH BASED PRODUCTS
UNIT III  BIO POLYESTERS

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, tiered systems for evaluating biodegradability, choice of environment, choosing the most appropriate methodology, description of current test methods – screening test for ready biodegradability, tests for inherent biodegradability, tests for simulation studies, other methods for assessing biodegradability – petri dish screen – environmental chamber method – soil burial tests, Test method developments for the future.

REFERENCES

TOTAL: 45 PERIODS

PL2027  SPECIALTY POLYMERS

UNIT I

UNIT II
Polymers with electrical and electronic properties Conducting polymers, conducting mechanisms, polyacetylene, polyparaphenylene polypyrrole, organometallic polymers, photo conducting polymers, polymers in non-linear optics, polymers with piezoelectric pyroelectric and pyroelectric properties, photoresists for semi conductor fabrication – liquid crystalline polymers.

UNIT III
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. Biological and inorganic ionic polymers.
UNIT IV
Polymer concrete, polymer impregnated concrete ultra high modulus fibres, polymers for biomedical applications, polymeric binders for rocket propellants, polymer supported reagents.

UNIT V
Polymers in telecommunications and power transmission, polymers as insulators – electrical breakdown strength – capacitance, dielectric loss and cable alteration, polymers in telecommunications – submarine, cable insulation, low fire risk materials, polymers in power transmission – Optical fibre telecommunication cables.

TOTAL: 45 PERIODS

REFERENCES

PL2033
SPECIALTY ELASTOMERS

<table>
<thead>
<tr>
<th>UNIT</th>
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</table>

TOTAL: 45 PERIODS
REFERENCES

PL2029 POLYURETHANE TECHNOLOGY

UNIT I
Introduction to polyurethane- chemistry and materials of polyurethane manufacture: basic reaction, cross linking in polyurethane, important building blocks for polyurethane(isocyanates, polyols, amines and additives)- The manufacturer of polyurethanes ( the process, parameters and controls).

UNIT II
Polyurethane processing-basic design principles of polyurethane processing equipment-steps in the polyurethane processing.
Flexible foams-(production, properties and application slabstock foam, carpet backing, flexible molded foams & semirigid molded foams. Reinforced RIM – trends in the use of RIM and RRIM.

UNIT III
Rigid polyurethane foams-chemistry of raw materials, manufacturing of rigid polyurethane (manufacturing of buns, panels, foaming of applications, molded rigid foams), properties, relationship between production methods and properties- application of rigid polyurethane.
Polyurethane skin integral foam- production, properties and applications.

UNIT IV
Solid polyurethane materials- polyurethane casting systems (cast elastomers and casting resins)-thermoplastic polyurethane elastomers: productions/ processing, properties and applications, polyurethane, pains, technique and coatings, adhesives builders, elastomers fibers, manufacture / processing and application.

UNIT V
Determination of composition and testing of polyurethane-chemical compositions, detection methods, identification of functional groups, determinations of properties materials and products (Characterisation, physics/mechanical, temp dependence, chemical performance, combustibility) polyurethane and environment health and safety: making and using polyurethane safety.

TOTAL: 45 PERIODS

REFERENCES
UNIT I  IDENTIFICATION AND ANALYSIS
IDENTIFICATION OF PLASTICS BY SIMPLE PHYSICAL METHODS; by chemical analysis, application of instrumental techniques for identification of polymers and additives. Thermoplastics – melting point, density, viscosity, melt flow, K – value. Thermosets – moisture analysis, particle size, apparent density, spiral flow, cupflow test, gel time and peak exothermic temperature. Resins – acid value, hydroxyl value, isocyanate index, epoxy equivalent.

UNIT II  MOLECULAR CHARACTERISATION
Determination of molecular weight, viscometry, end group analysis, colligative property, osmometry, light scattering technique, determination of molecular weight and molecular weight determination, gel permeation chromatography.

UNIT III  THERMAL ANALYSIS
Differential thermal analysis (DTA), Differential scanning calorimetry (DSC), Thermogravimetric analysis (TGA), Thermomechanical analysis (TMA), Dynamic mechanical thermal analysis (DMTA).

