PROGRAMME EDUCATIONAL OBJECTIVES (PEOs)

I. To provide an interdisciplinary specialization in master degree with emphasis on materials, engineering and fundamentals of polymers and their processing.
II. To produce employable graduates with knowledge and competency in scientific and engineering aspects of polymers, complemented by the appropriate skills and attributes.
III. To impart the fundamental concepts of synthetic resins, composites, engineering plastics, adhesives and conducting polymers and their applications in industries.
IV. To gain knowledge on biopolymers, specialty polymers/rubbers and fibers in engineering applications.
V. To provide comprehensive knowledge on heat and mass transport processes, analytical testing of polymers and plastic waste management.

PROGRAMME OUTCOMES (POs)

1. In-depth and detailed functional knowledge of the fundamental concepts and experimental methods of science and engineering.
2. To apply and integrate knowledge from four elements i.e., polymer structure, properties, process and performance to solve the industrial problems and also to develop an entrepreneur skill.
3. Knowledge of the topics of inter-disciplinary research, problem identification, formulation and solution in polymer technology.
4. To use the techniques, skills, and modern engineering tools necessary for engineering practice to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability.
5. Professionally skilled for higher studies in research institutions and to work in polymer industries.

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UNIVERSITY DEPARTMENTS
ANNA UNIVERSITY :CHENNAI 600 025
REGULATIONS-2015
CHOICE BASED CREDIT SYSTEM
I – IV SEMESTER CURRICULUM AND SYLLABUS
M.TECH. POLYMER SCIENCE AND ENGINEERING
### SEMESTER III

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**TOTAL CREDITS : 74**
## FOUNDATION COURSE (FC)

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## PROFESSIONAL CORE (PC)

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## Employability Enhancement Courses (EEC)

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OBJECTIVE

- To make the student to acquire knowledge in fundamentals of polymers and bioinorganic polymers
- To provide exposure to the students about Molecular weight, solubility and fractionation of polymers

UNIT I  BASICS OF POLYMERS AND CHAIN GROWTH POLYMERIZATION  9
Basics—polymer classifications based on occurrence, types, process, and end uses. Kinetics and mechanism of free radical, cationic, anionic, living polymers and coordination polymerization— Ziegler Natta catalysts—monometallic mechanism—stereo regular polymerization—chain transfer reaction and constant.

UNIT II  STEP GROWTH POLYMERIZATION AND COPOLYMERIZATION  9

UNIT III  STRUCTURAL PROPERTIES AND REACTION OF POLYMER MOLECULES  9

UNIT IV  THERMAL TRANSITION, MOLECULAR WEIGHT AND POLYMER DISSOLUTION  9
Thermal transitions—TGA, DSC, HDT, MFI. Number, weight and viscosity average molecular weights—polydispersity—molecular weight distribution—determination of molecular weight by GPC and viscometry—polymer dissolution—thermodynamics of polymer dissolution—solubility parameter—fractionation of polymers.

UNIT V  BIO AND INORGANIC POLYMERS  9

TOTAL: 45 PERIODS

OUTCOME

- Will be aware of preparation and properties of polymers at length.
- Will be able to methodically discuss moulding techniques.
- Will develop capacity to characterize polymers and draw a parallel to their properties.
TEXT BOOK

REFERENCE BOOKS

PL7102 POLYMER PROCESS ENGINEERING L T P C
3 0 0 3

OBJECTIVE
- To impart knowledge on mixing devices, extrusion moulding.
- To know the importance of Injection moulding and special moulding techniques. To understand the basic concepts in die design.

UNIT I MIXING DEVICES
Additives and Mixing process, different types of mixing devices - twin drum tumblers, ribbon blenders, Z-blade Mixer, high speed mixer, ball mill, two roll mill, banburymixer, internal mixing and screw mixing – twin screw compounding machines – high temperature and pressure mixing devices – antistatic agents.

UNIT II EXTRUSION MOULDING

UNIT III INJECTION MOULDING
Injection moulding machines and its components - moulds, multi cavity moulds, mould clamping devices, mould clamping force, disc moulding, injection blow moulding, reaction injection moulding.

UNIT IV SPECIAL MOULDING TECHNIQUES

UNIT V BASIC CONCEPTS IN DIE DESIGN
Types of moulds – ejector system – ejection techniques – mould cooling – CAD / CAM applications
OUTCOME
- Will be aware of different mixing devices, extrusion moulding.
- Will be able to methodically discuss moulding techniques.
- Will understand the basic concepts in die design

TEXT BOOKS

REFERENCE BOOKS

PL7103 SCIENCE OF POLYMERIC MATERIALS

OBJECTIVE
- The objective of this course is introduction to polymer structure, chain structure and mechanical properties.
- To impart knowledge on thermal properties and electrical properties. Students should be conversant with rheological properties.

UNIT I INTRODUCTION
Polymer structure – chain structure – micro structure – crystal structure- crystallinity – determination of crystallinity, size and orientation of crystallites using x-rays-conformation and configuration.

