

 सत्यं शिवं सुन्दरम्		The Maharaja Sayajirao University of Baroda Faculty: Technology and Engineering Department: Chemical Engineering Kalabhavan, Vadodara.		
Email ID: head-chemengg@msubaroda.ac.in				
Name of the Programme: M.E. Chemical (Polymer Technology) Type of the Programme: M.E. Part - I Chemical (Polymer Technology)				
Year	I	CORE / ELECTIVE / FOUNDATION 1: ELECTIVE PAPER CODE: CHL 2106 PAPER NAME: PROCESS SYNTHESIS	Credit	
Semester	I		Hours	45
UNIT – I	Basic concept in process synthesis. The synthesis step, Structure and synthesis of process flow diagrams. Product life cycles. Understanding process conditions.			7
UNIT – II	Design and scheduling of batch processes, Gantt charts, transfer policies, sizing of vessels, inventories. Optimal design and scheduling of multiproduct batch plants			8
UNIT – III	Synthesis of heat exchanger networks. Pinch technology, Heat and power integration.			8
UNIT – IV	Synthesis of distillation sequences, energy conservation in distillation, heat integration techniques in distillation. MILP model for distillation sequences.			8
UNIT – V	Synthesis of reactor networks, elements of process flowsheet optimization, green engineering.			7
UNIT – VI	Process flexibility analysis, economic analysis of process, capital expenditure and operating expenditure.			7
REFERENCES				
1.	Robin Smith, ‘Chemical Process Design and Integration’, Wiley, 2005.			
2.	L.T. Biegler, I.E. Grossmann and A.W. Westerberg, ‘Systematic Methods of Chemical Process Design’, Prentice Hall, 1997.			
3.	W.D. Seider, J.D. Seader, D.R. Lewin, ‘Product and Process Design Principles’, 2nd Ed, Wiley 2004.			

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Name of the Programme: M.E. Chemical (Polymer Technology) Type of the Programme: M.E. Part - I Chemical (Polymer Technology)				
Year	I	CORE / ELECTIVE / FOUNDATION 1: ELECTIVE PAPER CODE: CHL 2107 PAPER NAME: PROCESS MODELLING, AND CONTROL	Credit	
Semester	I		Hours	45
UNIT – I	Philosophy of mathematical modelling, classifications of models, procedure of model development.			5
UNIT – II	Theoretical process modelling – Heat and mass balances, development of process models for liquid level, stirred tank heaters, CSTR, gas absorbers, Heat exchangers, packed bed reactor, Fluid catalytic cracking, etc.			10
UNIT – III	Process identification: Principles of Empirical modelling. Identification by step response, Impulse response and frequency response.			7
UNIT – IV	Review of Controller selection and design for feedback control loops. Controller design issues, Analysis of typical control loops, advanced control strategies, Model predictive control.			8
UNIT – V	Multi variable process control, Interaction analysis and multiple single loop design, relative gain array, loop pairing, design and tuning of multivariable controller. Multivariable controller trouble shooting			8
UNIT – VI	Control loop hardware and troubleshooting. Aspects of distributed control systems, programmable logic controllers, fieldbus technology. Actuator systems, Sensor systems. Troubleshooting control loops.			7
REFERENCES				
1.	D.M. Himmelblau and K.B. Bishoff ‘Process Analysis and Simulation’, Wiley 1968.			
2.	W.L. Luyben, ‘Process Modeling, Simulation and Control for Chemical Engineers’, 2nd Ed., Mc Graw-Hill, 1990.			
3.	B.W. Bequette, ‘Process Dynamics’, Prentice Hall, 1998.			
4.	B. Ogunnaike and W. Harmon Ray ‘Process Dynamics, Modeling and Control’, Oxford, 1994.			

