SARDAR PATEL UNIVERSITY
VALLABH VIDYANAGAR

SYLLABUS EFFECTIVE FROM: 2017-18
Programme & Subject: M.Sc. (Polymer Science & Technology)

Semester: II

Paper Code: PS02CPST21	**Total Credit: 4**
Title Of Paper: Polymer Characterization	

Unit	Description in detail	Weightage (%)
I	**Importance of Quality control and Characterization of molecular weight:** Importance of specification & standards in quality control of polymers, Preparation of polymer test specimens and conditioning, determination of molecular weight by Ultra Centrifugation, Gel Permeation Chromatography. End Group Analysis, Ebulliometry, Cryoscopy, Osmometry, and viscometry.	**25%**
II	**Material Characterization Test:** Introduction, Melting point, Softening point, Thermal conductivity, Shrinkage, Melt Flow Index test, Particle size, Density, and bulk factor, Water and Moisture absorption.	**25%**
III	**Mechanical and Flammability Properties:** Introduction, Hardness, Tensile strength, Compression strength, Flexural strength, Impact strength, Ignition properties, Test for flexible & self supporting polymer sheet, Oxygen index test and Smoke generation tests.	**25%**
IV	**Electrical, Chemical and Weathering Properties:** Introduction, Dielectric strength, Dielectric constant, Insulation resistance and arc resistance, Immersion test, Stain resistance test, Solvent stress cracking resistance test, Environmental stress cracking resistance test, Accelerated weathering test, Outdoor weathering of polymers.	**25%**

Basic Text & Reference Books:-

- Handbook of plastics test method, R. P. Brown, Longman Scientific and Technical.
- Handbook of plastics testing technology, Vishu Shah, John Wiley & Sons, New York.
- ASTM, BIS, ISO standards.
- Instrumental methods of Analysis, Will and Merritt, CBS Publisher, New Delhi.
- Principles of Instrumental Analysis, Douglas A. Skoog, F. James Holler and Timothy A. Nieman, Harcourt Brace Coolege Publishing, Philadelphia.
- Encyclopedia of Polymer science and Engineering, Wiley Inter science, New York.

Paper Code: PS02CPST22	Total Credit: 4
Title Of Paper: Polymer Processing Technology	

Unit	Description in detail	Weightage (%)
I	**Principles of the processing of plastics**: Introduction, Melt processing of thermoplastics and melt processing of thermosetting plastics. Introduction to mixing, Types of mixers- Twin drum tumbler, ribbon blender, high speed mixer, ball mill and Cowles dissolver	**25%**
II	**Compression, Extrusion, Blow & Rotational Moulding**: Fundamental principles, Materials- factors to be considered while processing, Techniques of preheating, Comparison with transfer moulding, Troubleshooting for compression, extrusion, blow & rotational moulding	**25%**
III	**Injection moulding**: Fundamental principles, Materials- factors to be considered while processing. Types of moulding machines and moulding process. Specifications of injection moulding machine, Injection unit- screw, nozzles, heating cylinders. Clamping unit, Mould cycle and Troubleshooting, Gas injection moulding, Injection moulding of thermosets.	**25%**
IV	**Calendaring, Casting, Thermoforming:** Fundamental principles, Materials- factors to be considered while processing, Process, Machinery & equipments, Moulds, Heating & cooling of moulds, Finishing and troubleshooting.	**25%**

Basic Text & Reference Books:-

- Polymer Processing, Morton & Jones, Chapman & Hall.
- Plastics Engineering, R. J. Crawford, Maxwell Macmillan International.
- Plastics Engineering Handbook, M.L. Berins, Van Nostrand Reinhold, New York.
- Plastics Engineering Handbook, Joel Frados, Van Nostrand Reinhold, New York.
- Plastics Processing Data Hand Book, Dominick. V. Rosato and Donald V. Rosato, Van Reinhold Nostrand, New York.
- Plastics materials & Process, H. Goodman, Van Nostrand Reinhold Company, New York.
- Plastics materials and processes, Seymour S. Schwartz and Sidney, H. Goodman, Van Nostrand Reinhold.

