20CY203 CHARACTERIZATION METHODS FOR MATERIALS

Hours Per Week :

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3	1	-	4

COURSE DESCRIPTION AND OBJECTIVES:

This course will be providing students with understanding the working principles and applications of various modern analytical instrumentation techniques in chemical analysis. This course will cover advanced analytical techniques including AAS, AES, DSC, TGA, TMA, DMA, BET, SEM, SPM, STEM, TEM, XPS, and UPS, as these instrumental techniques are play an important role in the advanced research. Throughout the course, students will learn the working knowledge, principle, of instrumentation techniques and interpretation of both physical, chemical properties.

COURSE OUTCOMES:

Upon completion of the course, the student will be able to achieve the following outcomes:

COs	Course Outcomes
1.	Apply the basic concepts of atomic spectroscopic methods for qualitative and quantitative measurements of materials.
2.	Analyze physico-chemical properties of the materials using thermal and mechanical instrumental techniques.
3.	Apply the basic principles of X-ray techniques to determine the structural properties of materials.
4.	Identify the appropriate microscopic techniques to study the topography and morphological behaviour of materials.
5.	Evaluate importance of surface analysis to ascertain the surface properties of materials.

Unit - I :

Atomic Absorption Spectroscopy : Principle; Instrumentation: Flame and Flameless Techniques; Quantitative Analysis; Qualitative Analysis: Interferences & their Elimination. Atomic emission spectroscopy - Principle; Instrumentation: Atomic action sources – ICP, Arc, Spark, Induction; Applications of AAS and AES.

Unit - II :

Thermal and Mechanical Analysis :

Thermo gravimetric analysis (TGA), and differential scanning calorimetry (DSC) - Principle; Instrumentation; Factors Affecting Results; Applications. Dynamic mechanical analysis (DMA) - principle; instrumentation; applications.

Mechanical Testing of Materials: Tensile and Compression tests- Brittle and ductile failure Universal Testing Machine. Hardness and Fatigue test.

Unit - III

X-ray Spectroscopy :

X-ray Spectroscopy: X-ray spectrometers, energy dispersive and wavelength dispersive techniques, instrumentation, matrix effects and applications. X- ray diffraction – Debye Scherrer formula – powder diffraction –dislocation density strain and stress-particle size analysis by schemer formula –Weber-Frenchmen method of particle size determination.

Unit - IV :

Microscopy :

Scanning Probe Microscopy (SPM), Atomic force microscopy (AFM) – different methods of operation-Scanning Electron Microscopy (SEM), Transmission electron microscopy (TEM), Energy dispersive X-ray Spectroscopy (EDS)

Unit - V :

Surface Area Analysis :

Langmuir and Brumauer-Emmett-Teller (BET) theory Fundamentals, instrumentation and applications of Photoelectron spectroscopy (XPS and UPS).

Text Books :

1. Instrumental methods of analysis – H.H Willard, Meritt Jr. and J.A Dean
2. Principles of instrumental analysis – Skoog and West
3. Vogels Textbook of Quantitative Inorganic analysis – J. Basset, R.C Denney, G.H Jefferey and J.Madhan
4. Instrumental methods of analysis – B.K Sarma, Goel Publishing House, Meerut
5. Instrumental methods of Analysis – Chatwal and Anand
6. Instrumental methods of Analysis – Ewing

References Books

1. A. Moutaser and D.W Gologhtly (Eds), ICP in Analytical Atomic Spectrometry, VeH Publishers, New York
2. G.I Moore, Introduction to ICP emission Spectrometry in Analytical Spectroscopy, Elsevier, Amsterdam.
3. Edith A. Turi, Thermal Characterization of Polymeric Materials, Academic Press, New York,1981
4. Campbell and J. R. White, Polymer Characterization Physical Techniques, Chapman and Hall, London, 1989