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Year	I	CORE / ELECTIVE / FOUNDATION 1: ELECTIVE PAPER CODE: CHL 2108 PAPER NAME: ADVANCED TRANSPORT PROCESSES	Credit	
Semester	I		Hours	45
UNIT – I	Rheology: Classification of fluid behavior, rheological models, Rheometry, flow of non-Newtonian fluids in closed conduits.			8
UNIT – II	Kinematics and Dynamics of fluids: Lagrangian and Eulerian specifications, Time derivatives, Stream functions. Conservation laws, constitutive equations for Newtonian fluids, Navier-Stokes equation and its solutions.			8
UNIT – III	Boundary Layer Theory: Laminar and Turbulent boundary layers, von Karman momentum integral, Blasius Solution.			7
UNIT – IV	Particulate flows and Introduction to fluidization: Particle characterization, interparticle and fluid particle forces, behavior of fluidized beds, minimum fluidization velocity, pressure drops, void age, transport disengaging height, bubbling bed models, turnover rates of solid, interchange coefficients.			7
UNIT – V	Heat Transfer: Finite difference methods for steady and unsteady state conduction. Analogy between momentum and heat transfer. Radiant heat transfer.			8
UNIT – VI	Mass Transfer: Inter phase mass transfer, interfacial turbulence, Marangoni effect, mass transfer with chemical reaction.			7
REFERENCES				
1.	R.B. Bird, W.E. Stewart and E.N.Lightfoot, ‘Transport Phenomena’, 2nd Ed, Wiley,2002.			
2.	J.C. Slattery,’ Momentum Heat and Mass transfer in Continuiua’, McGraw-Hill, 1972			
3.	J.W. Goodwin and R.W.Hughes, ’Rheology for Chemists’, RSC Publishing, 2008.			
4.	D.Kunni and O. Levenspiel, ‘Fluidization Engineering’, 2nd Ed, Butterworth-Heinemann, 1991.			
5.	W.M. Deen, ‘Analysis of Transport Phenomena’, Oxford, 1998.			

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Year	I	CORE / ELECTIVE / FOUNDATION 1: ELECTIVE PAPER CODE: CHL 2109 PAPER NAME: ADVANCED CHEMICAL ENGINEERING THERMODYNAMICS	Credit	
Semester	I		Hours	45
UNIT – I	Review of Chemical Engineering Thermodynamics: Property estimation methods, PVT behavior and EOS, Fundamental property relations, Thermodynamics derivatives, Residual and Excess properties, Partial molar properties			9
UNIT – II	Solution Thermodynamics: EOS models and fugacity estimation and mixing rules for extension to mixtures Excess free energy models and activity estimation: Local composition and group contribution models, Parameter estimation using regression analysis, Methodology for associating molecules.			9
UNIT – III	Vapour-Liquid Equilibria: Experimental techniques, K-values, BUBL P, DEW P, BUBL T, DEW T and Flash Calculations, $\Phi - \Phi$ and $\gamma - \Phi$ approach, Liquid-liquid Equilibria: Binary and ternary systems, stability criteria, Vapour-liquid-liquid Equilibria: Concept, calculations and applications.			10
UNIT – IV	Chemical reaction equilibria for complex and multiple reactions, Analysis, methods and computations.			6
UNIT – V	Vapour-liquid equilibria in ternary systems: Distillation lines, Residue curve maps.			5
UNIT – VI	Solid-liquid, Solid-Gas and Supercritical fluid equilibria: Fundamentals, Experimental techniques, modelling and applications.			6
REFERENCES				
1.	J. M. Smith H. C. VanNess, M. M Abbott, Introduction to Chemical Engineering Thermodynamics (6th Ed), McGraw Hill, Singapore, 2001.			
2.	J.M. Prausnitz, R. N. Lichtenthaler, E. G.De Azevado, Molecular Thermodynamics of Fluid Phase Equilibria (3rd Ed), Prentice Hall, 1986.			
3.	S. M. Walas Phase Equilibria in Chemical Engineering, Butterworth 1985.			

