M.Sc.-Polymer Science & Technology

Course Description and Learning Outcome

SEMESTER - 1

Subject: PS01CPST21- Basic Concept in Polymer Science

Faculty: Dr. M M Raj

Course Description

The course introduces basic knowledge of polymer science which is very important for learning of post graduate course. The course provides important information regarding Molecular Weight, Glass transition temperature & Crystallization of Polymers, Chemistry of polymerization and its techniques. Course also covers important aspects of polymer degradation.

Learning Outcomes/Capability Development

At the completion of this course, students should be able to

- Understand the basic concepts of polymers
- To understand polymerization techniques and reactions
- Understand various transition of polymers.
- Understand basic knowledge of molecular weights.
- Understand the idea of polymer degradation.

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Course Description and Learning Outcome

SEMESTER - 1

Subject: PS01CPST22**-** Industrial Polymers

Faculty: Dr. M M Raj

Course Description

The course provides an introduction to thermoplastics and thermosets materials and introduces practical application in industry. It also covers synthesis of monomers, Polymerization, Structure related properties, general properties, copolymers and applications of thermoplastic and thermoset materials and also covers the curing of thermoset materials.

Learning Outcomes/Capability Development

At the completion of this course, students should be able to

- Detail study of monomer synthesis and its polymerization
- Course also covers study of copolymerization
- To understand different thermoplastics materials and its application
- To understand different thermoset resins and its application
- To understand curing kinetics of thermoset polymer
- To understand process parameters of polymers

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Course Description and Learning Outcome

SEMESTER - 1

Subject: PS01CPST23: Polymer materials and recycling

Faculty: Dr. Amit Thummar

Course Description

The course provides basic information and synthesis and application about engineering polymers like Nylon, Polyimide, polycarbonate, polyacetals etc. Thermoplastics elastomers like styrenics, polyesters, polyurethanes etc. Course

also covers polymer from green precursor and polymer recycling and waste management

Learning Outcomes/Capability Development

At the completion of this course, students should be able to

- Have basic knowledge of engineering polymers.
- Understand the thermoplastics elastomers.
- Have some idea about polymer recycling and waste management.
- Detail knowledge of polyamide, polyimide, polyacetal and their applications
- Knowledge of important polymer from green precursor.

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Course Description and Learning Outcome

SEMESTER - 1

Subject: PS01EPST 21**-** Industrials Chemistry I

Faculty: Mr Jay Mehta

Course Description

The course provides basic information about the unit operation and unit processes. The course covers the concept of various unit processers like halogenations, alkylation, oxidation, hydrogenation, nitration, sulfonation, esterification, hydrolysis and hydration.

Learning Outcomes/Capability Development

At the completion of this course, students should be able to

- Understand the basic concepts of unit operation and unit process.
- Understand the reaction mechanism, kinetics and thermodynamics of unit processes.
- Gain knowledge about raw materials, agents and reaction conditions required to carry out the specific unit process.
- Knowledge of material of construction
- Understand the safety and hazard criteria related to unit processes.

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Course Description and Learning Outcome

SEMESTER - 2

Subject: PS02CPST21**-** : Polymer Characterization

Faculty: Dr. M M Raj

Course Description

The course provides basic information about Importance of Quality control and Characterization of molecular weight in which different molecular weight determination techniques, Material Characterization Test which covers Melting point, Softening point, Thermal conductivity, Shrinkage, Melt Flow Index test Melting point, Softening, Mechanical and Flammability Properties,Electrical, Chemical and Weathering Properties:

Learning Outcomes/Capability Development

At the completion of this course, students should be able to:

- Understand the Importance of Quality control.
- Understand Characterization of molecular weight.
- Gain knowledge about different molecular weight determination techniques, Material Characterization Test which covers Melting point, Softening point.
- Knowledge of Dielectric strength, Dielectric constant, Insulation resistance and arc resistance, Immersion test, Stain resistance test
- Knowledge of Hardness, Tensile strength, Compression strength, Flexural strength, Impact strength, Ignition properties

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Course Description and Learning Outcome

SEMESTER - 2

Subject: PS02CPST22 - Polymer Processing Technology

Faculty Dr M M Raj

Course Description

The first part of the course aims to introduce Principles of the processing of plastics basic concepts and principles of Compression, Extrusion, Blow & Rotational Moulding heat transfer encountered in chemical process industries. It covers Fundamental principles, Materials- factors to be considered in Injection moulding. It also covers Fundamental principles, Materials- factors to be considered in Calendaring, Casting, Thermoforming

Learning Outcomes/Capability Development

At the completion of this course, students should be able to:

- Understand the basic concepts Melt processing of thermoplastics and melt processing of thermosetting plastics
- Understand and use Types of mixers- Twin drum tumbler, ribbon blender, high speed mixer, ball mill and Cowles dissolver
- Basic knowledge of Types of mixers- Twin drum tumbler, ribbon blender, high speed mixer, ball mill and Cowles dissolver
- Understand and use Types of injection moulding machines and moulding process. Specifications of injection moulding machine, Injection unit-screw, nozzles, heating cylinders.
- Understand the Process, Machinery & equipments, Moulds, Heating &

cooling of moulds, Finishing and troubleshooting in Calendaring, Casting, and Thermoforming.

