REVISED (DRAFT) SYLLABUS

FOR

M.Sc. Chemistry

(CBCS- Based)

CBCS-based syllabus for M.Sc. Chemistry (2 years) Programme

General Informations:

(1) It is two years Master Degree Programme

(2) There shall be four semester to complete programme, i.e. 1st, 2nd, 3rd and 4th semester

(3) Each semester shall consist of 15 weeks of academic work equivalent to 90 actual teaching days.

(4) This programme will have three types of courses, i.e. Core course and Elective course.

Core course- The core courses are those courses whose knowledge is deemed essential for the students registered for a particular Master's degree programme.

Elective course- The elective course can be choosen from a pool of papers in IInd and IVth semester.

(5) Each course will have 100 marks in full and divided into 70 marks for end-semester exam and 30 marks for internal assessment work except AEC, AECC-1, AECC-2 and practical papers. Internal assessment will be in two internal exams of 10 marks each, 5 marks for seminar/internal project and 5 marks for attendance/discipline.

(6) In practical papers the distribution of marks in CIA will be same as prescribed for term end semester practical papers.

(7) A student in fourth semester can choose a generic paper or CC-5 paper of any other subject of the faculty as DSE.

Credits- A unit by which the course work is measured. It determines the number of hours of instruction required per week. One credit is equivalent to one hour of teaching (lecture or tutorial) or two hours of practical work/ field work per week.

Semester- III
Core Course- X
Application of Spectroscopy

Full Marks- 70 **Credits – 5**

Inorganic Spectroscopy

Unit- I(A) Rotational Spectroscopy

Quantization of rotational energy and interactions of radiation with rotators. Classification of rotators; rigid rotator and Non-rigid rotator linears, Symmetric top, symmetric and asymmetric rotators, isotopic effect, starck effect, effect of nuclear spin, and electron spin on rotational spectra.

(B) Applications –

Determination of internuclear distance of diatomic molecule, dipolemoment, atomic mass of isotope, effect of bond distortion on rotational energies.

Unit- II (A) Vibrational Spectra

Harmonic oscillator model, harmonic and anharmonic vibration, Normal vibration, Factors affecting vibration frequencies, vibrating rotators, P.Q.R. Branches, overtones, anharmonicity constant, Raman effect, stokes and antistokes lines, selection rules for IR and Raman spectra, Principle of mutual exclusion. Polarization of Raman Lines.

(B) Applications-

Organic effect of conjugation, resonance inductive effect, ring strain and hydrogen bonding on group frequencies and band shapes.

Inorganic: Changes with vibrational frequencies upon co-ordination, cases of linkage isomers, I.R. and Raman active form of vibrational geometry of AB_2, AB_3, AB_4 and AB_5. Hydrogen bonding.

Unit- III **(A) Magnetic Resonance Spectroscopy**

Nuclear magnetic resonance, chemical shift, factors controlling its value spin-spin interaction and factors affecting its value. Spin Lattice relaxation and quantative treatment of relaxation, selection rule and relative intensities of line. Principle of ESR spectroscopy, presentation of spectrum, theory of hyperfine, interaction, Isotopic g and Δ values.

(B) PMR and CMR Spectroscopy

Chemical shifts value and correlation for proton-bonded with carbon. Effect of chemical exchange on line width, coupling constants, Interpretation of PMR and CMR spectra of organic compounds. Double resonance application of ^{19}F and ^{31}P spectra of inorganic compounds.

Unit- IV **(A) Mass Spectrometry**

Ion production and Fragmentation, molecular ion peak, Metastable peak, Mc. Lafferty rearrangement. Examples of mass spectra of organic compounds.

(B) Basic principles, spectral parameters and spectrum display, Application of the technique to the studies of (1) bonding and structure of Fe^{+2} and Fe^{+3} compounds including those of intermediates spin. (2) Sn^{+2} and Sn^{+4}

Unit- V

(A) UV-Visible Spectroscopy

Spectra of carbonyl compounds and conjugated polyenes, Woodward-Fisher rules , aromatic and heterocyclic compounds, and steric effect in diphenyls, quantitative determinations.

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(B) Photoelectron Spectroscopy

Basic principles of photoelectric effect ionization. Process, PES and XPS photo-electron spectra of O_2, N_2 and NO (simple molecule). Adiabatic and vertical ionization energy, Koopman's theorem.

