B.Tech III Year II Semester

JNTUA COLLEGE OF ENGINEERING (AUTONOMOUS)::PULIVENDULA

19ABS34-MATERIALS CHARACTERIZATION TECHNIQUES

(Open Elective-II)

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Course Objectives:

- To learn and understand an exposure to evaluation of special characteristics of materials.
- To understand the principle and important applications of characterization techniques
- To learn and understand the materials structural characteristics
- To learn and understand the materials Mechanical & Thermal characteristics

UNIT – I: STRUCTURE ANALYSIS BY POWDER X-RAY DIFFRACTION **9 Hrs**

Introduction, Bragg's law of diffraction, Intensity of Diffracted beams –factors affecting Diffraction Intensities - structure of polycrystalline Aggregates, Determination of crystal structure, Crystallite size by Scherrer and WH Methods, Small angle X-ray scattering (SAXS) (in brief).

Learning Outcomes:

At the end of this unit, the student will be able to

- Understand the diffraction phenomenon in crystals **L1**
- Identify the factors affecting diffraction pattern intensities **L2**
- Explain the polycrystalline nature of the material **L3**
- Analyze the crystal structure and crystallite size by various methods **L4**
- Illustrate the Small angle X-ray scattering (SAXS) **L2**

UNIT – II: MICROSCOPY TECHNIQUE -1 –SCANNING ELECTRON MICROSCOPY(SEM) 9 Hrs

Introduction, Principle, Construction and working principle of Scanning Electron Microscope, Specimen preparation, Different types of modes used (Secondary Electron and Backscatter Electron), Advantages, limitations and applications of SEM.

Learning Outcomes:

At the end of this unit, the student will be able to

- Explain the basic concepts and working principle of Scanning Electron Microscope **L1**
- Classify the different types of Scanning Electron Microscope modes used **L2**
- Identifies the specimen preparation for Scanning Electron Microscope **L2**
- Analyze the morphology of the sample by using Scanning Electron Microscope **L4**
- Understand the advantages and limitations of Scanning Electron Microscope **L2**

UNIT – III: MICROSCOPY TECHNIQUE -2 - TRANSMISSION ELECTRON MICROSCOPY (TEM) **9Hrs**

Construction and Working principle, Resolving power and Magnification, Bright and dark fields, Diffraction and image formation, Specimen preparation, Selected Area Diffraction, Applications of Transmission Electron Microscopy, Difference between SEM and TEM, Advantages and Limitations of Transmission Electron Microscopy.

Learning Outcomes:

- Explain the basic principle and working principle of Transmission Electron Microscope
- Classify the different types of Transmission Electron Microscope modes used **L1**
- Identifies the specimen preparation for Transmission Electron Microscope **L2**
- Analyze the morphology and crystal structure of the sample by using Transmission Electron Microscope **L2**
- Understand the advantages and limitations of Transmission Electron Microscope **L2**
- Explain the basic principle and working principle of Transmission Electron Microscope **L3**

UNIT – IV:SPECTROSCOPY TECHNIQUES **9Hrs**

Principle, Experimental arrangement, Analysis and Advantages of the spectroscopic techniques – (i) UV-Visible spectroscopy (ii) Raman Spectroscopy, (iii) Fourier Transform infrared (FTIR) spectroscopy, (iv) X-ray photoelectron spectroscopy (XPS).

Learning Outcomes:

At the end of this unit, the student will be able to

- Explain the principle and experimental arrangement of spectrometers **L1**
- Understand the analysis and advantages of the spectroscopic techniques **L2**
- Explain the concept of UV-Visible spectroscopy **L2**
- Explain the principle and experimental arrangement of Raman Spectroscopy **L2**
- Explain the principle and experimental arrangement of Fourier Transform infrared (FTIR) spectroscopy **L2**
- Explain the principle and experimental arrangement of X-ray photoelectron spectroscopy (XPS) **L2**

UNIT – V: ELECTRICAL & MAGNETIC CHARACTERIZATION TECHNIQUES

Electrical Properties analysis techniques (DC conductivity, AC conductivity) Activation Energy, Effect of Magnetic field on the electrical properties (Hall Effect). Magnetization measurement by induction method, Vibrating sample Magnetometer (VSM) and SQUID (Superconducting Quantum Interference Device)

Learning Outcomes:

At the end of this unit, the student will be able to

- Explain the various types of electrical properties analysis techniques **L1**
- Classify the solar cells based on manufacturing material **L2**
- Explain the effect of magnetic field on the electrical properties **L2**
- Analyze the magnetization by using induction method **L2**
- Explain the construction and working principle of VSM **L2**
- Explain the construction and working principle of SQUID **L2**

Text Books:

1. Material Characterization: Introduction to Microscopic and Spectroscopic Methods – Yang Leng – John Wiley & Sons (Asia) Pvt. Ltd. 2008
2. Microstructural Characterization of Materials - David Brandon, Wayne D Kalpan, John Wiley & Sons Ltd., 2008.

Reference Books:

1. Fundamentals of Molecular Spectroscopy – IV Ed. – Colin Neville Banwell and Elaine M. McCash, Tata McGraw-Hill, 2008.
2. Elements of X-ray diffraction – Bernard Dennis Cullity & Stuart R Stocks, Prentice Hall ,2001 – Science.

Course Outcomes:

At the end of this Course the student will be able to

- Identify the various characterization techniques **L1**
- Classify the characterization techniques based on their applications and properties **L2**
- Apply the various characterization techniques for materials characterization. **L3**