

# Name of SoS – School of Studies in Chemistry

## Syllabus- Choice Based Syllabus (Second Semester)

### Name of paper- ANALYTICAL TECHNIQUES AND DATA ANALYSIS

Total Credit-03

Total Marks -80+20

#### ANALYTICAL TECHNIQUES AND DATA ANALYSIS

##### Elective Course

##### Choice Based Credit System in Master Course in Chemistry

#### **SAMPLE PREPARATION, DEGESTION AND STATISTICAL ANALYSIS**

- A. Sampling - Collection, Preservation and preparation of sample, Techniques of sampling solids, liquids and gases, Operation of drying and preparing a solution of the analyte.  
Principle, methodology and application of different types of digestions such as acid digestion, base digestion, enzymatic and microwave digestion for liquid and solid materials.
- B. Evolution and procession of Analytical Data, Precision and Accuracy, Types of Errors, Normal Distribution Curve, Standard deviation, Confidence limit, Graphical presentation of result-method of average, Method of Linear regression, Significant figures, Statistical aid to hypothesis testing-t-test, F-test, Correlation coefficient, Rejection of data.

#### **SEPARATION TECHNIQUES**

- A. Efficiency of extraction, Selectivity of extraction, Extraction system, Method of Extraction, applications.
- B. Principles, classification of chromatographic techniques, Technique and applications of paper chromatographic, Thin-layer chromatographic, HPTLC, Column chromatography.

#### **INSTRUMENTATION INVOLVED IN PHYSICAL CHEMISTRY**

- A. UV visible and Tensiometer
- B. Principles, Instrumentation, Application of TGA, DTA and DSC methods.
- C. Automated methods, Principle, instrumentation and application of flow injection analysis.

#### **ELECTROCHEMISTRY**

- A. Principles and instrumentation of pH potentiometry, coulometry and conductometry.
- B. Basic principles, Diffusion current, polarized electrode, Micro electrode, Dropping mercury Electrode Ilkovic equation, Polarographic wave, Qualitative analysis Stripping methods, Cyclic Voltammetry, Amperometric titration :-curves, Differential pulse polarography and Square wave polarography.

#### **BOOK SUGGESTED :**

1. Fundamental of Analytical Chemistry-Skoog D.A. and West D.M.
2. Saunders, College Publication.
3. Textbook of Quantitative Inorganic Analysis-Vogel A.I.
4. Principles and Practice of Analytical Chemistry-Fifield F.W and Kealey
5. D. Black well Science
6. Instrumental Analysis R. Braun, McGraw Hill, International Edition.
7. Analytical Chemistry, Christain, WSE/Wiley.
8. Instrumental Analysis, Willard Merilt, CBS.
9. Chemical Analysis, Brawn, McGraw Hill
10. Fundamental of Analytical Chemistry-Skoog D.A. and West D.M.
11. Principles of instrumental analysis, Skoog Holler - Niemann.
12. Instrumental analysis, Wizard Dean and Merit.
13. Principal and PRACTICAL analytical chemistry, Fifield and Kealey.

# Name of SoS – School of Studies in Chemistry

## Syllabus- Choice Based Syllabus (Second Semester)

### Name of paper- INSTRUMENTAL METHODS OF ANALYSIS

Total Credit-03

Total Marks -80+20

#### INSTRUMENTAL METHODS OF ANALYSIS

Elective Course

Choice Based Credit System in Master Course in Chemistry

##### **ADVANCED CHROMATOGRAPHY:**

- A. Ion chromatography: Ion exchange equilibrium, Ion-exchange packing and Inorganic Applications.
- B. Size exclusion chromatography: Column packing, Theory of size of exclusion chromatography and applications.
- C. Supercritical fluid chromatography: Properties of supercritical fluid SFC-Instrumentation and operating variables, comparison with other types of chromatography, applications.
- D. Capillary Electrophoresis and capillary electro chromatography : overviews and applications

##### **X-RAY AND PROTON INDUCED SPECTROSCOPY:**

- A. X-Ray fluorescent method: Principals-Characteristics x-ray emission. Instrumentation x-ray tube, Radioactive sources. Wavelength dispersive instruments. Energy dispersive instruments. Analytical Applications-Qualitative Analysis.
- B. Proton Induced X-Ray Spectroscopy: Theory, instrumentation and application.

##### **ATOMIC EMISSION SPECTROSCOPY**

- A. Selectivity, sensitivity and interferences of atomic spectroscopy.
- B. Theory, instrumentation and application of flame photometer, AES, ICP-AES and AFS.