Paper Code: PS02CPST23	Total Credit: 4
Title Of Paper: Polymer Additives	

Unit	Description in detail	Weightage (%)
I	**General aspects of Additives:** Technical requirements of Additives, unavoidable side effects, Deterioration of properties and methods of incorporation of Additives into polymer.	**25%**
II	**Lubricants – internal and external:** General principles, external and internal lubricants of plastics to processing, thixotropic agents, mold releasing agents, evaluation of lubricants and effects on plastics properties. Plasticizers, Theory of plasticization, primary and secondary plasticizers, classification of plasticizers, plasticization efficiency and their evaluation, plasticizers anomalies and anti-plasticization, loss of plasticizers and effects on polymer properties.	**25%**
III	**Fillers and reinforcements:** Introduction, general characteristics of fillers and reinforcements, mechanical and thermal properties of filled polymers. Classification of fillers, Application of nano filler and semi reinforcements, source, properties and application in plastics processing. Principles of filler selection, incorporation of filler into plastics matrix, .Coupling agents, types, and action mechanism, evaluation of fillers and Reinforcement and effects on polymer properties.	**25%**
IV	**Specific Purpose Additives:** **Stabilizers:** Primary, and secondary stabilizers, Metal deactivators, Light stabilizers, synergistic stabilizers, Evaluation of processing stabilizers and effects on plastics properties. **Anti-ageing additives:** Introduction, antioxidants, classification, action mechanism, synergistic and antagonistic effects of antioxidants combination. Ultra violet protective agents- types, action mechanism and effects on plastics properties. **Optical property modifiers:** Brightening agents, Inorganic and Organic pigments, Criteria for selection of pigments,	**25%**

Basic Text & Reference Books:-

- The role of additives in plastics, L. Mascia, Edward Arnold.
- Additives of plastics, Stepek, Springer Verlag, New York.
- Plastics additives and modifiers, Jesse Edenbaum, Van Nostrand Reinhold, New York.
- Plastics materials, J.A. Brydson, Butterworth Science, London.
- Additives for Plastics Handbook, Elsevier Advanced Technology, John Murphy.
- Polymer modifiers and additives, Marcel Dekker, John T. Lutz, Richard F. Grossman.
- Plastics Additives Handbook, 5th Ed.,HansZweifel,Hanser Gardner
- Comprehensive polymer science, Pergamon, New York.
- Engineering materials Handbook, Vol, 1-3, ASTM International, USA.
- Plastics Engineering Handbook, Joel Frados, Van Nostrand Reinhold, New York.

Paper Code: PS02CPST24	Total Credit: 4
Title Of Paper: Practical – Polymer Processing & Testing – I	

Unit	Description in detail	Weightage (%)
I	Details to be Worked Out by the Department	100 %

Paper Code: PS02CPST25	Total Credit: 4
Title Of Paper: Practical – Identification & Characterization of Polymer	

Unit	Description in detail	Weightage (%)
I	Details to be Worked Out by the Department	100 %

Paper Code: PS02EPST21	Total Credit: 4
Title Of Paper: Industrial Chemistry – II	

Unit	Description in detail	Weightage (%)
I	**Crystallization: C**rystallization mechanisms, crystallization in nature, methods, process. **Separation of solid from solid:** Diffusional separation, mechanical separations, grizzlies (fixed inclined screens), trammels (revolving screens), vibrating screens, electrostatic separation, **Transportation of fluid:**Methods of transportation of fluids, basic principal of pipes, fittings and their standards,various types of valves, pumps.	**25%**
II	**Absorption&Adsorption:**Gas Absorption**:** Choice of solvent for absorption, Minimum Liquid- Gas ratio for Absorbers,Co-current & counter current absorption, HETP in continuous contact Equipments, Equipments for gas-liquid absorption, Calculations forLeaching operation, **Filtration:** filter press, rotary drum filter, filter aids, Thickness, Porosity.	**25%**
III	**Heat Exchangers:**Heat transfer Co-efficient, effect of scale formation,Design of Heat transferequipments, LMTD correction factors, Effectiveness and number of transfer units for heat exchangers, Solar thermal collectors, **Flow meters:** venturimeter, rotameter, orifice meter, pitot tube, prandtls boundary layer concept.	**25%**
IV	**Size reduction equipments:** Theory and principles involved in crushing grinding, jaw crusher, roll crusher, hammer mill, ball mill, **Agitation & mixing:** Definitions, principles involved in mixing, types of mixing, ribbon blender, double cone blender, types of impellers.	**25%**