UNIT II MECHANICAL PROPERTIES

UNIT III THERMAL PROPERTIES
Enthalpy –melting and crystallization – importance of Tg - factors affecting Tg – determination of Tg – thermal conductivity – thermal expansion and contraction - factors affecting thermal expansion.

UNIT IV ELECTRICAL PROPERTIES
Electrical properties at low stress and high stress- breakdown mechanisms – electrically conductive plastics – electrical applications of plastics.

UNIT V RHEOLOGICAL PROPERTIES
Melt flow properties - fundamental concepts of rheology – geometry of flow – rheological

**TOTAL:** 45 PERIODS

**OUTCOME**
- Will be aware of preparation and properties of polymers at length.
- Will be able to discuss the properties of polymers.
- Will develop capacity to characterize polymers and draw a parallel to their properties.

**TEXT BOOKS**

**REFERENCE BOOKS**

**PL7104**

**SYNTHETIC RESINS**

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**OBJECTIVE**
- To acquire knowledge on the classification of natural, synthetic polymers and its commercial applications.
- To understand the basic concepts of water soluble polymers and its applications in various fields.
- To understand the concepts of thermoplastics and thermosetting resins, the importance of rubbers, fibers and plastics and their engineering applications.

**UNIT I **

**CLASSIFICATION OF POLYMERS**


**UNIT II **

**WATER SOLUBLE POLYMERS**


**UNIT III **

**THERMOPLASTIC RESINS**

UNIT IV  THERMOSETTING RESINS

UNIT V  RUBBERS AND FIBERS

TOTAL: 45 PERIODS

OUTCOME
- Will be aware of classification of polymers
- Will develop capacity to appreciate the applications of natural and synthetic polymers.

TEXT BOOKS

REFERENCE BOOKS

PL7111 POLYMER SCIENCE LABORATORY

OBJECTIVE
- To make the student conversant with polymer synthesis, kinetics of polymerization.
- To enable students develop their determination of reactivity ratio and molecular weight.
- To know the importance of fractionation of polymers.

UNIT I  POLYMERIZATION TECHNIQUES
Polymer synthesis – bulk, solution, emulsion, suspension and slurry polymerization- lowand high temperature condensation polymerization, interfacial polycondensation, thermal and redox initiated polymerizations.

UNIT II  KINETICS OF POLYMERIZATION
Kinetics of polymerization – dilatometry, gravimetry.

UNIT III  CHARACTERIZATION OF POLYMERS

UNIT IV  MOLECULAR WEIGHTS DETERMINATIONS
Determination of Molecular weight,Molecular weight determination – viscometry, end group analysis, GPC, light scattering, osmometry.
OUTCOME
- Will gain awareness in synthesis and kinetics of polymers.
- Will be able to methodically discuss fractionation of polymers.
- Will develop capacity to characterize polymers and draw a parallel to their properties.

TEXT BOOKS

REFERENCE BOOKS

OBJECTIVE
- To pass on knowledge on characterization tests, thermal and electrical properties.
- To learn mechanical properties and flammability, optical properties and analytical tests.
- To provide exposure to understand the testing of foam plastics and testing organizations.

UNIT I CHARACTERIZATION TESTS
TGA, DTA, DSC, TMA, XRD, SEM, AFM, TEM, IR, NMR, GC, GPC melt index and viscosity.

UNIT II THERMAL AND ELECTRICAL PROPERTIES
Heat deflection temperature, Vicat softening temperature, thermal conductivity thermal expansion, brittleness temperature – dielectric strength dielectric constant, dissipation factor, resistance.

UNIT III MECHANICAL PROPERTIES AND FLAMMABILITY
Tensile tests, compressive properties, impact properties, deformation, brittleness abrasion resistance hardness tests – incandescence resistance, ignition properties, oxygen index, surface burning characteristics.

UNIT IV OPTICAL PROPERTIES AND ANALYTICAL TESTS
Refractive index, luminous transmittance, haze, density, water absorption, moisture analysis, sieve analysis, crush and burst strength.

UNIT V TESTING OF FOAM PLASTICS AND TESTING ORGANIZATIONS
Foam properties, rigid and flexible foam - testing methods - ASTM, ANSI, NBS, NEMA, NFPA, UL, SPI and SPE.
OUTCOME
- Will be aware of characterization tests, thermal and electrical properties.
- Will be able to appreciate optical properties and analytical tests.
- Will get an idea about testing of foam plastics and testing organizations.

TEXT BOOKS

REFERENCE BOOKS

PL7202 HEAT, MASS AND MOMENTUM TRANSPORT PROCESSES

OBJECTIVE
- To acquire knowledge on momentum transport process and solution to equations of motion.
- To understand the basic concepts of heat transfer by conduction process and convective heat transfer process.
- To know the importance of mass transfer.

UNIT I MOMENTUM TRANSPORT PROCESS
Momentum transport – fluid behavior – overall mass, energy and momentum balances – differential mass, energy and momentum balance-polymeric liquids.

