POLYMER SCIENCE

COURSES OFFERED BY DEPARTMENT OF CHEMISTRY

Category I

Polymer Science Courses for Undergraduate Programme of Study with Polymer Science as a Single Core Discipline

(B.Sc. Honours in Polymer Science in four years)

STRUCTURE OF VII-VIII SEMESTER

Semester	Discipline specific Core	Elective DSE	GE	Project	AEC	VAC	Total Credit
VII	**Specialty Polymers** (2T+2P)	3 DSE (4) or 2DSE (4)+GE (4) Or 1DSE(4)+2 GE (4)		Project/ Internship/ Technical Report/ Project (6)			22
VIII	**Paints, Coatings, and Adhesive** (2T+2P)	3 DSE (4) or 2 DSE (4)+GE (4) Or 1 DSE(4)+2 GE (4)		Project/ Internship/ Technical Report/ Project (6)			22

A student who pursues undergraduate programme with Polymer Science as single core discipline is offered the following courses:

COURSES OFFERED UNDER B.Sc. (H) POLYMER SCIENCE PROGRAMME

COURSE CODE	NAME OF THE COURSE	CREDITS T=Theory Credits P=Practical Credits
DSE: Paper 16	Wire and Cable Technology	T=2, P=2

DSE: Paper 17	Polymers in Sports and Footwear Technology	T=2, P=2
DSE: Paper 18	Polymeric Membrane	T=2, P=2
DSE: Paper 19	Polymer Foam Technology	T=2, P=2
***DSE: Paper 1 to DSE: Paper 7 will be offered in odd semesters & DSE: Paper 8 to DSE: Paper 14 will be offered in even semesters.** ****DSE: Paper 15 is compulsory for all the students who want to pursue VII and VIII semesters. It will be offered in both VI and VII semesters.** **DSE 16,17 will be offered in VII,whileand 18,19 wil be in VIII semester**		
Details of Generic Elective (GE) Courses		
GENERIC ELECTIVES COURSES (GE)– (4 credits each) –offered for other Departments		
COURSE CODE	**NAME OF THE COURSE**	**CREDITS** **T=Theory Credits** **P=Practical Credits**
GE: Paper 7	Polymer in Toady's Life	T=2, P=2
GE: Paper 8	Sustainability and Environment	T=3, P=1

SEMESTER-VII

DISCIPLINE SPECIFIC COURSES (DSC-19)

Credit distribution, Eligibility and Pre-requisites of the Course

Course title & Code	Credits	Credit distribution of the course			Eligibility criteria	Pre-requisite of the course
		Lecture	Tutorial	Practical/ Practice		
SpecialtyPolymers	4	2	0	2	12^{Th} with PCM	---

COURSE OBJECTIVES:

1. To study basic concepts of speciality polymers including temperature and fire-resistant and high-performance polymers.
2. To learn about applications of speciality polymers

LEARNING OUTCOMES:

After studying this paper, students will be able to

1. Understand the chemistry for preparation, properties and applications of speciality polymers
2. To analyze the properties of specialty polymers for specific applications such as aerospace, telecommunication, biomedical, defense etc.

THEORY: (30 Hours)

UNIT 1: PREPARATION, PROPERTIES AND APPLICATIONS (15 Hours)

Introduction to engineering/speciality polymers, high temperature and fire-resistant polymers, preparation, properties and applications of the following polymers:

- Polycarbonate (PC)
- Poly(ether ether ketone) (PEEK) and poly(ether-ketone) (PEK)
- Sulphur based polymers (Polysulphone and polyphenylenesulfide)
- Aromatic polyamides, polyamide-imide resins (PAI) and polyimide resins
- Polyacetals
- Polyphenylene oxide (PPO)
- Silicones and polyphosphazenes

UNIT 2: RECENT ADVANCES IN SPECIALITY POLYMERS (5 Hours)

High performance polymer blends and composites, dendrimers, self-healing polymers

UNIT 3: LIQUID CRYSTAL POLYMERS (5 Hours)

Introduction, chemistry of liquid crystal polymerization, synthesis, properties, characteristics of liquid crystal polymers Polyimide, polyamide (Kevlar, Nomax etc.) and polyester-amide based.

