PLASTINDIA INTERNATIONAL UNIVERSITY

(Sponsored by Plastindia Foundation)

Dungra, GIDC, Vapi, Dist. Valsad - 396193, Gujarat, India

(Established under Gujarat Government Private Universities Act, 2016)

School of Engineering

B. Tech (Plastics and Polymer Engineering)

P-2024

SY B. Tech (Plastics and Polymer Engineering)

Course Category	Course Code	Course Name	Teaching Scheme (Hours/ Week)			Examination Scheme and Marks							Credits			
			Theory	Practical	Contact Hr/Week	ISE- I	ISE - II	TA	ESE	TW	PR/OR	TOTAL	TH	TW/PR	TOTAL	In Line WithUML
Semester - III																
BSC	BSC301	Calculus - III	3	-	3	15	15	20	50	-	-	100	3	-	3	√
PCC	PPE331	Polymeric Materials-I	3	-	3	15	15	20	50	-	-	100	3	-	3	√
PCC	PPE332	Introduction to Organic and Polymer Chemistry	3	-	3	15	15	20	50	-	-	100	3	-	3	√
PCC	PPE333	Principles of Processing Equipment and Automation	3	-	3	15	15	20	50	-	-	100	3	-	3	√
PCC	PPE334	Polymer Additives and Compounding	3	-	3	15	15	20	50	-	-	100	3	-	3	
PCC	PPE392	Lab: Introduction to Organic and Polymer Chemistry	-	2	2	-	-	-	-	-	25	25	-	1	1	√
PCC	PPE393	Lab: Principles of Processing Equipment and Automation	-	2	2	-	-	-	-	25	-	25	-	1	1	√
PSI	PSI371	Seminar	-	4	4	-	-	-	-	25	25	50	1	1	2	
HSSM	HSSM321	Environmental Studies	2	-	2	Non-Credit Mandatory Course										
HSSM	HSSM322	Professional Communication	2	-	2	Non-Credit Mandatory Course										
		Total	**19**	**8**	**25**	**75**	**75**	**100**	**250**	**50**	**50**	**600**	**16**	**3**	**19**	

Year, Program, Semester	S.Y. B. Tech in Plastics and Polymer Engineering, Semester-III						
Course Code	BSC301						
Course Category	BSC (Basic Sciences and Humanities Courses)						
Course title	**Calculus - III**						
Teaching Scheme and Credits	**L**	**T**	**P**	**Total Contact Hours**	**Total Credits**		
	03	-	-	03	03		
Evaluation Scheme	**ISE-I**	**ISE-II**	**ESE**	**TA**	**TW**	**PR/OR**	**Total**
	15	15	50	20	-	-	100
Pre-requisites (if any)	• Calculus – I and II • Diploma Level Mathematics						
Course Objectives	• To comprehensively introduce the concepts of vector calculus and its applications using integral theorems. • To develop an understanding of Fourier and Z-transforms, including their properties and applications in solving engineering problems. • To equip students with numerical methods for solving various equations. • To enable students to approximate derivatives and integrals of functions using numerical techniques for solving real-world engineering problems.						
Course Outcomes	• CO 1: Retrieve fundamental concepts of Advance Engineering Mathematics. (Remember) • CO 2: Understand the significance of Advance Engineering Mathematics in various domains. (Understand) • CO 3: Analyze the engineering problems and apply appropriate method to solve problems. (Apply) • CO 4: Identify the advanced engineering problem and evaluate using various methods and propose solution. (Analyze) • CO 5: Examine the error and solve it using various Numerical methods. (Evaluate)						

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Unit No.	Course Content	Hours
I	**Vector Calculus** Gradient, Divergence and Curl, Directional derivative, Vector Integration, Surface and Volume Integrals, Green's Theorem in plane, Gauss divergence theorem and Stokes' theorem (without Proof).	6
II	**Fourier Transform** Fourier Integral, Fourier Sine and Cosine transform, Properties of Fourier Transform, Parseval's Identity Applications in different domains.	6
III	**Z – Transform** Z- transform, Properties of Z – transforms, Convolution of two sequences, inverse Z – transform, Solution of Difference equations.	6
IV	**Numerical Methods for Algebraic and Transcendental Equations** Nature of equations, Importance, Graphical method, Bisection method, Regula Falsi method, Newton-Raphson method	6
V	**Numerical Differentiation and Integration** Newton's Forward and Backword difference formula, Central difference formula, Trapezoidal rule, Simpson's 1/3 and 3/8 rule, Finite difference,	6
VI	**Numerical Solution of Ordinary Differential Equations** Euler's method, Modified Euler's method, Runge-Kutta method (fourth order), Predictor corrector methods	6

	Text Books
1	B. S. Grewal, "Higher Engineering Mathematics", Khanna Publishers, New Delhi (1965)
2	Erwin Kreyszig, "Advanced Engineering Mathematics", John Wiley & Sons. (1962)
3	B. V. Ramana, "Higher Engineering Mathematics", Tata McGraw-Hill, New Delhi. (2007)
	Reference Books
1	C. R. Wylie, "Advanced Engineering Mathematics", McGraw Hill Publication, New Delhi. (2003)
2	Shanti Narayan, "Differential Calculus" S. Chand and company, New Delhi. (1942)
3	H. K. Dass, "Advanced Engineering Mathematics", S. Chand Publishing. (2007)
4	M. D. Greenberg, "Advanced Engineering Mathematics", Pearson Education. (1998)
	Web Links and Video Lectures (E-Resources)

1	NPTEL Course on Numerical Methods https://archive.nptel.ac.in/courses/111/107/111107105/
2	NPTEL Course on Advance Engineering Mathematics https://archive.nptel.ac.in/courses/111/107/111107119/

Activity Based Learning (Suggested Activities in Class)

1. Flipped Classroom
2. Online Interactive Tool
3. Collaborative and Individual Problem based learning.
4. Quizzes/Assignment

Mapping of Course Outcomes with Program Outcomes

COs / POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	1	-	-	-	-	-	-	-	-	-	2
CO2	2	2	-	-	-	-	-	-	-	-	-	2
CO3	3	2	-	-	-	-	-	-	-	-	-	2
CO4	3	3	-	-	-	-	-	-	-	-	-	2
CO5	3	3	-	-	-	-	-	-	-	-	-	2
Avg.	**2.4**	**2.3**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**2**

Mapping of Course Outcomes with Program Specific Outcomes

CO/PSO	PSO 1	PSO 2	PSO 3
CO 1	2	-	-
CO 2	2	-	-
CO 3	2	-	-
CO 4	3	-	-
CO 5	3	-	-
Avg.	**2.4**	**-**	**-**

Correlation Level

- Slightly Low: 1
- Moderately (Medium): 2
- Substantially (Strong): 3

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CO-PO-PSO Mapping Justification

- CO1 (Recall the fundamental concepts): Strongly relates to PO1 (Engineering knowledge), slightly to PO2 (problem solving), and moderately to PO12 (life-long learning). It moderately supports PSO1 (understanding fundamentals).
- CO2 (Describe variations in methods): Moderately maps to PO1, PO2 and PO12 due to understanding the variations in the methods to apply, which moderately aligns with PSO1 as it builds foundational understanding.
- CO3 (Apply methods): Strongly maps to PO1 due to basic concepts, moderately to PO2 and PO12 due to understanding methods to apply, which moderately aligns with PSO1 as it builds foundational understanding.
- CO4 (Observation of problems): Strongly aligns with PO1 and PO2 as it involves multiple observations to analyse with fundamentals and apply a particular method, and moderately with PO12 (lifelong learning) for personal growth, which strongly maps with PSO1.
- CO5 (Error detection): It strongly maps with PO1 and PO2 due to it involves fundamental to analysis process to solve engineering problems and detect errors, which is strongly connected with PSO1.

