

MAHATMA GANDHI UNIVERSITY
Ph.D. COURSE WORK IN CHEMISTRY
COURSE II – INSTRUMENTAL METHODS OF ANALYSIS IN CHEMISTRY

Unit I: SPECTROSCOPIC METHODS

General principles, Instrumentation and applications of the following spectroscopic techniques.

Infrared Spectroscopy (IR), Raman Spectroscopy, nuclear Magnetic Spectroscopy (NMR), Electron Spin Resonance (ESR), Mossbauer Spectroscopy, Nuclear Quadrupole Resonance (NQR) Spectroscopy, Fluorescence Spectroscopy, Atomic Absorption Spectroscopy (AAS), Atomic Emission spectroscopy (AES), Inductively Coupled Plasma Atomic Emission spectroscopy, UV/Visible Spectroscopy and Mass Spectroscopy.

Unit 2 : SURFACE ANALYSIS

Principles, instrumentation and applications of Auger Electron Spectroscopy, Secondary Ion Mass spectroscopy (SIMS), X-ray Photoelectron Spectroscopy (XPS)

Unit 3: MICROSCOPIC TECHNIQUES

Working Principle, instrumentation and applications of Atomic Force Microscopy (AFM), Optical microscopy, Polarizing Optical Microscopy, Interference Microscopy, Fluorescence Microscopy, Scanning Probe Microscopy (SPM), Scanning Tunneling Microscopy (STM), Transmission Electron Microscopy (TEM), Techniques of preparing samples for microscopy, Fourier Transformation in Microscopy.

Unit 4 : THERMAL ANALYSIS:

Principles, instrumentation and applications of Differential Scanning calorimetry (DSC), Thermo Mechanical Analysis (TMA), Thermo gravimetric Analysis (TGA), Dynamic Mechanical Spectroscopy (DMS), Differential Thermal Analysis (DTA), Dielectric Thermal Analysis (DETA), Thermal Conductivity, Thermal Diffusivity, Effusivity

Unit 5: CHROMATOGRAPHIC TECHNIQUES

Principles, Instrumentation (basic components) and applications of gas chromatography, High Performance Liquid Chromatography (HPLC), Ion Exchange Chromatography: Size Exclusion Chromatography, Thin Layer Chromatography, Inverse Gas Chromatography.

Unit 6: SCATTERING TECHNIQUES;

Principles, Instrumentation (basic components) and application of X ray Diffraction (XRD) technique SAXS and WAXD, Dynamic and Static Light Scattering, SALS, Turbidimetry, Nephelometry and small angle neutron scattering techniques.

Unit 7: MOLECULAR WEIGHT DETERMINATION

Principles, Instrumentation (basic components) and application of Osmometric Techniques – Vapour Pressure Techniques (VPO), membrane Osmometry (MO), Differential Refractometry and Light Scattering techniques.

Unit 8: DIELECTRIC SPECTROSCOPY/IMPEDANCE SPECTROSCOPY

Principles, Instrumentation (basic components) and application Surface Resistivity, Dielectric Spectroscopy/Impedance Spectroscopy, Volume Resistivity, Dielectric Loss, Arc Resistivity spectroscopy/Impedance Spectroscopy, Volume Resistivity, Dielectric Loss, Arc Resistivity

Unit 9: MECHANICAL AND VISCOELASTIC CHARACTERIZATION

Properties of materials in tension, compression, bending, abrasion, flexural modes, Static mechanical properties, Dynamic properties, creep, stress relaxation and dynamic mechanical properties.

Unit 10: FLOW/RHEOLOGICAL CHARACTERIZATION

Viscosity determination, capillary rheometer, rotational rheometer, different types of viscometers

Unit 11: OPTICAL CHARACTERIZATION

Haze, Gloss, Transparency, Scattering, color, luster, streak, index of refraction, dispersion, luminescence, fluorescence.

Reference Books

1. Fundamentals of analytical chemistry, Douglas A.Skoog, Donald M.West, F.James Holler, Stanley R.Crouch: Thomson Brooks/Cole (8th Edition).
2. Spectrometric identification of Organic compounds, Silverstein, Bassler and Morrill; John Wiley & sons, New York, 1981.
3. Instrumental methods of analysis, Willard, Merritt and Dean
4. Vogel's Text book of quantitative inorganic analysis, J Basset, R.C.Denny; Langman group, Lardan, G.H.Jeffery and J.Mendham (5th Edition)
5. Spectroscopy, G.R.Chatwal and S.K.Anand; Himalaya publishing aHouse 2002.
6. Spectroscopic identification of organic compounds, R.M.Silverstein and Webster.
7. NMR in chemistry – A multinuclear introduction, William Kemp.
8. Instrumentation to modern chromatography. L.R.Snyder and J.J.Kirkland: John Wiley and Sons, Inc (II Edition)
9. Introduction to High Performance Liquid Chromatography, Hamilton, R.J; Chapman AND Hall, 1978
10. Fundamentals of molecular spectroscopy, N.Banwell; Tata Mcgraw Hill 1994 (4th Ed.)
11. Applications of absorption spectroscopy of organic compounds. J.R.Dyer; Prentice Hall of India.
12. Spectroscopy of Organic Compounds. P.S.Kalsi; New Age International, New Delhi
13. Spectroscopic Methods in Organic Chemistry, D.H.Williams, I.Fleming: Tata McGraw Hill, New Delhi 2005 (5th Ed.)
14. Instrumental Methods of Chemical Analysis, Chatwal, G.R. and Anand S.K; Himalaya Publishing House, 2007 (5th Edition.)