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Course Description and Learning Outcome

SEMESTER - 2

Subject: PS02CPST23 **–** Polymer Additives

Faculty: Dr. Amit Thummar

Course Description

The course introduces the General aspects of Additives i.e. technical requirement of additives, unavoidable side effects, methods of incorporation of additives.

Other portion of the course deals with the various important additives such as lubricants, filler and reinforcement, stabilizer, anti-ageing additives, optical property modifier, thixotropic agents

Learning Outcomes/Capability Development

At the completion of this course, students should be able to:

- Understand the technical requirement of additives in polymers
- Understand the general mechanism of lubricants and stabilizer how they are useful in processing
- Understand the plasticizer, filler, reinforcing agent and its application in improve flexibility and cost reduction
- Understand the mechanism and application other additives such as optical property modifier, thixotropic agents, uv stabilizer etc

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Course Description and Learning Outcome

SEMESTER - 2

Subject: PS02EPST21 **-** Industrial Chemistry – II

Faculty: Mr. Smit Patel

Course Description

To study the basics crystallization, separation of solid from solid, absorption and adsorption of gas and solvent, filtration, size reduction equipments, heat exchangers

The second part of the course aims to apply knowledge from The second part of the course aims to cover the basic concept of fluid flow and its application to chemical process industries including pipe flow, fluid machinery and agitation & mixing.

Learning Outcomes/Capability Development

At the completion of this course, students should be able to:

- Understand the basic concepts of crystallization.
- Understand the different type of adsorption and absorption.
- Understand various methods of size reduction.
- Analyse fluid system and design pumps
- Apply concepts of mass, momentum and energy conservation to flows
- Understand the basic principle behind various mixers used in chemical industries and their selection in respective applications

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Course Description and Learning Outcome

SEMESTER - 3

Subject: PS03CPST21 - Polymer Rheology

Faculty: Dr. M M Raj

Course Description

The course is divided into four units. The first unit highlight on Basic introduction of flow properties of polymer melts.
The second unit comprises various effects of flow properties during processing of polymer melts.
The third unit covers various processing equipments with different flow properties of various polymers. The four-unit covers the instrumentation methods of measurements of rheology

Learning Outcomes/Capability Development

At the completion of this course, students should be able to:

- Understand the basic of rheology of polymers
- Understand theory, principle and application of various analytical equipments use for measurements of flow properties of polymer melts.
- Basic understanding of working with different rheological aspects
- Understand process parameters of different rheology of polymers.
- Understanding of mathematical parameters with process equipments.

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Course Description and Learning Outcome

SEMESTER - 3

Subject: PS03CPST22 - Polymer Composites & Fibre Technology

Faculty: Dr. Amit Thummar

Course Description

The first part of the course emphasises on the knowledge of composite which covers types of mold for composites and preparation of molds, release agents.
The second part of the course aims to cover the reinforcing materials in which natural, semi synthetic, synthetics fiber its properties and applications.
The third part of the course aims to cover the polymer matrix materials i.e epoxy resin, polyester resin synthesis, curing, properties and applications
The fourth part of the course aims to cover the processing techniques of composites i.e. hand lay up, spray lay up, vaccum bag, pressure bag etc.

Learning Outcomes/Capability Development

At the completion of this course, students should be able to:

- Understand composite and design of mould to make composite
- Understand the reinforcement material i.e. natural, semi synthetic, synthetics fiber
- Understand the Spinning & Finishing of fiber
- Understand the matrix material for composite and its curing kinetics
- Understand the processing of composite
- Filament winding, centrifugal casing, pulstrusion, continuous lamination etc

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Course Description and Learning Outcome

SEMESTER - 3

Subject: PS03CPST 23 **-** Petrochemicals

Faculty: Dr. Amit Thummar

Course Description

The course introduces the crude petroleum and natural gas as a resource for energy production and chemical production. It also includes the technologies of petroleum refining and processing to obtain the more valuable lighter fractions and intermediates for petrochemicals.

Other portion of the course deals with the production technologies of various important petrochemicals from various saturated, unsaturated and aromatic hydrocarbons obtained from petroleum.

Learning Outcomes/Capability Development

At the completion of this course, students should be able to:

- Understand the importance of crude petroleum as a resource for energy and chemicals
- Understand the chemical composition of natural gas and crude petroleum and learns the common analytical techniques to evaluate the quality of a crude oil
- Understand the commercial processes used for the refining and processing of natural gas and crude petroleum
- Understand the commercial production technology of various important petrochemicals

SEMESTER - 3

Subject: PS03EPST21- Analytical Techniques

Faculty: Mr. Jay Mehta

Course Description

The course is divided into four units. The first unit highlight on IR and NMR spectroscopy. The knowledge of IR and NMR spectroscopy helps to identify an unknown compound. It covers principle, theory and application of spectroscopy. The second unit comprises an introduction, principle and application of mass spectroscopy.

