6TH SEMESTER

DISCIPLINE SPECIFIC ELECTIVES (DSES)

OPTION-I

CH616DA: CHEMISTRY: INSTRUMENTAL METHODS OF CHEMICAL ANALYSIS

CREDITS: THEORY-4, PRACTICAL-2

Unit I Introduction to spectroscopic methods of analysis (12 Contact hours)

(i) Properties of Electromagnetic radiations:

The Electromagnetic spectrum. General nature of electromagnetic waves; wave parameters, radiant power (Intensity), superposition of waves, diffraction, transmission, dispersion, refraction, reflection, scattering and polarization of radiation. Absorption, emission, fluorescence and phosphorescence.

(ii) Instruments for optical spectroscopy:

Components of optical instruments: radiation sources; continuous sources, line sources, lasers. Wavelength selectors, sample holders. Radiation detectors; photon detectors; vacuum phototubes, photomultiplier tubes, photoconductivity detectors, silicon diode detectors. Signal processors and read outs.

Unit II Molecular Spectroscopy 15L

(i) UV-Visible -Near IR spectroscopy:

UV-Visible-Near IR regions of EMS. Transmittance, absorbance, Beer-Lambert. law, limitations to the applicability of the Beer's law, molecular electronic excitations (π-π:*, n-π*, d-d transitions, charge transfer transitions, intra-ligand transitions). Fluorescence, phosphorescence. Instrumentation: Light sources, wavelength dispersion (gratings, prisms, interference filters, lasers).Sample holders, detection of signals (photocells, photo multipliers, diode arrays),Sensitivity and S/N ratio. Single and double beam instruments.

(ii) Infrared spectroscopy:

Theoretical principles, vibrational modes and IR absorption process, selection rules. Vibrational IR region (4000-400cm-1); group frequency region, the fingerprint region, metal• ligand absorption region, IR peak positions of some common functional groups of organic molecules- IR correlation tables.

Instrumentation: Light sources, infrared detectors, sample preparation techniques; liquids, solids. Dispersive IR spectrometer. Fourier transfer spectrometer (FTIR), construction and advantages.

Unit III Atomic spectroscopy I5L

Sample atomization; continuous atomizers, discrete atomizers. Sources of atomic spectra; atomic absorption spectra, atomic emission spectra, atomic fluorescence spectra. Flame atomization (fuel and oxidants), Electrothermal atomization.

Atomic absorption spectroscopy*;* radiation sources-hollow cathode lamps, instruments-single beam spectrophotometer, double beam spectrophotometer. ***Flame emission spectroscopy****;* instrumentation, spectrophotometer, photometer.

Unit IV Chromatographic techniques l5L

(i) Introduction to chromatography:

Basic Concept of chromatography; mobile phase and stationary phase. Classification of chromatographic methods, chromatogram, partition coefficients, retention times, retention volumes, the capacity factor, the selectivity factor theoretical plates and efficiency, Van Deemter equation, column resolution.

(ii) Gas chromatography:

Principle of Gas Chromatography. *Instrumentation*· carrier gas, sample injection systems, column configuration and column ovens. Detectors; flame ionization detectors, thermal conduction detectors, electron capture detectors etc.Columns; packed columns, solid support materir.ls, particle size; open tubular columns. The stationary phase materials.

(iii) Liquid chromatography:

HPLC, column efficiency in liquid chromatography. Instruments for liquid chromatography; mobile gas reservoirs, solvent treatment system, pumping systems, liquid chromatographic columns, detectors.

Books Recommended

1. Principles of Instrumental Analysis - 6th Edition by Douglas A. Skoog, F. James Holler, and Stanley Crouch (ISBN 0-495-01201-7)
2. 2 Instrumental Methods of Analysis, 7th ed, Willard, Merritt, Dean, Settle.
3. P.W. Atkins: Physical Chemistry.
4. G.W. Castellan: Physical Chemistry.
5. C.N.Banwell: Fundamentals of Molecular Spectroscopy.
6. Brian Smith: Infrared Spectral Interpretations: Systematic Approach.
7. W.J. Moore: Physical Chemistry.