##### **ATOMIC ABSORPTION SPECTROSCOPY AND HYPHENATED TECHNIQUES**

- A. Theory instrumentation and application of flame and graphite furnace AAS, cold-vapor and hydride generated AAS.
- B. Theory , instrumentation and application of hyphenated techniques i.e. GC/HPLC/-MS, GC/IC/HPLC-ICP-MS.

#### **BOOK SUGGESTED:**

1. Instrumental methods of analysis, Willard, Meritt and Dean.
2. Basic concepts of analytical chemistry, S.M. Khopkar, John Wiley & Sons.
3. Metallurgical analysis, S.C. Jain.
4. Material Science and Engineering. An Introduction, W.D. Callister, Wiley.
5. Material Science, J.C. Anderson, K.D. Leaver, J.M. Alexander and R.D. Rawlings, ELBS.
6. Fundamentals of Analytical Chemistry, Skoog, Welt, Holler and Crouch Thomson Learning Inc.

# Name of SoS – School of Studies in Chemistry

## Syllabus- Choice Based Syllabus(Third Semester)

### Name of paper- RESONANCE SPECTROSCOPY AND PHOTOCHEMISTRY

Total Credit-03

Total Marks -80+20

#### RESONANCE SPECTROSCOPY,PHOTOCHEMISTRY AND ORGANOCATALYSIS

##### Elective Course

##### Choice Based Credit System in Master Course in Chemistry

- A. ELECTRON SPIN RESONANCE SPECTROSCOPY :** Hyperfine coupling, spin polarization for atoms and transition metal ions, spin-orbit coupling and significance of g-tensors, application to transition metal complexes (having one unpaired electron).
- B. NUCLEAR QUADRUPOLE RESONANCE SPECTROSCOPY:** Quadrupole nuclei, quadrupole moments, electric field gradient, coupling constant, splittings, applications.
- A. PHOTOELECTRON SPECTROSCOPY :** Basic principle both for atoms and molecules; Photo-electric effect, ionization process, extraKoopman'sofsimplemolecules,theorem,Auger p electron spectroscopy, Determination of Dipole moment.
- B. PHOTOACOUSTIC SPECTROSCOPY:** Basic principle of Photo acoustic Spectroscopy (PAS), PAS –gases and condensed system Chemical and Surface application.
- A. PHOTOCHEMICAL REACTIONS :** Interaction of electromagnetic radiation with matter, Stern Volmer equation, types of excitations, fate of excited molecule, quantum yield, transfer of excitation energy, Actinometry.
- B. DETERMINATION OF REACTION MECHANISM:** Classification, rate constatnts and life times of reactive energy states –determination of rate constants of reactions. Effect of light intensity on the rate of photochemical reactions.
- C. MISCELLANEOUS PHOTOCHEMICAL REACTIONS :** Photo-Fries reactions of anilides, Photo-Fries rearrangement. Barton reaction. Singlet molecular oxygen reactions. Photochemical formation of smog. Photodegradation of polymers, Photochemistry of vision.
- A. ORGANOCATALYSIS**  
General Principles: Energetic, Catalytic cycles, catalytic efficiency and life time, selectivity. Type of organometallic reaction: Ligand substitution, Oxidative addition, reductive elimination and insertion and deinsertion. Homogeneous catalysis: Hydrogenation of alkenes, Hydroformylation, Monsanto acetic acid synthesis, Wacker oxidation of alkenes, Alkenes metathesis, Palladium-Catalysed C-C bond forming reactions, asymmetric oxidation. Heterogenous catalysis: The nature of heterogenous catalysts, Fischer-Tropsch synthesis, alkene polymerization.

#### BOOK SUGGESTED:

1. Infrared and Raman Spectra: Inorganic and Coordination Compounds, K. Nakamoto, Wiley.
2. Fundamentals of Photochemsitry, K.K. Rohtagi-Mukherji, Wiley-Eastern.
3. Essentials of Molecular Photochemistry, A. Gilbert and J. Baggott, Blackwell Scientific Publications.
4. Molecular Photochemsitry, N.J. Turro, W.A. Benjamin.
5. Introductory Phtochemistry, A. Cox and T. Camp, McGraw-Hill.
6. Photochemistry, R.P. Kundall and A. Gilbert, Thomson Nelson.
7. Application of Spectroscopy of Organic Compounds, J.R. Dyer, Prentice Hall.
8. Photochemistry , R.P. Kundall and A. Gilbert, Thomson Nelson.
9. Organic Photochemistry, J. coxon and B. Halton, Cambridge University Press.
10. Shriver& Atkins Inorganic Chemistry: P.Atkins, T.Overtone, J. Rourke, M. Weller, F. Armstrong, Oxford University Press
11. Inorganic Chemistry: C.E. Housecraft, A.G. Sharpe, Pearson Education Limited.
12. Inorganic Chemistry: Principles of Structure and Reactivity: J.E. Huheey, E.A. Keiter, R.L.Keiter, O.K. Medhi, Pearson Education

