SYLLABUS

M.Sc. (CHEMISTRY) Part-I
(SEMESTER I & II)
2009-10 & 2010-11 SESSIONS

Paper	Title of Paper	No. of Lectures	Max. Marks	Time Allowed
SEMESTER-I				
101	Inorganic Chemistry	65	75	3 hrs.
102	Organic Chemistry	65	75	3 hrs.
103	Physical Chemistry	65	75	3 hrs.
*104 (A)	Mathematics for Chemists	65	75	3 hrs.
	OR			
*104 (B)	Biology for Chemists	65	75	3 hrs.
Practicals				
105	Inorganic Chemistry	100	100	6 hrs.
106	Analytical Chemistry	100	100	6 hrs.
SEMESTER-II				
201	Inorganic Chemistry	65	75	3 hrs.
202	Organic Chemistry	65	75	3 hrs.
203	Physical Chemistry	65	75	3 hrs.
204	Computer Fundamentals and Programming with C	65	75	3 hrs.
Practicals				
205	Organic Chemistry	100	100	6 hrs.
206	Physical Chemistry	100	100	6 hrs.

*** Note :** B.Sc. Non-medical students will take Biology for Chemists paper while B.Sc. Medical students will take the paper Mathematics for Chemists.

SEMESTER-I

PAPER–101 : INORGANIC CHEMISTRY

Maximum Marks : 75 *Lectures : 65*
(i) Semester Paper : 60 *Time : 3 Hours*
(ii) Internal Assessment : 15 *Pass Marks : 35%*

INSTRUCTIONS FOR THE PAPER-SETTER

The question paper will consist of five Sections A, B, C, D and E. Section A, B, C and D each will have two questions from the respective sections of the syllabus and will carry 12 marks each. Section E will consist of 8 short-answer question (two from each section) and each part will be of 1½ marks.

INSTRUCTIONS FOR THE CANDIDATES

Candidates are required to attempt five questions selecting one question from each section.

SECTION-A **16 Hrs.**

Chemical Bonding

The ionic bond, covalent bond, the variation method, ground state energy of hydrogen atom, the secular equations, the molecular orbital theory, electron distribution in hydrogen molecule ion, symmetric and antisymmetric energy states, the classical interaction energy, resonance contribution of ionic terms, sp^3 hybridisation, three centered bond, Linnetts doublet - quartet approach, the Pauli's exclusion principle.

SECTION-B **16 Hrs.**

Pi Bonding Ligand Complexes

Pi Acid Ligands CO as prototype, other pi acid ligands-isocyanide ligands, dinitrogen, the CS ligands, the NO ligands, pi acid ligands : trivalent phosphorus compound, multiple bonds from ligands to metal, pi complexes of unsaturated organic molecules : alkene & alkyne, enyl ligands, aromatic ring systems.

Theories of Bonding in Transition Metal complexes - Qualitative Approach :

Qualitative introduction to the molecular orbital theory, complexes with no pi bonding, complexes with pi-bonding, the crystal field & ligand field theories, orbital splitting and magnetic properties, the angular overlap model.

SECTION-C **16 Hrs.**

Structural and Thermodynamic Consequences of Partly Filled- shells

Ionic radii, Jahn - Teller effects, thermodynamic effects of d-orbital splitting, magnetic properties of chemical compounds, origin of magnetic behavior, magnetic susceptibility and types of magnetic behavior : diamagnetism, paramagnetism, ferromagnetism : types of paramagnetic behavior : Large multiplet separation, small multiplet separations, spin only, heavy atoms, high spin-low spin cross overs.

Spectral Properties

Russel - Saunder's term, selection rules, break down of selection rules, band widths & shapes, energy level diagrams and dd complex spectra, Orgel diagrams - weak fields, charge - transfer spectra, photochemical reactions of chromium & ruthenium complexes.