Basic Text & Reference Books:-

- Mass Transfer operations; Robert Trebal, Mc Graw Hill Co., 3rd edition.
- Unit operations of chemical engineering, W. Mc Cabe Smith, Mc Graw Hill Co., 7th edition
- Chemical process principal Vol. I & II, Horghen Watson, Asian Pub. House, 2nd edition.
- Chemical Kinetics, S. K. Jain, Vishal pub. , Jallander.
- Unit process in organic systems, Groggins, Tate, Mc Graw Hill Co., 5th edition.
- Encyclopedia of industrial chemical analysis, Foster Dee Snell, Leslie S., Ettre, Interscience pub., Wiley & Sons N.Y., 1973, Vol-1 to 20
- Ullmann's Encyclopedia of industrial chemistry, Vol.:1 to 39, Wiley-VCH, Weinheim,2003
- Shreve's chemical process industries by George T Austin, Mc Grow-Hill International Co.

Paper Code: PS02EPST22	Total Credit: 4
Title Of Paper: Biophysical Chemistry	

Unit	Description in detail	Weightage (%)
I	**State of matters**, **Solubility and Dissolution:** **Solubility and Dissolution:** Solute – solvents interactions, polar and non polar solvents, Dissolution of drugs – drug absorption, tablets and capsule dissolution, factors affecting dissolution, mathematical treatment of powder dissolution.	**25%**
II	**Viscosity and Surface and interfacial phenomena:** **Viscosity:** Introduction – Concepts of viscosity, factors influencing viscosity, Newtonian and Non – Newtonian systems. **Thixotropy:** Measurement of Thixotropy bulges and spurs, negatives thixotropy, thixotropy in formulation, **Determination of Rheologic properties:** Type & choice of Viscometer, Viscoelasticity, **Surface and interfacial phenomena:** Liquid interfaces, surface and interfacial tensions, surface free energy, measurement of surface and interfacial tensions method spreading co – efficient, Adsorption of liquid interfaces: surface active agents, systems of hydrophile – lipophile classification.	**25%**
III	**Buffered and isotonic solutions:** Buffer capacity: Approximate calculation of buffer capacity, equation for buffer capacity, maximum buffer capacity, neutralization curves and buffer capacity. · Buffers in pharmaceutical and biological systems: In vivo biological buffer systems, pharmaceutical buffers, preparation of pharmaceutical buffer solution, influence of buffer Capacity and pH on tissue irritation, stability vs optimum therapeutic response, pH and solubility.	**25%**
IV	**Dispersion and Emulsion:** Coarse dispersion (Dispersion systems), Suspensions: Classification of suspensions, Particle – Particle interaction and behavior, Interfacial properties of suspended particles (Brownian movement), **Emulsion:** Emulsion types, pharmaceutical applications, Theories of emulsification. Mono moleuclular adsorption, multimolecular adsorption and film formation, solid particle adsorptions, Physical stability of emulsions (Preservation of emulsions), Microemulsions.	**25%**

Basic Text & Reference Books:

- Text book of Physical pharmaceutics by C. V. S Subramanyam, Vallabh prakashan, New Delhi; ISBN:81-85731-08-X.
- Martin's Physical Pharmacy and Pharmaceutical Sciences by Patrick J. Sinko, Publisher: Lippincott Williams & Wilkins; ISBN: 0-7817-6426-2.
- Surfactants and Interfacial Phenomena by by Michael J Rosen, Milton J Rosen; Publisher: Wiley-Interscience; ISBN-13: 9780471836513; ISBN: 0471836516.
- Physical Pharmacy: Physical Chemical Principles in the Pharmaceutical Sciences by Alfred N Martin; ISBN-13: 9780812101638; ISBN: 0812101634.