UNIT 4: THEMOSETTING POLYMERS (5 Hours)

High performance thermosetting resins such as epoxides, polybenzoxazine etc.

PRACTICALS: (60 Hours)

- Synthesis thiokol rubber and tested its thermal stability
- Synthesis of heat resistant polymers and determine their thermal stability.
- Preparation of high-performance composites [(variation in dispersed phase/matrix/coupling agent) like epoxy-kevlar composite]
- Ageing effect of solvents on mechanical properties of polymers.
- Investigation of performance properties of speciality polymers/composites such as thermal stability and fire resistance.
- Determine the acid value of Nylon 6-10
- Characterization of commercially available speciality polymer samples.
- Preparation of polyethylene tetrasulfide and analysis by chemical methods.
- Determine the dielectric properties (dielectric strength and electrical resistance).

REFERENCES:

1. Brydson J.A., (2016) Plastics Materials, Butterworth Heinemann, 8th Edition.
2. Dyson R. W., (1990) Engg. Plastics, Blackie, Chapman and Hall.
3. Mohammad, F., (2013) Specialty Polymers: Materials and Applications, I.K. International Publishing House Pvt. Ltd.
4. Fink, J. K. (2014). High performance polymers, William Andrew.
5. Gupta, R. K. (2023),Specialty Polymers: Fundamentals, Properties, Applications and Advances, Taylor & Francis Ltd.

ADDITIONAL RESOURCES:

1. Seymour R.B., Kirshenbaum G.S., (1986) High Performance Polymers: their origin and development, Springer.
2. James E. Mark University of Cincinnati., Polymer data hand book, oxford university press (2013).
3. J. Scheirs, Modern Fluoropolymers:High performance polymers, Wiley Inter science (1997)

ASSESSMENT METHODS:

All the examiniations and assement methods shall be in the line with the University of Delhi guidelinceissused from time to time

KEYWORDS:

Polysulfones, Polyaniline, PEEK, Smart hydrogels, Polycarbonate

SEMESTER-VIII

DISCIPLINE SPECIFIC CORE (DSC-20)

Credit distribution, Eligibility and Pre-requisites of the Course

Course title & Code	Credits	Credit distribution of the course			Eligibility criteria	Pre-requisite of the course
		Lecture	Tutorial	Practical/ Practice		
Paints, Coatings, and Adhesive	**4**	**2**	**0**	**2**	**12Th with PCM**	**---**

COURSE OBJECTIVES:

1. To learn about of basics of paints, coatings and adhesive technology and their applications
2. To gain knowledge of formulations of various types of paints, coatings and adhesives

LEARNING OUTCOMES:

After studying this paper, students will be able to

1. Make formulations of various types of paints, coatings and adhesives for desired applications
2. Evaluate quality assessment of paints, coatings and adhesives
3. Understand the challenges and scope of paints, coatings and adhesives industry

THEORY: (30 Hours)

UNIT 1: INTRODUCTION TO PAINTS, COATINGS AND ADHESIVES (5Hours)

General information about paint, paint composition, types of paints: wall, industrial, automobile, Corrosion resistance and flame retardants.Function and properties of paints, Types of adhesives: structural, elastomeric and pseudo plastic

Definition and importance of coating.challenges and future scope of paints, coatings and adhesives industry

UNIT 2: PREPARATION OF PAINTS, COATINGS AND ADHESIVES (10 Hours)

Preparation and compounding ingredients of paints, coatings and adhesives.Formulations, selection and water solubility, manufacturing and uses of paints, coatings (manufacture, criteria and type), adhesive (manufacturing of structural and elastomeric), manufacturing equipment's: high-speed mixers, mill (vertical, horizontal, continuous, sand mill and ball mill)

UNIT 3: COATING OPERATIONS (7 Hours)

