SEMESTER III

Paper XI
MCH-501: APPLICATION OF SPECTROSCOPY
(Inorganic Chemistry)

Unit-I
Vibrational Spectroscopy
Symmetry and shapes of AB2, AB3, AB4, AB5, AB6, mode of bonding of ambidentate ligands, nitrosyl, ethylenediamine and diketonato complexes, application of resonance, Raman spectroscopy particularly for the study of active sites of metalloproteins.

Unit-II
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) including biological systems and to inorganic free radicals.

Unit-III
Nuclear Magnetic Resonance of Paramagnetic Substances in Solution
Properties of paramagnetic compounds, The contact and Pseudo contact shifts, factors affecting nuclear relaxation, contrast agents, shifts reagent, some applications including biochemical systems, an overview of NMR of metal nuclide with emphasis on $^{195}$Pt and $^{119}$Sn NMR.

Unit-IV
Mossbauer Spectroscopy
Basic principles, instrumentation, chemical shift, spectral display, Application of the technique to the studies of (1) bonding and structure of Fe +2 and Fe +3 compounds including those of intermediate spin, (2) Sn +2 and Sn +4 compounds, nature of M-L bond, co-ordination number, structure and (3) detection of oxidation state and inequivalent MB atoms.

Unit-V
Electronic Spectroscopy
Electronic Spectral Studies for d$^1$ - d$^9$ systems in octahedral, tetrahedral and square planar complexes.

BOOKS SUGGESTED

Photochemical Reactions
Interaction of electromagnetic radiation with matter, types of excitations, fate of excited molecule, quantum yield, transfer of excitation energy, actinometry.

Determination of Reaction Mechanism
Classification, rate constants and life times of reactive energy state determination of rate constants of reactions. Effect of light intensity on the rate of photochemical reactions. Types of photochemical reactions-photo dissociation, gas-phase photolysis.

Photochemistry of Alkene
Intramolecular reactions of the olefinic bond-geometrical isomerism, cyclisation reactions, rearrangement of 1,4- and 1,5-dienes.

Photochemistry of Aromatic Compounds
Isomerisations, additions and substitutions.

Photochemistry of Carbonyl Compounds
Intramolecular reactions of carbonyl compounds-saturated, cyclic and acyclic, α, β unsaturated and α, β unsaturated compounds, cyclohexadienones. Intermolecular cycloaddition reactions-dimerisations and oxetane formation.

Miscellaneous Photochemical Reactions.
Photo-Fries reactions of annelid's, Photo-Fries rearrangement. Barton reaction. Singlet molecular Oxygen reaction. Photochemical formation of smog. Photodegradation of
polymers. Photochemistry of vision.

Books Suggested

Paper-XIII
MCH-503: BIOCHEMISTRY

Unit I

Metal Ions in Biological Systems
Bulk and trace metals with special reference to Na, K, Mg, Ca, Fe, Cu, Zn, Co, and K+/Na+ pump.
Bioenergetics and ATP Cycle.
DNA polymerisation, glucose storage, metal complexes in transmission of energy; chlorophyll's, photosystem I and photosystem II in cleavage of water.
Transport and Storage of Oxygen
Haem proteins and oxygen uptake structure and function of haemoglobin's, myoglobin, haemocyanins and hemerythrin, model synthetic complexes of iron, cobalt and copper.

Unit II

Electron Transfer in Biology
Structure and function of metal of proteins in electron transport processes cytochrome's and ion-sulphure proteins, synthetic models.
Nitrogen fixation
Biological nitrogen fixation, and its mechanism, nitrogenase, Chemical nitrogen fixation.

Unit III

Enzymes
Introduction and historical perspective, chemical and biological catalysis, remarkable properties of enzymes like catalytic power, specificity and regulation. Nomenclature and classification, extraction and purification. Fischer's lock and key and Koshland's induced fit hypothesis, concept and identification of active site by the use of inhibitors, affinity labeling and enzyme modification by site-directed mutagenesis. Enzyme kinetics, Michael's-Menten and Lineweaver Burk plots, reversible and irreversible inhibition.
Mechanism of Enzyme Action
Transition-state theory, orientation and Steric effect, acid-base catalysis, covalent catalysis, strain or distortion. Examples of some typical enzyme mechanisms for chemotrypsin, ribonuclease, lysozyme and carboxypeptidase.