Book Suggested

1. Physical Methods for Chemistry by R.S. Drago, Saunders Company.
2. Structural Methods in Inorganic Chemistry by E.A.V. Ebsworth, D.W.H. Rankin and S. Cradock, ELBS.
3. Infrared and Raman Spectra: Inorganic and Co-ordination Compounds by K. Nakamoto, Wiley.
4. Progress in Inorganic Chemistry Vol. 8, ed by F.A. Cotton, Vol. 15, ed, S.J. Lipard, Wiley.
5. Inorganic Electronic Spectroscopy by A.P.B. Lever, Elsevier.
6. Organic Spectroscopy by Jagdamba Singh and Jaya singh.
7. Spectroscopy of Organic Compounds by P S Kalsi.
8. Spectrometric identification of organic compounds by Silverstein.

Semester- III

Core Course- XI

Bio-Inorganic Chemistry

Full Marks – 70 **Credits- 5**

Unit- I **Metal Ions in Biological Systems**

Essential and trace metals. Role of metals ions (Ca,Mg,Na,K) in biological processes. Toxicity of heavy metals and their detoxification, role of Selenium in Biological systems with reference to its essentiality and toxicity, mechanism of metal ion induced toxicity.

Unit- II **Bioenergetics and ATP Cycle**

DNA polymerization, metal complexes in transmission of energy, chlorophylls, photosystem I and photosystem II in cleavage of water system.

Unit- III. **Transport and Storage of Dioxygen**

Structure and function of haemoglobin, myoglobin, hemicyanics model synthetic complexes of iron, cobalt and copper.

Unit- IV **Electron Transfer in Biology**

Structure and function of metalloproteins in electron transport processes – cytochromes and ion-sulphur proteins, synthetic models.

Nitrogenase

Biological nitrogen fixation, molybdenum nitrogenase, spectroscopic and other evidence, other nitrogenases model system.

Unit- V **Metals in Medicine**

Biochemical bases of essential metal deficient diseases; Iron, copper and zinc deficiencies and their therapies, carcinogens and

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carcinostatic agents, zinc in tumour growth and inhibition, anticancer activity and mechanism of platinum complexes, anticancer activity of Rhodium, copper and Gold complexes, anti cancer activity of Selenium, antibacterial and antiviral properties of metal complexes.

Books Recommend :

1. Principles of Bio-inorganic Chemistry- S.J. Lippard and J.M. Berg, University Science Books.
2. Bio-inorganic Chemistry- I. Bertini, H.B. Gray, S.J. Lippard and J.S. Valentine, University Science Books
3. Progress in Inorganic Chemistry, Vols 18 and 3S Ed. J.J. - Lippard, Wiley.

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Semester- III
Core Course- XII
(Environmental Chemistry and Green Chemistry)

Full Marks- 70 **Credits – 5**

Unit- I Environment

Introduction, Composition of atmosphere, vertical temperature, heat budget of the earth atmospheric system, vertical stability atmosphere, Biogeochemical cycles of C, N, P, S and O. bio distribution of elements.

Unit -II Hydrosphere

Chemicals compositions of water bodies-lakes, streams, rivers, and wet lands etc. hydrological cycle, Aquatic Pollution – inorganic, organic, pesticide, agricultural, industrial and sewage, detergents, oil spills and oil pollutants. Water quality parameters – dissolved oxygen, biochemical oxygen demand (BOD), Solids, metals, content of chloride, sulphate, phosphate, nitrate and microorganism. Water quality standards,

Analytical methods for measuring BOD, DO, COD, F, Oils, Metals (As, Cd, Cr, Hg, Pb, Se etc.). Residual chloride and chlorine demand. Purification and treatment water.

Unit- III Atmosphere

Chemical composition of atmosphere-particles, ions and radical and their formation. Chemical and photochemical reactions in atmosphere, smog formation, oxides of N, C, S, O and their effect, pollution by chemicals, petroleum, minerals, chlorofluorocarbons (CFC's). Greenhouse effect, acid rain, air pollution controls and their chemistry. Analytical methods for measuring air pollutants. Continuous monitoring instruments.

Unit- IV **Green Chemistry : Definition and Objective**

The twelve principles of Green Chemistry, atom economy in chemical synthesis, important technique employed in practice of Green Chemistry, Application of microwave irradiation and ultrasound in chemical reactions. Use of renewable raw materials and biosynthesis, organic waste management, use of safer reagents and green solvents and green catalysts.

