Department of Chemistry

2019-20

M.Sc. Part-I (Semester-II)

MCT-A-205: ENVIRONMENTAL CHEMICAL ANALYSIS ANDCONTROL

UNIT-I: Sampling in analysis (15)

Definition, theory and techniques of sampling, sampling of gas, liquids and solids, Criteria of Good sampling, Minimization of Variables, transmission and storage of samples, high pressure ashing techniques (HPAT), particulate matter, its separation in gas stream, Filtering and gravity separation. Analysis of particulate matter like asbestos, mica, dust and aerosols etc

UNIT-II: Electrochemical and spectral methods Environmental analysis (15)

Introduction to instrumental techniques, principle instrumentation and applications with respect to environmental analysis of Conductometry, Potentiometry, Ion selective electrodes, Cyclic voltammetry, Amperometry, Coulometry, Atomic absorption spectrometry, Atomic fluorescence spectrometry, Inductively coupled plasma spectrometry, Turbidimetry, Non Dispersive Infrared Analysis (NDIR).

UNIT-III: Air and Water Pollutant Analysis (15)

Chemistry of Air pollutants, characterization.source, methods of analysis of air pollutants; CO, CO_2 , NOX, NH_3 , H_2S, SO_2 etc. Monitoring Instruments, Potable and Industrial water, major and minor components, dissolved oxygen (DO) Chemical oxygen demand(COD) Biochemical oxygen demand (BOD) and their measurements. Analysis of Pd, Cd, Hg, Cr, As and their physiological manifestations. Quality of industrial waste water analysis for organic and inorganic constituents.Chemistry of odour and its measurements.

UNIT-IV: Organic Pollutants and Their Analysis (15)

Sources, disposal, treatment and analysis of phenolic residues, methods of recovery of phenols from liquid effluents, Organomercurials and its analysis, Analysis of organochlorine pesticides, volatile organic pollutants and their analysis

Recommended books:

1) A.K. De : Standard Methods of Waste and Waste water analysis.

2) P. M. S. Monk Fundamentals of Electroanalytical chemistry-John Wiley & Sons (2001)

3) Instrumental methods of chemical analysis H. Kaur

4) S.M. Khopkar, Environmental Chemistry ; Environmental pollution analysis

5) M.S. Creos and Morr, Environmental Chemical Analysis, American publication(1988) 64

6) A.K. De, Environmental Chemistry, New Age International publishers.Moghe and Ramteke, Water and aste water analysis : (NEERI)

7) A.C. Stern, Air pollution: Engineering control Vol.IV(AP)

8) P.N.Cheremisinoff and R.A.Young, Air Pollution controlandDesign.Hand Book Vol.I&II (Dekker)

9) R.B.Pohasek, Toxic and Hazardous waste disposal, Vol.I& II (AAS)

10) M.Sitting, Resources Recovery and Recycling, Handbook of industrial Waste.

11) B.K.Sharma, Industrial Chemistry.

12) S.P.Mahajan, Pollution Control in Process Industries.

13) R.A.Horne, Chemistry of our Environment.

MCTP-205 Applied Physical Chemistry

Solid State Chemistry and catalysis

UNIT-I: The solid state (15)

Introduction, laws of crystallography, lattice types, X-ray diffraction, Bragg's equation, Miller indices, Bragg Method, Debye-Sherrer method of X-ray structure analysis of crystals, indexing of reflections, identification of unit cells from systematic absence in diffraction pattern, structure of simple lattice and X-Ray intensities, structure factor and its relation to intensity and electron density, phase problem, procedure for an X-ray structure determination.

UNIT –II: Solid State Reactions (15)

General principle, types of reactions: Additive, structure sensitive, Decomposition and phase transition reactions, tarnish reactions, kinetics of solid state reactions, factors affecting the reactivity of solid state reactions.

UNIT –III: Electronic Properties and Band Theory (15)

Metals, insulators and semi conductors, free electron theory and its applications, electronic structure of solids, band theory, band structure of metals, insulator, and semiconductors, doping in semiconductors, p- n junction, superconductors, Molecular materials, Organic materials, some examples of organic semiconductors, charge carrier injection and transport, Optical properties of organic semiconductors, applications and devices involving optical properties, luminescence photoluminescence, effect of impurity levels on photoluminescence, light emitting diodes, luminous efficiency, photo-conduction and photoelectric effects, laser, principle of laser action, solid state laser and their applications.

Unit-IV Catalysis (15)

i) Fundamentals of adsorption and catalysis: Physical and Chemical adsorption – adsorption isotherms: evaluation, chemisorption on metals and metal oxides. Catalysis: concept of activity, selectivity, poisoning, promotion and deactivation. Types of catalysis: homogeneous, heterogeneous. Heterogeneous catalysis and catalytic kinetics: concept of Langmuir-Hinshelwood (4L)

ii) Preparation and Characterization of Catalyst: general methods for preparation of catalysts: precipitation, sol-gel, hydrothermal, impregnation, hydrolysis, vapour deposition. Activation of catalysts: calcinations, reduction. Catalyst characterization: surface area, pore size distribution, particle size determination, XPS, AES, UV-Vis, FT-IR and thermal methods (4L)

iii) Nanomaterials and Catalysis: General definition, Nanochemistry basics, distinction between molecules, nanoparticles and bulk materials. Physicochemical considerations of nanomaterials. Size-dependent properties. (3L)

iv) Catalysis in green chemistry and environmental applications: Purification of exhaust gases from different sources: auto-exhaust catalysts (petrol vehicles, diesel vehicles), VOC removal; ozone decomposition; photocatalysis in effluent treatment. (2L)

v) Photo-catalysis: Photoprocesses at metals, oxides and semiconductors: concepts and mechanism. Photocatalysis application in organic pollutant degradation present in water and air. (2L)

REFRENCE BOOKS

1) Molecular Photochemistry , N. J. Turro, W.A. Benjamin

2) Fundaments of Photochemistry , K. K. Rohatagi - Mukherji, Weiley - Eastern

3) Elements of Inorganic Photochemistry : G. S. Ferraudi , Wiley

4) Concepts of Inorganic Photochemistry , A.W. Adamson & P. J. Fleischauer , Wiley

5) A Guide To lasers in chemistry , Gerald R. Van Hecke & Kerry K. Karukstis.