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Name of the Programme: M.E. Chemical (Polymer Technology) Type of the Programme: M.E. Part - I Chemical (Polymer Technology)				
Year	I	CORE / ELECTIVE / FOUNDATION 1: ELECTIVE PAPER CODE: AMT 2127 PAPER NAME: ADVANCED COMPUTATIONAL METHODS IN CHEMICAL ENGINEERING	Credit	
Semester	I		Hours	45
UNIT – I				
UNIT – II				
UNIT – III				
UNIT – IV				
UNIT – V				
UNIT – VI				
REFERENCES				
1.				
2.				
3.				

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Name of the Programme: M.E. Chemical (Polymer Technology) Type of the Programme: M.E. Part - I Chemical (Polymer Technology)				
Year	I	CORE / ELECTIVE / FOUNDATION 1: ELECTIVE PAPER CODE: CHL 2105 PAPER NAME: SEMINAR	Credit	
Semester	I		Hours	45
UNIT – I		Literature Survey based investigation preferably in the areas to Environment, Safety and Hazard management in Refining/ Petrochemical/ Polymer industries. During the term two presentations on the area of investigation has to be made to the department		

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Name of the Programme: M.E. Chemical (Polymer Technology) Type of the Programme: M.E. Part - II Chemical (Polymer Technology)				
Year	I	CORE / ELECTIVE / FOUNDATION 1: ELECTIVE PAPER CODE: CHL 2217 PAPER NAME: POLYMER COMPOSITE BLENDS AND ALLOYS	Credit	
Semester	II		Hours	45
UNIT – I		Introduction to composites, nanocomposites, blends and alloys. Characteristics of composite materials, classification of composites based on reinforcement and matrix materials. Property enhancement due to reinforcements. Application of composites.	08	
UNIT – II		Polymer and rubber nanocomposites, nature of fillers, carbon nanotubes, fullerenes, silica, and clays, intercalated and exfoliated nanocomposites. Property enhancements, commercial applications	07	
UNIT – III		Polymer blends: History, types of blends and classification. Methods of blending, Thermodynamics of blending, binary interaction model, compositional window of miscibility. Solubility parameter, hydrogen bonding and specific interactions	08	
UNIT – IV		Phase behaviour, appearance of new phase, disappearance of phase boundary, Temperature, molecular weights, glass transition effects, partially miscible blends. Typical applications and industrial examples.	07	
UNIT – V		Polymer Alloys (Thermoplastics): Definition and distinction between blend and alloys PVC alloys, Polyolefin alloys, ABS alloys, Natural polymer alloys.	07	
UNIT – VI		Fillers: Different fillers and their Characterization, Reinforcement of Elastomeric encapsulated fillers, characteristics of filler-elastomer systems, improvement of elastomer properties, fillers, and its analysis.	08	
REFERENCES				
1.	K. R. Sharma, ‘Polymer Thermodynamics: Blends and copolymers, CRC press, 2012			
2.	J.L. Halary, F. Laupretre and L, Monnerie ‘Polymer Materials’, Wiley, 2011.			
3.	A. Kumar and R.K. Gupta, ‘Fundamentals of Polymers’ McGraw-Hill, 1998.			