Year, Program, Semester	S.Y. B. Tech in Plastics and Polymer Engineering, Semester-III						
Course Code	PPE331						
Course Category	PCC (Professional Core Course)						
Course title	**Polymeric Materials-I (Theory)**						
Teaching Scheme and Credits	**L**	**T**	**P**	**Total Contact Hours**	**Total Credits**		
	03	-	-	03	03		
Evaluation Scheme	**ISE-I**	**ISE-II**	**ESE**	**TA**	**TW**	**PR/OR**	**Total**
	15	15	50	20	-	-	100
Pre-requisites (if any)	• Engineering Chemistry • Materials Science and Engineering • Engineering Physics						
Course Objectives	• This subject introduces the types, structures, properties, and characterization of polymers, especially thermoplastics and thermosets.						
Course Outcomes	• CO 1: Recall the names, types, and basic characteristics of common polymeric materials and their monomers. (Remember) • CO 2: Explain the structure-property relationships and polymerization methods used for commodity plastics. (Understand) • CO 3: Utilize appropriate polymeric materials for specific applications based on their structural and property requirements. (Apply) • CO 4: Differentiate the thermal and mechanical behaviour of thermoplastics and thermosets using standard test data. (Analyse)						

Unit No.	Course Content	Hours
I	**Introduction to Plastics and Historical Development:** History and evolution of synthetic polymers, development of the plastics industry, classification of polymers – thermoplastics and thermosets, difference between plastics, elastomers, and fibres, introduction to polymer nomenclature and structure representation, commercial importance of plastics, global and Indian plastics market overview, key milestones in polymer material discovery	6
II	**Polymer Structures and Polymerization Methods:**	6

	Definition of monomers and polymers, degree of polymerization, molecular weight and distribution, chain structure – linear, branched, crosslinked, types of polymerizations – addition and condensation, commercial polymerization techniques – bulk, solution, suspension, emulsion, effect of polymerization method on polymer properties, copolymers – types and significance, tacticity and its effect on properties	
III	**Commodity Thermoplastics** Introduction to commodity thermoplastics, polyethylene (LDPE, LLDPE, HDPE) – structure, properties, grades, applications, and processing behaviour, polypropylene – isotactic, syndiotactic, and atactic forms, crystallinity and thermal properties, structure-property relationships, mechanical performance and recyclability, typical molding and extrusion behaviours	6
IV	**Commodity Thermoplastics – Part II:** Poly(vinyl chloride) – types (rigid, plasticized), polymerization and additives used, thermal stability and processing considerations, polyvinyl chloride applications in construction, electrical, and healthcare, polystyrene – general purpose (GPPS), high impact (HIPS), expandable (EPS), properties and limitations, structure–property behaviour, common applications in packaging and consumer goods	6
V	**Elastomers and Thermosets:** Introduction to elastomers – natural and synthetic rubbers, diene rubbers – NR, SBR, BR, NBR – synthesis, properties, and applications, vulcanization and crosslinking concepts, classification and processing of thermosets – phenol-formaldehyde, urea-formaldehyde, epoxy, unsaturated polyester resins, curing mechanisms, structure–property relationships, end-use application areas	6
VI	**Testing, Applications, and Environmental Considerations:** Overview of ASTM standards and testing protocols, tensile, impact, hardness, thermal (DSC, TGA) testing methods, melt flow index (MFI), Vicat softening point, environmental stress cracking resistance (ESCR), end-use application case studies – automotive, packaging, construction, recyclability and degradation of commodity plastics, environmental impact and life cycle considerations	6

	Text Books
1	V R Gowariker, N V Viswanathan, Jayadev Sreedhar, Polymer Science, New Age International Publishers, Mumbai.
2	V. K. Ahluwalia, Anuradha Mishra, Polymer Science: A Textbook, ANE Books, New Delhi
3	P. Ghosh, Polymer Science and Technology: Plastics, Rubber, Blends and Composites, Tata McGraw Hill, 2nd Edition
4	J. A. Brydson, Plastics Materials, Butterworth Heinemann, 7th Edition
	Reference Books
1	Gilbert, Marianne. (2017). Brydson's Plastics Materials (8th Edition). Elsevier (available free online at Knovel.com)
2	Osswald, Tim A. Baur, Erwin Brinkmann, Sigrid Oberbach, Karl Schmachtenberg
3	Ernst. (2006). International Plastics Handbook - The Resource for Plastics Engineers (4th Edition). Hanser Publishers. (available free online at Knovel.com)
4	Plastic Materials and Processing- A. Brentstrong, 2006

Mapping of Course Outcomes with Program Outcomes

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO 1	3	2	1	-	-	-	-	-	-	-	-	1
CO 2	3	3	2	1	-	-	1	-	-	-	-	2
CO 3	3	3	3	2	2	-	2	-	-	-	1	3
CO 4	3	3	2	3	2	-	2	1	-	-	-	3
Avg.	3	2.75	2	2	2	-	1.6	1	-	-	1	2.25

Mapping of Course Outcomes with Program Specific Outcomes

CO/PSO	PSO 1	PSO 2	PSO 3
CO 1	3	-	-
CO 2	3	1	-
CO 3	3	3	2
CO 4	3	3	2
Avg.	**3**	**2.33**	**2**

Correlation Level

- Slightly Low: 1
- Moderately (Medium): 2
- Substantially (Strong): 3

CO-PO-PSO Mapping Justification

- CO1 (Recall names and basic characteristics): Strongly maps to PO1 (engineering knowledge) and PSO1 (fundamentals of polymer science). Slight linkage to PO2 for basic classification and PO12 for knowledge foundation.
- CO2 (Explain structure-property relationships and polymerization methods): Tied to PO1, PO2, and PO3 for understanding material design and properties. Environmentally-relevant decisions (like polymer choice) tie weakly to PO7. Supports PSO1 (conceptual understanding) and moderately PSO2.
- CO3 (Select suitable polymer for an application): Applies knowledge for material selection → strongly related to PO3, PO5, and even PO11 (project contexts). Heavily aligned with PSO2 (tools and design) and PSO3 (application/processing).
- CO4 (Analyse mechanical/thermal behaviour): Engages with data analysis and testing → PO4 (investigation), PO5 (tools), and PO7 (material impact). Strong mapping to PSO1, PSO2, and PSO3, especially as it involves experimental data interpretation.

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Year, Program, Semester	B. Tech in Plastics and Polymer Engineering, Semester-III						
Course Code	PPE332						
Course Category	PCC (Polymer Core Course)						
Course title	**Introduction to Organic and Polymer Chemistry (Theory)**						
Teaching Scheme and Credits	**L**	**T**	**P**	**Total Contact Hours**	**Total Credits**		
	03	-	-	03	03		
Evaluation Scheme	**ISE-I**	**ISE-II**		**ESE**	**TA**	**TW**	**PR/OR**	**Total**
	15	15		50	20	-	-	100
Pre-requisites	• Engineering Chemistry • Introduction to Plastics Engineering						
Course Objectives	• To introduce students to the fundamentals of organic chemistry essential for understanding chemical structure and bonding. • To develop the ability to analyze organic reaction mechanisms and molecules • To enable students to apply organic chemistry knowledge in polymer structure. • To foster awareness of sustainable and green chemistry practices in organic synthesis related to polymer engineering.						
Course Outcomes	• CO 1: Identify the types of chemical bonds, hybridizations, hydrocarbons and petroleum and natural resources that direct the structure of organic molecules in polymer engineering. (Remember) • CO 2: Summarize the preparation of organic compounds through key reaction mechanisms, stereochemistry, different name reactions. (Apply) • CO 3: Basic structure and configuration of monomer, oligomer and intermediate in polymer building, types of polymeric structures. (Understand) • CO 4: Utilize principles of green chemistry and organic						

	synthesis to propose environmentally sustainable routes for polymer and material development. (Apply)

