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- I
Core Course – I
Inorganic I

Full Marks – 70 Credits- 5

Unit- I (a) VSEPR theory, $d\pi$-$p\pi$ bonding, Bent rule and energetic of hybridisation.

(b) M.O. diagram for hetero-nuclear di- molecules.

Unit- II Magnetochemistry

Term symbols, ground state and all possible term, symbols for p^2 and d^2 configuration, quenching of orbital contribution in metal complexes, magnetic properties of inner transition metals, anomalous magnetic behavior of E_u^{3+} and Sm3+ ions.

Unit- III Metal-Ligand Equilibrium in Solution

Stepwise and overall formation constants and their interaction, trends in stepwise constants, factors affecting the stability of metal complexes with reference to the nature of metal ion and ligand, chelate effect and its thermodynamic origin.

Unit – IV Reaction Mechanism of Transition metal complexes.

Inert and labile complexes, kinetic application of VBT and CFT, kinitics of octahedral substitution, acid hydrolysis, base hydrolysis, CB mechanism, Evidences of CB mechanism, Anation reaction, reaction without M-L bond cleavage, substitution reactions in square planar complexes. The trans-effect, Theories of trans-effect.

Unit – V Isopoly and Heteropoly Acids and salts, Isopoly and Heteropoly acids and salts of Mo and W. structure of isopoly and heteropoly anions.

Books Recommended

1. Concise Inorganic Chemistry- J.D. Lee
2. Inorganic Chemistry- T. Moeller.
3. Modern Aspects of Inorganic Chemistry- H.J. Emeleus and A.G. Sharpe

4. Introduction to ligand field- B.N. Figgis
5. Inorganic Reaction Mechanism- Basalo and Pearson
6. Chemical bonding- O.P. Agrawal
7. Structural Principles in Inorganic Chemistry- W.E. Addison.
8. Introduction the Magneto Chemistry- A. Earnshasw

Semester- I

Core Course – II

Physical Chemistry-I

Full Marks- 70 **Credits- 5**

Unit- I **Macromolecules**

Types of polymers, Kinetics and machanisms of polymerization, Molar mass, number and mass average molar mases, determinations of molar mass by osmometry, viscometric and light scattering method.

Unit- II **Electro Chemistry**

(i) Electrode potential in terms of Chemical Potential and activity.

(ii) Debye Huckel theory of conductance of electrolytic solution, its application and limitations.

(iii) Quantitative treatment of Debye Huckel Limiting law and its modification for finite size of ions, effect of ion solvent interaction on activity coefficients.

(iv) Butle-Volmer equation under equilibrium and non equilibrium condition. Exchange current density, Tafel Plot.

Unit- III **Chemical Dynamics**

(a) Machanism and Dynamics of consecutive and opposing reactions.

(b) Activated complex theory of reaction rate, Evalution of free anergy, enthalpy and entropy of activation.

(c) Mechanism and dynamics of Photolysis of acetaldehyde and photo dimerisation of Anthracene, Polymerization and Auto oxidation reaction.

(d) Homogeneous catalysis, Kinetics of Enzyme catalysis, study of fast reactions by flow method and relaxation method.

Unit- IV **Chemical Thermodynamics**

(a) Partial molar properties in ideal mixture, Chemical Potential, its determination and variation with temperature and pressure, Gibbs Duhem equation.

(b) Fugacity and activity its variation with temperature and pressure, its determination of fugacity of a gas in mixture, Duhem. Margules equation and its application.

Unit- V **Statistical Thermodynamics**

Ensembles, Thermodynamic probability, Boltzman Distribution Law, Boltzman Planck Equation, Partition function and its significance, Relationship with thermodynamic functions, Translational, Rotational, Vibrational and Electronic partition function. Its application in the case of monatomic and diatomic molecules, Sackur-Tetrode Equation.

Books Suggested:

1. Physical Chemistry : P.W. Atkins (ELBS)
2. Comprehensive Physical Chemistry : Hemant Snehil
3. Theoretical Physical Chemistry : Gladstone.
4. Physical Chemistry : G.M. Barrow.
5. Modern Electrochemistry : JOM Bakris and A.K.N. Reddy
6. Text Books of Polymer Science : F.W. Billmayer Jr.
7. Advanced Physical Chemistry : Gurdeep Raj

Semester- I

Core Course- III

Organic Chemistry- I

Full Marks – 70 **Credits- 5**

Unit- I **Nature of Bonding in Organic Molecules**

Delocalized chemical bonding conjugation, cross conjugation, resonance, hyperconjugation, Aromaticity in benzenoid and non-benzenoid compounds, Huckel's rule, energy level of π-molecular orbitals, annulenes, antiaromaticity, homo-aromaticity, PMO approach.