SARDAR PATEL UNIVERSITY
VALLABH VIDYANAGAR

SYLLABUS EFFECTIVE FROM: 2017-18
Programme & Subject: M.Sc. (Polymer Science & Technology)

Semester: III

Syllabus with Effect from: June-2017

Paper Code: PS03CPST21	**Total Credit: 4**
Title Of Paper: Polymer Rheology	

Unit	Description in detail	Weightage (%)
I	**Introduction to Rheology:** Different parameters, Rheological equation of state, Newtonian and Non-Newtonian, Importance aspects of rheology, Importance of rheology on polymer processing, shear thinning behavior, influence of temperature and molecular structure.	**25%**
II	**Flow Properties:** Flow through circular tube, flow between parallel plates, Die Swell, and Melt fracture, Sharkskin, Orientation and Shrinkage, Frozen in orientation, Weissenberg effect, and entrance effect.	**25%**
III	**Rheology in polymer processing:** Introduction, Low flow process, Mixing process, Constrained flows, Free surface flows, Bulk deformations, Injection moulding, Blow moulding, Film blowing and Sheet extrusion.	**25%**
IV	**Measurements of flow properties:** Mixing equipments, concentric cylinder rheometer, Cone and plate rheometer, Capillary rheometer, Parallel disc rheometer, torque rheometer, rheo-optics. Flow properties of individual polymers like polyethylene, propylene, polystyrene, poly vinyl chloride, nylons, poly acetals, poly tetrafluroethylene, polycarbonates and rubbery materials.	**25%**

Basic Text & Reference Books:-

- Polymer and Composite Rheology, Rakesh K. GuptaMarcel Dekker Inc., New York
- Polymer Melt Rheology, F. N. Cogswell, George Godwin Ltd., London
- Rheology of Polymer Systems, Carreau, De Kee, Chhabra, Hanser Gardner Publication Inc.,
- Cincinnati.
- Flow of high polymers, Stanley Middleman, Inter science publishers.
- Melt Rheology and its role in Plastics processing, John M. Dealy and Kurt. F. Wissbrun, Van Nostrand Reinhold, New York.
- Plastics Rheology in Plastics Quality Control, John M. Dealy and Peter C. Saucier, Hanser Gardner Publication Inc., Cincinnati.

Paper Code: PS03CPST22	Total Credit: 4
Title Of Paper: Polymer Composites & Fibre Technology	

Unit	Description in detail	Weightage (%)
I	**Composites:** Introduction to composite materials, definitions, classifications, applications, advantage and disadvantages of composites. Types of reinforcements, short fiber reinforcement, matrix material, types of mold for composites and preparation of molds, release agents, core materials, coupling agents, fillers and pigments, gel coats. Spinning & Finishing of fiber: Introduction, Melt spinning, Solution spinning, Dry spinning, Gel spinning, Wet spinning	**25%**
II	**Reinforcing materials:** Defination of fibres, Classification and nomenclature of fibres, Definition of various textiles terms, structure principles of fibre forming polymers. Natural & Synthetic fiber: Introduction, Cotton, Rayon, Cellulose acetate, Wool, Polyamide, Acrylic fibre, Polyethylene terephthelate, Polyolefines, Spandex, Glass, Asbestos, Carbon, Steel fibres preparation, properties and applications.	**25%**
III	**Polymer matrix materials**: Important thermosetting materials viz. Polyester, Epoxy and Phenolics and their curing systems. Thermoplastics and elastomeric materials, properties and applications of composites.	**25%**
IV	**Processing of composites:** Sheet moulding compounds (SMC), Dough moulding compounds (DMC) and Prepregs. Composites processes like Hand lay up, Spray lay up, Vacuum bag, Pressure bag, Autoclave moulding, Cold press, Hot press moulding, Resin injection, Resin transfer moulding, Foam reservoir, Filament winding, Centrifugal casting, Pultrusion, continuous laminations, Injection moulding, Compression and transfer moulding of composites. Troubleshooting and remedies for composite processing.	**25%**