## Name of SoS – School of Studies in Chemistry

### Syllabus- Choice Based Syllabus (Third Semester)

#### Name of paper- CHEMISTRY OF BIOMOLECULES

Total Credit-03

Total Marks -80+20

#### CHEMISTRY OF BIOMOLECULES

##### Elective Course

##### Choice Based Credit System in Master Course in Chemistry

- A. **BIOENERGETICS:** Standard free energy change in biochemical reactions, exergonic, endergonic. Hydrolysis of ATP, synthesis of ATP from ADP.
- B. **ELECTRON TRANSFER IN BIOLOGY:** Structure and function of metalloproteins in electron transport processes –cytochromes and iron-sulphur proteins, synthetic models.
- C. **TRANSPORT AND STORAGE OF DIOXYGEN:** Heme proteins and oxygen uptake, structure and function of haemoglobin, myoglobin, haemocyanins and haemerythrin, model synthetic complexes of iron, cobalt and copper.
  
- A. **METALLOENZYMES:** Zinc enzymes –carboxypeptidase and carbonic anhydrase. Iron enzymes – catalase, peroxidase and cytochrome P-450. copper enzymes- superoxide dismutase. Molybdenum oxatransferase enzymes –xanthine oxidase.
- B. **ENZYME MODELS:** Host-guest chemistry, chiral recognition and catalysis, molecular recognition, molecular asymmetry and prochirality. Biomimetic chemistry, Cyclodextrin-based enzyme models, calixarenes, ionophores, synthetic enzymes or synzymes.
  
- A. **ENZYMES:** Nomenclature and classification of induced Enzyme. F<sub>o</sub>F<sub>1</sub> hypothesis, concept and identification of active site by the use of inhibitors.
- B. **CO-ENZYME CHEMISTRY:** Structure and biological functions of coenzyme A, thiamine pyrophosphate, pyridoxal phosphate, NAD<sup>+</sup>, NADP<sup>+</sup>, FMN, FAD, lipoic acid, vitamin B<sub>12</sub>.
- C. **BIOTECHNOLOGICAL APPLICATIONS OF ENZYMES:** Techniques and methods of immobilization of enzymes, effect of immobilization on enzyme activity, application of immobilization of enzymes in medicine and industry. Enzymes and Recombinant DNA Technology.
  
- A. **BIOPOLYMER INTERACTIONS:** forces involved in biopolymer interaction. Electrostatic charges and molecular expansion, hydrophobic forces, dispersion force interactions. Multiple equilibria and various types of binding processes in biological systems. Hydrogen ion titration curves.
- B. **THERMODYNAMICS OF BIOPOLYMER SOLUTIONS:** Thermodynamics of biopolymer solution, osmotic pressure, membrane equilibrium, muscular contraction and energy generation in mechanochemical system.
- C. **CELL MEMBRANE AND TRANSPORT OF IONS:** Structure and functions of cell membrane, ion transport through cell membrane, irreversible thermodynamic treatment of membrane transport and Nerve conduction.

#### BOOK SUGGESTED:

1. Principles of Bioinorganic Chemistry, S.J. Lippard and J.M. Berg, University Science Books.
2. Bioinorganic Chemistry, I. Bertini, H.B. Gray, S.L. Lippard and J.S. Valentine, University Science Books.
3. Inorganic Biochemistry vols II and I. Ed G.L. Eichhorn, Elsevier.
4. Principles of Bioinorganic Chemistry, S.J. Lippard and J.M. Berg, University Science Books.

5. Bioinorganic Chemistry, I. Bertini, H.B. Gary, S.J. Lippard and J.S. Valentine, University Science.
6. Inorganic Biochemistry vols I and II ed. G.L. Eichhorn, Elsevier.
7. Bioorganic Chemistry: A Chemical Approach to Enzyme Action, Hermann Dugas and C. Penny, Springer-verlag.
8. Understanding Enzymes, Trevor palmer, Prentice Hall.
9. Enzyme Chemistry : Impact and Applications, Ed. Collin J Suckling, Chapman and Hall.
10. Enzyme Mechanisms Ed, M.I. Page and A. Williams, Royal Society of Chemistry.
11. Fundamentals of Enzymology, N.C. Price and L. Stevens, Oxford University Press.
12. Immobilizaed Enzymes: An Introduction and Applications in Biotechnology, Michael D. Trevan, and John Wiley.
  