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Name of the Programme: M.E. Chemical (Polymer Technology) Type of the Programme: M.E. Part - II Chemical (Polymer Technology)				
Year	I	CORE / ELECTIVE / FOUNDATION 1: ELECTIVE PAPER CODE: CHL 2219 PAPER NAME: POLYMER COMPOUNDING AND TESTING	Credit	
Semester	II		Hours	45
UNIT – I		Mixing and Blending of Polymers: Basic concepts, Mixing: Mixing in major routes for melt processing of polymers, Additives, Extensive & intensive mixing, Characterization of state of mixture, Statistical description of mixing, scale and intensity of segregation, Laminar mixing.	07	
UNIT – II		Polymer Compounding (Thermoplastics & Elastomers): Types and characteristics of compounds, Mechanism and theory, Fillers, additives and compatibilizers, Polymer formulations, Master batches, Polymer nanocomposites. Role of rheological modifiers	08	
UNIT – III		Polymer compounds: Ingredients, Types of fillers, reinforcement agents, antioxidants, flame retardants (halogenated/non-halogenated) etc., Polymer compound properties, Case studies of conventional polymer compounds, Compounding lines, Post compounding operations.	06	
UNIT – IV		Compounding applications for Commodity and Engineering plastics	05	
UNIT – V		Compounding and Mixing machinery: Batch mixers, Single screw, and twin-screw extruders – co-rotating and counter rotating, Feeder mechanism, Two roll mills – design aspects, Internal mixers – design features, Planetary mixers, Safety aspects.	07	
UNIT – VI		Testing of polymers: Mechanical – Tensile, compressive, Impact etc., Thermal – TGA, DSC, DTA, Optical – Transmittance and reflectance, Colour, Gloss, Haze, Transparency, Electrical – Dielectric constant, resistivity, dielectric strength, Arc resistance, Chemical – Resistance to solvents, Vapour permeability, Weathering, Flammability aspects, Adhesion testing, Microscopy (SEM, TEM), Environmental resistance- stress cracking, weathering.	12	
REFERENCES				
1.	Zloczwero IM, Mixing and Compounding of Polymers: Theory and Practice, Hanser Publications, 2009			
2.	Cheremisinoff N, Polymer Mixing and Extrusion, Marcel Dekker, 1998			
3.	Tadmor Z, Gogos CG, Principles of Polymer Processing, Wiley Interscience, 2006			
4.	Brown R, Handbook of Polymer Testing: Physical Methods, CRC Press, 1999.			
5.	Lutz JT, Thermoplastic Polymer Additives, Marcel Dekker, 1989.			
6.	Billmeyer FW, Textbook of Polymer Science, John Wiley & Sons, 1984			

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Name of the Programme: M.E. Chemical (Polymer Technology) Type of the Programme: M.E. Part - II Chemical (Polymer Technology)				
Year	I	CORE / ELECTIVE / FOUNDATION 1: ELECTIVE PAPER CODE: CHL 2220 PAPER NAME: ELEMENTS OF POLYMERIZATION ENGINEERING	Credit	
Semester	II		Hours	45
UNIT – I		Fundamentals, Characteristic differences from simple molecules, Precursors and feedstocks, Classification, Commodity and Engineering plastics, Biodegradable polymers, Safety aspects in polymer industries.	05	
UNIT – II		Molecular weight distribution: Number and weight average molecular weight, Relationship with degree of polymerization, Effect on the properties, Grades of polymers	04	
UNIT – III		Characterization of polymers: End group analysis, Colligative property measurement, dilute solution viscometry, Light scattering, IR, NMR, GPC etc.	06	
UNIT – IV		Polymer solution thermodynamics: Solubilisation process – crystalline and amorphous polymers, Effect of molecular weight on solubilisation, Types of solutions – Dilute, semi-dilute, Solubility parameter and Cohesive Energy Density, Flory Huggins Theory, Flory Krigbaum Theory, Concept of good and poor solvent, Determination of size of polymer chain in a solution, Semi-dilute solutions, and Blob model.	12	
UNIT – V		Polymer reaction engineering: Mechanism and kinetics of addition (free radical, ionic, coordination) and condensation polymerization, Techniques of polymerization – Bulk, Solution, Emulsion, Suspension, Copolymerization, Overview of different reactors used for polymerization. Structure-property relationship	13	
UNIT – VI		Plastic waste management: Polymer degradation, Overview of different techniques and present trends, Recycling codes	05	
REFERENCES				
1.	Billmeyer FW, Textbook of Polymer Science, John Wiley & Sons, 1984			
2.	Gowarikar VR, Vishwanathan NV, Sreedhar J, Polymer Science, New Age Int. (P) Ltd. Publishers, 1997			
3.	Odian G, Principles of Polymerization (4 th Edition), Wiley Interscience, 2004			
4.	Kumar A, Gupta RK, Fundamentals of Polymers, McGraw Hill, 1998.			