Unit No.	Course Content	Hours
I	**Structure and Bonding in Organic Molecule** Atomic structure, atomic weight, molecular weight and mole concept, chemical bonding in hydrocarbons, IUPAC Nomenclature, classifications, intra and intermolecular forces, chemical and physical properties, hybridization, hydrocarbons extraction from petrochemical refinery, renewable and natural resources.	6
II	**Organic Reactions and Stereochemistry** Organic chemistry in polymer engineering, bond polarity, inductive effect, resonance, hyperconjugation, carbocation, carbanion, free radical, carbene, Isomerism, Stereochemistry, chirality, R/S Nomenclature, optical activity, organic reactions. Aromaticity, addition, substitution; SN1, SN2, elimination; E1, E2, ECB, coupling and photo-chemical reactions, o and p-directing groups.	7
III	**Pericyclic and Name Reactions** cycloadditions, cyclic transition state, Diels-elder reaction, Ene reaction, Beckmann rearrangement, Cope and Claisen rearrangement, Pinacol-Pinacolone rearrangement, Grignard reaction, Aldol condensation, Witting reaction, Sandmeyer reaction. Oxidations and Reductions.	5
IV	**Applied Organic Chemicals** Applied organic compounds e.g. ethene, ethylene, propene, vinyl, acrylic acid, acrylate, epoxy, alcohol, aldehydes, ester, amide and amines. Organic reactions of benzene, nitrobenzene, styrene, aniline, phenol, melamine, benzoic acid and terephthalic acid. Chromatography, separation and purifications.	6
V	**Fundamentals in Polymer Chemistry** Structure of monomers, functionality, oligomer and polymers, chemical and geometrical structures, classification, Ziegler-Natta-catalyst,	7

	initiator, inhibitor, addition and condensation reactions, mechanism steps, rate of polymerization, ring opening, Mw, Mn calculation, degree of polymerization D_p, phase transitions in structure.	
VI	**Organic and Sustainable Polymer Chemistry** Copolymerization, copolymers, ionic, coupling reactions, organic reactions at polymeric structure, amorphous and crystalline, green principles in polymer chemistry, bio-based and sustainable resources, polymer solubility, chain breaking, and bond scission, unsaturation and factors.	5

	Text Books
1	Brown and Poon, Introduction to Organic Chemistry, 6th Ed, 2017, John Wiley and Sons, Hoboken **(custom-made for UMass Lowell)** ISBN: 9781119471790
2	Robert Thornton Morrison, Robert Neilson Boyd, Organic Chemistry, 7th Edition, 2010, Pearson Education, Delhi.
3	Paul T. Anastas, John C. Warner, *Green Chemistry: Theory and Practice*, 1st Edition, 1998, Oxford University Press, Oxford.
4	George Odian, Principles of Polymerization, 4th Edition, 2004, John Wiley & Sons, New York.
	Reference Books
1	Fred W. Billmeyer, Textbook of Polymer Science, 3rd Edition, 1984, John Wiley & Sons, New York.
2	Organic Reaction Mechanisms, 5/Ed by V.K. Ahluwalia & Rakesh K. Parashar by V K Ahluwalia and Rakesh Kumar Parashar. Narosa Publishing House, 2024, ISBN; 978-8184876468.
3	P.S. Kalsi, Organic Reaction and Mechanism, New Age International private limited, 5th edition.
4	M. B. Smith, March's Advanced Organic Chemistry: Reactions, Mechanisms and Structure; 7th ed. 2015, Wiley, India
5	Malcolm P. Stevens. Introduction to Polymer Chemistry, Oxford University Press, New York, 1999. 3rd Edition.

Mapping of Course Outcomes with Program Outcomes

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO 1	3	2	1	-	-	-	-	-	-	-	-	1
CO 2	3	3	2	2	-	-	-	-	-	-	-	2
CO 3	3	3	3	2	2	-	1	-	-	-	-	2
CO 4	2	2	3	1	1	1	3	2	-	-	-	3
Avg.	**2.75**	**2.5**	**2.25**	**1.67**	**1.5**	**1**	**2**	**2**	**-**	**-**	**-**	**2**

Mapping of Course Outcomes with Program Specific Outcomes

CO/PSO	PSO 1	PSO 2	PSO 3
CO 1	3	-	-
CO 2	3	-	-
CO 3	2	2	3
CO 4	2	1	3
Avg.	**2.5**	**1.5**	**3**

Correlation Level

- Slightly Low: 1
- Moderately (Medium): 2
- Substantially (Strong): 3

CO-PO-PSO Mapping Justification

- CO1 is foundational and focuses on understanding molecular structure and properties — it correlates well with PO1, PO2, and PSO1.
- CO2 expands on reaction mechanisms, relevant to problem analysis and investigation — mapping to PO2, PO3, PO4 and PSO1.
- CO3 involves synthesis and application of reactions — strongly mapping to design and development, problem solving, and PSO2/PSO3.
- CO4 introduces sustainability and green chemistry, which ties into PO7 (Environment and sustainability) and PSO3.

Year, Program, Semester	S.Y. B. Tech in Plastics and Polymer Engineering, Semester-III						
Course Code	PPE333						
Course Category	PCC (Professional Core Course)						
Course title	**Principles of Processing Equipment and Automation (Theory)**						
Teaching Scheme and Credits	**L**	**T**	**P**	**Total Contact Hours**	**Total Credits**		
	3	**-**	**-**	**3**	**3**		
Evaluation Scheme	**ISE - I**	**ISE – II**	**ESE**	**TA**	**TW**	**PR/OR**	**Total**
	15	**15**	**50**	**20**	**-**	**-**	**100**
Pre-requisites (if any)	• Engineering Physics • Materials Science and Engineering • Engineering Graphics and Design						
Course Objectives	• Understand the basic components and systems (hydraulic, pneumatic, electrical) used in plastics processing equipment automation. • Explore control systems such as PLCs, sensors, and user interfaces, focusing on their role in ensuring system efficiency and safety. • Introduce safety interlocks and integrated systems, emphasizing their importance in the overall design and operation of automated processing machines. • Equip students with the skills to analyze and integrate mechanical, electrical, and control components for optimizing machine performance and safety						
Course Outcomes	• CO 1: Recall the functions and components of processing equipment and automation systems used in plastics manufacturing. (Remember) • CO 2: Explain the underlying theory and operation of hydraulic, pneumatic, electrical, and control systems used in plastics processing equipment. (Understand) • CO 3: Demonstrate the ability to design and implement safety interlocks and control systems in plastics processing equipment. (Apply) • CO 4: Examine the integration of electrical, hydraulic, pneumatic, and						

	control systems in processing equipment, assessing their impact on machine performance and safety. (Analyse) • CO 5: Assess the performance and efficiency of automated systems, considering operational constraints, safety standards, and industry best practices. (Evaluate)