Coating operations: brush, roller, both side roller, spray (manual/airless/air guns), dip coating (advantages & limitations), flow coating

UNIT 4: TESTING OF PAINTS COATINGS AND ADHESIVES (8 Hours)

Color and appearance, adhesion, scratch resistance, chemical resistance, wet ability, Thickness, Hardness, weathering, abrasion resistance, viscosity, UV resistance, corrosion resistance etc.,

PRACTICALS: (60 Hours)

- Prepare paints (water and solvent-based) and determine the physical properties. i.e. drying time, spreadability, solid content.
- Evaluate adhesive strength by peel test method.
- Prepare adhesive of different formulations.
- Measure the wettability/flowability of adhesives.
- Measure the resin/paint viscosity by Ford cup 4 and Brookfield viscometer.
- Test the film hardness of a coated adhesive film.
- Measure the scratch resistance of painted films.
- Calculate weight percent of paint in a painted film.
- Analyze humidity content of painted films.
- Analysis of paints film by pencil hardness test
- Preparation of coatings by different solvents and medium
- Determination of color, drying time, non -volatile content of coatings.
- Analyse electrical resistance, chemical resistance, durability and thermal resistance of adhesive films.

ESSENTIAL/RECOMMENDED READINGS

1. Morgan W.M., (2000) Outline of Paint Technology, CBS Publisher.
2. StoyeD.,andW.Freitag, (2008) Paints, Coatings and Solvents, Wiley-VCH.
3. Talbert R., (2008) Paints Technology Handbook, CRC Press.
4. Pocius A.V. (2021) Adhesion and Adhesives Technology, Hanser-Verlag

ADDITIONAL RESOURCES:

1. Ryntz R.A., Yaneff P.V., (2003) Coatings of polymers and plastics, Marcel Dekker.
2. Mittal K.L., (2003) Adhesion aspects of polymeric coatings, VSP.
3. Kondekar N.R., A window to paints and coatings technology by colour publications Pvt. Ltd.
4. Arthur A. Tracton.(2006),Coatings Technology: Fundamentals, Testing, and Processing, Taylor and Francis.
5. Board, N. R. (2023). Modern technology of paints, varnishes & lacquers. Asia Pacific Business Press Inc.

ASSESSMENT METHODS:

All the examiniations and assement methods shall be in the line with the University of Delhi gidelinceissused from time to time

KEYWORDS:

Structural adhesives, Wettability, Dip coating, Paints, Surface treatments

DISCIPLINE SPECIFIC ELECTIVE (DSE-16)

Credit distribution, Eligibility and Pre-requisites of the Course

Course title & Code	Credits	Credit distribution of the course			Eligibility criteria	Pre-requisite of the course
		Lecture	Tutorial	Practical/ Practice		
Wire and Cable Technology	**4**	**2**	**0**	**2**	**12Th with PCM/PCB**	**---**

COURSE OBJECTIVES:

The Learning Objectives of this course are as follows:

1. To familiarize with the selection criteria of materials for cable
2. To acquire knowledge of insulation thermal and mechanical properties of cable materials

LEARNING OUTCOMES

The Learning Outcomes of this course are as follows:

After studying this paper, students will be able to

1. Understand the basic concepts materials used in cable industries
2. Develop the understanding of the properties and applications of cable materials.

SYLLABUS OF DSE 16

THEORY: (30 Hours)

UNIT 1: INTRODUCTION (5 Hours)

Introduction to Insulator, semiconductor and conductor, classification wire and cables (eg. Electric, telecommunication etc.), cable characteristics.