6) Photochemistry , R.P. Kundall, A Gilbert, Thomson Nelson

7) W. Adamson, Physical Chemistry of Surfaces , Wiley Intersciences, 1990 (5th edition) 1990.

8) Bond, G C, Heterogeneous Catalysis: Principles and Application. Oxford University Press 1987

9) D.K. Chakrabarty and B. Viswanathan, Hetergogeneous Catalysis, Hardcover - Oct 2008 New Age International Publishers)

10) B.C. Gates, Catalytic Chemistry, John Wiley and Sons Inc. (1992).

11) G. Cao, Nanostructures and Nanomaterials - Synthesis, Properties and Applications, World-Scientific, 2004.

12) P.T. Anastas and J.C.Warner, Green Chemistry, theory and practice,

13) Nick Serpone and Ezio Pelizzetti, Photocatalysis: Fundamentals and Applications, Wiley, NewYork, NY, 1989.

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2019-20

M.Sc. Part-I (Semester-II)

MCT-I-205: INORGANIC CHEMICAL SPECTROSCOPY

UNIT-I: X-ray diffraction and neutron diffraction

A) X-ray powder diffraction (07)

X-ray source, Diffraction of X-rays-ray powder diffraction, Instrumentation and use of standards, identification of compounds using powder diffraction. The importance of intensities, Absences due to lattice centering, Determination of unknown cubic structure by sin2θ, parameter to be determined from XRD.

B) Single crystal X- ray diffraction: (05)

Solving single crystal structures, refining a structure-ray crystal structures in literature.

C) Introduction to neutron diffraction, theory, Instrumentation and application. **(03)**

UNIT-II: Electronic absorption Spectroscopy (15)

Term symbols, energies of atomic and Molecular transitions, Selection rule, and Morsepotential energy diagram, electronic transitions, polarized absorption spectra. Nature of absorption spectra, nature of absorption spectra of transition metal complexes, Orgel diagram,Tanabe Sugano diagram, and charge transfer spectra.

UNIT-III: A] Infrared and Raman Spectroscopy (10)

Molecular vibrations, force constants, Molecular vibrations and absorption of InfraredRadiations Raman Spectroscopy, polarized Raman lines, Use of symmetry considerations todetermine the no. of lines in IR and Raman Spectra, Spectra of gases, applications of Raman andInfrared spectroscopy. Selection rule in Inorganic structure determinations, Hydrogen bondingand infrared spectra, metal ligand and related vibrations.

B] X-ray Fluorescence spectroscopy (XRF) (5)

Introduction and basic theory, instrumentation, spectral analysis and applications.

UNIT-IV: A] Nuclear Magnetic Resonance Spectroscopy (NMR) (9)

Principle Instrumentation of NMR, the chemical shift, mechanism of electron shieldingand factors contributing to the magnitude of chemical shift. Local & remote effect, spin-spinsplitting, applications of spin coupling to structural determination, double Resonance techniques.The contact and Pseudo contact shifts Factors affecting nuclear relaxation, an overview of NMRof metal nucleus with emphasis on 195Ag &119Sn NMR, applications of solid-state NMRtechnique.

B] X-ray Photo electron Spectroscopy (XPS) (6)

Introduction and basic theory, Instrumentation, sample selection and preparation, spectralanalysis, Ar ion sputtering technique and applications of XPS.

Recommended books:

1. K. Burger, Coordination Chemistry-experimental methods, Butterworth's
2. R. Drago: Physical method in Inorganic Chemistry, DUSAP.
3. Hill & Day advanced methods in Inorganic Chemistry, J.Weily
4. F.A. Cotton, chemical application of group theory, Weily eastern
5. Figgis, Introduction to ligand field theory field
6. Schaefer & Gilman: Basic principles of ligand field Theory, J. Wiely
7. P.R. Backer: Molecular symmetry and Spectroscopy A.P.
8. Ferraro Ziomeek, Introduction to Group theory, plenum
9. Scotland Molecular symmetry DVN
10. Dorian: symmetry in Chemistry EWAP
11. Hall: Group theory and symmetry in Chemistry MGLt
12. Nakamoto Infrared R Raman Spectra of Inorganic & Coordination compounds J.Weily
13. Nakanisha: Spectroscopy and structure J. Weily
14. Ferroro: Metal ligand and related vibrations
15. CNR Rao Spectroscopy in Inorganic Chemistry Vol I, II, III
16. Durie: vibrations spectra and structure Vol. I to IV, Elsevier
17. Dudd, chemical Spectroscopy Elsevier
18. Popel: H.N.M.R. Spectroscopy J.Weily
19. R.J. Abraham, J.Fisher and P Loftus Wiley Introduction to NMR spectroscopy.
20. P.K. Bhattacharya: Group Theory & Its Chemical Applications
21. K.V. Reddy: Symmetry & spectroscopy of Molecules.

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MCT-P-205 Applied Physical Chemistry

Solid State Chemistry and catalysis

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iv) Catalysis in green chemistry and environmental applications: Purification of exhaust gases from different sources: auto-exhaust catalysts (petrol vehicles, diesel vehicles), VOC removal; ozone decomposition; photocatalysis in effluent treatment. **(2L)**

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