**Kinds of Reactions Catalysed by Enzymes**

Nucleophilic displacement on a phosphorus atom, multiple displacement reactions and the coupling of ATP cleavage to endergonic processes. Transfer of sulphate, addition and elimination reactions, enolic intermediates in Isomerisations reactions, b-Cleavage and condensation, some isomerization and rearrangement reactions. Enzyme catalyzed carboxylation and decarboxylation.

**Unit IV**

**Co-Enzyme Chemistry**
Cofactors as derived from vitamins, coenzymes, prosthetic groups, apoenzymes. Structure and biological functions of coenzyme A, thiamine pyrophosphate, pyridoxal phosphate, NAD+, NADP+, FMN, FAD, lipid acid, vitamin B12. Mechanisms of reactions catalyzed by the above cofactors. Enzyme Models

Host-guest chemistry, chiral recognition and catalysis, molecular recognition, molecular asymmetry and prochirality Biometric chemistry, crown ether, cryptates. Cyclodextrins, cyclodextrin-based enzyme models, elixarenes, ionospheres, micelles synthetic enzymes or synthymes.

**Biotechnological Applications of Enzymes**

Large-scale production and purification of enzymes, techniques and methods of immobilization of enzymes, effect of immobilization on enzyme activity, application of immobilized enzymes, use of enzymes in food and drink industry-brewing and cheese-making, syrups from corn, starch, enzymes as targets for drug design. Clinical uses of enzymes, enzyme therapy, enzymes and recombinant DNA Technology.

**Unit V**

**Biological Cell and its Constituents**

Biological cell, structure and functions of proteins, enzymes, DNA and RNA in living systems. Helix coils transition.

**Bioenergetics**

Standard free energy change in biochemical reactions, exergonic, endergonic. Hydrolysis of ATP, synthesis of ATP from ADP.

**Biopolymer Interactions**

Forces involved in biopolymer interactions. Electrostatic charges and molecular expansion, hydrophobic forces, dispersion force interactions. Multiple equilibrium and various types of binding processes in biological systems. Hydrogen ion titration curves.

**Cell Membrane and Transport of Ions**


**Book Suggested**

7. Understanding Enzymes, Trevor Palmer, Prentice Hall.

Paper XIV: Elective Paper

Paper XV: Elective Paper
Disconnection Approach
An introduction to synthons and synthetic equivalents. Disconnection approach, functional group inter-conversions, the importance of the order of events in organic synthesis, one group C-X and two group C-X disconnections, chemoselectivity, reversal of polarity, cyclisation reaction, amine synthesis.

Unit II

One Group C-C Disconnections
Alcohols and carbonyl compounds, regioselectivity, alkene synthesis, use of acetylenes and aliphatic Nitro compounds in organic synthesis.

Two Group C-C Disconnections
Diels-Alder Reaction, 1,3-difunctionalised compounds, a-b- unsaturated carbonyl compounds, control in carbonyl condensations, 1,5-difunctionalised compounds. Micheal addition and Robinson annelation.

Unit III

Oxidation

Reduction

Unit IV

Organometallic Reagents
Principle, preparations, properties and applications of the following in organic synthesis with mechanistic details. Group I and II metal organic compounds Li, Mg, Hg, Cd, Zn and Ce Comounds.

Unit V

Synthesis of some complex molecules:
Application of the above in the synthesis of following compounds:
Canthar, longifolène, cartisone, reserpine, vitamin D, juvabion, aphidicolin and fredericamycin.

Books Suggested
analyst chute literature
Introduction
Role of analytical chemistry, classification of analytical methods, classical and instrumental. Types of instrumental analysis: Selecting an analytical method, neatness and cleanliness, laboratory operations and practices, analytical balance, techniques of weighing, errors. Volumetric glassware cleaning and calibration of glassware, sample preparation-dissolution and decomposition. Gravimetric techniques, selecting and handling of reagents. Laboratory notebooks, safety in the analytical laboratory.