UNIT II SOLUTION TO EQUATIONS OF MOTION
Solution to equations of motion - flow measurement - boundary layer flow – turbulent flow– dimensional analysis applied to momentum transport – design equation for incompressible fluid-flow through packed column–fluidization.

UNIT III HEAT TRANSFER BY CONDUCTION PROCESS

UNIT IV CONVECTIVE HEAT TRANSFER PROCESS
Convective heat transfer – heat transfer in laminar and turbulent flow- boiling and condensation – design equations for convective heat transfer – heat exchangers.

UNIT V MASS TRANSFER
Mass transfer – molecular diffusion – binary systems – convective mass transfer coefficients – mass transfer in laminar and turbulent flow – design equations for convective mass transfer – analysis between momentum, heat and mass transfer.
OUTCOME
- Will be aware of momentum transport process and solution to equations of motion.
- Will be able to methodically discuss heat transfer process.
- Will understand the importance of mass transfer.

TEXT BOOKS

REFERENCE BOOKS

PL7203 INSTRUMENTATION IN POLYMER INDUSTRY

OBJECTIVE
- To make the student familiar with the process variables, measurement and control etc.,
- To understand the use of mathematical analysis of processes, etc., and Computer control and applications.
- To acquaint the student with Instrumentation in blow moulding etc.,

UNIT I PROCESS VARIABLES
Process variables such as temperature, pressure, flow etc. and their measurements. Examples in polymer processing in moulding, extrusion.

UNIT II MEASUREMENT AND CONTROL
Measurement and control – Simple systems-first and higher order systems- Design specifications on system time response – feedback control diagram – proportional, integral, derivative and PID controls.

UNIT III MATHAMATICAL ANALYSIS
Mathematical analysis of processes and feedback control systems –poles, zeros and system stability-Stability Analysis- Routh’s Test-Root locus-frequency response using Bode plot.

UNIT IV COMPUTER CONTROL
Computer control and application – mathematical concepts of discrete variables analysis and multivariable processes and other control methods as feed forwardcontrol, ratio control and internal model control etc.

UNIT V INSTRUMENTATION
Instrumentation in blow moulding, extrusion and injection moulding and control systems.

TOTAL : 45 PERIODS
OUTCOME
- Will be familiar with the process variables, measurement and control etc.,
- Will be able to use computer control and its applications effectively.
- Will develop capacity to use moulding techniques.

TEXT BOOKS

REFERENCE BOOKS

PL7204 POLYMER PROCESS TECHNOLOGY

OBJECTIVE
- To impart knowledge on raw materials and polymerization techniques.
- Students should be conversant with technology of polymerization, polymer processing.
- To provide exposure to the students to understand technology of elastomers.

UNIT I RAW MATERIALS
Petroleum, natural gas, biogas and coal sources of monomers – manufacture of acetylene, ethylene, propylene, vinyl chloride, toluene, phenol and styrene.

UNIT II POLYMERIZATION TECHNIQUES
Condensation and solution polymerization – melt, interfacial, gas phase – bulk, dispersion, solution, suspension and emulsion – RAFT and ATRP polymerization - reactors for polymerization.

UNIT III TECHNOLOGY OF POLYMERIZATION
Specific technology of polymerization – polystyrene, LDPE, HDPE, LLDPE, nylons, butyl rubber, polypropylene, PVC and PET – copolymerization techniques – SBR and ABS.

UNIT IV POLYMER PROCESSING
Processing of thermoplastics and thermosetting plastics – compounding – fillers, plasticizers, coupling agents, antidegradants, cross-linking agents, stabilizers, lubricants, colorants, and antioxidants – machines for compounding.

UNIT V TECHNOLOGY OF ELASTOMERS

TOTAL: 45 PERIODS
OUTCOME
- Will be aware of raw materials and polymerization techniques.
- Will be able to methodically discuss technology of polymerization and polymer processing.
- Will develop capacity to characterize elastomers and draw a parallel to their properties.

TEXT BOOKS

REFERENCE BOOKS

PL7211 POLYMER PROCESSING AND TESTING LABORATORY

OBJECTIVE
- To enable students to know the processing of polymers and testing of plastics etc.,
- To know the importance of thermal, electrical and optical properties of the polymeric materials.
- To understand the basic concepts of identification, characterization, flammability and analytical testing of polymers.

UNIT I PROCESSING OF POLYMERS
Processing of polymers – principles of compounding and processing for the manufacture of plastics and rubber products- injection, blow and compression moulding, extrusion, calendaring and casting processes.

UNIT II TESTING OF PLASTICS
Testing of plastics and dry rubber products – mechanical properties – tensile, Flexural, compressive, impact, hardness, abrasion and fatigue resistance tests.

UNIT III THERMAL PROPERTIES
Thermal properties – thermal conductivity, thermal expansion and brittleness temperature, heat deflection temperature.

UNIT IV ELECTRICAL PROPERTIES
Electrical properties – dielectric strength, dielectric constant and dissipation factor. Electrical resistance tests - arc resistance.