UNIT 2: PROPERTIES OF CABLE INSULATING MATERIALS (10 Hours)

i) Electrical: Volume and surface resistivity, break down voltage, dielectric constant, dielectric loss etc.

ii) Thermal: Heat resistance, permissible temperature, effect of overloading on the life of electrical appliances and thermal conductivity

iii) Chemical: Solubility, chemical resistance, weatherability

iv) Mechanical and physical: Mechanical strength, porosity, density, brittleness, mouldability.

v) Factors affecting the electrical, thermal, chemical and mechanical properties of cable insulating materials. Selection of cable insulating materials

UNIT 3: POLYMERS FOR CABLE (10 Hours)

Polymers for cable insulation and sheathing (eg. CM, CSM, HDPE, LDPE, PVC, NBR, PTFE, EPDM, EVA, EMA etc.)

UNIT 4: MANUFACTURING OF CABLE (5 Hours)

Basic techniques, Extrussion, wire extrusion, Multy wire extrusion.

PRACTICALS: (60 Hours)

- Analysis of the thermal stability of cable material.
- Determination of the volume and surface resistivity of cable material.
- Chemical identification of the cable insulating materials
- Determination of fire resistance and smoke density of cable insulating materials.
- Evaluate weatherability of cable materials.
- Determination of mechanical strength (tensile, compressive, elongation, low temperature flexibility (to check ASTM) and hardness), and density of cable materials.
- Manufacturing of wire and cables.
- Determination of limiting oxygen index (LOI) of wire and cable materials.
- Determination of K-value of PVC.
- Industrial visitof cable industries for exposure to instruments and working.

ESSENTIAL/RECOMMENDED READINGS

1. Cousins K., (2000) Polymers for wire and cables- changes within an industry, SmithersRapra Publishing.
2. Black R.M., (1983) The History of Electric wire and Cables, Peter Peregrinus Ltd.

ADDITIONAL RESOURCES:

1. Martin J.M., Smith W.K., (2007) Handbook of Rubber Technology, CBS Publishers.
2. Ganguli, S. K., & Kohli, V. (2016). Power cable technology. CRC Press.

ASSESSMENT METHODS:

All the examiniations and assement methods shall be in the line with the University of Delhi gidelinceissused from time to time

KEYWORDS:

Mechanical strength, thermal insulation, weatherability, Polyvinyl chloride

DISCIPLINE SPECIFIC ELECTIVE (DSE-17)

Credit distribution, Eligibility and Pre-requisites of the Course

Course title & Code	Credits	Credit distribution of the course			Eligibility criteria	Pre-requisite of the course
		Lecture	Tutorial	Practical/ Practice		
POLYMERS IN SPORTS AND FOOTWEAR TECHNOLOGY	4	2	0	2	12^{Th} with PCM/PCB	---

COURSE OBJECTIVES:

The Learning Objectives of this course are as follows:

1. To impart knowledge of the basic concepts of raw material and its use in manufacturing of sports and footwear.
2. To learn design and design criteria of sports and footwear

LEARNING OUTCOMES

The Learning Outcomes of this course are as follows:

After studying this paper, students will be able to

1. Apply the knowledge of various type of polymers used in footwear manufacturing
2. Analyse the soling and its material requirements

SYLLABUS OF DSE 17

THEORY: **(30Hours)**

UNIT 1: SHOE SOLES **(10Hours)**

Soling requirements, soling materials, compounding and processing. Individual soling compounding-PVC, thermoplastic rubber, polyurethane, ethylene vinyl acetate, etc.

UNIT 2: ADHESIVES FOR SHOE **(10 Hours)**

Soling adhesives and types of adhesives, adhesion principle, adhesive selections, Heel covering; sole attaching, neoprene, PU, hot melt and liquid curing adhesives, adhesion problems. Coated fabrics: PVC, PU coated fabric.

UNIT 3: SOLES MATERIALS **(5 Hours)**

Molded and pre fabricated units, individual solings – rubbers, vulcanized rubbers, nylons, polyesters, PVC, thermoplastic rubbers, PU, EVA.

UNIT 4: PROCESSING **(5 Hours)**

Injection moulding, sponge moulding, direct molded shoes, thermoplastic moulding, polyurethane injection moulding, insert moulding, HF flow moulding.