Errors and Evaluation
Definition of terms in mean and median, precision-standard deviation, relative standard deviation, accuracy-absolute error, relative error. Types of error in experimental data: determinate (systematic), indeterminate (random) and gross. Sources of error and the effects upon the analytical results. Methods for reporting analytical data, statistical evaluation of data-indeterminate errors. The uses of statistics.

Unit II

Food analysis

Unit III

Analysis of Water Pollution

Unit IV

Analysis of soil, Fuel, Body Fluids and Drugs
(a) Analysis of soil, moisture pH total nitrogen, phosphorus, silica, lime, magnesia, manganese, sulphur and alkaline salts.

Unit V

(a) Clinical Chemistry: Composition of blood-collection and preservation of samples. Clinical analysis. Serum electrolytes, blood glucose, blood urea nitrogen, uric acid, albumin, globulins, barbiturates, acid and alkaline phosphates. Immunoassay: principles of radio immunoassay (RIA) and applications. The blood gas analysis trace elements in the body.

(b) Drug analysis: Narcotics and dangerous drug. Classification of drugs. Screening by gas and thin-layer chromatography and spectrophotometric measurements.

Book Suggested
MCH-609: Medicinal Chemistry

Unit I

Unit II
Pharmacodynamics:
Introduction, elementary treatment of enzymes stimulation, enzyme inhibition, sulphonamides, membrane active drugs, drug metabolism, xenobiotics, biotransformation, significance of drug metabolism in medicinal chemistry.

Unit III
Antibiotics and antibacterials
Introduction, Antibiotic β-Lactam type – Penicillins, Cephalosporins, Antitubercular – Streptomycin, Broad spectrum antibiotics – Tetracyclines, Anticancer – Dactinomycin (Actinomycin D)

Unit IV
Antifungal – polyenes, Antibacterial – Ciprofloxacin, Norfloxacin, Antiviral – Acyclovir

Antimalarials: Chemotherapy of malaria. SAR. Chloroquine, Chloroguanide and Mefloquine

Unit V
Non-steroidal Anti-inflammatory Drugs: Diclofenac Sodium, Ibuprofen and Netopam

Antihistaminic and antiasthmatic agents: Terfenadine, Cinnarizine, Salbutamol and Beclomethasone dipropionate.
MCH-608: Electrochemistry

Unit I


Electrochemical Energy Storage:

Unit II

Corrosion and Stability of Metals:

Unit III

Bioelectrochemistry:
Bioelectrodes, Membrane Potentials, Simplistic theory, Modern theory, Electrical conductance in biological organism: Electronic, Protonic electrochemical mechanism of nervous systems, enzymes as electrodes.

Kinetic of Electrode Process:
Essentials of Electrode reaction. Current Density, Overpotential, Tafel Equation, Butler Volmer equation. Standard rate constant (K0) and Transfer coefficient (a), Exchange Current. Irreversible Electrode processes: Criteria of irreversibility, information from irreversible wave.

Unit IV

Methods of determining kinetic parameters for quasi-reversible and irreversible waves: Koutecky’s methods, Meits Israel Method, Gellings method.

Electrocatalysis:
Unit V

Potential Sweep Method:
Linear sweep Voltammetry, Cyclic Voltammetry, theory and applications. Diagnostic criteria of cyclical voltammetry. Controlled current microelectrode techniques: comparison with controlled potentials methods, chronopotentiometry, theory and applications.

Bulk Electrolysis Methods:
Controlled potential coulometry, Controlled Coulometry, Electroorganic synthesis and its important applications. Stripping analysis: anodic and cathodic modes, Pre electrolysis and Stripping steps, applications of Stripping Analysis.

Books Suggested
4. Modern Polarographic Methods by A.M. Bond, Marcel Dekker.
7. Electroanalytical Chemistry by Basil H. Vessor & alen w. ; Wiley Interscience.
8. Topics in pure and Applied Chemistry, Ed. S. K. Rangarajan, SAESt Publication, Karaikudi (India)