UNIT V OPTICAL PROPERTIES
Optical properties – refractive index, transmittance and haze, gloss.
UNIT VI  MATERIAL CHARACTERIZATION
Material characterization tests – thermoplastics – MFI, capillary rheometer test – thermosets – apparent (bulk) density, bulk factor, pourability, viscosity (Brookfield), gel time and peak exothermic temperature.

UNIT VII  FLAMMABILITY TESTS
Flammability tests – oxygen index test, ignition temperature determination.

UNIT VIII  ANALYTICAL TESTS
Analytical tests – specific gravity, density, water absorption, moisture analysis.

UNIT IX  ANALYSIS OF PLASTICS
Identification and analysis of plastic and dry rubber materials – chemical and thermal analysis for identification of polymers.

OUTCOME
- Will be able to develop methods for processing of polymers and testing of plastics etc.
- Will be able to discuss thermal, electrical and optical properties of the polymeric materials.
- Will be able to recognize the basics in analytical testing of polymers.

TEXT BOOKS

REFERENCE BOOKS

PL7301  ENGINEERING PLASTICS  L T P C
3 0 0 3

OBJECTIVE
- To acquire knowledge of polymers meant for electrical, electronics and high temperature applications.
- To impart basic knowledge on polymer blends, alloys and liquid crystals.
- To gain knowledge of polymers in lithography, water treatment and biomedical applications.

UNIT I  POLYMERS FOR ELECTRICAL AND ELECTRONICS APPLICATIONS

UNIT II  POLYMERS FOR HIGH TEMPERATURE APPLICATIONS
UNIT III POLYMER BLENDS, ALLOYS AND LIQUID CRYSTALS

UNIT IV POLYMERS IN LITHOGRAPHY AND WATER TREATMENT

UNIT V POLYMERS FOR BIOMEDICAL APPLICATIONS

TOTAL: 45 PERIODS

OUTCOME
- Will be able to apply polymers to electrical, electronics and high temperature fields.
- Will understand polymer blends, alloys and liquid crystals.
- Will appreciate the application of polymers in a variety of fields.

TEXT BOOKS

REFERENCE BOOKS

PL7001 ADHESIVE SCIENCE AND TECHNOLOGY

OBJECTIVE
- To bring a sound knowledge of theoretical and technological aspects of mechanism and characterization of adhesives.
- To understand the various types of Adhesives employed in Industries.
- To acquire knowledge of Applications of adhesives in various fields.

UNIT I ADHESION MECHANISM
UNIT II CHARACTERIZATION OF ADHESIVES
Principle of fracture mechanics, peel, lap sheen and butt tensile tests. Pull out of an extendable fibre, various testing and evaluation of adhesives, energy dissipation – plasticity – strength of elastomers.

UNIT III INDUSTRIAL ADHESIVES

UNIT IV ADHESIVE TYPES

UNIT V APPLICATIONS OF ADHESIVES
Adhesives for building construction, medical use, automobile industry bonded and coated abrasives – fabrics, cyanoacrylate based adhesives, bonding technology for textile, metal, plastics, wood, paper and glass.

TOTAL: 45 PERIODS

OUTCOME
• Will be able to attain the basic knowledge of adhesives.
• Will be able to comprehend the utility of adhesives in industry.
• Will develop capacity to apply adhesives in various fields.

TEXT BOOKS

REFERENCE BOOKS

PL7002 BIOPOLYMERS AND BIODEGRADABLE POLYMERS

OBJECTIVE
• To acquire knowledge on synthetic biodegradable polymers and its applications.
• To gain knowledge on principles of biodegradation and disposal of municipal waste.
• To study about the biopolymers and their structures.

UNIT I SYNTHETIC BIODEGRADABLE POLYMERS
Biodegradable polymers - poly-caprolactone- modified poly-caprolactone copolymer with ester, amide and urethane linkages, polyglycolate, polymandelic acid. Copolymer of 1,4- butanediol with adipic acid and sebacic acid, polyalkylene tartrate cellulose block copolymers.

UNIT II PRINCIPLES OF BIODEGRADATION 9
Biodegradation - introduction – modes of biological degradation – enzymatic degradation of biopolymers (poly saccharides, proteins, nucleic acids) and synthetic polymers - microbial degradation of synthetic polymers.

UNIT III DISPOSAL OF MUNICIPAL WASTE 9

UNIT IV BIOPOLYMERS 9

UNIT V STRUCTURE OF BIOPOLYMERS 9
Proteins, nucleic acids and polysaccharides – the macromolecular structure and biological functions of polymers- primary, secondary, tertiary and quaternary structure of polymers – structure maintenance and transmission of the biological information- structure and enzymatic activity – mechano structural function of biopolymers- viruses and phages – living macromolecules.

TOTAL: 45 PERIODS

OUTCOME
• Will be concerned for environment by synthesizing synthetic biodegradable polymers.
• Will be able to methodically discuss importance of waste management.
• Will develop capacity to comprehend biopolymers and their application.

TEXT BOOKS

REFERENCE BOOKS
OBJECTIVE

- To acquire a knowledge of various types of composites and its advantages and needs.
- To understand the various types of fiber materials and its applications for making composites.
- To understand the knowledge of various resins materials used in processing of composites and the basic destructive and non-destructive testing of composites.