The third unit covers instrumentation of HPLC, explains the various application of it. The four-unit covers the introduction and instrumentation of TGA, DTA, DSC, and SEM. It

Learning Outcomes/Capability Development

also covers various applications of all instruments.

At the completion of this course, students should be able to:

- Understand the basic of spectroscopy
- Understand theory, principle and application of various analytical techniques like IR, NMR, Mass Spectroscopy that help to examine the effect of the energy of particular spectral range.
- Analyse sample with the best utilization of technology that provides structural information.
- Understand stereoisomer, bonding and a special arrangement of molecules, Examine molecular weight and their probable cleavage.
- Understand separation techniques for the purification of the organic mixture.
- Identification of impurities and purities of sample and method development for the specific compound in nature.
- Educate in structure identification, topology, morphology, composition and blending of polymers and fillers by SEM.
- Understand the effect of heat on the easily degradable compound.
- Analyse melting point, type of reaction like endothermic or exothermic.

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Course Description and Learning Outcome

SEMESTER - 4

Subject: PS04PST21 – Rubber Technology

Faculty: Dr. M M Raj

Course Description

The first part of the course aims to give basic understanding of various natural polymers. The second unit comprises monomer and its polymerization of various synthetic rubber, this section also cover properties and application of synthetic rubber.

Third unit give basic idea of compounding procedure of natural and synthetic rubber. Fourth unit gives processing idea of tyre and other rubber products.

Learning Outcomes/Capability Development

- Understanding of natural rubber – plantation, cultivation, collection of latex, and its final process
- Application and properties of different natural rubbers
- Modifications of natural rubber
- Development of synthetic rubber and its applications
- Basic understanding of SBR
- Understand the applications of rubber compounding
- Detail study of tyre process, V-belt, hose pipe and other rubber goods

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Course Description and Learning Outcome

SEMESTER - 4

Subject: PS04CPST22**-** Specialty Polymers

Faculty: Dr. Amit Thummar

Course Description

The first part of the course aims to introduce the fundamentals of High temperature and fire resistant polymers: Introduction, Improving low performance plastics for high temperature use, Polymers for low fire–hazards,
The second part of the course includes the topics related to the Hydrophilic polymers i.e natural polymers, semi-synthetic polymers and synthetic polymers
The third part of the course includes the topics related to the Ionic polymers
The fouth part of the course includes the topics related to the Polymers with electrical & electronic properties i.e. conducting polymers and photo-conducting polymers

Learning Outcomes/Capability Development

- Understanding of High temperature and fire resistant polymers
- Development of Improving low performance plastics for high temperature use
- Understanding of Polymers for low fire–hazards
- Understand synthesis, properties and application of polysulfone, polyether, fluoropolymer, polyimide etc.
- Understand the hydrophilic polymer and its application
- Understand the synthesis, physical properties and applications of ionic polymers

- Understand the Polymers with electrical & electronic properties i.e. Conducting polymers and photoconducting polymers

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Course Description and Learning Outcome

SEMESTER - 4

Subject: PS04CPST23 - Polymer Blends & Adhesives

Faculty: Dr. Amit Thummar

Course Description

The first part of the course covers the terminology, classificationTerminology, classification, equilibrium phase behavior and thermodynamics, methods of studying miscibility and immiscibility, techniques for preparation and characterization of polymer blends. The second part of the course covers Practical compatibilization, factors affecting miscibility, compatibilization by Physical processes, Physical additives, polymer modifications for physical compatibilization, reactive compatibilizers and reaction mechanism for polymer blends.

The third and fourth part covers classification of adhesive, surface preparation and different types of adhesives

Learning Outcomes/Capability Development

- Understand the phase behaviour and thermodynamics of polymer blend
- Understand the preparation techniques and its characterization
- Understand the role and need for binders in surface coating.

- Gain knowledge of compatibilization of polymer blend and different factor affecting the compatibilization
- Understand the adhesive, joint design, surface preparation and different bonding process.
- Sound knowledge about solvent cementing of thermoplastics, thermosetting polymer and welding of thermoplastics,

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Course Description and Learning Outcome

SEMESTER - 4

Subject: PS04EPST21- Environmental Science

Faculty: Mr. Smit Patel

Course Description

The course aims to introduce various source of soil, water and air pollution. It covers a different type of pollution like natural and anthropogenic, vehicle pollution, aeroallergens

The course also covers various standard of air, environmental factors like heat, wind, precipitation, mixing height, topography. It covers the prevention and control of pollution with case studies. Different types of analytical and statistical method to measure air pollution are also covered under the course.

Learning Outcomes/Capability Development

At the completion of this course, students should be able to:

- Understand the basic knowledge of soil pollution.
- Understand about the water pollution and waste water analysis.
- Understand the basic concepts of air pollution.
- Understand the different type of air pollution and their sources.

- Understand various factors that affect water pollution.
- Analyse the different type of model to understand air pollution.
- Educated in various measurements and monitoring techniques of air pollution.
- Educated in statistical method to monitor and analyses air pollution.