Basic Text & Reference Books:-

- Polymer blends and Composites, L.H. Sperling, Published by Plenum Press.
- Handbook of Plastics Elastomers and Composites, Charles A Harper, McGraw Hill, New York.
- FRP technology- Fiber reinforced Resin systems, Weatherhead, Applied Science, and London.
- Handbook of Polymer Composites for Engineer's, Leonard Holloway, Jaico, India.
- Handbook of Reinforcements for plastics, Milewski Katz, Van Nostrand Reinhold, New York.
- Polymer Engineering Composites, M.C. W Richardson, Published by Applied science, London.
- Modern Textiles by Dorothy Lyle
- Essentials of Textiles by M.J. Joseph
- Textile fibres and their use by K.P. Hess

Paper Code: PS03CPST23	Total Credit: 4
Title Of Paper: Petrochemicals	

Unit	Description in detail	Weightage (%)
I	**Introduction:** Petrochemical, Development of petrochemical industry, Petroleum refining, Petrochemical feed stocks from petroleum refining, The basic building block processes, Petrochemical process technology, Costs in chemical processing, Primary raw materials for Petrochemicals like Natural gas, Crude oils, coal, oils shell, tar sand and gas hydrates.	**25%**
II	**Crude Oil Processing and Production of Hydrocarbon:** Introduction, Physical separation Processes, Conversion Processes, Production of Olefines, Paraffinic hydrocarbon, olefins hydrocarbons, dienes, aromatic hydrocarbons, liquid petroleum fraction and residues.	**25%**
III	**Alkanes and higher Paraffin based Chemicals:** Introduction, Chemical based on synthetic gases, Chemical based on direct reaction of methane, ethane, propane and naphtha based chemicals from high molecular weight n-paraffin.	**25%**
IV	**Chemicals based on olefin diolefin and aromatic hydrocarbon:** Introduction, Chemicals from n-butenes, isobutylenes, butadiene, benzene, toluene, xylene.	**25%**

Basic Text & Reference Books:-

- Chemistry of Petrochemical Process, Sami Matar, Lewis F. Hatch, Gulf Professional Publishing. Boston.
- Fundamental of Petroleum Chemical Technology, P. Belov, Mir Publications, Moscow.
- Advanced Petroleum Refining, G. N. Sarkar, Khanna Publishers, Delhi
- Petrochemicals, Peter Wisheman, John Wiley & Sons, New York.

Paper Code: PS03CPST24	Total Credit: 4
Title Of Paper: Practical –Polymer Processing & Testing – II	

Unit	Description in detail	Weightage (%)
I	Details to be Worked Out by the Department	100 %

Paper Code: PS03CPST25	Total Credit: 4
Title Of Paper: Practical –Polymer Synthesis	

Unit	Description in detail	Weightage (%)
I	Details to be Worked Out by the Department	100 %

Paper Code: PS03EPST21	Total Credit: 4
Title Of Paper: Analytical Techniques	

Unit	Description in detail	Weightage (%)
I	**Fundamentals of Analytical Chemistry:** Definitions, Application of analytical Chemistry, Classification of analytical techniques and importance, GMPs and its Components, Verification and Validation in chemical analysis.	**25%**
II	**Chemical calculations and Chromatography:** Concentration units, preparation and standardization of analytical reagents Introduction to chromatography techniques: classification and working principles. (Paper chromatography, Thin Layer chromatography, Column chromatography, HPLC, GC and GPC)	**25%**
III	**Fundamentals of Spectroscopy and Components of Optical Instruments:** Introduction, Classification, EMR and Interactions of EMR with Matters, Sources of radiations, wave length selectors, sample holders, detectors and signal processors and readouts, Lambert's and Beer's Law, FTIR, NMR, Mass Spectroscpy	**25%**
IV	**Instrumental Polymer Analysis:** Thermogravimetric Analysis (TGA), Differential Scanning Calorimetry, Thermomechanical Analysis, Dynamic Mechanical Analyses, Scanning electron Microscopy (SEM), TEM	**25%**

