

UTKALMANIGOPABANDHUINSTITUTE OFENGINEERING, ROURKELA



LESSON PLAN

SESSION-2025-26

SUBJECT: MATERIAL CHARACTERIZATION (THEORY-04)

DEPARTMENT OF METALLURGICAL ENGINEERING

Discipline: Metallurgical Engineering	Semester: 4th	Name of the Teaching Faculty: Harihar Hansda
Subject: Material Characterization (Th-4)	No of Days/Week Class Allotted:04	Semester starts From Date:22.12.2025 To Date: 18.04.2025 No.Of Weeks: 15
Week	Class/Day	Theory/Practical Topics
U-1, Week 1	1st	Importance of material characterization in metallurgy
	2nd	Classification of characterization techniques: Structural, chemical, mechanical, and thermal analysis
U-1, Week 2	1st	Selection criteria for characterization methods Specimen Preparation Techniques
	2nd	Cutting, grinding, polishing, and etching
	3rd	Sample preparation for different characterization methods (metals, ceramics, polymers)
U-2, Week 3	1st	Principles of optical microscopy
	2nd	Bright-field and dark-field imaging
	3rd	Grain size analysis using ASTM standards
U-2, Week-4	1st	Scanning Electron Microscopy (SEM) & Energy Dispersive Spectroscopy (EDS)
	2nd	Energy Dispersive Spectroscopy (EDS)
	3rd	Working principle and components of SEM
U2, Week-5	1st	Image contrast mechanisms and resolution
	2nd	EDS for elemental composition analysis
U2, Week-6	1st	Atomic Force Microscopy (AFM): Principles of AFM
	2nd	(TEM): Principles and applications of TEM
U-2, Week-7	1st	Diffraction contrast and phase identification
	2nd	Atomic Force Microscopy (AFM): Principles of AFM
	3rd	Surface topography
U-3, Week-8	1st	roughness measurement
	2nd	Bragg's law and diffraction principles
	3rd	Bragg's law and diffraction principles
U-3, Week-9	1st	1 st Internal Assessment
	2nd	1 st Internal Assessment
	3rd	1 st Internal Assessment
U-3, Week-10	1st	Crystallite size determination
	2nd	Applications in metallurgy and materials science
	3rd	UV-Visible Spectroscopy
U-3, Week-11	1st	Absorption and bandgap analysis
	2nd	Absorption and bandgap analysis
U-3, Week-12	1st	Infrared (IR) Spectroscopy: Functional group identification
	2nd	Infrared (IR) Spectroscopy: Functional group identification
	3rd	Raman Spectroscopy
Week-13	1st	2 nd Internal Assessment
	2nd	2 nd Internal Assessment
U-4, Week-14	1st	Raman Spectroscopy: Vibrational analysis of materials
	2nd	Revision of Unit-3
	3rd	Revision of Unit-3
U-4, Week-15	1st	Differential Scanning Calorimetry (DSC)
	2nd	Phase transformation studies
U-4, Week-16	1 st	Thermogravimetric Analysis (TGA)
U-4, Week-17	1st	Thermal stability
	2nd	Decomposition analysis
	3rd	Dilatometry: Thermal expansion studies

	<u>ReferenceBook</u>	<u>AuthorName</u>	<u>PublisherName</u>
01	Materials Characterization: Introduction to Microscopic and Spectroscopic Methods"	Yang Leng	(Wiley)
02	X-ray Diffraction: A Practical Approach"	C. Suryanarayana &M. Grant Norton	Springer
03	Material Characterization Techniques"	S. Zhang &L. Li	(CRC Press)