U.G.C. Model Curriculum
CHEMISTRY
M.Sc. Classes

The M.Sc. Examination has been divided in to two parts (i) M.Sc. 1 year and (ii) M.Sc. II year Entire course will be of two years duration based on the U.G.C. model. The following teaching programme has been framed for M.Sc. classes.

Classes	Theory	Practical Course	Total Hour's
M.Sc. 1 year	18 Hrs./Weekly	18 Hrs./Weekly	36 Hrs./Weekly
	540 Hrs./Yearly	540 Hrs./Yearly	1080/Hrs./Yearly
M.Sc. II year	18 Hrs./Weekly	18 Hrs./Weekly	36 Hrs./Weekly
	540 Hrs./Yearly	540 Hrs./Yearly	1080/Hrs./Yearly

M.Sc. 1 Year

There shall be five papers in theory and practical examination in M.Sc. 1 year. Details are given here.....?

Paper	Subject	Marks
Paper I	Inorganic Chemistry	100 Marks
Paper II	Organic Chemistry	100 Marks
Paper III	Physical Chemistry	100 Marks
Paper IV	Group Theory and Spectroscopy	100 Marks
Paper V	**Section A-**Mathematics for a chemists 40 marks (for a student without Mathematics in B.Sc.)	
	Or	
	Biology for a chemists 40 marks (for a student without Biology in B.Sc.)	100 Marks
	Section B- Computers for Chemists 60 marks.	
Paper VI	Chemistry Practical (Inorganic + Organic + Physical)	250 Marks

M.Sc. I Year

Paper I : Inorganic Chemistry

I **Stereochemistry and Bonding in Main Group Compounds :** VSEPR, Walsh diagrams (tri-and penta-atomic molecules), d, p, bonds, Bent rule and energetics of hybridization, some simple reactions of covalently bonded molecules.

II **Metal-Ligand Equilibria 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 ligand, chelate effect and its thermodynamic origin, determination of binary formation constants by pH-metry and spectrophotometry.

III **Reaction Mechanism of Transition Metal Complexes :** Energy profile of a reaction, reactivity of metal complexes, inert and labile complexes, kinetic application of valence bond and crystal field theories, kinetics of octahedral substitution, acid hydrolysis, factors affecting acid hydrolysis, base hydrolysis, conjugate base mechanism, direct and indirect evidence in favour of conjugate mechanism, anation reactions, reaction without metal ligand bond cleavage. Substitution reactions in square planar complexes, the trans effect, mechanism of the subtitution reaction. Redox reactions, electron transfer reaction, mechanism of one electron transfer reactions, outer-sphere type reactions, cross reactions and Marcus –Hush theory, inner sphere type reactions

IV **Metal-Ligand Bonding :** Limitation of crystal field theory, molecular orbital theory, octahedral, tetrahedral and square planar complexex, π-bonding and molecular orbital theory.

V **Electronic Spectra and Magnetic Properties of Transition Metal Complexes :** Spectroscopic ground states, correlation, orgel and Tanabe-Sugano diagrams for transition metal complexes (d^1-d^2 states). calculations of Dq. B and β parameters, charge transfer spectra, spectroscopic method of assignment of absolute configuration in optically active metal chelates and their stereo chemical information, anomalous magnetic moments, magnetic exchange coupling and spic crossover.

VI **Metal π-Complexes :** Metal carbonyls, structure and bonding, vibrational spectra of metal carbonyls for bonding and structural elucidation, important reactions of metal carbonyls; preparation, bonding structure and important reaction of transition metal nitrosyls, dinitrogen and dioxygen complexes; tertiary phosphine as ligand

VII **Metal Clusters :** Higher boranes, carboranes, metalloboranes and metallocarboranes. Metal carbonyl and halide clusters, compounds with metal-metal multiple bonds.