Basic Text & Reference Books:-

- Skoog, Holler, Niemon, "principles of instrumental analysis" 5th edition, Saunders college publisher.
- Robert D. Braun "Introduction to chemical analysis" McGraw-HILL International Edition.
- Robert D. Braun "Introduction to instrumental analysis" McGraw-HILL International Edition.
- Gary D. Christian. " Analytical chemistry" 6th edition John Wiley & sons, Inc. 2004
- B. K. Sharma. "Instrumental method of chemical analysis" 24th edition, GOEL publishing house Meerut .2005
- R. A. Day, jr , A. L. Underwood., "Quantitative analysis" 6th edition, Prentice –Hall of India Private limited, New Delhi. 2006.
- L.Huber, "Validation and qualification in analytical laboratories" 2nd Edition, 2007.

Paper Code: PS03EPST22	Total Credit: 4
Title Of Paper: Selected Topics in Polymer Science	

Unit	Description in detail	Weightage (%)
I	**Polymers in Medicine:** Introduction, Polymers and Polymer Chemistry Pertinent to Medical Application, Medical Applications, Dental Application, Orthopedic Applications, Ophthalmology, Ear, Brest Implant, Facial Implants, Gynecology	**25%**
II	**Specialty Coatings and Adhesives:** New Generation Hybrid Coating, Antifouling Coating, Coating based on sustainable Resource-Development of Anticorrosive coating Based on Seed Oils, Specialty Adhesive- Synthetic & Natural Adhesive	**25%**
III	**Inorganic Polymer:** Introduction, Polyphosphazenes, Polysiloxanes and Related Polymer, Polysilane and Related Polymer, Micellaneous Inorganic Polymer	**25%**
IV	**Product Design:** Introduction, Geometric Shape, Plate, Beam, Rib, Column, Torsion, Sandwich, Gear, Bearing, Grommet, Gasket, Shape – Cylinder, Sphere, Tank, Pipe, spring, Building, Transportation, Medical, Metal, Design limitation and Constraint	**25%**

Basic Text & Reference Books:-

- Specialty Polymers materials & Application, Faiz Mohammad
- Inorganic Polymer, James E. Mark, Prentice Hall Advanced References Series
- Plastics Engineered Product Design, Dominick V Rosato, Elsevier

SARDAR PATEL UNIVERSITY
VALLABH VIDYANAGAR

SYLLABUS EFFECTIVE FROM: 2017-18
Programme & Subject: M.Sc. (Polymer Science & Technology)

Semester: IV

Paper Code: PS04CPST21	**Total Credit: 4**
Title Of Paper: Rubber Technology	

Unit	Description in detail	Weightage (%)
I	**General Introduction & Natural Rubber:** Introduction, Source, Cultivation, Harvesting, Biosynthesis of rubber, Composition of latex, Crop Collection, Modified forms of natural rubber, Properties of natural rubber, Applications.	**25%**
II	**Synthetic Rubber:** Polybutadiene, Polyisoprene, Polychloroprene, Styrene – butadiene rubber, EPDM, Butyl & halobutyl rubber, Nitrile rubber, Acrylic elastomer, Chlorosulphonated polyethylene, Silicone rubber, Fluorocarbon elastomer	**25%**
III	**Rubber Compounding** Introduction to mixing, Distributive mixing, Dispersive mixing, Two roll mill, Banbary mixer, continuous mixing, Vulcanizing agents, Vulcanizing accelerators, Activators, Retarders & inhibitors, Fillers, antidegradents, softners, plasticizers, processing aids etc. relation between curing system and properties. Carbon black as a reinforcing agent for rubber industries.	**25%**
IV	**Rubber Processing:** Calendaring, Extrusion, Molding processes, Rubber Products such as Tyres, Belting & Hoses, Finished product testing, Rubber recycling.	**25%**