Unit No.	Course Content	Hours
I	**Introduction to Plastics Processing Equipment and Automation:** Introduction to plastics processing machines, role of automation in plastics processing, basic machine architecture, overview of system integration, interrelation of mechanical, electrical, and control subsystems, safety considerations and standards, introduction to machine prints and diagrams	6
II	**Safety interlocks and hydraulic power systems:** Types of machine safety interlocks – mechanical, electrical, software-based, functions and importance of safety interlocks, fundamentals of hydraulic power systems, hydraulic fluid properties, hydraulic pumps, valves, actuators, flow and pressure control, circuit diagrams and symbol interpretation	6
III	**Pneumatic systems and their applications:** Introduction to pneumatics in processing equipment, comparison with hydraulics, components – compressors, valves, actuators, air preparation units, control methods, pneumatic circuit design and troubleshooting, advantages and limitations in plastics machinery	6
IV	**Electrical power systems – High voltage AC and Low voltage DC:** Basics of industrial electrical systems, high voltage AC power distribution in machines, transformers, protection systems, grounding and insulation, low voltage DC control circuits, relays, switches, fuses, wiring diagrams and labelling standards, integration with other subsystems	6
V	**Programmable Logic Controllers (PLC) and Human-Machine Interface (HMI):** Role of PLCs in automation, PLC hardware and software, I/O modules, ladder logic basics, timers and counters, HMI design and configuration,	6

	communication between PLC and HMI, real-time monitoring and diagnostics, sample applications in injection molding and extrusion	
VI	**Optical sensors and mechanical integration in machine design:** Types of sensors – photoelectric, proximity, infrared, encoders, working principles and selection criteria, integration with control systems, sensor placement strategies, reading and analyzing machine prints, mechanical layout of components, design considerations for automation-ready processing equipment.	6

	Text Books
1.	M. Mitra, S. Sengupta, Programmable Logic Controllers and Industrial Automation: An Introduction, 2nd Edition, 2017, Penram International Publishing
2.	S. Ilango, V. Soundararajan, Industrial Hydraulics and Pneumatics, PHI Learning
3.	B.L. Theraja & A.K. Theraja, A Textbook of Electrical Technology – Volume I: Basic Electrical Engineering, 2nd Edition, 2024, S. Chand
4.	J. Fraden, Handbook of modern sensors-Physics Designs and Applications, 4th Edition, 2010, Springer.
	Reference Books
1	D. Lobsiger, P. Giuliani, & K. Rexford, Electrical Control for Machines, 7th ed, Cengage Learning, Boston, 2016, ISBN: 978-1-133-69338-3
2	Eaton Hydraulics Group, Industrial Hydraulics Manual, 6th ed, 2015. ISBN-13: 978-0-692-53210-2
3	W. Bolton, Programmable Logic Controllers, 4th Edition, 2006, Elsevier, eBook ISBN: 9780080462950
4	S. Soloman, Sensors Handbook, 2nd Edition, McGraw Hill, ISBN: 978-0-07-160571-7

Mapping of Course Outcomes with Program Outcomes

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO 1	3	2	1	-	-	-	-	-	-	-	-	1
CO 2	3	3	2	-	1	1	1	-	-	-	-	2
CO 3	3	2	3	2	3	2	1	2	2	2	2	3
CO 4	3	3	3	3	3	2	2	2	2	2	3	3

CO 5	3	3	3	3	3	3	2	3	2	2	3	3
Avg	**3**	**2.6**	**2.4**	**2.67**	**2.5**	**2**	**1.5**	**2.33**	**2**	**2**	**2.67**	**2.4**

Mapping of Course Outcomes with Program Specific Outcomes

CO/PSO	PSO 1	PSO 2	PSO 3
CO 1	3	2	1
CO 2	3	3	2
CO 3	3	3	3
CO 4	3	3	3
CO 5	3	3	3
Avg.	**3**	**2.8**	**2.4**

Correlation Level

- Slightly Low: 1
- Moderately (Medium): 2
- Substantially (Strong): 3

CO-PO-PSO Mapping Justification

- CO1 (Remembering equipment functions/components): Aligns with PO1 (basic engineering knowledge) and PSO1/2 (fund. of polymer processing systems).
- CO2 (Understanding system operation): Strong ties to PO1, PO2, PO5 due to theory-heavy nature; medium link to PSO2/3 for conceptual grasp of tools and systems.
- CO3 (Application of interlocks and control systems): High relevance to PO3–PO5, PO6, PO8–PO12, and all PSOs due to hands-on system design, safety implementation, and teamwork.
- CO4 (Analysing system integration): Deep analytical mapping to all core engineering outcomes and professional skills including PO1–PO5, PO6–PO11. Strong relevance to PSO2/3 for assessing integrated systems.
- CO5 (Evaluating performance/safety of automation): Tightly linked to PO2–PO5, PO6, PO8, PO11–PO12, requiring critical evaluation skills and understanding of best practices and sustainability. Strong on PSO3 for performance assessment in polymer sector context.

Year, Program, Semester	S.Y. B. Tech in Plastics and Polymer Engineering, Semester-III						
Course Code	PPE334						
Course Category	PCC (Professional Core Course)						
Course title	**Polymer Additives and Compounding (Theory)**						
Teaching Scheme and Credits	**L**	**T**	**P**	**Total Contact Hours**	**Total Credits**		
	03	-	-	03	03		
Evaluation Scheme	**ISE-I**	**ISE-II**	**ESE**	**TA**	**TW**	**PR/OR**	**Total**
	15	15	50	20	-	-	100
Pre-requisites (if any)	• Engineering Chemistry • Engineering Physics • Introduction to Plastics Engineering						
Course Objectives	• To introduce the classification, purpose, and selection criteria of additives used in polymer compounding. • To familiarize students with the properties and applications of various fillers, reinforcements, stabilizers, colorants, plasticizers, lubricants, and other functional additives. • To explain the machinery, mixing mechanisms, and process parameters involved in polymer compounding operations. • To develop understanding of formulation design, manufacturing workflows, and quality control practices for polymer-based products.						
Course Outcomes	• CO 1: List various types of polymer additives along with their technical roles in compounding applications. (Remember) • CO 2: Illustrate the functions of common fillers and reinforcements used in polymers using suitable examples and diagrams. (Understand) • CO 3: Construct a basic compounding formulation for a selected polymer product. (Apply) • CO 4: Categorize different additives based on their functional mechanisms. (Analyse)						

Unit No.	Course Content	Hours
I	**Introduction:** Introduction, classification of additives, technical requirements of use of additives in polymer compounding, types of additives used in polymers.	4
II	**Fillers and reinforcements:** Properties and applications of jute, coir, hemp, aramid, polymeric, carbon and glass fibres, wood, calcium carbonate, talc, wollastonite, clay and silicates.	5
III	**Stabilizers, colorants and process aids:** • Stabilizers: Mechanism of photodegradation of polymers, photo stabilization concept, antioxidants, antiozonants, UV stabilizers, and heat stabilizers. • Colorants: Pigments and dyes, types of pigments and their role in coloration, master batches, colour matching. • Plasticizers: Plasticizers and anti-plasticizers, chemistry, properties, characteristics and applications. • Lubricants: Types and effect of lubricants, zinc stearate, waxes.	9
IV	**Miscellaneous additives:** Impact modifiers, peptizers, blowing agents, flame retardants, nucleating agents, coupling agents, anti-microbial agents, anti-fogging agents, anti-static agents, metal deactivators, cross linking agents, biodegradable additives	7
V	**Polymer compounding: process, machinery and devices:** Mixing mechanisms: dispersion and distribution, internal batch mixers, continuous mixers, two roll mill, single and twin-screw extruder, modular extruder concept, rotation mechanisms, screw elements, kneaders, vent and vacuum ports, conveying systems: feeding types, feeders and their screws, challenges and feed enhancement technology	7
VI	**Formulations, Manufacturing and Quality Control** Formulating a compounding recipe, basic recipe for packaging films, medical products, automotive products, material movement in manufacturing, in line quality control, safety and health hazards	4