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Name of the Programme: M.E. Chemical (Polymer Technology) Type of the Programme: M.E. Part - II Chemical (Polymer Technology)				
Year	I	CORE / ELECTIVE / FOUNDATION 1: ELECTIVE PAPER CODE: CHL 2221	Credit	
Semester	II		PAPER NAME: POLYMERIC MATERIALS	Hours
UNIT – I		Introduction to Polymer materials, classification, and structure, four classes of polymer materials. The glass transition, overview of glass transition temperature theories, effect of polymer architecture on T _g .		08
UNIT – II		Industrial manufacture of important polymers such as polyolefins, polyvinyl chloride, polystyrene, polyamides, polyesters, epoxy resins etc.		07
UNIT – III		Properties and applications of thermoplastics, high modulus thermoplastic polymers, high impact polystyrene, toughened PMMA etc. Thermoset plastics, mechanical properties of epoxy resins, poly urethanes etc. Toughened epoxy resins etc		10
UNIT – IV		Rubber: Properties, applications and manufacture of important elastomeric polymers NR, BR, SBR, NBR, Chloroprene, EPDM etc. Reinforcement and Crosslinking in Rubbers, Special processing techniques for rubbers, Additives, Rubber chemicals their functions.		08
UNIT – V		Fibers & Filaments: Properties, applications, and manufacture of important fiber forming polymers, Spinning technology		06
UNIT – VI		Speciality Polymers, film formers, coatings, block copolymers properties and applications, Compostable polymers.		06
REFERENCES				
1.	F.W. Billmeyer, ‘Textbook of Polymer Science’. 3 rd Ed, Wiley, 1984			
2.	F. Rodrigues, ‘Principles of Polymer Systems’, 4 th Ed, Taylor and Francis, 1996			
3.	S.L. Rosen, ‘Fundamental principles of polymeric materials’, 2 nd Ed, Wiley, 1993			
4.	C.E. Carraher, ‘Introduction to Polymer Chemistry’, Taylor and Francis, 2007			
5.	IRI, ‘Rubber Engineering’, Tata McGraw- Hill, 1998.			

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Year	I	CORE / ELECTIVE / FOUNDATION 1: ELECTIVE PAPER CODE: CHL 2222	Credit	
Semester	II		PAPER NAME: POLYMERIC MATERIALS	Hours
UNIT – I		Introduction to polymer processing: Classification of polymer processes, elementary steps in polymer processing, basics of polymer process design.		03
UNIT – II		Viscoelastic behaviour of polymeric fluids: Material functions for shear and shear free flow, elongational flows, Rheometry, Rheological measurements and polymer processability		06
UNIT – III		Handling and transportation of polymer particulate solids. Morphology and structure of polymers, polymer-melt crystallization, factors effecting crystallization, polymer molecular orientation.		06
UNIT – IV		Extrusion: Flow mechanism and analysis (pressure and drag flows), single and twin-screw extruders, extrudate non-uniformity, die swell, melt fracture.		09
UNIT – V		Extrusion dies: Sheet and film dies, angular dies, side fed and spiral mandrel dies, wire-coating dies, profile extrusion dies, multiple layer extrusion, flow instabilities in multilayer flows. Post extrusion techniques: Metallisation, stamping, painting, welding bonding, printing etc		09
UNIT – VI		Molding: Injection molding principle, design, cycle time, Compression molding, Transfer molding, Rotational molding, Blow molding, Reaction injection molding and other processes, Pultrusion		12
REFERENCES				
1.	Z Tadmor and C.G. Gogos, ‘Principles of Polymer Processing’ Willey, 2006.			
2.	S. Middleman, ‘Fundamentals of Polymer Processing’, McGraw-Hill, 1977			
3.	J.M. McKelvey, ‘Polymer Processing’, Willey, 1962.			
4.	J.L. Throne, ‘Plastics Process Engineering’, Marcel Dekker, 1979.			
5.	R. J. Crawford, Plastics Engineering. Pergamon Press, 1989.			