SECTION-D **17 Hrs.**

Bioinorganic Chemistry

Introduction, the biochemistry of Iron : iron storage and transport ferritin, transferrin, bacterial iron transport, hemoglobin and myoglobin, nature of the heme-dioxygen binding, model systems, cooperativity in hemoglobin cytochromes, other iron - porphyrin bimolecule peroxidases & catalases, cytochrome P_{450} enzymes, other natural oxygen carriers - hemerythrins, iron - sulfur proteins. The biochemistry of other, metals : zinc, carboxypetidase A, carbonic anhydrase, metallothioneins, copper, superoxide dismutase (CuZn SOD) hemocyanins, oxidases, cobalt, molybdenum & tungsten, nitrogenases, miscellaneous other elements : vanadium, chromium & nickel metal ions and chelates in chemotherapy, synthetic metal chelates as antimicrobial agents, lithium and mental health, gold and its compounds, metal complexes as antitumour agents, chelation therapy.

LIST OF BOOKS

1. *Advanced Inorganic Chemistry* - Cotton & Wilkinson (3rd, 4th & 5th Ed.)
2. *Theoretical Inorganic Chemistry* - Day & Selbin.
3. *Inorganic Chemistry* - Shriver, Atkins & Lang Ford.
4. *Inorganic Chemistry of Biological Processes* - Hughes.
5. *Bio-Inorganic Chemistry* - R.W. Hay (John Wiley & Sons).

PAPER–102 : ORGANIC CHEMISTRY

Maximum Marks : 75 *Lectures : 65*
(i) Semester Paper : 60 *Time : 3 Hours*
(ii) Internal Assessment : 15 *Pass Marks : 35%*

INSTRUCTIONS FOR THE PAPER-SETTER

The question paper will consist of five Sections A, B, C, D and E. Section A, B, C and D each will have two questions from the respective sections of the syllabus and will carry 12 marks each. Section E will consist of 8 short-answer question (two from each section) and each part will be of 1½ marks.

INSTRUCTIONS FOR THE CANDIDATES

Candidates are required to attempt five questions selecting one question from each section.

SECTION-A 16 Hrs.

(a) Recall Reactive Intermadiate

(i) Carbocations : Generation, Structure, Stability, Application of NMR spectroscopy in the detection of Carbocation, allylic and benzyllic carbocations. Stereochemistry and reactions. Nonclassical carbocations : Phenonium ion, norbornyl system, explaination based on rearrangement.

(ii) Carbanions : Generation, Structure, stability, stereochemistry, Tautomerism, Prototropy and general reactions.

(iii) Carbenes : Formation, Structure, Singlet & Triplet carbene, Stereochemsitry and reactions.

(iv) Nitrenes : Formation, Structure Singlet & Triplet nitrene, Stereochemsitry and reactions.

(v) Arynes : Formation, Structure and reactions.

(vi) Free radicals : Formation, Structure, Stability, Stereo-chemsitry and reactions.

(b) Reaction of Free Radicals

(i) Polymerisation

(ii) Halogenation : Chlorination, bromination, Bromination by NBS, Iodination, Fluorination, Polar effects in halogenation.

(iii) Addition Reactions : Free radical addition of HBr, thiols and halogens.

(iv) Auto-oxidation

(v) Rearrangements

SECTION-B 16 Hrs.

(a) Nature of Bonding in Organic Molecules

(i) Introduction to funllernes

(ii) Aromaticity in benzenoid and non-benzenoid compounds, alternant and non-alternant hydrocarbons, Huckel's Rule, anti-aromaticity, homo-aromaticity, PMO - approach.

(iii) Bonding weaker than Covalent :
Addition compounds, Crown ether complexes and Cryptands, inclusion compounds, Cyclodextrins, Catenanes and rotaxane.

(b) Techniques used.for determination of reaction mechanism

(Non-kinetic method) :

Use of optical, Stereochemical and isotopic techniques. Reaction studies from identification of products. Trapping of intermediate, crossover experiments use of Catalyst etc. use of isotopes in reaction mechanism studies in case of Favorskii, Claisen's and Benzyne reactions.