UNIT I CHARACTERISTICS OF COMPOSITES

Characteristics, advantages, and need of composites – Classification – particulate, fibrous, laminated, advanced and hybrid composites, CCCs, nanocomposites. Predicting properties of Fiber-Reinforced composites.

UNIT II MATERIALS


UNIT III PROCESSING OF COMPOSITES

Different types of molds- DMC, SMC and prepregs. Hand & Spray layup- RTM, Bag, autoclave, centrifugal and compression molding processes, pultrusion, Vacuum infusion, filament winding and sandwich construction.

UNIT IV TESTING OF COMPOSITES


UNIT V NANOCOMPOSITES

Introduction: Nanoscale Fillers – Clay, POSS, CNT, nanoparticle fillers; Processing into nanocomposites; Modification of interfaces; Properties. Applications.

TOTAL: 45 PERIODS

OUTCOME

- Will be conversant with knowledge of various types of composites and its advantages and needs.
- Will be able to know various types of fiber materials and its applications for making composites.
- Will understand the knowledge of various resins materials used in processing of composites and the basic destructive and non-destructive testing of composites.

TEXT BOOKS

REFERENCE BOOKS

PL7004 COMPUTER AIDED DESIGN

OBJECTIVE

- To impart knowledge on Computer graphics fundamentals and Interactive computer programming.
- The students should be conversant with Computer animation and Mechanical assembly.
- To introduce Proto typing, process planning and CAD CAM integration.

UNIT I COMPUTER GRAPHICS FUNDAMENTALS

UNIT II INTERACTIVE COMPUTER PROGRAMMING
Requirements of interactive programming – types of interactive programming – objective oriented programming – development of interactive programme in languages like auto LISP etc. – applications.

UNIT III COMPUTER ANIMATION

UNIT IV MECHANICAL ASSEMBLY

UNIT V PROTOTYPING, PROCESS PLANNING AND CAD CAM INTEGRATION
Basics of prototyping - principles and planning – basics of process planning and CAD CAM integration.

OUTCOME
- Will be able to appreciate incorporation of computers in chemistry.
- Will be able to use computers as a tool in solving chemistry related problems.
- Will be able to create programs for direct use in problem solving.

TEXT BOOKS

REFERENCE BOOKS
PL7005  CONDUCTING POLYMERS  L T P C
3 0 0 3

OBJECTIVE
- To acquire a knowledge of chemistry on conducting polymers and its conductivity.
- To understand the basic concepts of synthesis, processing and applications of conducting polymers.
- To impart knowledge on spectral, morphological, thermal, mechanical and electrochemical characterization of conductive polymers.

UNIT I  ELECTROCHEMISTRY OF CONDUCTING POLYMERS  9

UNIT II  SYNTHESIS, PROCESSING AND APPLICATIONS OF CONDUCTING POLYMERS  9
Synthesis of conducting polymers – chemical, electrochemical and enzymatic methods – Synthesis, processing methods and applications of polyacetylene, polyaniline, polypyrrole, polythiophene and poly-paraphenylene based conducting polymers.

UNIT III  ELECTROCHEMICAL CHARACTERIZATION OF CONDUCTING POLYMERS  9
Electro-analytical techniques – cyclic voltammetry, chronoamperometry and chrono-coulometry

UNIT IV  SPECTRAL AND MORPHOLOGICAL CHARACTERIZATION OF CONDUCTING POLYMERS  9
FTIR, UV-vis, Raman, XRD, SEM, TEM and NMR

UNIT V  MECHANICAL AND THERMAL CHARACTERIZATION OF CONDUCTING POLYMERS  9
UTM, Dilatometry, TGA, DTA, DSC and DMA

TOTAL: 45 PERIODS

OUTCOME
- Will get a basic idea about conducting polymers.
- Will be able to synthesis conducting polymers.
- Will be able to characterize and analyse the properties of conducting polymers.

TEXT BOOKS

REFERENCE BOOKS
OBJECTIVE

- To make the student to acquire knowledge in polymers for special application.
- To provide exposure to the students about advanced polymeric materials.

UNIT I LIQUID CRYSTALLINE POLYMERS (LCPS) 9
Concept of liquid crystalline (LC) phase, liquid crystalline polymers and their classification. theories of liquid crystallinity, characteristics of LC state and LCPs, synthesis, structure property relationship, rheology of liquid crystalline polymers, blends of LCPs, self reinforced composites, applications of LCPs.

UNIT II CONDUCTING POLYMERS 9
Theory of conduction, semi conductors and conducting polymers, band theory, requirements for polymer to work as conductor, types of conducting polymers - intrinsic and extrinsic, doping of polymeric systems, Mechanism of conducting polymers - Polyaniline, Polyacetylene, Polypyrole, organometallic polymers – Photo conducting polymers- Polymers with Piezzo, ferro and pyro electric properties.

