

GANPAT UNIVERSITY									
FACULTY OF ENGINEERING AND TECHNOLOGY									
Programme	Master of Technology				Branch	Mechanical Engineering (Specialization in Additive Manufacturing)			
Semester	II				Version	1.0.0.0			
Effective from Academic Year	2025-26				Effective for the batch Admitted in	July 2025			
Subject code	3ME1119		Subject Name		Polymer Engineering				
Teaching scheme									
(Per week)	Lecture(DT)		Practical(Lab.)		Total	CE	SEE	Total	
	L	TU	P	TW					
Credit	2	0	2	0	4	Theory	40	60	100
Hours	2	0	4	0	6	Practical	60	40	100

Pre-requisites:
Basic knowledge of chemistry, materials science, and engineering mathematics.

Course Learning Outcomes:
The course content should be taught and implemented with an aim to develop different skills leading to the achievement of the following competencies and course learning outcomes: CO1: Explain polymer structure, classification, and fundamental properties. CO2: Analyze polymerization mechanisms and processing techniques. CO3: Evaluate mechanical, thermal, and rheological behavior of polymers. CO4: Apply polymer materials in additive manufacturing and engineering applications. CO5: Assess polymer testing methods, degradation, recycling, and sustainability issues.

Course Content		
Name of Unit	Content	Hrs
<b>UNIT – I: Introduction to Polymers</b>	Definition and classification of polymers. Natural and synthetic polymers. Molecular weight and its distribution. Polymer chain structure and configuration. Crystallinity and morphology. Glass transition temperature (T <sub>g</sub> ) and melting temperature (T <sub>m</sub> ).	<b>8</b>
<b>UNIT – II: Polymerization and Chemical Structure</b>	Addition (chain-growth) polymerization and condensation (step-growth) polymerization. Free radical, ionic, and coordination polymerization. Copolymerization. Degree of polymerization. Cross-linking and branching. Polymer blends and composites.	<b>10</b>
<b>UNIT – III: Physical, Mechanical and Rheological Properties</b>	Mechanical properties: tensile, compressive, impact, and fatigue behavior. Thermal properties: T <sub>g</sub> , T <sub>m</sub> , thermal conductivity, heat distortion temperature. Viscoelastic behavior. Rheology of polymer melts and solutions. Time–temperature superposition principle.	<b>8</b>

<b>UNIT – IV: Polymer Processing Techniques</b>	Extrusion, injection molding, compression molding, blow molding, calendaring, thermoforming. Processing parameters and defects. Polymer processing for additive manufacturing: filament fabrication, FDM/FFF process, SLA resins, SLS powders.	<b>8</b>
<b>UNIT – V: Testing, Degradation and Applications</b>	Polymer testing methods: mechanical, thermal, and chemical tests. Degradation mechanisms: thermal, oxidative, UV, and biodegradation. Recycling and sustainability. Applications in automotive, biomedical, packaging, and additive manufacturing industries.	<b>6</b>

#### List of Practical

The practical should be carried out in such a manner that students are able to acquire different learning outcomes in cognitive, psychomotor and affective domain to demonstrate course learning outcomes.

No.	Unit	Name of Practical
1	1	Study of polymer samples and identification of different polymers.
2	2	Determination of molecular weight using viscosity method.
3	3	Tensile testing of polymer specimens.
4	4	Processing of polymer using FDM or injection molding simulation.
5	5	Thermal analysis of polymers (DSC/TGA).
6	5	Case study on polymer application in additive manufacturing.

#### List of Instruments / Equipment / Trainer Board

No.	Instruments / Equipment
1	Universal Testing Machine (UTM).
2	Differential Scanning Calorimeter (DSC) / TGA.
3	Polymer processing equipment (extruder / injection molding trainer).
4	FDM 3D printer and filament extruder.
5	Rheometer and viscometer.

#### List of Reference Books

No.	Title of Reference Books	Authors	Publication
1	Introduction to Polymer Science and Technology	Joel R. Fried	Prentice Hall
2	Polymer Science and Technology	Raghavan, T. S.	PHI Learning
3	Plastics Materials	J. A. Brydson	Butterworth-Heinemann
4	Polymer Chemistry	Hiemenz & Lodge	CRC Press
5	Additive Manufacturing Technologies	Gibson, Rosen, Stucker	Springer