SECTION-C 17 Hrs.

Elimination Reactions

(a) E_2, E_1 and E_1 CB mechanism, Stereochemistry Product ratio, Orientation of double bond, Hofman Rule, Saytzeff Rule. Factors Governing E_2 & E_1 Mechanism.

(b) Cyclic Elimination : Amine Oxide, Esters, Xanthate, and Free radical elimination. Dehalogeriation by zinc. Triple bond by elimination. Elimination versus substitution. Effect of solvent, temperature, Nature of Base, Structure of the reactants.

(c) Aromatic Elimination : Benzyne, Nucleophillic aromatic substitution, addition elimination.

SECTION-D **16 Hrs.**

Pericyclic Reactions

Molecular Orbital symmetry, Frontier Orbitals of ethylene, 1,3 - butadiene, 1, 3, 5-hexatrience and allylsystem. Classification of Pericyclic reactions. Woodward-Hoffman correlation diagrams. FMO and PMO approach.

Electrocyclic reactions - conrotatory and disrotatorymotions 4n, 4n+2 and allylsystems.

Cycloadditions - antarafacial and suprafacial additions 4S+2S Systems and 2S+2S additions of alkene.

Sigmatropic rearrangement - suprafacial and antarafacial shift involving carbon moieties. 3, 3-and 5, 5-sigmatropic rearrangement Claisen, Cope-rearrangement reactions.

BOOKS

1. *Advanced Organic Chemsitry - Reaction, Mechanism and Structure*, Jerry March, Johny Wiley.
2. *Advanced Organic Chemistry,* F.A. Carey and R.J. Sundberg, Plenum.
3. *A Guide Book to Mechanism in Organic Chemistry*, Peer Sykes, Longman.
4. *Structure and Mechanism in Organic Chemistry*, C.K. Ingold, Cornell University, Press.
5. *Organic Chemistry,* R.T. Morrison and R.N. Boyd, Prentice-Hall.
6. *Principles of Organic Synthesis*, R.O.C. Norman and J.M. Coxon, Blackie Academic & Professional.
7. *Pericyclic Reactions*, S.M. Mukherji, Macmillan, India.
8. *Reaction Mechanism in Organic Chemistry*, S.M. Mukherjii and S.P. Singh, Macmillan.

PAPER–103 : PHYSICAL CHEMISTRY

Maximum Marks : 75 *Lectures : 65*
(i) Semester Paper : 60 *Time : 3 Hours*
(ii) Internal Assessment : 15 *Pass Marks : 35%*

INSTRUCTIONS FOR THE PAPER-SETTER

The question paper will consist of five Sections A, B, C, D and E. Section A, B, C and D each will have two questions from the respective sections of the syllabus and will carry 12 marks each. Section E will consist of 8 short-answer question (two from each section) and each part will be of 1½ marks.

INSTRUCTIONS FOR THE CANDIDATES

Candidates are required to attempt five questions selecting one question from each section.

SECTION-A **17 Hrs.**

Thermodynamics

(i) Recall : Concepts involved in first and second law of thermodynamics, Entropy, free energy and chemical equilibrium. Thermodynamic equation of state. Maxwell relations.

(ii) Non-ideal systems : Excess functions for non-ideal systems. Activity and activity coefficients and their determination. Concept of fugacity and its experimental determination. Partial molal properties and their determination.

(iii) Third law of the thermodynamics : Indentification of statistical and thermodynamic entropy. Nernst postulate, Plank's contribution. Alternate formulation of third law. Cooling by adiabatic and demagnetisation. Evaluation of absolute entropy.

(iv) Thermodynamic and living systems : Simultaneous or coupled reactions. Coupled reactions and metabolism. Free energy utilisation in metabolism. Terminal oxidation chain. Overall metabolic plan. General thermodynamic consideration of living systms.