PRACTICALS

Note: *The suggested experiments cannot be Conducted in our colleges because of lack of instrumental facilities. However, I may suggest the following few experiments.*

1. Determination of concentration of an acidic solution by pH metric titrations.
2. Determination of the isoelectric pH of a protein.
3. Potentiometric titration of a Chloride-Iodide Mixture.
4. The standardization of an Fe (II) solution with a standard dichromate solution over Pt and Calomel assembly.
5. Determination of concentration of Ce (IV) Sulfate solution with a standard Fe (II) Solution over Pt and calomel assembly.
6. Determination of λ_{max} of Potassium permanganate ($KMn0_4$)solution.
7. Determination of Fe (II) in a sample of well water with thiocyanate as complexation agent, spectrophotometrically.
8. Determination of Aluminum in a given sample solution, spectrophotometrically.
9. Determination of concentration of sodium in an aquous solution by using a flame photometer.
10. Separation of permanganate and dichromate ions from a binary mixture on an alumina column.

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2. Instrumental Methods of Analysis, 7th Ed, Willard, Merritt, Dean, Settle.

6TH SEMESTER
DISCIPLINE SPECIFIC ELECTIVES (DSES)
OPTION-II

CH616DB: CHEMISTRY: MATERIAL CHEMISTRY

CREDITS: THEORY-4, PRACTICAL-2

Unit-I Elementary Lattice Dynamics

Lattice Vibrations and Phonons: Linear Monatomic and Diatomic Chains. Acoustical and Optical Phonons. Qualitative Description of the Phonon Spectrum in Solids. Dulong and Petit's Law, Einstein and Debye theories of specific heat of solids. T3 law **(15 Contact hours)**

Unit-II Magnetic Properties of Matter

Dia-, Para-,Ferri- and Ferromagnetic Materials. Classical Langevin Theory of dia -- and Paramagnetic Domains. Quantum Mechanical Treatment of Paramagnetism.Curie's law, Weiss's. Theory of Temperature dependence of magnetism.

(15 Contact hours)

Unit-III Nonmaterial

Nanormaterials-General introduction, special properties of Nanormaterials with special reference to Nanotubes, Fullurenes, Nanometal Nanoparticles, carbon Nanotubes.Preparation of gold and silver metallic Nanoparticles. Surfactant and Polymers based self-assemb1ies like Micelles and gels etc. and brief account of their applications.

(15 Contact hours)

Unit-IV superconducting materials

History and introduction to Superconductivity, Characteristics of Superconductors Heat capacity and Thermal Conductivity, Effect of Temperature on Superconductivity, BCS theory of Superconductivity, Applications.

Books Recommended:

(15 Contact hours)

1. Fahlman B.D materials chemistry, springer, 2004.
2. Shriver & Atkins. Inorganic Chemistry.
3. Poole C.P & Owens, F.J Introduction to Nanotechnology John Wiley & Sons, 2003.
4. Rodger G.E Inorganic and solid state chemistry, learning India Edition, 2002.
5. Introduction of solid state physics, Charles kittel, 8th Ed, .2004, wiley India Pvt.Ltd.
6. Elements of solid state physics, J.P Srivastava, 2nd Ed., 2006, prentice-hall of India.
7. Introduction to solids, leonid V.Azaroof, 2004, Tata Mc-Graw Hill.
8. Solid state chemistry by west.

PRACTICALS

Note: Attempt any five exercises

1. Synthesis of silver and gold metal nanoparticles.
2. Preparation of nay two polymers,
3. Determination of molecular weight of polymer by Viscometry.
4. Measurement of susceptibility of paramagnetic solution (Quinck's Tube method).
5. To measure the Magnetic Susceptibility of solids.
6. Determination of *cmc* of a detergent.

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1. Shriver & Atkins inorganic chemistry.
2. Rodger G.E Inorganic and solid state chemistry, learning India Edition, 2002.
3. Introduction of solid state physics, Charles kittel, 8th Ed, .2004, wiley India Pvt.Ltd
4. Elements of solid state physics, J.P Srivastava, 2nd Ed., 2006, prentice-hall of India.