UNIT III HEAT RESISTANT POLYMERS 9
Requirements for heat resistance, determination of heat resistance, synthesis, structure-property relationships, applications of heat resistant polymers like polyamides, polyimides and its derivatives, polyquinolines, polyquinoxalines, Polymers for high temperature resistant-PBT, PBO, PBI, PPS, PPO, PEEK, Fluro polymers, aromatic polymers and heterocyclic polymers.

UNIT IV PHOTOSENSITIVE POLYMERS AND POLYMERS AS COATING ADDITIVES 9
Photosensitive polymers - synthesis, curing reactions, applications in various fields. Photo resist for semiconductor fabrication. Membranes, their types, methods of casting and their applications. Polymer as coating additives - types, synthesis, requirements for polymer to work as coating additives and applications.

UNIT V POLYMERS IN MISCELLANEOUS SPECIALTY APPLICATIONS 9
Polymers in agricultural applications: green houses, mulches, control release of agricultural chemicals, seed coatings, etc., polymers in construction and building applications, polymer concrete, polymeric materials used in telecommunication and power transmission applications, polymer composites in aerospace and other light weight applications, polymers in cosmetics

TOTAL: 45 PERIODS

OUTCOME

- Will be aware of preparation and properties of speciality polymers
- Will be able to methodically discuss application of speciality polymers.
- Will develop capacity to characterize polymers and draw a parallel to their properties.

TEXT BOOKS

OBJECTIVE
- The objective of this course is introduction to packaging application using polymers
- To impart knowledge on packaging application
- Students should be conversant with packaging materials

UNIT I POLYMERIC MATERIALS FOR PACKAGING APPLICATION
Major polymers used for packaging - Evaluation of the following polymers for packaging Applications - polyethylene, EVA, EAA, ionomers, LDPE, HDPE, LLDPE, metalloocene polymer, PP, PVC, PVDC, PS, PVOH, EVOH, nylon, polyester, polycarbonate, fluoropolymers, ABS, acrylonitrile

UNIT II METHODS OF PROCESSING OF PACKAGING
Adhesives, heat sealing types, sealing method, extrusion blown film and cast film and sheet coextrusion, surface treatment testing and evaluation of films, flexible packaging, pouches, bulk and heavy duty bags, thermoforming, thin sheet thermoforming, blow moulding, extrusion and injection blow moulding, foams, cushioning and distribution packaging thermoplastic

UNIT III POLYMERS FOR BIO BASED FOOD
Edible and biobased food packaging materials, edible film and coating, Polysaccharide based coatings, Lipid based coatings, Protein based coating, First, Second and third biobased packaging materials. permeability of thermoplastic polymers, multilayer films, processing, deteriorative reaction in foods, enzyme reactions, chemical reactions, physical change, biological change, shelf life of foods, factors controlling shelf life.

UNIT IV POLYMERS FOR MEDICAL APPLICATION
Polymer used in pharmaceutical products-polymers in packaging and medical prosthetics. Bioderadable polymers in medical field-Polymers application in medical devices. Polymers used in drug delivery. Environmental friendly microbial polymers, Polyhydroxyalkanoates(PHAs) for Packaging and biomedical applications

UNIT V ATMOSPHERE PACKAGING FOR FOODS AND OTHER INNOVATIONS

TOTAL: 45 PERIODS
OUTCOME
- Will be aware of processing methods of polymers used for packaging applications
- Will develop capacity to understand polymers employed in various fields
- Will be able to discuss the application of polymers in packaging field

TEXT BOOKS
2. Sajid Alavi, Sabu Thomas, K. P. Sandeep, Nandakumar Kalarikkal, Jini Varghese,
4. Press
6. Isevier 2009

REFERENCE BOOKS

PL7006 INDUSTRIAL MANAGEMENT

OBJECTIVE
- To acquire knowledge on man power planning, motivation and productivity.
- To learn the Industrial relations, public policies, leadership and management in the trade union.
- To understand the basic concepts of dynamics of conflict and collaboration and also on Workers participation and management.

UNIT I MAN POWER PLANNING

UNIT II MOTIVATION AND PRODUCTIVITY

UNIT III UNION MANAGEMENT PERSPECTIVE

UNIT IV DYNAMICS OF CONFLICT AND COLLABORATION
UNIT V   WORKERS PARTICIPATION AND MANAGEMENT
Concept, strategies and practices –models in workers participation management – design and dynamics of anticipative forms – case studies– case study analysis – synthesis
TOTAL: 45 PERIODS

OUTCOME
• Will be able to manage industrial issues effectively.
• Will be concerned about labour laws and policies.

TEXT BOOKS

REFERENCE BOOKS
1. C.B. Memoria and S_MEMoria, Dynamics of Industrial Relations in India, Himalaya Publishing co., Bombay, 1985

PL7007   PLASTICS WASTE MANAGEMENT

OBJECTIVE
• To make the student familiar with the polymer wastes and primary and secondary recycling.
• To acquaint the student with tertiary and quaternary recycling, recycling of plastics.
• To introduce to students with recycling of plastics.