	Text Books
1	J. A. Brydson, Plastics Materials, 1st Edition, 1999, Butterworth-Heinemann, Oxford
2	R. H. Wildi and C. Maier, *Understanding Compounding*, 1st Edition, 1998, Hanser Gardner Publications, Cincinnati.
3	H. Panda, Plastics Additives Technology Handbook, 1st Edition, 2012, Engineers India Research Institute, Delhi
4	M. J. Stevens, J. A, Kovas., Extrusion Principles and Operation, 2nd Edition, 1995, Chapman and Hall
	Reference Books
1	Nicholas P. Cheremisinoff, Polymer Mixing and Extrusion Technology, 1st Edition, 1987, Marcel Dekker Inc., New York.
2	R. Gachter and H. Müller, Plastics Additives, 3rd Edition, 1993, Hanser Publishers, Munich.
3	Ica Manas-Zloczower and Zehev Tadmor, Mixing and Compounding of Polymers: Theory and Practice, 2nd Edition, 2009, Hanser Publications, Munich
4	Jesse Edenbaum, Plastics Additives and Modifiers Handbook, 1st Edition, 1992, Springer, New York.
5	John Murphy, The Additives for Plastics Handbook, 2nd Edition, 2001, Elsevier Advanced Technology, Oxford
	Nicholas P. Cheremisinoff - Practical Guide to Industrial Safety Methods for Process Safety Professionals, 2000, CRC Press.

Mapping of Course Outcomes with Program Outcomes

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO 1	3	2	1	-	-	-	-	-	-	-	-	1
CO 2	3	2	2	-	-	-	1	-	-	-	-	2
CO 3	3	3	3	2	2	-	1	-	-	1	2	3
CO 4	3	3	2	2	2	-	2	2	-	-	-	3
Avg	**3**	**2.5**	**2**	**2**	**2**	**-**	**1.33**	**2**	**-**	**1**	**2**	**2.25**

Mapping of Course Outcomes with Program Specific Outcomes

CO No.	PSO 1	PSO 2	PSO 3
CO 1	3	-	-
CO 2	3	2	-
CO 3	2	3	3
CO 4	2	3	2
Avg.	2.5	2.66	2.5

Correlation Level

- Slightly Low: 1
- Moderately (Medium): 2
- Substantially (Strong): 3

CO-PO-PSO Mapping Justification

- CO1 (List additives and their roles): Relates to PO1 (fundamental knowledge), PO2 (basic analysis), and PSO1 (understanding fundamentals of polymer science).
- CO2 (Illustrate fillers/reinforcements): Maps to PO1, PO2, PO3 and PO7 (sustainability), because filler selection influences environmental performance. It strongly supports PSO1 and PSO2 as it deals with materials and applications.
- CO3 (Formulation construction): Applies design and formulation principles (PO3), moderate investigative ability (PO4), use of tools/resources (PO5), and project planning (PO11). Strongly aligned with PSO2 (tools & design) and PSO3 (process design).
- CO4 (Categorization based on mechanisms): Requires analysis and understanding of structure-function relationships, thus maps to PO2, PO3, PO4, PO5, PO7, PO8, and PO12 (lifelong learning). Strongly supports PSO2 and PSO3 due to its relevance to formulation strategy and technical challenge-solving.

Year, Program, Semester	F.Y. B. Tech in Plastics and Polymer Engineering, Semester-II						
Course Code	PPE392						
Course Category	PCC (Program Core Course)						
Course title	**Introduction to Organic and Polymer Chemistry (Practical)**						
Teaching Scheme and Credits	**L**	**T**	**P**	**Total Contact Hours**	**Total Credits**		
	-	-	2	02	01		
Evaluation Scheme	**ISE-I**	**ISE-II**	**ESE**	**TA**	**TW**	**PR/OR**	**Total**
	-	-	-	-	-	25	25
Pre-requisites (if any)	• Chemistry at First Year or Diploma Level						
Course Objectives	• To understand the basic guideline of chemistry laboratory and knowledge about glassware and apparatus used in chemistry laboratory. • To get practical knowledge of qualitative analysis of element, and functional group in an organic group. • Organic preparation: synthesis of organic compound by different processes. • To get practical knowledge of quantitate analysis of polymer sample such as ester, hydroxyl, iodine value and ester values.						
Course Outcomes	• CO 1: Student will learn basic guideline of laboratory practical and knowledge about glassware and chemicals used in organic practical • CO 2: Able to get practical knowledge of detection and qualitative analysis of element, amine, alcohol, esters, acid, etc. • CO 3: Student will learn to detect the ester value, hydroxyl value, iodine values. • CO 4: Student will be able to determine dilute solution viscosity of polymer solution.						

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No.	Name of Practical	Hours
1	To understand the chemistry laboratory guidelines and know about glassware, apparatus, and chemicals used in for organic and polymer analysis.	2
2	To detect the presence of elements like nitrogen and halogens in an organic compound.	2
3	To determine the functional group in a given organic compound.	2
4	Separation and purification of a mixture of organic compounds by Chromatography.	2
5	Single-step synthesis of an organic compound and determination of melting point.	2
6	Green synthesis of an organic compound using green catalyst/solvent/methodology.	2
7	End group analysis of a given polymer sample	2
8	To detect acid and iodine values in a given polymer sample	2
9	To determine ester and saponification values in a given polymer sample	2
10	To determine dilute solution viscosity of polymer solution of different concentrations.	2
	Reference Books	
1	B.S. Furniss, Vogel's textbook of Practical Organic Chemistry, Pearson India.	
2	Sanjay Kumar Batra, Shikha Gulati and Shefali Shukla, Green Chemistry: Strategies & Experiments. Shree Kala Prakashan, New Delhi.	
3	Abdul Rahman, Organic Chemistry Laboratory Manual, Caravan Book House.	
4	D.G. Hundiwale, Experiments in Polymer Science, New Age International (P) Ltd., 2009.	
5	Siddaramaiah, Practical in Polymer Science, CBS Publishers & Distributors, 2007, ISBN: 9788123912721.	

Mapping of Course Outcomes with Program Outcomes

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO 1	3	1	-	-	-	-	-	-	-	-	-	-
CO 2	2	2	-	3	2	-	-	-	-	-	-	-
CO 3	3	2	2	2	-	-	-	-	-	-	-	-
CO 4	3	2	3	2	2	-	-	-	-	-	-	-
Avg.	2.75	1.75	2.50	2.33	2.00	-	-	-	-	-	-	-

Mapping of Course Outcomes with Program Specific Outcomes

CO/PSO	PSO1	PSO2	PSO3
CO1	3	–	–
CO2	2	2	2
CO3	3	–	2
CO4	3	2	3
Avg.	**2.75**	**2**	**2.33**

Correlation Level

- Slightly Low: 1
- Moderately (Medium): 2
- Substantially (Strong): 3

CO-PO-PSO Mapping Justification

- CO1 → PSO1: Provides foundational chemical knowledge essential for understanding polymer science.
- CO2 → PSO1, PSO2, PSO3: Builds lab skills and introduces tools, analysis, and chemical techniques useful in processing and technical problem-solving.
- CO3 → PSO1, PSO3: Reinforces core concepts like thermodynamics and kinetics relevant to polymer behavior and process design.
- CO4 → PSO1, PSO2, PSO3: Links organic chemistry to polymer synthesis, supporting material design, process development, and industry applications.