SECTION-B **16 Hrs.**

Statistical Thermodynamics

(i) General introduction : Phase space, microstates, macrostates, thermodynamic probability. Brief introduction to different types of statistics. Ensemble concept. Canonical, grand canonical and microcanocical ensembles. Stirling approxination, Maxwell Baltzmann distribution law.

(ii) Partition function and thermodynamic properties : Partition function and its factorization. Translational, rotational, vibrational; electronic and nuclear partition functions. Expressions for internal energy, entropy, Helmholtz function, Gibb's function, pressure, work and heat in terms of partition function. Thermodynamic properties of ideal gases. Vibrational, rotational, electronic and nuclear contributions to the thermodynamic properties.

SECTION-C **16 Hrs.**

Electrochemistry

(i) Ion-solvent interactions : Born model of ion-solvent interactions, Structural models of ion - solvent interations. Experimental determination of salt-solvent interactions. Relative heats of solvation of ions in the hydrogen scale. Evaluation of ion-solvent interactions from experimental data of salt-solvent interactions.

(ii) Ion - ion interactions : Debye - Huckel theory of ion - ion interactions. Verification of Debye - Huckel limiting law. Activity, coefficients at moderate concentrations and higher concentrations. Activity coefficients as a function of ion-ion and ion-solvent interactions. Mean activity coefficients and their experimental determination.

(iii) Conductance and Ionic mobilities : Conductance of electrolytic solution. Variation of equivalent conductance with concentration. Debye - Huckel - Onsager theory. Modification of Debe - Huckel - Onsager equation. Ionic conductances. Ion-association and ion-pair formation. Ion-triplets in electrolyte solutions. Ion-triplets and conductance.

SECTION-D **16 Hrs.**

Applied Electrochemistry

(i) Electrical Double layer : Electrokinetic phenomenon. Null point and its determination. Structure of electrical double layer, parallel plate condenser theory, diffuse layer theory and absorption theory of double layer.

(ii) Electrocatalysis : A chemical catalyst and an electrochemical catalyst, Electrocatalysis in redox reactions. Electrocatalysis in reactions involving absorbed species. Some specific feature of electrocatalysis.

(iii) Electrochemical Energy Conversion and Electricity storage : Direct energy convertors. Efficiency of electrochmical energy convertors. Some typical examples of electrochemical energy convertors. Advantages and applications of fuel cells. Electricity storage density and energy density. Various electricity storers and their applications.

(iv) Corrosion of Metals : Classification of corrosion processes, theories of corrosion processes, passivation of metals. Corrosion monitoring and methods of corrosion prevention.

RECOMMENDED BOOKS

1. Bockris and Reddy, *Modern Electrochemistry*, Vol. I & II.
2. Antropov, *Theoretical Electrochemisty*.
3. Glasstone, *Electrochemistry*.
4. Aston and Fritz, *Thermodynamic and Statistical Thermodynamics*.
5. Lee, Seers and Turcotte; *Statistical Thermodynamics*.
6. Dickerson, *Molecular Thermodynamics*.
7. Glasstone, *Thermodynamics for Chemists*.

PAPER–104 (A) : MATHEMATICS FOR CHEMISTS
(For Students without Mathematics in B.Sc.)

Maximum Marks : 75 *Lectures : 65*
(i) Semester Paper : 60 *Time : 3 Hours*
(ii) Internal Assessment : 15 *Pass Marks : 35%*

INSTRUCTIONS FOR THE PAPER-SETTER

The question paper will consist of five Sections A, B, C, D and E. Section A, B, C and D each will have two questions from the respective sections of the syllabus and will carry 12 marks each. Section E will consist of 8 short-answer question (two from each section) and each part will be of 1½ marks.

INSTRUCTIONS FOR THE CANDIDATES

Candidates are required to attempt five questions selecting one question from each section.

SECTION-A **16 Hrs.**

Vectors and Matrix Algebra

Vectors :

Vectors, dot, cross and triple products. The gradient, divergence and curl.

