

GANPAT UNIVERSITY									
FACULTY OF ENGINEERING AND TECHNOLOGY									
Programme		Master of Technology			Branch		Mechanical Engineering (Specialization in Additive Manufacturing)		
Semester		I			Version		1.0.0.0		
Effective from Academic Year				2025-26		Effective for the batch Admitted in			July 2025
Subject code		3ME1116		Subject Name		Material Characterization Techniques			
Teaching scheme					Examination scheme (Marks)				
(Per week)	Lecture(DT)		Practical(Lab.)		Total		CE	SEE	Total
	L	TU	P	TW					
Credit	3	0	2	0	5	Theory	40	60	100
Hours	3	0	4	0	7	Practical	60	40	100

Pre-requisites:
Students should be compatible to basics of computer systems operating, basics of engineering drawing and drafting, to perform AutoCAD two dimensional drawings, formal knowledge of limit, fit, tolerances and surface finish symbols.

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. Understand the material mechanical behaviours CO2. Explore the various failure mechanisms for different materials CO3. Understand the different characterization techniques CO4. Analyse the material failure reason using suitable characterization techniques

Course Content		
Name of UNIT	Unit Content	Hrs
UNIT – 1 Introduction	Introduction, Need for material characterization, Importance in engineering and research, Classification of characterization techniques, Overview of destructive and non-destructive methods, Applications of material characterization.	5
UNIT- 2 Various Spectroscopy methods	Optical Microscopy: Optical microscope - Basic principles and components, Different examination modes (Bright field illumination, Oblique illumination, Dark field illumination, Phase contrast, Polarised light, Hot stage, Interference techniques), Stereomicroscopy, Photo- microscopy, Colour metallography, Specimen preparation, Applications. Electron Microscopy: Interaction of electrons with solids, Scanning electron microscopy Transmission electron microscopy and specimen preparation techniques, Scanning transmission electron microscopy, Energy dispersive spectroscopy, Wavelength dispersive spectroscopy.	25
UNIT – 3 Diffraction Methods	Fundamental crystallography, Generation and detection of X-rays, Diffraction of X-rays, X-ray diffraction techniques, Electron diffraction.	10

UNIT – 4 Surface Analysis	Atomic force microscopy, scanning tunneling microscopy, X-ray photoelectron spectroscopy.	5
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Unit - 5 Spectroscopy methods	Atomic absorption spectroscopy, UV/Visible spectroscopy, Fourier transform infrared spectroscopy, Raman spectroscopy. Thermo gravimetric analysis, Differential thermal analysis, Differential Scanning calorimetry, Thermo mechanical analysis and dilatometry.	15
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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	To prepare 3D solid parts using AutoCAD command including Extrude, Revolve, Sweep and Loft.
2	2	Testing of 3d printed part using tensile testing method
3	3	Characterization of 3d printed part using SEM method
4	3	Characterization of 3d printed part using DSC method

List of Instruments / Equipment / Trainer Board

1	CAD Workstations.
2	3D printer based on any AM technique
3	Testing equipment : UTM , Scanning electron microscope, DSC setup

List of Reference Books

No.	Title of Reference Books	Authors	Publication
1	Mechanical Metallurgy	George E. Dieter	McGraw Hill
2	Introduction to Fracture Mechanics	Hellan K	McGraw Hill
3	Deformation and Fracture Mechanics of Engineering Materials	Richard W. Hertzberg, Richard P. Vinci, Jason L. Hertzberg	Wiley