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Year, Program, Semester	S.Y. B. Tech in Plastics and Polymer Engineering, Semester-III						
Course Code	PPE393						
Course Category	PCC (Professional Core Course)						
Course title	**Principles of Processing Equipment and Automation (Laboratory)**						
Teaching Scheme and Credits	**L**	**T**	**P**	**Total Contact Hours**	**Total Credits**		
	-	-	02	02	01		
Evaluation Scheme	**ISE-I**	**ISE-II**	**ESE**	**TA**	**TW**	**PR/OR**	**Total**
	-	-	-	-	25	-	25
Pre-requisites (if any)	• Engineering Physics • Materials Science and Engineering • Engineering Graphics and Design						
Course Objectives	• To familiarize students with various plastics processing machines, their subsystems, and associated safety interlocks. • To develop the ability to read and interpret machine prints, hydraulic/pneumatic diagrams, and electrical control schematics used in plastics manufacturing. • To provide hands-on experience in assembling, operating, and troubleshooting hydraulic and pneumatic control systems. • To introduce students to the basics of industrial automation by implementing control logic using PLCs, HMIs, and sensor-based systems for process control and monitoring.						
Course Outcomes	• CO 1: Identify various plastics processing machines, subsystems, and their safety interlocks. (Remember) • CO 2: Interpret machine drawings, electrical diagrams, and process flow representations for plastics machinery and control systems. (Understand) • CO 3: Construct basic hydraulic and pneumatic circuits and demonstrate flow and pressure control using valves and actuators. (Apply) • CO 4: Diagnose faults in pneumatic and electrical control systems, and troubleshoot process equipment failures. (Analyze)						

Sr. No.	List of Experiments
1	Identification and Study of Plastics Processing Machines and Subsystems
2	Reading and Interpreting Machine Prints and Electrical Diagrams
3	Demonstration of Machine Safety Interlocks (Mechanical, Electrical, Software-Based)
4	Assembly and Operation of a Basic Hydraulic Circuit
5	Flow and Pressure Control in Hydraulic Systems Using Valves
6	Construction of a Simple Pneumatic Circuit with Directional Valves and Actuators
7	Troubleshooting a Pneumatic System with Fault Diagnosis
8	Study of High Voltage AC Power Distribution and Protection in Processing Equipment
9	Wiring and Testing a Low Voltage DC Control Circuit Using Relays and Switches
10	Programming Basic Ladder Logic on a PLC Trainer Kit (Timers, Counters, Logic Gates)
11	Interfacing a PLC with HMI for Process Monitoring and Control
12	Integration of Optical Sensors in a Mechatronic Setup for Object Detection
	Text Books
1.	M. Mitra, S. Sengupta, Programmable Logic Controllers and Industrial Automation: An Introduction, 2nd Edition, 2017, Penram International Publishing
2.	S. Ilango, V. Soundararajan, Industrial Hydraulics and Pneumatics, PHI Learning
3.	B.L. Theraja & A.K. Theraja, A Textbook of Electrical Technology – Volume I: Basic Electrical Engineering, 2nd Edition, 2024, S. Chand
4.	J. Fraden, Handbook of modern sensors-Physics Designs and Applications, 4th Edition, 2010, Springer.
	Reference Books
	D. Lobsiger, P. Giuliani, & K. Rexford, Electrical Control for Machines, 7th ed, Cengage Learning, Boston, 2016, ISBN: 978-1-133-69338-3
	Eaton Hydraulics Group, Industrial Hydraulics Manual, 6th ed, 2015. ISBN-13: 978-0-692-53210-2
	W. Bolton, Programmable Logic Controllers, 4th Edition, 2006, Elsevier, eBook ISBN: 9780080462950
	S. Soloman, Sensors Handbook, 2nd Edition, McGraw Hill, ISBN: 978-0-07-160571-7

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Mapping of Course Outcomes with Program Outcomes

COs\POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	–	–	2	2	1	3	2	2	–	2
CO2	3	3	–	–	2	–	–	–	2	2	–	2
CO3	3	2	3	–	3	–	–	2	2	2	2	2
CO4	3	3	3	3	3	2	–	2	2	2	2	2
Avg.	**3**	**2.5**	**3**	**3**	**2.5**	**2**	**1**	**2.33**	**2**	**2**	**2**	**2**

Mapping of Course Outcomes with Program Specific Outcomes

CO No.	PSO 1	PSO 2	PSO 3
CO 1	3	2	2
CO 2	3	3	2
CO 3	3	3	3
CO 4	3	3	3
Avg.	**3**	**2.75**	**2.5**

Correlation Level

- Slightly Low: 1
- Moderately (Medium): 2
- Substantially (Strong): 3

CO-PO-PSO Mapping Justification

- CO1 (Remembering machine types and safety interlocks): Aligns with PO1 (basic engineering knowledge) and PO2, PO5, PO6, PO8–PO10, and PO12 due to the need for understanding processing equipment, safety elements, and communication of safety procedures. Strong contribution to PSO1/2/3
- CO2 (Understanding machine diagrams and electrical schematics): Strong ties to PO1, PO2, and PO5 as students learn to interpret technical documents and control diagrams; moderate link to PO9, PO10, and PO12 for team-based interpretation and lifelong learning. Supports PSO1/2 through diagram reading and system understanding.
- CO3 (Applying hydraulic and pneumatic circuit assembly): High relevance to PO1–PO3, PO5, and PO9–PO12 due to hands-on circuit construction, teamwork, tool usage, and safety-conscious implementation. Strongly mapped to PSO1/2/3 for practical operation of polymer processing support systems.
- CO4 (Analysing and troubleshooting system faults): Deep analytical mapping to PO1–PO4, PO5–PO6, and PO8–PO12 as students diagnose, investigate, and solve technical

failures while ensuring safety and ethical handling. Strong relevance to PSO1–3 for troubleshooting and maintaining polymer processing equipment.

Year, Program, Semester	F.Y. B. Tech in Plastics and Polymer Engineering, Semester-II						
Course Code	PSI371						
Course Category	PSI (Project Seminar Internship)						
Course title	**Seminar**						
Teaching Scheme and Credits	**L**	**T**	**P**	**Total Contact Hours**	**Total Credits**		
	-	-	4	04	02		
Evaluation Scheme	**ISE-I**	**ISE-II**	**ESE**	**TA**	**TW**	**PR/OR**	**Total**
	-	-	-	-	25	25	50
Pre-requisites (if any)	None						
Course Objectives	• To introduce the concept and importance of technical seminars and effective literature review in engineering research. • To enhance the ability to identify, access, and interpret scientific and technical resources from peer-reviewed journals, patents, databases, and online repositories. • To develop skills in summarizing scientific literature, preparing technical presentations, and citing references using standard formats. • To build students' confidence in delivering oral presentations and engaging in academic discussions based on technical topics.						
Course Outcomes	• CO 1: Recall the importance and structure of a scientific seminar, and the sources used for literature review such as journals, patents, and online databases. (Remember) • CO 2: Explain the components of a research paper and the fundamentals of technical referencing, citation styles, and plagiarism ethics. (Understand) • CO 3: Apply literature review techniques to gather and organize information relevant to a selected topic in polymer science or engineering. (Apply)						

	• CO 4: Analyze published research papers to identify research gaps, methodologies, and conclusions relevant to their project domains. (Analyze)

Guidelines and Rubrics

A group of 4-5 students will be mentored by faculty mentors and will be evaluated on a continues level. There will be three evaluations namely during ISE I, ISE II and ESE. The students shall engage in independent survey and research and organize it together in a team to report it with the help of their peers.

The assessment for the Seminar Course will be based on continues evaluation of the following components:

1. Topic and Proposal (10 % Marks)

- Select a relevant and specific topic in the field of polymers/plastics or related engineering domains.
- Submit a concise proposal (approx. 300–500 words) explaining:
  - Background
  - Objective
  - Scope
  - Expected outcome
- Ensure the topic is not too broad or vague.
- Approval by faculty is mandatory.