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Name of the Programme: M.E. Chemical (Polymer Technology) Type of the Programme: M.E. Part - II Chemical (Polymer Technology)				
Year	I	CORE / ELECTIVE / FOUNDATION 1: ELECTIVE PAPER CODE: CHL 2218L PAPER NAME: RESEARCH METHODOLOGY IN POLYMER TECHNOLOGY	Credit	
Semester	II		Hours	45
UNIT – I	Scientific Research: Characteristics of scientific research, steps in scientific research, types of scientific research, methods of scientific research.			11
UNIT – II	Hypothesis development: General aspects, specific aspects for polymeric materials.			11
UNIT – III	Research design, phases in research design, design for exploratory research in areas of polymeric products.			11
UNIT – IV	Elements of content analysis, projective techniques. Scaling techniques, measurement, sampling and data analysis. Correlation development, regression analysis, correlation coefficients, statistical analysis.			12
REFERENCES				
1.	D. V. Thiel, Research Methods for Engineers, Cambridge University Press, 2014.			
2.	C. R. Kothari and G. Garg, Research Methodology, Methods and techniques, Third Edition, New Age Publications, 2014.			
3.	A. M. Novikov and D. A. Novikov, Research Methodology, CRC Press, 2013.			
4.	R. Snee, Experiments in Industry, Design, Analysis, and interpretation of results. ASQ Publications, 1985.			
5.	R. O Kuehl, Design of Experiments: Statistical Principles of Research Design and analysis, Duxbury/Thomson Learning, 2000			
6.	D. Balkose, Applied Methodology in Polymer Research and Technology, Apple Academic Press, 2014.			

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Name of the Programme: M.E. Chemical (Polymer Technology) Type of the Programme: M.E. Part - II Chemical (Polymer Technology)				
Year	I	CORE / ELECTIVE / FOUNDATION 1: ELECTIVE PAPER CODE: CHL XXXX PAPER NAME: PLASTIC WASTE MANAGEMENT	Credit	
Semester	II		Hours	39
UNIT – I		Introduction to Plastic Waste – Sources, Production, Global and Indian Context. Current industry positions on plastics waste and management.		6
UNIT – II		Plastic Waste Management Rules 2022 (India) and Global Rules and Regulations, Plastic Bans including China Sword Policy implication on global plastic waste management		5
UNIT – III		Impact of plastics on Marine Life, Effect on Wildlife, Human Health and Environment.		6
UNIT – IV		Plastics waste Management, Control, Recycling, and Disposal. Plastics waste reprocessing economic and ecological aspects.		7
UNIT – V		Plastic Waste Management Practices – Use of Plastic waste in roads, issues and challenges		8
UNIT – VI		Possible Alternate Materials to Plastics – Greener Alternatives, Plastics Resource Recovery and Circular Economy.		7
REFERENCES				
1.	Trevor M. Letcher, Plastic Waste and Recycling - Environmental Impact, Societal Issues, Prevention, and Solutions, Elsevier, 2020.			
2.	Natalie Rudolph, Raphael Kiesel, Understanding Plastics Recycling Economic, Ecological, and Technical Aspects of Plastic Waste Handling, 1 st Edition, Hanser Publications.			
3.	Randall Curlee, Sujit Das, Plastic Waste Management, Control, Recycling, and Disposal, Noyes Data Corporation, 1991.			
4.	Dr. M. N. Subramanian, Plastics Waste Management: Processing and Disposal, Smithers Rapra Technology Ltd, 2016.			