PRACTICALS: (60Hours)

- Selection and identification of materials for sports equipment (tennis/badminton racket, football, tennis ball, cricket ball etc.)
- Determination of bonding strength of sole.
- Preparation and testing of shoe sole by compression molding.
- Testing of shoe components for different properties such as compressive strength, tensile strength, compression set, shore A etc.
- Estimate tear strength and abrasion resistance of a sole.
- Prepare different compounded sheets of EVA.
- Determine low temperature flexibility of shoe materials.
- Prepare the sponge sole and calculate its specific gravity.
- Prepare PU adhesive for sole bonding and determine the peel strength.
- Estimate out cold flexibility of sport goods
- Demonstration of design aspects of different footwear.
- Industrial visit for exposure to instruments and working.

ESSENTIAL/RECOMMENDED READINGS

1. Martin J.M., Smith W.K., (2007) HandBook of Rubber Technology, CBS Publisher.
2. Harvey A.J., (1982) Footwear Materials and Process Technology, A LASRA publication.
3. Cohn, W.E., (1969) Modern Footwear Materials & Process, Fairchild Publications.
4. Luximon, A. (Ed.). (2021). Handbook of footwere design and manufacture. Woodhead Publishing.

SUGGESTIVE READINGS

1. Venkatappaiah, B. (1997). Introduction to Modern Footwear Technology. B. Sita.
2. S SMuthu, (2020) Leather and Footwear sustainability, Springer.

ASSESSMENT METHODS:

All the examiniations and assement methods shall be in the line with the University of Delhi gidelinceissused from time to time

KEYWORDS:

Compounding, Shoe adhesives, Polyurethane, fabrication of sole.

DISCIPLINE SPECIFIC ELECTIVE(DSE-18)

Credit distribution, Eligibility and Pre-requisites of the Course

Course title & Code	Credits	Credit distribution of the course			Eligibility criteria	Pre-requisite of the course
		Lecture	Tutorial	Practical/ Practice		
Polymeric Membrane	**4**	**2**	**0**	**2**	**12Th with PCM/PCB**	**---**

COURSE OBJECTIVES:

The Learning Objectives of this course are as follows:

1. To apprise students with the concept of polymer-based membrane along with their properties and application in water purification, electro dialysis, reverse osmosis and proton conduction.
2. To impart knowledge of synthesis, device fabrication and application of membranes
3. Testing of different polymeric membranes for ion exchange capacity, electrical conductivity and life cycle etc.

LEARNING OUTCOMES

The Learning Outcomes of this course are as follows:

After studying this paper, students will be able to

1. Acquire knowledge about membrane and their preparation.
2. Apply the use polymer membranes for resolving environmental hazards.
3. Develop skills to select different type of polymeric membranes for different type of separations.
4. Use appropriate methods to reduce membrane fouling.

SYLLABUS OF DSE-18

THEORY: (30 Hours)

UNIT 1: INTRODUCTION (5Hours)

Basics of polymer membrane, classifications of membrane: porous vs. non-porous membranes, Charged and neutral membranes,electrical double layer theory, scale-up and commercialization challenges, Policy, regulation, and sustainability aspects

UNIT 2:FABRICATION TECHNIQUES (10Hours)

Polymer used in membrane: PE, PET, PS, biopolymers, etc. Phase inversion techniques, Non-solvent and thermal, Electrospinning and nanofiber membranes, Interfacial polymerization, solvent casting method, and Surface modifications of membrane for enhanced performance

UNIT 3:PROPERTIES AND TESTING (7Hours)

Properties of membrane: mechanical, chemical, permeability, selectivity, flux, dimension, morphology, permeability and selectivity measurements, thermal properties (DSC and TGA), fouling resistance and stability evaluations,

UNIT 4: APPLICATIONS (8 Hours)

Water treatment**:** Reverse osmosis, Desalination and water treatment,

Gas separation**:** Carbon dioxide capture, oxygen enrichment, hydrogen purification.