2. Literature Review (20 % Marks)

- Minimum 5 authentic sources: peer-reviewed journals, patents, conference papers, or books.
- Summarize findings, compare different studies, and highlight gaps.
- Avoid copy-pasting—use your own understanding.
- Maintain a bibliography in proper format (APA/Havard).
- Use citation tools like Zotero, Mendeley, or Google Scholar.

3. Seminar Content (30 % Marks)

- Organize into sections: Introduction, Literature Review Summary, Discussion, Conclusion.

- Highlight key findings and relate them to the chosen topic.
- Include figures, charts, or tables where appropriate.
- Demonstrate depth of understanding and relevance to future project work.
- Original thought and integration of information will be valued.

4. Presentation (20 % Marks)

- 8–10 minutes of presentation time.
- Use professional slides (clear text, visuals, limited bullet points).
- Speak clearly and confidently—no reading from slides or notes.
- Handle questions confidently; acknowledge if unsure.
- Dress formally and maintain good posture.

5. Report (20 % Marks)

- 8–10 pages, typed in A4, 1.5 spacing, Times New Roman, 12 pt.
- Structure: Title Page, Abstract, Introduction, Literature Review, Discussion, Conclusion, References.
- Include figures with proper captions and references.
- Proofread for grammar and clarity.
- Plagiarism should be below 15%.

Component	Marks	Assessment Method
Topic and Proposal	10%	Faculty evaluation of topic relevance, clarity, and feasibility of the proposal submitted by student.
Literature Review	20%	Assessment of quality, depth, and diversity of reviewed sources (journals, patents, conference papers, etc.).
Seminar Content	30%	Evaluation based on content accuracy, technical depth, structure, originality, and understanding.
Presentation	20%	Rubric-based assessment of communication, clarity, use of visual aids (PPT), body language, time management, and Q&A handling.
Report	20%	Structured report with proper formatting, referencing (APA/IEEE), grammar, and conclusion.

Information Sources	
1	Scopus: A large abstract and citation database that covers a wide range of subjects, including chemistry, physics, engineering, and materials science.
2	Web of Science: Another significant bibliographic database with multidisciplinary coverage across sciences, social sciences, and arts & humanities.
3	ScienceDirect: A leading platform for millions of academic articles published by Elsevier, with a strong focus on scientific and technical content.
4	Google Scholar: A freely accessible web search engine that indexes a broad range of scholarly literature, including journal articles, theses, books, and abstracts from various publishers.

Mapping of Course Outcomes with Program Outcomes

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO 1	2	1	-	-	-	-	-	-	-	2	-	-
CO 2	1	-	-	-	-	-	-	2	-	3	-	-
CO 3	-	2	-	2	-	-	-	-	-	3	-	-
CO 4	-	3	-	-	-	-	-	-	2	2	-	-
Avg.	1.5	2.33	-	2	2	-	-	**2**	**2**	**2.5**	-	-

Mapping of Course Outcomes with Program Specific Outcomes

CO/PSO	PSO 1	PSO 2	PSO 3
CO 1	-	**2**	**2**
CO 2	-	-	**3**
CO 3	-	**2**	**3**
CO 4	-	**3**	**2**
Avg.	-	**2.33**	**2.5**

Correlation Level

- Slightly Low: 1
- Moderately (Medium): 2
- Substantially (Strong): 3

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CO-PO-PSO Mapping Justification

- CO 1→ PO2, PO10; PSO2, PSO3: Introduces students to the structure and purpose of scientific seminars, enabling them to recognize credible literature sources and effectively present domain-specific knowledge.
- CO 2→ PO8, PO9, PO10; PSO3: Builds understanding of research documentation, citation ethics, and plagiarism, fostering responsible scientific writing and communication in polymer-related work.
- CO 3→ PO2, PO4, PO9; PSO2, PSO3: Develops the ability to independently gather, organize, and apply literature review techniques for relevant polymer engineering topics.
- CO 4→ PO2, PO4, PO10; PSO2, PSO3: Trains students to critically analyze scientific papers to identify research gaps and methodologies, enhancing their investigative and reporting skills in polymer science.

Year, Program, Semester	S.Y. B. Tech in Plastics and Polymer Engineering, Semester-III						
Course Code	HSSM322						
Course Category	HSSM (Humanities and Social Sciences including Management Courses)						
Course title	**Environmental Studies (Theory)**						
Teaching Scheme and Credits	**L**	**T**	**P**	**Total Contact Hours**	**Total Credits**		
	02	-	-	02	02		
Evaluation Scheme	**ISE-I**	**ISE-II**	**ESE**	**TA**	**TW**	**PR/OR**	**Total**
	15	15	-	20	-	-	50
Pre-requisites (if any)	• Engineering Chemistry • Engineering Physics • Introduction to Polymer Sustainability						
Course Objectives	• Introduce students to the foundational principles and multidisciplinary scope of environmental studies. • Develop an awareness of the interactions between human society and the natural environment. • Promote understanding of natural resource management and ecosystem dynamics. • Encourage critical thinking about contemporary environmental challenges and sustainable development. • Familiarize students with environmental laws, ethics, and policy frameworks relevant to engineering practice.						
Course Outcomes	• Outline the scope, significance, and interdisciplinary nature of environmental studies. (Remember) • Summarize how various human activities influence ecosystems and deplete natural resources. (Understand) • Illustrate practical strategies for sustainable living and resource conservation. (Apply) • Investigate environmental issues such as pollution, biodiversity loss, and climate change using real-world data. (Analyze)						

Unit No.	Course Content	Hours
I	**Introduction to Environmental Studies and Sustainability** Definition of environmental studies, scope and importance, need for public awareness, multidisciplinary nature, concept of sustainable development, role of individuals in environmental conservation.	4
II	**Natural Resources and Their Conservation** Renewable and non-renewable resources, over-exploitation of forests, water, minerals, and energy resources, land degradation, water logging, and desertification, equitable use of resources, role of individuals in sustainable lifestyles.	4
III	**Ecosystems and Energy Flow** Concept, structure and function of ecosystems, producers, consumers and decomposers, energy flow, ecological succession, food chains, food webs, ecological pyramids, types of ecosystems: forest, grassland, desert, aquatic (ponds, lakes, oceans)	4
IV	**Biodiversity and Its Conservation** Levels of biodiversity – genetic, species, ecosystem, value of biodiversity, threats (habitat loss, poaching, man-wildlife conflict), India as a mega-diversity nation, hotspots, endangered and endemic species, in-situ and ex-situ conservation.	4
V	**Environmental Pollution and Disaster Management** Air, water, soil, marine, noise, thermal, and nuclear pollution – causes, effects and control measures, solid waste management, case studies, role of individuals, disaster management – floods, earthquakes, cyclones, landslides.	4
VI	**Social Issues, Population and Environmental Legislation** From unsustainable to sustainable development, environmental ethics, climate change, global warming, ozone depletion, population growth, health and human rights, environmental acts (Air, Water, Wildlife, Forest), public awareness, value education.	4

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	Text Books
1	Textbook of Environmental Studies, Erach Bharucha, University Grants Commission (UGC), New Delhi, 2005.
2	Fundamental Concepts in Environmental Studies, D.D. Mishra, S. Chand & Company Ltd., New Delhi, 2011.
3	Perspectives in Environmental Studies, Anubha Kaushik and C.P. Kaushik, New Age International Publishers, New Delhi, 2019.
	Reference Books
1	Principles of Environmental Science: Inquiry and Applications, William P. Cunningham and Mary Ann Cunningham, Tata McGraw-Hill Education, New Delhi, 2012.
2	Textbook of Environmental Studies for Undergraduate Courses — Erach Bharucha, Universities Press (India) Pvt. Ltd., 2020.
3	Fundamental Concepts in Environmental Studies — D.D. Mishra, S. Chand & Company Ltd., 2019.
4	Environmental Studies: From Crisis to Cure — R. Rajagopalan, Oxford University Press, 2018.
5	Environmental Science: A Global Concern — William P. Cunningham and Barbara Woodworth Saigo, McGraw Hill International, 2016.