Basic Text & Reference Books:-

- Basic Compounding and Processing of Rubber, Harry Long, American Chemical Society, New Jersey.
- Rubber Handbook, Vanderbilt, Vanderbilt World trade cooperation, New York.
- Rubber Technology and Manufacture, C.M. Blow, Butterworth, London.
- Rubber Technology Handbook, Hofman.
- High Polymer Latices, D.C. Blackly
- Applied science of Rubber, William, and J.
- Polymer Processing, Morton Jones. Chapman & Hall.
- Polymer Processing, McKelvey.
- Rubber Processing, Peter S Johnson, Hanser Publishers
- Rubber Technologist Handbook,J R White & S. K. De, Rapra Technology

Paper Code: PS04CPST22	Total Credit: 4
Title Of Paper: Specialty Polymers	

Unit	Description in detail	Weightage (%)
I	High temperature and fire resistant polymers: Introduction, Improving low performance plastics for high temperature use, Polymers for low fire–hazards, Polymers for high temperature resistance–Fluoropolymers, Aromatic polymers, Poly ethers, Polyphenylenesulphide, Polysulphones, Polyketones and Heterocyclic polymers.	**25%**
II	Hydrophilic polymers: Natural polymers–Carbohydrates, Proteins, Semisynthetic polymers, Synthetic polymers– Hydrogel polymers, Polyacrylamide hydrophilic polymers, Polyvinyl alcohol, Polyvinyl pyrrolidone, Superabsorbent polymers.	**25%**
III	Ionic polymers: Introduction, synthesis, physical properties and applications.	**25%**
IV	Polymers with electrical & electronic properties: Conducting polymers–conducting mechanisms, Polyacetylene, Polyparaphynelenes, Polypyrroles, Polyaniline, Photoconducting polymers, Polymers in optoelectronics, Polymers with piezoelectric, pyroelectric and ferro electric properties, Photoresists for semiconductor fabrication.	**25%**

Basic Text & Reference Books:-

- Engineering Polymers, R.W. Dyson, published by Chapman and Hall, New York.
- Specialty Polymers, R.W. Dyson, published by Chapman and Hall, New York.
- Encyclopedia of polymer science and Engineering, Wiley Inter science, New York.
- Comprehensive polymer science Sir, Geoffrey Allen and Sunder L. Aggrawal, Pergamon press, New York.
- Engineering materials Handbook, Vol, 1-3, ASTM International, USA.
- Plastics Materials, J. A. Brydson, Butterworth, London.
- Inorganic Polymers, James E. Mark, Harry R. Allcock, Robert West, Prentice Hall, NJ, USA.

Paper Code: PS04CPST23	Total Credit: 4
Title Of Paper: Polymer Blends & Adhesives	

Unit	Description in detail	Weightage (%)
I	**Polymer blends:** Terminology, classification, equilibrium phase behavior and transitions, thermodynamics, methods of studying miscibility and immiscibility, molecular interpretation of polymer–polymer miscibility, Flory-Huggins theory, parameters influencing miscibility, methods of enhancing miscibility, Techniques for preparation and characterization of polymer blends. Phase morphology and application.	**25%**
II	**Compatibilization:** Practical compatibilization, factors affecting miscibility, compatibilization by Physical processes, Physical additives, polymer modifications for physical compatibilization, reactive compatibilizers and reaction mechanism. Commercial polymer blends: Thermoplastics polymer blends and thermosetting polymer blends viz. High impact polystyrene (HIPS), Acrylonitrile-Butadiene-Styrene (ABS), Polypropylene, Nylons, Epoxy resins.	**25%**
III	**Adhesives–I**: Concepts and terminology, classification of adhesive, advantages and disadvantages of adhesives bonding, joint design, adhesive selection, adhesive properties surface preparation and bonding process.	**25%**
IV	**Adhesives–II**: Characteristics of adhesive material, Solvent cementing of thermoplastics, cementing of thermosetting Polymer, Welding of thermoplastics, Ultrasonic assembly, and testing of adhesive bonds.	**25%**

