

PMT5J003 CHARACTERIZATION OF MATERIALS

Module I (12 Hours)

Introduction:

Scope of subject, classification of techniques for characterization, macro and micro-characterization structure of solids. Bulk averaging techniques:

Thermal analysis: DTA, DSC, TGA, dilatometry, resistivity/ conductivity.

Optical & X-ray spectroscopy: Atomic absorption spectroscopy, X-ray spectrometry, infrared spectroscopy and Raman spectroscopy.

Mass spectroscopy: Principles and brief account.

Metallographic techniques: Optical metallography, image analysis, quantitative phase estimation.

Module II (14 Hours)

Diffraction methods:

X-ray diffraction, X-ray topography, residual stress measurement techniques, small angle X-ray and neutron scattering.

Electron optical methods: Scanning electron microscopy and X-ray microanalysis including electron probe microanalysis, electron optics, electron beam specimen interaction, image formation in the SEM. X-ray spectral measurements: WDS and EDS, quantitative X-ray analysis; application of SEM and EPMA to solid samples and biological materials; type of data base required to process the results.

Module III (14 Hours)

Analytical transmission electron microscopy: Electron diffraction, reciprocal lattice, analysis of SAD patterns; different electron diffraction techniques, atomic resolution microscopy, analytical devices with TEM, field ion microscopy, scanning tunneling microscopy, advanced techniques.

Methods based on sputtering or scattering phenomena: Field ion microscopy, atom probe microanalysis, low energy ion scattering spectroscopy, Rutherford back scattering spectroscopy, ion channeling and secondary ion mass spectroscopy.

Chromatography: Principles of gas chromatography, mass spectrometry, liquid and ion chromatography.

Books for reference:

1. *Materials Characterization, Metals Handbook, Vol 10, ASM*
2. *Characterization of Materials, by E N Kaufman, Wiley Publishers*
3. *Structure of Metals, by Barrett, C.S. and Massalski, T.B., Pergamon Press, Oxford.*
4. *Elements of X-ray Diffraction, by Cullity B.D., Addison-Wesley, 1978*
5. *Transmission Electron Microscopy by Williams, D.B. and Barry Carter C., Plenum Press.*
6. *Scanning Electron Microscopy and X-Ray Microanalysis, by J.I. Goldstein, C. E. Lyman*
7. *Differential Thermal Analysis by R.C. Machenzie*
8. *Modern Metallographic Techniques and their application by Victor A. Phillips*