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Year	I	CORE / ELECTIVE / FOUNDATION 1: ELECTIVE PAPER CODE: CHL XXXX PAPER NAME: MOLD DESIGN	Credit	
Semester	II		Hours	39
UNIT – I		Introduction: Overview of mold design in plastic engineering, Types of molds and their applications, Materials used for molds.	4	
UNIT – II		Mold design Principles: Basic design principles for molds, Considerations for mold cavities and cores, Mold cooling systems and gating systems.	6	
UNIT – III		Manufacturing Processes for Molds: Mold manufacturing techniques such as CNC machining, EDM, and laser cutting, Mold assembly techniques, Quality control measures for mold manufacturing.	6	
UNIT – IV		Injection Molding: Overview of injection molding, The injection molding process, Injection molding machine and tooling and Mold design and cost calculations.	8	
UNIT – V		Mold Maintenance and Safety Considerations: Mold maintenance procedures, Safety considerations for mold design and operation, Troubleshooting common mold design problems.	7	
UNIT – VI		Case Studies and Applications: Case studies of successful mold designs, Real-world applications of mold design in plastic engineering.	7	
REFERENCES				
1.	Dr. Erwin Baur, Mold Design for Plastic Engineers.			
2.	David O. Kazmer, Injection Mold Design Engineering, 3rd edition, 2022.			
3.	R.G.W Pye, Injection Mould Design : An Introduction and Design for The Thermoplastics Industry, 2nd edition, 2000.			
4.	S K Nayak and P C Padhi, Fundamentals of Plastic Mould Design.			
5.	Robert A. Malloy, Plastic Part Design for Injection Molding.			
6.	Robert M. Suess, Molded Part Design for Aerospace Applications.			

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Year	I	CORE / ELECTIVE / FOUNDATION 1: ELECTIVE PAPER CODE: CHL XXXX PAPER NAME: BIOPLASTICS	Credit	
Semester	II		Hours	39
UNIT – I		Introduction: Bioplastics - standards & certifications (ASTM, ISO, CEN, JBPA), global bioplastic market, current material and market trends, and limitation toward biopolymer commercialization, Fundamentals on Biodegradability.	6	
UNIT – II		Classification, chemical structures, and sources: Biobased Materials: Types and Sources, Bioplastic from Renewable Biomass, defining bioplastic, biopolymer, bio-based, and oxo-degradable terminologies, Mechanisms of Polymer Degradation.	5	
UNIT – III		Applications: Applications of bioplastics in health and hygiene.	6	
UNIT – IV		Production processes: Microbial Technology in Bioplastic Production and Engineering, Synthesis of Green Bioplastics, Processing Bioplastic Polymers.	7	
UNIT – V		Environment and economic impacts: Biodegradation, Limitations, economic impact, environmental impact, Bioplastic cycle, future perspective, Recycling of Bioplastics: Mechanism and Economic Benefits.	8	
UNIT – VI		Bioplastics Blending and compounding: Polymer selection (PP, PLA/PLB, PHA, PBS, PBAT, PVOH & many more), Properties identification based on polymers, Different strategies to enhance compatibility between polymers, formulating bioplastics with enhanced properties (impact strength, thermal resistance), Understanding Bioplastic Additives.	7	
REFERENCES				
1.	Syed Ali Ashter, Introduction to Bioplastics Engineering, PDL Handbook Series.			
2.	James Clark & Fabien Deswarte, Introduction to Chemicals from Biomass, 2 nd edition.			
3.	Stephen Kabasci, Bio-based Plastics: Materials and Applications, Wiley & Sons, 2014			
4.	Inamuddin and Tariq Altalhi, Handbook of Bioplastics and Bio composites Engineering Applications, 2 nd edition, Scrivener Publishers, Wiley.			
5.	Navodita Bhatnagar, Bio-based plastics: materials and applications, Arcler Press			
6.	Srikanth Pilla, Handbook of Bioplastics and Bio composites Engineering Applications, Scrivener Publishing, Wiley			