Energy applications**:** Proton exchange membranes for fuel cells and Batteries

Biomedical applications**:** Hemodialysis membranes, and drug delivery systems

PRACTICALS: (60Hours)

- Prepare a membrane by i) casting ii) analyse its morphology
- Preparation of membrane for Ultrafiltration using Phase Inversion and test its permeability
- Fabricate a membrane by interfacial polymerisation and study its condition
- Determine the ion exchange capacity of a membrane using titration method
- Evaluate the sieving nature of a laboratory prepared polymer membrane
- Evaluate the swelling index and percentage porosity of representative membrane
- Determine the performance and fouling nature of a standard membrane
- Demonstrate the decontamination of polluted water after using membrane
- Evaluate the proton conducting of a standard membrane.

ESSENTIAL/RECOMMENDED READINGS

1. Winston W. S. Ho, Sirkar K. K., (1992), Membrane handbook, Springer.
2. Baker R. W., (2012) Membrane Technology and Applications, John Wiley and Sons.
3. Mulder M., (1996) Basic Principles of Membrane Technology, Springer.
4. Batrinescu, G., Constantin, L. A., Cuciureanu, A., & Constantin, M. A. (2016). Conductive polymer-based membranes, Intehopen Ltd.
5. Mahmoud A. A., (2024) Polymer Membrane, De Gruyter

SUGGESTIVE READINGS

1. Wang, L. K., Chen, J. P., Hung, Y. T., & Shammas, N. K. (Eds.). (2008). Membrane and desalination technologies (Vol. 13). Springer Science, Business Media, LLC.
2. Porter, M. C. (1989). Handbook of industrial membrane technology.US Department of Energy.

ASSESSMENT METHODS:

All the examiniations and assement methods shall be in the line with the University of Delhi gidelinceissused from time to time

KEYWORDS:

Neutral membranes, Fabrication,Electrospinning, Standard membrane, Fuel cells

DESCIPILNE SPACIFIC ELECTIVE COURSES (DSE-19)

Credit distribution, Eligibility and Pre-requisites of the Course

Course title & Code	Credits	Credit distribution of the course			Eligibility criteria	Pre-requisite of the course
		Lecture	Tutorial	Practical/ Practice		
POLYMER FOAM TECHNOLOGY	**4**	**2**	**0**	**2**	**12Th with PCM/PCB**	**---**

COURSE OBJECTIVES:

The Learning Objectives of this course are as follows:

1. To learn about the raw materials of foams.
2. Understand the fundamentals of polymer foam technology.
3. Learn about different types of polymer foams and their properties.
4. Study foam formation mechanisms and processing techniques.

LEARNING OUTCOMES

The Learning Outcomes of this course are as follows:

After studying this paper, students will be able to

1. Analyse the building blocks of polyurethanes.
2. Justify the applications of polymer foams in various industries.
3. Understand the effect of the chemical composition of polyurethane foam on properties.

SYLLABUS OF DSE-19

THEORY: **(30Hours)**

UNIT 1: INTRODUCTION OF FOAMS **(7Hours)**

Basics and classification of polymer foams. Raw materials, types of foam: Nitrile rubber, Natural rubber latex, Silicone, polyurethane. polystyrene. polyethylene, polypropylene, rebondfoams,etc.

UNIT 2: MANUFACTURING OF FOAM **(8Hours)**

Foam Formation Mechanisms: Nucleation and growth of bubbles. Foam stabilization and destabilization.

Foam Processing Techniques:Batch foaming, Casting, Spray, continuous foaming, Reaction injection molding of foams and extrusion process.

UNIT 3: PROPERTIES **(8Hours)**

Polymer Foam Properties: Density, Mechanical properties (compression strength, tensile strength, compression set, low temperature flexibility). Thermal properties(thermal conductivity, etc.). Acoustic properties (sound absorption, etc.).

UNIT 4: APPLICATIONS (7Hours)

Cushioning and packaging. Insulation and energy efficiency. Automotive and aerospace applications. Medical devices and healthcare applications.