UNIT IV  SPECTROSCOPY
Infrared spectroscopy (IR & FTIR), Nuclear magnetic resonance spectroscopy (NMR), GC – Mass spectrometer (GC –MS)

UNIT V  X-RAY AND MICROSCOPY
X –ray diffraction (wide angle and small angle), Optical microscopy, Scanning electron microscopy (SEM) and Transmission electron microscopy (TEM)

TOTAL : 45 PERIODS

TEXT BOOKS
1. Chermisinoff, Polymer characterization – Laboratory Techniques and Analysis

REFERENCES
1. ASTM – Volume: 8.01, 8.02 & 8.03, 2000
2. Kampff, Characterization of plastics using physical methods, Experimental techniques and practical applications.
UNIT III

UNIT IV

UNIT V

TOTAL: 45 PERIODS

REFERENCES

PL2042 POLYMER NANOCOMPOSITES L T P C
3 0 0 3

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

UNIT II
Nanocomposites: particulate, clay, and carbon nanotube nanocomposites Nanocomposite: synthesis, characterization, properties, and applications

UNIT III
Clay/Polymer Nanocomposites: Physical and chemical properties of clayl nanoparticles; Synthesis; Potential Applications

UNIT IV
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
Rheology and processing ; Applications and economics

TOTAL: 45 PERIODS
REFERENCES


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<th>PL2043</th>
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UNIT I


UNIT II


UNIT III


UNIT IV


UNIT V


TOTAL: 45 PERIODS
REFERENCES

PL2034 ADHESIVES AND SURFACE COATINGS

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

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

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

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

UNIT V

TOTAL : 45 PERIODS

REFERENCES
UNIT I

UNIT II
Physical structure: Structure properties relationship-crystallizing, melting temperature, to solubility, molecular weight, melt viscosity, degradation and stabilization, Electrical and mechanical properties. Characterisation: Identification, composition/moisture analysis, separation techniques, BGGMolecular mass and distribution, IR, NMR and X-ray diffraction.

UNIT III
Fundamentals of Melt Processing: Measurements of viscosity, PVT relationships, importance of moisture, effect of molecular mass, shear, temperature, additives and channel shape. Applications of Rheological data to flow situation.
Processing techniques of melt processing: Processing reagents, material handling and drying, injection moulding, extrusion, blow moulding and monomer processing.
Other processing Techniques: Powder coating, blending and solution coatings.
Secondary Treatments: Assembly, Moisture conditioning, mechanical surface clearing, and decorating.

UNIT IV
Modification: Physical change- co-polymerisation-transparent nylons, filled and reinforced nylons, toughened nylons, fire retardant nylons, plasticized and lubricated nylons, additives for heat stabilization, processing and color and other modifications.
Polymer Blends Alloys And Composites: Properties-factors affecting the properties of nylons, mechanical, thermal electrical and optical properties, moisture absorption, dimensional stability and density, environmental resistances and impact, flammability and failure analysis.

UNIT V
Commercial Nylon Blends And Their Applications: PA6, PA66, PA46, PA6/2,PA11 &PA12 Raw materials- preparation –polymerisation- Methods of manufacturing, modifications, processing (methods, procedure processing parameters etc.,) Properties (material, tribological durability, water absorption dimension stability (immersion resistance, thermal/ electrical/optical properties, flammability resistance to permeation Applications)

REFERENCES
UNIT II
BIOMEDICL POLYMERS: Criteria for the Selection of Biomedical Polymers, Physicochemical Aspects of the Blood Compatibility of Polymeric Surface. Biomedical Polymers from biological source, Poly hydroxy Alkanoic Acids, Microbial polysaccharides, Silk, Collagen, Microbial Cellulose, Hyaluronic Acid, Synthetic Polymers such as PMMA, Silicon Rubber, Polyethylene, Natural Rubber, Hydrogels.

UNIT III

UNIT IV

UNIT V
DENTAL POLYMERS: Dental applications, denture bases, dentate reliners, 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

REFERENCES
8. Chiellini; Emo, Sunamoto; Junzo, Migliaesi; Claudio, Ottebrite; Raphael and Cohn; Daniel (Eds.), Biomedical Polymers and Polymer Therapeutics, Kluwer Academic/Plenum Publishers, New York (2001).
9. Galaev; Igor and Mattiasson; Bo (Eds.), Smart Polymers; Applications in Biotechnology and Biomedicine, CRC Press, Boca Raton (2008).
UNIT II
SQC Techniques and their applications – Organising for data collection; summarization of
data, presentation if data in the form of pie diagrams; Histograms and frequency
distributions,- Measures of central tendency and dispersion; their calculation and
interpretation-Concept of distributions; Normal, Binomial and Poisson Mean and Variance
of distributions – Concept of Sampling distribution; ‘t’, ‘F’, and x) distributions.