UNIT I   POLYMER WASTES
Sources of plastics waste – definitions - generation of industrial plastic waste - plastic in solid waste; Separation of components in municipal refuse - separation process specific to plastics-legal aspects.

UNIT II   PRIMARY AND SECONDARY RECYCLING

UNIT III   TERTIARY AND QUATERNARY RECYCLING

UNIT IV   RECYCLING OF PLASTICS

UNIT V   RECYCLING PROCESSES
OUTCOME
- Will be aware of plastics waste management.
- Will develop techniques for recycling of plastics.
- Will develop concern for environment and develop skills to address the same.

TEXT BOOKS

REFERENCE BOOKS

PL7010 PROCESS INSTRUMENTATION

OBJECTIVE
- To learn about temperature measurement and pressure, level and flow measurement.
- To acquaint the student physical property measurement in and process chemical analyzer.
- To know the importance of Indicating and recording instruments.

UNIT I TEMPERATURE MEASUREMENT
Differential expansion and fluid expansion types - resistance thermometers-thermoelectric pyrometers - radiation pyrometers - optical pyrometers- pyrometric cones- ultrasonic thin wire thermometer- location of temperature measuring devices in equipment

UNIT II PRESSURE, LEVEL AND FLOW MEASUREMENT
Liquid types and spring balanced type pressure measuring devices- manometer and sealed belt types of pressure measuring equipment- pressure transmitters - various types of level measuring equipment - volumetric, variable head meters for flow measurement- variable area meters - velocity and current meters- ultrasonic flow meters - mass meters.

UNIT III PHYSICAL PROPERTY MEASUREMENT
Density and specific gravity - viscosity and consistency - refractive index analysers - boiling point and flash point analyzers - thermal conductivity measurement - moisture measurement.

UNIT IV PROCESS CHEMICAL ANALYZER
Chromatographic analyzers, infrared analyzers, ultraviolet and visible radiation analyzers mass spectrometers, electro analytical instruments.

UNIT V INDICATING AND RECORDING INSTRUMENTS
Measurement to indicator transducers, analog and digital indicating and recording instruments, variables of importance to various industries and their measurement.

TOTAL: 45 PERIODS
OUTCOME
- Will have a basic understanding of the engineering concepts involved in the chemical industry.
- Knows the importance of in physical property measurement the industrial operations.
- Can associate the reactions that he has already learnt with the actual process in the industry

TEXT BOOKS

REFERENCE BOOKS

PL7011 REACTION ENGINEERING L T P C 3 0 0 3

OBJECTIVE
- To train students in reaction kinetics and evaluation of reaction rate and reactors.
- To make the student conversant with the heat effects in reactors and reactor stability.
- To familiarize chemical equilibria and equilibrium constant to students

UNIT I REACTION KINETICS AND EVALUATION OF REACTION RATE

UNIT II REACTORS

UNIT III HEAT EFFECTS IN REACTORS
Heat effects in reactors – isothermal and non-isothermal homogeneous systems adiabatic reactors – rates of heat exchange for different reactors – design for constant rate heat input and constant heat transfer coefficient operation – batch and continuous reactors.

UNIT IV REACTOR STABILITY
Reactor stability – criteria for stability of reactors, limit cycles and oscillating reactions

UNIT V CHEMICAL EQUILIBRIA AND EQUILIBRIUM CONSTANT

TOTAL: 45 PERIODS

OUTCOME
- Will understand reaction kinetics.
- Will be able to comprehend heat effects in reactors and reactor stability.
Will be aware of different reactors.
Can grasp the idea of chemical equilibria and equilibrium constant

TEXT BOOKS

REFERENCE BOOKS

PL7012 RUBBER TECHNOLOGY

OBJECTIVE
- To acquire knowledge in the Fundamentals of Rubber and Specialty Rubbers.
- To know about the Processing of Rubber and Manufacture of tyres and Tubes.
- To impart knowledge on rubbers used in Belting, hoses and Footwear.

UNIT I FUNDAMENTALS OF RUBBER
Criteria for a polymer to behave as a rubber – structure vs Tg, chemical, mechanical and electrical properties – polymerization types and techniques involved in production of general purpose rubbers – ozone attack on rubbers – protection against oxidation – antioxidants – network bound antioxidants, vulcanization – mechanism of sulphur cure -effect of crosslink density on properties – role of accelerators, activators – non-sulphur vulcanization systems.

UNIT II SPECIALTY RUBBERS

UNIT III PROCESSING OF RUBBER

UNIT IV MANUFACTURE OF TYRE AND TUBES

UNIT V BELTING, HOSES AND FOOTWEAR

TOTAL: 45 PERIODS
OUTCOME

- Will be aware of preparation and properties of rubbers.
- Will be conversant in manufacture and properties of tyres and Tubes.
- Will develop capacity to appreciate the applications of rubber.

TEXT BOOKS


REFERENCE BOOKS


PL7014 SYNTHETIC FIBRES

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OBJECTIVE

- To introduce the textile process and also teach about manufacture of fibre forming polymers.
- To make the student conversant with the manufacture of filament fibre and Manufacture of Staple fibre.
- To teach Texturization.