PRACTICALS: (60 Hours)

- Preparation of nitrile rubber foam.
- Preparation of expanded polystyrene foam.
- To determine the thermal insulation of nitrile rubber foam.
- Testing of nitrile rubber foams (density, Compressive strength, porosity)
- Preparation of Flexible/Rigid PU foam by RIM.
- Preparation of Flexible PU foam by Molding.
- Testing of foam for handloom and automobile applications.
- Determination of physio-Mechanical properties of commercial polymeric foams (Impact, compression, Tear etc.)

ESSENTIAL/RECOMMENDED READINGS

1. Mills, N. J. (1993). Handbook of polymeric foams and foam technology: D. Klempner and KC Frisch (eds) Carl Hanser Verlag.
2. Oertel G., (1993), Polyurethane Handbook, Hanser Publishers; 2Rev Ed Edition.
3. D.Klempner, V.Sendijarevic,(2024) Polymeric Foams and Foam Technology, Hanser Publisher.

SUGGESTIVE READINGS

1. Walker, B. M., & Rader, C. P. (Eds.). (1979). Handbook of thermoplastic elastomers (pp. 115-205). New York: Van Nostrand Reinhold.
2. Elastomers, T. (1987). A Comprehensive Review, edited by NR Legge, G. Holden, and HE Schroeder.
3. Brydson J.A., (2016) Plastics Materials, Butterworth Heinemann, 8th Edition.

ASSESSMENT METHODS:

All the examiniations and assement methods shall be in the line with the University of Delhi gidelinceissused from time to time

KEYWORDS:

Compressive strength, Thermal properties, Cushioning, Open cell foam.

GENERIC ELECTIVE COURSES (GE-07)

Credit distribution, Eligibility and Pre-requisites of the Course

Course title & Code	Credits	Credit distribution of the course			Eligibility criteria	Pre-requisite of the course
		Lecture	Tutorial	Practical/ Practice		
Polymer in Toady's Life	**4**	**2**	**0**	**2**	**12Th**	**---**

COURSE OBJECTIVES:

The Learning Objectives of this course are as follows:

1. To give an over view about the use of polymer in current lifestyle
2. The course is designed to provide comprehensive knowledge to the students regarding importance of polymer and its impact in life and the environment.
3. The course is designed to make students aware of the problems due to polymer and their solution.

LEARNING OUTCOMES

The Learning Outcomes of this course are as follows:

After studying this paper, students will be able to

1. understand the importance of polymers in daily life and society
2. learn problems associated with polymers and solutions

SYLLABUS OF GE-07

THEORY: (30Hours)

UNIT 1: POLYMERS (7Hours)

Introduction to polymers, properties, and resources polymer.
Classification of polymer, Brief details about Natural and Synthetic polymer(cellulose, starch, PE PP and PS)

UNIT 2:PREPRATION OF POLYMERS (8Hours)

Polymerizations, different method of polymerizations, Modification of polymer, Polymercomposit.

UNIT 3: COMMON USE OF POLYMER (8Hours)

Polymer is Packaging
Polymer in Textile
Polymers in civil and structural applications
Polymers in electronic devices

UNIT 4: POLYMER AND ENVIRONMENT (7Hours)

Impact of polymer on environment and their solution
Rules and Regulations of use of plastic and its management: Indian Perspective
Reuse of plastics

PRACTICALS: (60Hours)

- Isolate the cellulose from sugarcane bagasse and identify their properties
- Identify the functional group of polymer by chemical methods and spectroscopic method
- Prepare a packaging film and determine its thickness and hardness
- Separate the polymer from flexible packaging film and report the yield
- Demonstrates the degradation effect of plastic in polymers
- Determine the biocompatibility of plastic items.

ESSENTIAL/RECOMMENDED READINGS

1. Fred W. Billmeyer Jr., (1984) Textbook of Polymer Science, Wiley-lnterscience Publication John Wiley & Sons
2. Joel R. Fried(2014), Polymer Science and Technology" Prentice Hall.

