

GOVERNMENT POLYTECHNIC JAIPUR

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DEPARTMENT OF METALLURGY

Discipline: Metallurgy	Semester: 4th	Name of the Teaching faculty: Rakesh Kumar Sahu
Subject: Material Characterization	No of Days/Week class allotted: 3	Semester from Date: 22/12/25 To Date: 18/04/26 No of weeks: 15
Week	Class Day	Topics
1st	1 st	Unit-I : Introduction to Material Characterization - Fundamentals, Importance of material characterization in metallurgy
	2 nd	Classification of characterization techniques: Structural, chemical, mechanical, and thermal analysis
	3 rd	
2nd	1 st	Selection criteria for characterization methods
	2 nd	Specimen Preparation Techniques: Cutting, grinding, polishing, and etching, Sample preparation for different characterization methods (metals, ceramics, polymers)
	3 rd	
3rd	1 st	Unit-II: Microstructural Characterization Techniques : Optical Microscopy (OM)
	2 nd	Principles of optical microscopy
	3 rd	Bright-field and dark-field imaging
4th	1 st	Grain size analysis using ASTM standards
	2 nd	Scanning Electron Microscopy (SEM) - Working principle and components of SEM
	3 rd	
5th	1 st	Image contrast mechanisms and resolution of SEM
	2 nd	Energy Dispersive Spectroscopy (EDS)- Working principle
	3 rd	EDS for elemental composition analysis
6th	1 st	Transmission Electron Microscopy (TEM): Principles and applications of TEM
	2 nd	
	3 rd	Diffraction contrast and phase identification Atomic Force Microscopy (AFM)
7th	1 st	Principles of AFM
	2 nd	Different modes of operation of AFM (contact, tapping, non- contact)
	3 rd	Surface topography, roughness measurement
8th	1 st	Class Test-1
	2 nd	Unit-III : X-ray and Spectroscopic Characterization : Thermal Analysis Methods
	3 rd	X-ray Diffraction (XRD): Bragg's law
9th	1 st	Diffraction principles
	2 nd	Phase identification
	3 rd	Crystallite size determination

10th	1 st	Applications of XRD in metallurgy and materials science
	2 nd	Spectroscopy Techniques: UV-Visible Spectroscopy
	3 rd	Absorption and bandgap analysis
11th	1 st	Infrared (IR) Spectroscopy: Functional group identification
	2 nd	Raman Spectroscopy: Vibrational analysis of materials
	3 rd	Unit-IV : Thermal & Mechanical Characterization Techniques
12th	1 st	Differential Scanning Calorimetry (DSC)
	2 nd	Phase transformation studies by DSC
	3 rd	Class Test-2
13th	1 st	Thermogravimetric Analysis (TGA): Thermal stability and decomposition analysis
	2 nd	
	3 rd	Dilatometry: Thermal expansion studies
14th	1 st	Doubt clearing class on Unit-I, II
	2 nd	Doubt clearing class on Unit- III, IV
	3 rd	Previous years questions answer discussion
15th	1 st	Previous years questions answer discussion
	2 nd	Very Similar Test(VST)-1 to Semester questions
	3 rd	VST-2

Ramesh M. Sahu
28/12/25
Signature of the Faculty

[Signature]
24/12/25
Signature of HOD