Unit- V **Green Chemistry : Real Applications**

Replacement of CFC and hydrocarbon blowing agents with environmental friendly blowing agent CO_2 in the production of polystyrene. Replacement of Ozone depleating and Smog producing solvents by surfactant assisted liquid or supercritical carbon dioxide for cleaning in manufacture of ICs and Computer chips.

Books Suggested

1. Environmental Chemistry and Green Chemistry, Asin Kr Das, Books and Allied (P) Ltd. Kolkata.
2. Environmental Chemistry, H. Kaur, Pragati Prakashan.
3. Environmental Chemistry, S.F. Manahan, Lewis Publishers
4. Environmental Chemistry, A.K. Dey, Wiley Easlem.
5. Environmental Chemistry, C. Baird, W.H. Freeman.

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Semester- III

Core Course- XIII

Bio-organic Chemistry

Full Marks – 70 **Credits- 5**

Unit- I **Enzymes**

Basic considerations, Proximity effects and Molecular adaption. Introduction and historical perspective, chemical and biological catalysis, remarkable properties of enzymes like catalytic power, specificity and regulation. Nomenclature and classification. Concept and identification of active site by the use of inhibitors. Affinity labeling and enzyme modification by site-directed mutagenesis. Enzyme kinetics, Michaelis-Menten equation.

Unit- II **Co-Enzyme Chemistry**

Cofactors as derived from vitamins, coenzymes, prosthetic groups, apoenzymes, Structure and biological functions of coenzyme A, thiamine pyrophosphate, pyridoxal phosphate, NAD, NADI, FMN, FAD, Lipoleic acid, vitamin B12, Mechanisms of reactions catalyzed by the above cofactors.

Unit- III **Carbohydrates:**

Conformation of mono saccharides and important derivatives of mono saccharides, deoxycosides, deoxysugar, aminosugar, disaccharides,structure determination and chemical synthesis of sucrose, maltose and lactose .

Unit- IV. **Amino acids, peptides and proteinas:**

Amino acids, essential and non essential amino acids, isoelectric point, amino acids sequencing primary, secondary structure, α-helix, β-sheet structure of protein and tertiary and quaternary structures of protein

Unit- V. **Vitamins:**

Classification, occurrence, Biological importance, structure determination and synthesis of vitamins A,B_1,B_2 & C.

Books Recommended :

1. Understanding Enzymes- Trevor Palmer, Prentice Hall.
2. Enzyme Chemistry - Impact and Application, Ed.- Collin J. Suckling, Chapma and Hail.
3. Enzyme Mechanisms Ed.- M.I Page and A. Villiams, Royal Society of Chemistry.
4. Fundamentals of Enzymology- N.C. Price and L. Slovens, Oxford University Press.
5. Immobilized Enzymes- An Introduction and Applications in Biotechnology, Michael O. Trevan, John Wiley.
6. Enzymatic Reaction Mechanisms- C. Walsh, W.H. Freeman.
7. Enzyme structure and Mechanism- A. Fersht, W.H. Freeman.
8. Chemistry of natural products –P.S Kalsi.
9. Natural products –Chemistry and Biological significance by J. Mann, R. S. Davison, J.B. Hobbs, Banthrope & J.B. Harborne.
10. Organic Chemistry- I.L. Phinar.

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Semester- III
Core Course – XIV
Practical (Inorganic Chemistry)

Full Marks – 50 Credits- 5

Unit- I Either of the two from the following.

1. Quantitative analysis of two constituent ions of the following.

(a) Cu, Zn (b) Fe, Ni (c) Ca, Mg (d) Al, Mg the cations

Mg^{++} Ca^{++} and Al^{+++} can be estimated using EDTA. 15

2. Green methods of preparation of the following and their study by IR, electronic spectra and T.G.A. 15

(a) Pot trioxalato ferrate (III)

(b) Pot trioxalato chromate (III)

(c) Chromus Acetate

(d) $Hg[Co(SCN)_4]$

(e) Hexa ammine Ni (II) chloride

3. Quantitative analysis of inorganic mixture containing six radicals including interfering radicals 15

4. Viva- voce 15

5. Note Book 5

Books Recommended

1. A text Book of Quantitative Inorganic Analysis – A. I. Vogel
2. Applied Analytical chemistry- O.P. Vermani

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