13. Enzymatic Reaction Mechanisms, C. Walsh, W.H. Freeman.
14. Biochemistry: The Chemical Reacitons of liging cells, D.E. Metzler, Academic Press.
15. Principles of Biochemistry, A.L. Lehninger, Wroth Publishers.
16. Biochemistry, L. Stryer, W.H. Freeman.
17. Biochemistry, J. David Rawn, Neil Patterson.
18. Biochemistry, Voet and Voet, John Wiley.
19. Outlines of Biochemistry, E.E. Conn and P.K. Stumpf, John Wiley.
20. Bioorganic Chemistry : A Chemistry Approach to Enzyme Action, H. Dugas and C. Penny, Springer-Verlag.
21. Biochemistry and Molecular Biology of Plants, Buchanan, Gruissem and Jones, I.K. International Pvt. Ltd.

**Name of SoS – School of Studies in Chemistry**

**Syllabus- Choice Based Syllabus (Third Semester)**

**Name of paper- NANOCHEMISTRY AND ITS APPLICATIONS**

**Total Credit-03**

**Total Marks -80+20**

**NANOCHEMISTRY AND ITS APPLICATIONS**

**Elective Course**

**Choice Based Credit System in Master Course in Chemistry**

**UNIT I: GENERIC METHODOLOGIES FOR NANOCHEMISTRY AND NANOTECHNOLOGY:**

*Introduction and classification* - What is nanotechnology? - Classification of nanostructures - Nanoscale architecture; Summary of the electronic properties of atoms and solids - The isolated atom - Bonding between atoms - Giant molecular solids - The free electron model and energy bands - Crystalline solids - Periodicity of crystal lattices -Electronic conduction; Effects of the nanometre length scale - Changes to the system total energy - Changes to the system structure - How nanoscale dimensions affect properties?

**UNIT -II. MATERIAL CHEMISTRY :**

Preparation and Properties of Nanoparticles, Materials-Metals, Ceramics (Oxide, carbides, sulphides, nitrides).physical and chemical Methods, Size and Shape controlled Synthesis, Sol-gel methods, Optical Properties, Electrical and Magnetic Properties, Application of Nanoparticles.

**UNIT-III . CHARACTERIZATION METHODS.**

X-ray diffraction - Debye-Scherrer formula – dislocation density – micro strain –Synchrotron Radiation – Principle and Applications –Raman Spectroscopy and its Applications – Dynamic Light Scattering (DLS). Electron microscopes: scanning electron microscope (SEM) – transmission electron microscope (TEM); atomic force microscope(AFM) – scanning tunneling microscope (STM) - XPS – Working Principle, Instrumentation and Applications. Differential

scanning calorimeter (DSC) – Thermogravimetric/Differential Thermal Analyzer (TG/DTA) – UV – Visible Spectrophotometer - FTIR – Principle and Applications – Photoluminescence (PL) Spectroscopy.

#### **UNIT-IV APPLICATIONS ON NANOCHEMISTRY**

Nanobiology - Introduction - Bio-inspired nanomaterials - Interaction Between Biomolecules and Nanoparticle Surfaces - Different Types of Inorganic Materials Used for the Synthesis of Hybrid Nano-bio Assemblies -

#### **UNIT-V APPLICATIONS OF NANO IN BIOLOGY**

Applications of Nano in Biology -Nanoprobes for Analytical Applications - Current Status of Nanobiotechnology - Future Perspectives of Nanobiology; Nanosensors, Electrochemical , Nanobiosensors - Smart Dust; Nanomedicines, Nanodrug Administration Diagnostic and Therapeutic Applications.

#### **References:**

1. Nanoparticles: From Theory to Application Edited by Gu¨nter Schmid, @ 2004 WILEY-VCH Verlag GmbH & Co. KGaA, Weinheim
2. Nanoparticles and Catalysis Edited by Didier Astruc @ 2008 WILEY-VCH Verlag GmbH & Co. KGaA, Weinheim
3. Peter Atkins, Tina Overton, Jonathan Rourke, Mark Weller, Fraser Armstrong, Mike HagermanShriver and Atkin’s Inorganic Chemistry, Fifth Edition, Oxford, 2010.
4. Nanoscale Science and Technology, Robert W. Kelsall, Ian W. Hamley and Mark Geoghegan, John Wiley & Sons, Ltd., UK, 2005.
5. Introduction to Nanotechnology, Charles P. Poole Jr and Frank J. Owens, Wiley Interscience, 2003.
6. Nano:The Essentials: Understanding Nanoscience and Nanotechnology, T.Pradeep, Tata McGraw-Hill Publishing Company Limited, New Delhi, 2008.