Basic Text & Reference Books:-

- Multi component polymer systems, I.S. Miles and S. Rostami, Chapman & Hall, New York.
- Polymer blends and Alloys, G.O. Shonaike and G.P. Simon, Marcel Dekker Inc, New York.
- Polymer Blends, Vol 1& 2, D.R. Paul and Seymour Newman, Published by Academic Press, New York.
- Plastics Engineering Handbook, Joel Frados, Van Nostrand Reinhold, New York.
- Plastics Engineering Handbook, M.L. Berins, Van Nostrand Reinhold, New York.
- Adhesives Handbook, Butterworth's, J. Shields.
- Adhesives Technology Handbook, Sina Ebnesassad, USA.
- Coloring of Plastics, Albrecht Muller, HANSER, Germany

Paper Code: PS04CPST24	Total Credit: 8
Title Of Paper: Project Work	

Unit	Description in detail	Weightage (%)
	A project report based on literature survey and laboratory work conducted on topics related to Polymer Science, Polymer Technology & Chemistry is to be submitted and presented as a seminar by each student.	**100 %**

Paper Code: PS04EPST21	Total Credit: 4
Title Of Paper: Environmental Science	

Unit	Description in detail	Weightage (%)
I	**Introduction to Environment Science:** Concepts and scope of study, Environmental composition, nomenclature of some useful Terms, and ecology. **Hydrosphere:** Water resources, Physical and Chemical properties of water, sea water model, microbiological processes, organic and inorganic matters in water. **Lithosphere:** Concentric layers of earth, Physical and Chemical weathering processes, composition of soil, Nitrogen cycle and NPK in soil. **Atmosphere:** Composition & structure of atmosphere, particles, ions, radicals and chemical reactions in atmosphere. **Biosphere:** Definition, ecosystem and natural cycles.	**25%**
II	**Air Pollution:** Environmental pollution, classification of pollutants, environmental indicators. Sources and effect of air pollutants: SMOK, FOG, SMOG, PAN, PAH, greenhouse effect, acid rain, ozone depletion, EL Nino phenomena. Analysis of air pollution.	**25%**
III	**Water pollution:** Definition, types of waters pollutants, Environmental toxicology and toxic elements & pesticides in water, Impact on enzymes, Biochemical effect of pesticides.Water and waste water analysis; collection of sample, Determinations of water quality parameters: Alkalinity, acidity, TDS, TH, D.O., BOD, COD, Chlorides, sulphate, nitrate and nitrite etc.	**25%**
IV	**Soil pollution and Waste management:** Introduction to soil pollution; waste and pollutants in soil. Classification of wastes, overview of waste management program, green chemistry, methodologies, techniques available and new approaches.	**25%**

Basic Text & Reference Books:-

- Environmental Chemistry by J. W. Moore & E. A. Moore, Academic Press. Inc. New York, 1976.
- Environmental Chemistry by A.K.De,4th edition, New Age International Publishers.
- Principles of Environmental Science: Inquiry and applications by William P. Cunningham & Mary
- Cunningham, 1st edition, 2002, Tata McGraw Hill Publishing Company Ltd., New Delhi.

Paper Code: PS04EPST22	Total Credit: 4
Title Of Paper: Technology of Essential Oils, Surfactants & Cosmetic Products	

Unit	Description in detail	Weightage (%)
I	Essential Oils, chemical constituents of essential oils, manufacturing technology, utilization of essential oils	25%
II	Surfactants, classification & physico chemical properties of surfactants, practical applications of surfactants in various fields, manufacturing of various industrial surfactants.	25%
III	Cosmetics, classification, raw materials for cosmetics, manufacturing of various cosmetic products.	25%
IV	Modifications of oils, fats & waxes, Introduction to chemical reactions of oils, fats & fatty acids, manufacturing of DCO, blown, boiled, stand & malenised oils.	25%

Basic Text & Reference Books:-

- The chemistry of oils & fats,F.D.Gunstone,Blackwell Pub.
- Baileys Industrial oils & fats products,Vol 1-5,John Wiley & Sons
- Essential Oils,Vol 1-7,D.Gunther,R.E.Krigger Pub Comp.,New York
- Cosmetic Science & Technology,Vol 1 &2,Wiley Interscience,New York
- Cosmetics,Sopas & Perfumes,W.A.Poucher,Chapman Hall,London & New York
- Handbook of surfactants,Porter,Mc Graw Hill Pub