UNIT I INTRODUCTION TO TEXTILE PROCESS

Classification of fibres, yarn manufacture, fabric manufacture, wet processing of textile, testing of textile materials.

UNIT II MANUFACTURE OF FIBRE FORMING POLYMERS

Polymer production - fibre forming polymers – properties, characterization - production of polyethylene terephthalate (PET), polyester, nylon, polyacrylonitrile and polypropylene.

UNIT III MANUFACTURE OF FILAMENT FIBRE

Filament fibre manufacture - melt, wet and dry spinning of polymers- spin finishes – functions, constitution and application - post spinning operations – drawing and winding.

UNIT IV MANUFACTURE OF STAPLE FIBRE

Staple fibre manufacture - production of staple fibres – drawing of tow, heat setting, crimping and cutting - tow to top converters – advantages, principles and working of machines.

UNIT V TEXTURIZATION

Texturization - introduction, methods, false twist texturing, air jet texturing, comparison.

TOTAL: 45 PERIODS

OUTCOME

- Will be up to date with the preliminary preparation of fibers.
- Will have clear understanding of the concept of dyeing.
- Will be familiar the machinery and stages involved in textile processing.
TEXT BOOKS

REFERENCE BOOKS

PL7008 POLYMERS FOR BIOMEDICAL ENGINEERING APPLICATIONS  L  T  P  C  3  0  0  3

OBJECTIVE
- To acquire a knowledge of various types of biopolymers and their advantages and needs.
- To understand the various types of bio-materials and their applications for bio-medical engineering.
- To understand the knowledge of various bio-materials used in processing of components and the basic destructive and non-destructive testing of such bio-materials.

UNIT I MATERIALS IN MEDICINE  9
Introduction to classes of materials used in medicine, world-wide market for biomaterials, clinical implications of biomaterials development. Types of materials - inert, toxic, bioactive, natural materials - collagen, biopolymers etc. Introduction to biocompatibility, requirements and standards, cell-material interaction, testing of biomaterials, in vitro assessment, in vivo assessment of tissue compatibility, testing of blood-materials interaction, animal models.

UNIT II BIO POLYMERS  9
Polymers as biomaterials, silicones, polyurethanes, polyvinyl chloride, polyethylenes, Ultra high molecular weight polyethylene, polyacrylates, polyether ether ketone, water soluble polymers, hydrogels, bio-adhesives, diffusion principles, polymers for controlled drug delivery applications, polysaccharides, poly(orthoesters), polyanhydrides, aminoacid derived polymers, polyphosphazenes, bacterial polyesters etc.

UNIT III COMPOSITES IN BIOMEDICAL APPLICATIONS  9
UNIT IV  MEDICAL DEVICES  9
Medical devices, medical device development, material choice, device design, extracorporeal devices, oxygenators, intravenous catheters, stents, polymeric implants, heart valves, total artificial heart, cardiac pace makers, vascular grafts, artificial kidney, dialysis membranes, hard tissue implants, orthopedic implants, fracture plates, intramedullary devices, spinal fixation, joint replacements, bone cement, soft tissue replacements, wound dressing, artificial skin, sutures, contact lenses, tissue adhesives, maxillofacial implants, ear and eye implants, controlled drug delivery systems, biosensors, gloves, condoms, urinary catheters, intrauterine systems, cosmetic implants. Regulation and standards for quality, FDA, EU-medical directives, GMP, GLP, ISO, CE marking etc.

UNIT V  MODIFICATION TECHNIQUES  9
Surface modification techniques, plasma modifications, coating methods. Sterilization methods, dry heat, steam, ethylene oxide, gamma ray, effect of sterilization on polymers, importance of packaging, shelf-life.

OUTCOME
- Will be aware of preparation and properties of bio-polymers.
- Will be able to use bio-polymeric materials for making components.
- Will be able to appreciate the basic destructive and non-destructive testing of bio-polymeric materials.

TEXT BOOKS

REFERENCE BOOKS

PL7015  TOTAL QUALITY MANAGEMENT  L T P C
3 0 0 3

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

UNIT I  CONCEPTS OF TQM  5
Philosophy of TQM, Customer focus, organization, top management commitment, team work, quality philosophies of Deming, Crosby and Muller.

UNIT II  TQM PROCESS 12
QC Tools, Problem solving methodologies, new management tools, work habits, quality circles, bench marking, strategic quality planning.
UNIT III  
TQM SYSTEMS
8
Quality policy deployment, quality function deployment, Standardization, designing for quality, manufacturing for quality.

UNIT IV  
QUALITY SYSTEM
10
Need for ISO 9000 system, Advantages, clauses of ISO 9000, Implementation of ISO 9000, quality costs, quality, auditing, case studies.

UNIT V  
IMPLEMENTATION OF TQM
10
Steps, KAIZEN, 5s, JIT, POKAYOE, Taguchi methods, case studies.

TOTAL : 45 PERIODS

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

REFERENCES