PPH423 CHARACTERIZATION TECHNIQUES

L	T	P	Cr
3	1	0	3.5

Course Objective(s): To introduce the students to the principles of optical and electron microscopy, X-ray diffraction and various spectroscopic techniques

Introduction: Need of materials characterization and available techniques.

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.

Diffraction Methods: Fundamental crystallography, Generation and detection of X-rays, Diffraction of X-rays, X-ray diffraction techniques, Electron diffraction.

Surface Analysis: Atomic force microscopy, scanning tunneling microscopy, X-ray photoelectron spectroscopy.

Spectroscopy: Atomic absorption spectroscopy, UV/Visible spectroscopy, Fourier transform infrared spectroscopy, Raman spectroscopy.

Thermal Analysis: Thermo gravimetric analysis, Differential thermal analysis, Differential Scanning calorimetry, Thermo mechanical analysis and dilatometry.

Course learning outcomes: Students will have achieved the ability to:

1. apply appropriate characterization techniques for microstructure examination at different magnification level and use them to understand the microstructure of various materials
2. choose and appropriate electron microscopy techniques to investigate microstructure of materials at high resolution
3. determine crystal structure of specimen and estimate its crystallite size and stress
4. use appropriate spectroscopic technique to measure vibrational / electronic transitions to estimate parameters like energy band gap, elemental concentration, etc.
5. apply thermal analysis techniques to determine thermal stability of and thermodynamic transitions of the specimen.

Recommended Books:

1. *Li, Lin, Ashok Kumar Materials Characterization Techniques Sam Zhang; CRC Press, (2008).*
2. *Cullity, B.D., and Stock, R.S., "Elements of X-Ray Diffraction", Prentice-Hall, (2001).*

3. *Murphy, Douglas B, Fundamentals of Light Microscopy and Electronic Imaging, Wiley-Liss, Inc. USA, (2001).*
4. *Tyagi, A.K., Roy, Mainak, Kulshreshtha, S.K., and Banerjee, S., Advanced Techniques for Materials Characterization, Materials Science Foundations (monograph series), Volumes 49 – 51, (2009).*
5. *Wendlandt, W.W., Thermal Analysis, John Wiley & Sons, (1986).*
6. *Wachtman, J.B., Kalman, Z.H., Characterization of Materials, Butterworth-Heinemann, (1993).*

Evaluation Scheme:

Sr. No.	Evaluation Elements	Weightage (%)
1	MST	30
2	EST	45
3	Sessionals (May include assignments/quizzes)	25