ADDITIONAL RESOURCES

1. Charles E. Carraher Jr.,(2017) Introduction to Polymer Chemistry, CRC Press.
2. O. Olatunji,(2024) Natural Polymers: Industry Techniques and Applications, Springer; 1st edition.

ASSESSMENT METHODS:

All the examiniations and assement methods shall be in the line with the University of Delhi gidelinceissused from time to time

KEYWORDS:

Synthetic polymer, Polymerizations, Natural polymers, cellulose.

GENERIC ELECTIVE COURSE (GE-08)

Credit distribution, Eligibility and Pre-requisites of the Course

Course title & Code	Credits	Credit distribution of the course			Eligibility criteria	Pre-requisite of the course
		Lecture	Tutorial	Practical/ Practice		
Sustainability and Environment	**4**	**3**	**0**	**1**	**12Th**	**---**

COURSE OBJECTIVES:

The Learning Objectives of this course are as follows:

1. To evaluate the environmental impact of products or services using life cycle assessment.
2. To manage Intellectual Property portfolio to enhance the value of the firm.
3. To apply sustainable practices in daily life (reduce, reuse, recycle).
4. To advocate for environmental policies and practices.
5. To develop a sense of responsibility for environmental conservation.

LEARNING OUTCOMES

The Learning Outcomes of this course are as follows:

After studying this paper, students will be able to

1. Analyze environmental issues and develop solutions.
2. Apply sustainability principles in various industries (business, government, non-profit).
3. Develop expertise in environmental management, policy, or conservation.

THEORY: (45Hours)

UNIT 1: CONCEPT OF SUSTAINABILITY (10Hours)

Importance and objective of Sustainability.Different aspects of sustainability: Energy, material, society and their correlation. Evolution of the concept of ESG (environment, social and governance). Sustainability and Net Zero concept. Concept of Life Cycle Analysis.

UNIT 2: RULES, REGULATION, AND POLICIES RELATED TO SUSTAINABILI

(10Hours)

Importance of Rules, regulations and policies in maintaining sustainability, Policies related to sustainability in India, Sustainability Policies in Global scenario, India's Policy Landscape and its Business Implications

UNIT 3: APPROACH TOWARDS SUSTAINABILITY (15Hours)

Cocept of Circular Economy - Challenges, Opportunities and FutureProspects, Renewable energy and optimization of energy usage Socio-cultural dimensions for sustainable approach, The business case studies for sustainability

UNIT 4: RESORCE MANAGEMENT (10Hours)

Natural resource and its management, Energy managements, material recycling for used polymers.

PRACTICALS: (30Hours)

1. Study the effect of polymer degradation on soil and water i.e. pH, porosity, water retaining capacity.
2. Estimate the waste generation during preparation of polymers
3. Demonstrate the chemical recycling of used plastic sample PVC pipe
4. Prepare a biodegradable film for packaging of edible items
5. Submit a assignment on Indian regulation on dumping of plastic
6. Calculate the recycling efficiency of plastic bottles of laboratory chemicals.
7. Demonstrate a small polymer processing plant with “Net Zero Concept”.

ESSENTIAL/RECOMMENDED READINGS

1. Wilson, G., Furniss, P., &Kimbowa, R. (Eds.). (2010). Environment, Development, and Sustainability: perspectives and cases from around the world. Open University Press.
2. Mulligan, M. (2017). Introduction to sustainability. Taylor & Francis.
3. Pugh, C. (2014). Sustainability the environment and urbanisation. Routledge.

ADDITIONAL RESOURCES:

1. Adams, B. (2008). Green development: Environment and sustainability in a developing world. Routledge.
2. Thangavel, P., & Sridevi, G. (2016). Environmental sustainability. Springer, India, Private.
3. Barr, S. (2016). Environment and society: Sustainability, policy and the citizen. Routledge.

ASSESSMENT METHODS:

All the examiniations and assement methods shall be in the line with the University of Delhi gidelinceissused from time to time

KEYWORDS:

Energy managements, Circular Economy, Life Cycle Analysis, Natural resource, Sustainability.