Matrix Algebra :

Addition and multiplication, determinants (upto 4th order) inverse, adjoint and transpose of matrices, special matrices (Symmetric, skew-symmetric, Hermitian; skew-Hermitian, unit, diagonal, unitary etc.) and their properties. Matrix equations : Homogeneous, non-homogeneous, linear equations and conditions for the solution, linear dependence and independence. Cayley Hamilton theorem, matrix eigenvalues and eigenvectors.

SECTION-B **16 Hrs.**

Coordinate Geometry

Cartesian system of co-ordinates in the plane, slope of a line, parallel and perpendicular lines, intercepts of a line on the co-ordinate axes, Various forms of equations of a line-parallel to axis, slope intercept form, the point slope form, two point form, intercept form, normal form and general forms.

Trigonometry

Degree and radian measure of positive and negative angles, relation between degree and radian, definition of trigonometric functions with the help of unit circle, Periodic functions, Concept of periodicity of trigonometric functions, values of trigonometric functions for different angles, trigonometric functions of sum and differences of angles, addition and subtraction formulae.

SECTION-C **16 Hrs.**

Calculus

Differential Calculus : Functions, continuity and differentiability, rules for differentiation, applications of differential calculus including maxima and minima. Functions of several variables, partial differentiation, Euler's theorem co-ordinate transformations (e.g. cartesian to spherical polar).

Integral calculus : Basic rules for integration, integration by parts, partial fraction and substitution definite integrals. Reduction formulae.

SECTION-D **17 Hrs.**

Elementary Differential Equations

Veriables - separable and exact, first order defferential equations. Homogeneous, exact and linear equations. Applications to chemical kinetics, secular equilibria, quantum chemistry etc. Solutions of differential equations by the power series method, Fourier series, solutions of harmonic oscillator and Legendre equation, spherical harmonics.

Permutation and Probability

Permutations and combinations, probability and probability theorems, probability curves, average, root mean square and most probable errors, examples from the kinetic theory of gases, curve fitting (including least square fit) with a general polynomial fit.

RECOMMENDED BOOKS

1. *The Chemistry Mathematics Book*, E. Steiner, Oxford University Press.
2. *Mathematics for Chemistry*, Doggett and Sucliffe, Longman.
3. *Mathematical Preparation for Physical Chemistry*, F. Daniels, McGraw Hill.
4. *Chemical Mathematics*, D.M. Hirst, Longman.
5. *Applied Mathematics for Physical Chemistry*, J.R. Barrante, Prentice Hall.
6. *Basic Mathematics for Chemists*, Tebbutt Wiley.

SUPPLEMENTARY READING

1. *Higher Engineering Mathematics*, S. S. Grewal (Khanna Pub.)

PAPER–104 (B) : BIOLOGY FOR CHEMISTS

Maximum Marks : 75 *Lectures : 65*
(i) Semester Paper : 60 *Time : 3 Hours*
(ii) Internal Assessment : 15 *Pass Marks : 35%*

INSTRUCTIONS FOR THE PAPER-SETTER

The question paper will consist of five Sections A, B, C, D and E. Section A, B, C and D each will have two questions from the respective sections of the syllabus and will carry 12 marks each. Section E will consist of 8 short-answer question (two from each section) and each part will be of 1½ marks.

INSTRUCTIONS FOR THE CANDIDATES

Candidates are required to attempt five questions selecting one question from each section.

SECTION-A **16 Hrs.**

1. Origin of Life

Unique properties of Carbon, Chemical evolution and rise of living systems. Introudction of biomolecules, building blocks of biomolecules.

2. Cell Structure & Functions

Structure of prokaryotic .& eukaryotic cells, Intrcellular organelles and their functions, Comparison of plant and animal cells. Overview of metabolic process - catabolism and Anabolism. ATP - the Biological energy currency.

3. Cell Division

Cell division stages of mitosis & meiosis. Significance of cell division and fertilization.