UNIT III
Introduction to tests of simple hypothesis; Single Mean, Standard Deviation; Two sample
tests for means and variable and attribute type of data- Their interpretation; Special purpose
charts;

UNIT IV
Dominant systems, Process and Product check – Inspection, quality control & testing
schemes: Concepts of Acceptance Sampling – Attribute characteristics, Single, Double
Sampling Plans – OC curves, Explanation of IS – 2500 Standard tables – Correlation and
regression analysis; Introduction of Statistical design of experiments for product quality
improvement.

UNIT V
Organization for quality control, quality audit, concept of quality circles, ISO 9000 –
concepts, procedures and documentations.

REFERENCES
   Company, New Delhi.

GE2022 TOTAL QUALITY MANAGEMENT L T P C
UNIT I INTRODUCTION
Introduction - Need for quality - Evolution of quality - Definition of quality - Dimensions of
manufacturing and service quality - Basic concepts of TQM - Definition of TQM – TQM
Framework - Contributions of Deming, Juran and Crosby – Barriers to TQM.

UNIT II TQM PRINCIPLES
Leadership – Strategic quality planning, Quality statements - Customer focus – Customer
orientation, Customer satisfaction, Customer complaints, Customer retention - Employee
involvement – Motivation, Empowerment, Team and Teamwork, Recognition and Reward,
Performance appraisal - Continuous process improvement – PDSA cycle, 5s, Kaizen -
Supplier partnership – Partnering, Supplier selection, Supplier Rating.

UNIT III TQM TOOLS & 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 & TECHNIQUES II
Quality circles – Quality Function Deployment (QFD) – Taguchi quality loss function – TPM
– Concepts, improvement needs – Cost of Quality – Performance measures.
UNIT V  QUALITY SYSTEMS


TOTAL : 45 PERIODS

TEXT BOOK

REFERENCES

PL2053  INDUSTRIAL SAFETY & HAZARD MANAGEMENT  L T P C

UNIT I 9
Industrial safety, industrial hygiene and safety aspects related to toxicity, noise, pressure, temperature, vibrations, radiation etc. explosions including dust, vapor, cloud and mist explosion.

UNIT II 9
Elements of safety, safety aspects related to site, plant layout, process development and design stages, identification of hazards and its estimation, risk, risk analysis and assessment methods, fault free method, event free method, scope of risk assessment, controlling toxic chemicals and flammable materials.

UNIT III 9
Toxic substances and degree of toxicity, its estimation, their entry routes into human system, their doses and responses, control techniques for toxic substances exposure, use of respirators, ventilation systems.

UNIT IV 9
Prevention of losses, pressure relief, provision for fire fighting, release of hazardous materials from tanks, pipes through holes and cracks, relief system: types and location of relief’s.

UNIT V 9
Handling, transportation and storage of flammable liquids, gases, and toxic materials and wastes, regulation and legislation, government role, risk management routines, emergency preparedness, disaster planning and management.

Training practices on Basic First Aids

TOTAL: 45 PERIODS

REFERENCES
PL2054  ENTREPRENEURSHIP  L T P C  3 0 0 3

UNIT I  ENTREPRENEURIAL DEVELOPMENT PERSPECTIVE  9

UNIT II  CREATING ENTREPRENEURIAL VENTURE  9
Business Planning Process, Environmental Analysis - Search and Scanning, Identifying problems and opportunities, Defining Business Idea, Basic Government Procedures to be complied with

UNIT III  PROJECT MANAGEMENT  9
Technical, Financial, Marketing, Personnel and Management Feasibility, Estimating and Financing funds requirement - Schemes offered by various commercial banks and financial institutions like IDBI, ICICI, SIDBI, SFCs, Venture Capital Funding

UNIT IV  ENTREPRENEURSHIP DEVELOPMENT AND GOVERNMENT  9
Role of Central Government and State Government in promoting Entrepreneurship - Introduction to various incentives, subsidies and grants - Export Oriented Units - Fiscal and Tax concessions available
Role of following agencies in the Entrepreneurship Development - District Industries Centers (DIC), Small Industries Service Institute (SISI), Entrepreneurship Development Institute of India (EDII), National Institute of Entrepreneurship & Small Business Development (NIESBUD), National Entrepreneurship Development Board (NEDB)

UNIT V  9
Why do Entrepreneurs fail - The FOUR Entrepreneurial Pitfalls (Peter Drucker) Case studies of Successful Entrepreneurial Ventures, Failed Entrepreneurial Ventures and Turnaround Ventures

REFERENCES
2. Entrepreneurship - Hisrich Peters.
3. The Culture of Entrepreneurship - Brigitte Berger.
5. Dynamics of Entrepreneurship Development - Vasant Desai.
7. Thought Leaders - Shrinivas Pandit.
8. Entrepreneurship, 3rd Ed. - Steven Brandt.
10. The Entrepreneurial Connection - Gurmit Narula.