Unit- II **Stereochemistry :**

Chirality, elements of symmetry, molecules with more than one chiral centre, diastereomerism. Determination of relative and absolute configuration, Methods of resolution, optical purity, conformational analysis of cycloalkanes (six membered rings), decalins, Effect of conformation on reactivity, optical activity in absence of chiral carbon (biphenyls, allenes and spiranes), chirality due to helical shape, stereospecific and stereoselective synthesis.

Unit- III **Reaction Mechanism: Structure and Reactivity:**

Types of reactions, kinetic and thermodynamic control, Hammond's postulate. Potential energy diagrams, transition states and intermediates, methods of determining mechanisms, isotope effects. Generation, structure, stability and reactivity of carbocations, carbanions, free radicals, carbenes

and nitrenes. Effect of structure on reactivity. The Hammett equation and linear free energy relationship, substituent and reaction constants.

Unit- IV **Aliphatic Nucleophilic Substtitution:**

The SN^2, SN^1, mixed SN^1 and SN^2, SN^i mechanisms. The neighbouring group participation by π and σ bonds. Classical and nonclassical carbocations, phenonium ions, Reactivity- effects of substrate structure, attacking nucleophile, leaving group and reaction medium. Ambident nucleophiles and regioselectivity. Nucleophilic substitution at an allylic, aliphatic trigonal and a vinylic carbon.

Aromatic Nucleophilic Substitution: The $ArSN^1$, $ArSN^2$, Benzyne and SRN^1 mechanisms. Reactivity – effect of substrate structure, leaving group and attacking nucleophile. Von- Richter, Sommelet-Hauser, and Smiles rearrangements.

Unit- V **Free radical Substitution:** Allylic halogenation, arylation of aromatic componds, Sandmeyer reaction, Hunsdiecker reaction.

Aromatic Electrophilic Substitution: The arenium ion mechanism, orientation and reactivity, energy profile diagrams. The ortho/para ratio, Diazonium coupling, Vilsmeir reaction, Gattermann-Koch reaction.

Elimination Reactions: The E2, E1 and E1CB mechanisms . Orientation of the double bond. Stereochemistry of E2 reaction, Hofmann's rule and Saytzeff's rule.

Books Recommendation :

1. Advanced Organic Chemistry- Reactions Mechanism and Structure by Jerry March.
2. A guide Book to Mechanism in Organic Chemistry by Peter Sykes.
3. Organic Chemistry by R.T. Morrison and R.N.Boyd.
4. Advanced Organic Chemistry by Jagdamba Singh and L. D. S. Yadav.
5. Reaction Mechanism in Organic Chemistry by S.M. Mukherji and S.P. Singh.
6. Stereochemistry of Organic Compounds by D. Nasipuri.
7. Stereochemistry of Organic Compounds by P.S. Kalsi.
8. Advanced Organic Chemistry by F.A. Carey and R.J. Sundberg.
9. Organic Synthesis by Jagdamba Singh, L. D. S. Yadav and Jaya singh.

Semester- I

Practical (Physical Chemistry)

(Core Course- IV)

Full Marks- 50 **Credits-5**

Any one experiment- 30 Marks

1. Water equivalent of calorimeter and determination of
   (i) Heat of solution of potassium nitrate
   (ii) Heat of neutralization of strong acid and strong base.
   (iii) Basicity of polybasic acids.
2. Determination of rate constant of hydrolysis of methyl acetate in acid medium.
3. The study of saponification of ethyl acetate by sodium hydroxide and determination of rate constant.
4. To determine the distribution coefficient of
   (i) Acetic acid
   (ii) Benzoic acid
   Between water and benzene by partition method.
5. Determination of specific and molar rotation of sucrose in different concentrations and to determine the concentration of given solution.
6. Determination of rate constant by inversion of cane sugar by Polarimetrically
7. Determination of
   (i) Dissociation constant of acetic acid.
   (ii) Acid-base titration.
   (iii) Solubility product of sparingly soluble salt.

Viva- voce- 15