VIII Isopoly and Heteropoly Acids and Salts :

Books Suggested

1. Advanced Inorganic Chemistry, F.A. Cotton and Wilkinson, John Wiley.
2. Inorganic Chemistry, J.E. Huhey Harpes & Row.
3. Cmemistry of the Elements. N.N. Greenwood and A. Eamshow. Pergamon
4. Inorganic Electronic Spectroscopy, A.B.P. Lever Elsevier.
5. Magnetochemistry, R.L. Carlin, Spinger verlag.
6. Comprehensive Co-ordination Chemistry eds., G. Wilkinson, R.D. Gillars and J.A. Mc Cleverty, Pergamon

Paper II (Organic Chemistry)

I **Nature of Bonding Organic Molecules :** Delocalized chemical bonding-conjugation, cross conjugation, resonance, hyperconjugation, bonding in fullerenes, tautomerism.

Aromaticity in benzenoid and non-benzenoid compounds, alternant nad non-alternant hydrocarbons, Huckel's rule, energy level of π-molecular orbitals, annulenes, anti-aromaticity, ψ-aromaticity, homo-aromaticity, PMO approach.

Bonds weaker than covalent-addition compounds, crown ether complexes and cryptands, inclusion compounds, cyclodextrins, catenanes and rotaxanes.

II **Stereochemistry :** Conformational analysis of cycloalkanes, decalins, effect of conformation on reactivity, conformation of sugars, steric strain due to unavoidable crowding.

Elements of symmetry, chirality, molecules with more than one chiral center, threo and erythro isomers, methods of resolution, optical purity, enantiotopic and diastereotopic atoms, groups and faces, stereospecific and stereoselective synthesis. Asymmetric synthesis. Optical activity int he absence of chiral carbon (biphenyls, allenes and soiranes), chirality due to helical shape.

Stereochemistry of the compounds containing nitrogen, sulphur and phosphorus.

III **Reaction Mechanism : Structure and Reactivity :** Types of Mechanisms, types of reactions, thermodynamic and kinetic requirements, kinetic and thermodynamic control, Hammond's postulate, Curtin-Hammett principle. Potential energy diagrams, transition states and intermediates, methods of determining

mechanisms, isotope effects. Hard and soft acids and bases.

Generation, structure, stability and reactivity of carbocations, carbanions, free radicals, carbenes and nitrenes.

Effects of structure on reactivity—resonance and field effects, steric effect, quantitative treatment. The Hammett equation and liner free energy relationship, substituent and reaction constatns. Taft equation.

IV **Aliphatic Nucleophilic Substitution :** The S_n2, S_n1, mixed S_n1 and S_n2 and SET mechanisms.

The neighbouring group mechanisms, neighboring group participation by π and σ bonds, anchimeric assistance classical and nonclassical carbocations, phenonium ions norbornyl system, common carbocation rearrangements. Applicationof NMR spectroscopy int he detectionof carbocations.

Tho SNi mechanism.

Nucleophilic substitution at an allylic, aliphatic trigonal and vinylic carbon. Reactivity effects of substrate structure, attacking nucleophile leaving group and reaction Medium, phase transfer catalysis and ultrasound, ambident nucleophile ragio selectivity.

V **Aliphatic Electrophilic Substitution :** Bimolecular mechanism-SE^2 and SE^i. The SE^i mechanism, electrophilic substitution accompanied by double bond shifts, Effect of substrate leaving group and the solvent polarity on the reactivity.

VI **Aromatic Electrophilic Substitution :** The arenium, Ion, mechanism, orientation and reactivity energy profile diagrams. The ortho/para ration, IpSO attack, orientation in other ring system. Quantitative treatment of reactivity in substrates and electrophiles. Diazonium coupling, Vilsmeir reaction, Gattermann-Koch reaction.

VII **Aromatic Nubleophilic Susbtitution :** The S_NAr,.SN^1, benzyne and S_{RN} 1 mechanisms. Reactivity, effect of substrate structure, leaving group and attacking nucleophile. The von Richter, sommelet-Hauser, and smiles rearranements.

VIII **Free Radical Reactions :** Types of free radical reactions. Free radical substitution mechanism, mechanism at an aromatic substrate, neighboring group assistance. Reactivity for aliphatic and aromatic substrates at a bridgehead. Reactivity in the attacking radicals. The effect of solvents on reactivity.

Allylic halogenation (NBS). oxidationof aldehydes to carboxylic acids, auto-oxidation, coupling of alkynes and arylation of aromatic compounds by diazonium salts. Sandmeyerreaction. Free radical