TOTAL: 45 PERIODS
UNIT I HUMAN RESOURCE DEVELOPMENT STRATEGIES, DESIGN AND EXPERIENCE 9
Human Resource Development: HRD-An Overview, Line Managers and HRD, Task Analysis, Motivational Aspects of HRD, Developmental Supervision, Counselling and Mentoring, HRD for Health and Family Welfare in Select HRD Culture and Climate, HRD for Workers, HRD/OD Approach to IR Corporate Business,

UNIT II BASICS OF HUMAN RESOURCE PLANNING 9

UNIT III WAGE AND SALARY ADMINISTRATION 9
Wage Concepts and Definition of Wages Under Various Labour Legislation, Norms for Wage Determination, Law relating to Payment of Wages and Bonus, Pay Packet Composition, Design of Performance-linked Reward System,

UNIT IV LABOUR LEGISLATION 9

UNIT V PERSONNEL OFFICE MANAGEMENT 9
Functions of the office, correspondence, O & M in personnel departments, Maintenance of Personnel records.
Time Management
Importance of Time factor, Time waster, Prioritizing Work Scheduling, Functions of the Time Office, Flexible Work arrangements.

TOTAL: 45 PERIODS

REFERENCES
UNIT I
Marketing and Its Applications
Introduction to Marketing, Marketing in a Developing Economy, Marketing of Services, Factors of Marketing, Levels of Marketing – Strategic Marketing and Operation Marketing, The four Ps of Marketing Plan : (Marketing Mix) - Product – Pricing – Promotion – Placement (or distribution)

UNIT II
Marketing Planning and Organisation
Planning Marketing Mix, Market Segmentation, Marketing Organisations, Marketing Research and its Applications

UNIT III
Understanding Consumers
Determinants of Consumer Behavior, Models of Consumer Behavior, Indian Consumer Environment

UNIT IV
Product Management
Pricing and Promotion Strategy
Pricing Policies and Practices, Marketing Communications, Advertising and Publicity, Personal Selling and Sales Promotion

UNIT V
Distribution and Public Policy
Sales Forecasting, Distribution Strategy, Managing Sales Personnel, Marketing and Public Cyber Marketing
Reasons for indirect selling methods, Reasons for using wholesalers, Reasons for bypassing wholesalers
Agents: Commission agents – Selling agents – Brokers – Factory representatives
Marketing communications – Advertising – Functions and advantages of successful advertising – Requirements of a good advertisement – Eight steps in an advertising campaign such as Market research – Setting out aims – Budgeting – Choice of media (TV, Newspaper, radio) – Choice of actors (New trend) – Design and wording – Coordination and Test results Personnel Sales – Sales promotion – Publicity – Customer focus – Product focus
Packing and Labeling, Trademarks, Brands, Pricinciples.

TOTAL: 45 PERIODS

REFERENCES
UNIT I  GENERAL INTRODUCTION  9
Risk Management Process – Developments in Risk Management Process – Roles and
Responsibilities in Risk Management – Perception of risks - Uncertainty, variability and
precaution.

UNIT II  EXPOSURE ASSESSMENT  9
Emissions of plastics to environment – Transport accumulation and transportation
process – Bioaccumulation – Biodegradation – Biotransformation – Bioavailability.

UNIT III  ENVIRONMENTAL EXPOSURE ASSESSMENT  9
Air models – Water models – Soil models – Human exposure through environment –
Consumer exposure assessment – occupational exposure.

UNIT IV  EFFECTS ASSESSMENT AND RISK CHARACTERIZATION  9
Toxicity testing for human risk assessment – Ecotoxicological effects – Human health

UNIT V  DATA AND PREDICTION  9
Data needs Availability source and evolution - Predicting fate Related physicochemical
properties – Predicting toxicological and exotoxicological end points.

TOTAL : 45 PERIODS

REFERENCES
1. Risk Assessment of chemicals – An Introduction. C.J Van Ieeuwen, T.G. Vermeire,
Grete Ostergaard.