Mapping of Course Outcomes with Program Outcomes

CO\PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	–	–	–	–	2	–	–	–	–	–	–
CO2	–	2	2	–	–	3	2	–	–	–	–	–
CO3	–	–	2	2	–	3	2	–	–	–	–	–
CO4	–	–	2	–	–	3	3	–	1	–	–	–
Average	**2**	**2**	**2**	**2**	**-**	**2.75**	**2.33**	**-**	**1**	**-**	**-**	**-**

Mapping of Course Outcomes with Program Specific Outcomes

CO/PSO	PSO 1	PSO 2	PSO 3
CO1	3	1	–
CO2	3	2	1
CO3	2	2	2
CO4	2	2	2
Average	**2.5**	**1.75**	**1.66**

Correlation Level

- Slightly Low: 1
- Moderately (Medium): 2
- Substantially (Strong): 3

CO-PO-PSO Mapping Justification

- CO1 is foundational and focuses on understanding the interrelationship between the environment and human life — it correlates well with PO1 (basic science knowledge), PO6 (understanding societal/environmental context), and PSO1 (sustainability in polymer science).
- CO2 expands on analysis of human impact on ecosystems — it maps to PO2 (problem analysis), PO3 (design solutions within realistic constraints), PO6 (sustainable thinking), PO7 (ethical considerations), and PSO1 and PSO2, as students learn to evaluate environmental implications in material and process design.
- CO3 involves applying knowledge for sustainable development — this aligns with PO3 and PO4 (data-based solutions and analysis), PO6 (environmental consciousness), PO7 (ethics), and moderately with PSO1, PSO2, and PSO3, especially in incorporating environmental awareness into polymer processing and systems design.
- CO4 introduces the examination of real-world issues like pollution, climate change, and waste management — it maps well with PO3 (problem-solving), PO6 and PO7 (environment and sustainability), PO9 (teamwork and communication), and PSO3, as it develops awareness of chemical and process-level sustainability in the polymer sector.

Year, Program, Semester	S.Y. B. Tech in Plastics and Polymer Engineering, Semester-III						
Course Code	HSSM322						
Course Category	HSSM (Humanities, Social Sciences including Management Course)						
Course title	**Professional Communication**						
Teaching Scheme and Credits	**L**	**T**	**P**	**Total Contact Hours**	**Total Credits**		
	02	-	-	02	-		
Evaluation Scheme	**ISE-I**	**ISE-II**	**ESE**	**TA**	**TW**	**PR/OR**	**Total**
	-	-	-	-	-	-	-
Pre-requisites (if any)	Ability to understand and use English in simple spoken and written contexts						
Course Objectives	To improve English language skills using CALL software and strengthen professional communication, presentation, and interpersonal abilities through ICS-based practical tasks						
Course Outcomes	• CO1: Identify the formats and features of professional documents such as emails and resumes. *(Remember)* • CO2: Interpret effective oral communication techniques through role-plays, group discussions, and presentations. *(Understand)* • CO3: Utilize grammar and vocabulary to produce clear and accurate written and visual communication. *(Apply)* • CO4: Demonstrate professional etiquette and interpersonal skills in mock interviews and team-based activities. *(Apply)* • CO5: Differentiate aspects of spoken professional content to identify tone, intent, and key points for improved comprehension and response. *(Analyse)*						

Sr. No.	List of Assignments/Exercises
1	To engage in group discussions on industry-related topics to build confidence, fluency, and teamwork.
2	To perform role-plays simulating workplace communication scenarios for strategic problem-solving skills.

3	To practice proofreading and editing for accuracy in grammar, punctuation, clarity, and professional tone.
4	To listen to professional talks and interviews to analyse communication styles and message clarity.
5	To present technical data orally by interpreting graphs, tables, and charts.
6	To compose workplace emails and formal proposals using correct format, tone, and structure.
7	To prepare technical reports based on visits, projects, or events with structured format and visuals.
8	To design infographics and visual resumes to creatively represent information.
9	To create digital resumes and professional profiles with accompanying elevator pitch scripts.
10	To plan and deliver project proposal presentations using slides and visual aids.
11	To collaborate on team-based writing tasks and conduct peer reviews for improvement.
12	To participate in mock interviews focusing on communication, body language, and etiquette.
Text Books	
1	Meenakshi Raman and Sangita Sharma's Technical Communication: Principles and Practice, 3rd Edition, Oxford University Press, 2017, replacing the 2nd Edition, 2011.
2	J.D.O Connor, "Better English Pronunciation", 2nd by Cambridge University Press, 1980
3	Wren and Martin, "High School English Grammar and Composition", S Chand and Company Ltd – 2015.
4	Exercises in Spoken English. Parts. I-III. CIEFL, Hyderabad. Oxford University Press
Reference Books	
1	Gajendra Singh Chauhan and Et al, "Technical Communication", Cengage learning India Pvt Limited, 019.
2	M Ashraf Rizvi's Effective Technical Communication, 2nd Edition, McGraw Hill Education (India), 2018
3	Word Power Made Easy by Norman Lewis, Goyal Publishers, 2020.
4	Randolph Quirk and S Greenbaum," A University Grammar of English Latest", Pearson 2007
5	Sanjay Kumar and Pushpalata Communication Skills", Oxford University Press India Pvt Ltd -2019

6	Practical English Usage by Michael Swan, Oxford University Press – 2016
7	Functional English (As per AICTE 2018 Model Curriculum), Cengage Learning India Pvt Limited, Latest Revised Edition, 2020.
8	D Praveen Sam, KN Shoba, "A Course in Technical English", Cambridge University Press – 2020.

Mapping of Course Outcomes with Program Outcomes

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO 1	-	-	-	-	-	-	-	-	3	3	-	-
CO 2	-	2	-	-	-	-	-	-	-	3	-	-
CO 3	2	-	-	-	-	-	-	-	-	3	-	-
CO 4	-	-	-	-	-	-	-	-	-	3	-	-
CO5	-	-	-	-	-	-	-	2	3	3	-	2
Avg.	**2**	**2**	**-**	**-**	**-**	**-**	**-**	**2**	**3**	**3**	**-**	**2**

Mapping of Course Outcomes with Program Specific Outcomes

COs	PSO1	PSO2	PSO3
CO1	-	3	-
CO2	-	2	-
CO3	-	3	-
CO4	-	3	-
CO5	-	3	-
Avg.	**-**	**2.8**	**-**

Correlation Level

- Slightly Low: 1
- Moderately (Medium): 2
- Substantially (Strong): 3

CO-PO-PSO Mapping Justification

- CO1: Aligns with PO9 and PO10 by developing students' teamwork and oral communication through discussions and presentations. It supports PSO2 by enhancing spoken fluency and interactive communication.
- CO2: Maps to PO2 and PO10 as it builds analytical listening and comprehension of professional content. It contributes to PSO2 by training students to evaluate tone, intent, and meaning in communication.

- CO3: Supports PO1 and PO10 through correct grammar usage and writing clarity. It strengthens PSO2 by improving the accuracy of professional written and visual communication.
- CO4: Contributes to PO10 by enabling students to understand and structure workplace documents. It links with PSO2 through familiarity with formal formats and language.
- CO5: Connects with PO9, PO10, and PO12 by building professional etiquette, interpersonal skills, and readiness for lifelong learning. It supports PSO2 by preparing students for real-world team and interview scenarios.