SECTION-B **17 Hrs.**

4. Carbohydrates

Conformation of monosaccharides, structure & functions of important derivatives of monosaccharides like glycosides, deoxy sugars, myoinositol, amino sugars, N-acetyl muramic acid, Sialic acid, disaccharide & Polysaccharides. Structural polysaccharides - cellulose and chitin. Storage Polysaccharides - starch and glycogen.

Structure and Biological functions of glucosamino glycans or muco polysacc–harides, Carbohydrates of glycoproteins and glycolipids. Role of sugars in Biological recognition. Blood group substances, Ascorbic acid. Carbohydrate metabolism - Kreb's Cycle, glycolysis, glycogenesis and glycogenolysis, gluconeogenesis, Pentose phosphate Pathway.

5. Lipids

Fatty acids, essential fatty acids, structure and function of triglycerots glycerophospholipids, Sphingolipids, cholesterol, Bile acids, prostaglandins, Lipoproteins — composition and function role in atherosclerosis, Properties of lipid aggregates — micelles, bilayers, liposomes and their possible biological functions, Biological membranes. Fluid mosaic model of membrane structure.

Lipid metabolism - b - oxidation of fatty acids.

SECTION-C **16 Hrs.**

6. Structure of Proteins

Chemical and enzymatic hydrolysis of Proteins to peptides, amino acid sequencing. Secondary structure of proteins, forces responsible for holiding of secondary structure, a. triple helix, b. sheets, super secondary structure, triple helix structure of collagen/Tertiary structure of protein — folding and domain structure. Quarternary structure.

7. Amino acid metabolism

Degradation and biosynthesis of amino acids, sequence determination : chemical/enzymatic/ mass spectral, racemization/detection. Chemistry of oxytocin and tryptophan releasing harmone (TRH).

8. Enzymes

Enzymes as biological catalyst and mode of their action.

SECTION-D **16 Hrs.**

9. Structure of Nucleic Acids

Purines and Pyrimidine bases of nucleic acids, base pairing via H-bonding. Structure of ribonuclic acids (RNA) and deoxyribonucleic acids (DNA), double helix model of DNA and forces responsible for holding' it Chemical and enzymatic hydrolysis of Nucleic acids.

10. Replication of DNA

The chemieal basis of heredity and overview of replication of DNA.

11. Protein synthesis & Genetic Code

Transcription, translation and genetic code, chemical synthesis of mono and trinucleoside.

RECOMMENDED BOOKS

1. *Principles of Biochetnistry*, A.L. Lehninger, Worth Publishers.
2. *Biochemistry*, L. Stryer, W.H. Freeman.
3. *Biochemistry*, J. David Rawn, Neil Patterson.
4. *Biochemistry*, Voet and Voet, John Wiley.

5. *Outlines of Biochemistry*, E.E. Conn and P.K. Stumpf, John Wiley.

PAPER–105 : PRACTICAL INORGANIC CHEMISTRY

Maximum Marks : 100
(i) Semester Paper : 80 Time : 6 Hours
(ii) Internal Assessment : 20

PREPARATION AND ESTIMATIONS

1. Preparation of Tris-thioureacuprous chloride
2. Estimation of Cu, and Chloride.
3. Preparation of Hexammine-cobalt (III) chloride.
4. Estimation of cobalt.
5. Preparation of Tin tetraiodide.
6. Estimation of Sn.
7. Preparation of K_3 $[Fe(C_2O_4)_3]$.
8. Estimation of iron.
9. Preparation of Hg $[Co(NCS)_4]$
10. Simultaneous estimation of Hg and Co.
11. Preparation of $(NH_3)_2Hg$ Cl_2.
12. Estimation of Hg.
13. Mercuration of phenol and separation of the compound into o—, and p—, isomers.
14. Preparation of $K_3[Cr(C_2O_4)_3]$
15. Estimation of Cr and oxalate.
16. Spectrophotometric Estimation of
    (a) Iron with 1, 10 phenanthroline.
    (b) Chromium with diphenyl carbazide.
17. Chromatographic separation of ions.
    (a) Paper chromatography.
    (b) Thin layer chromatography.
    (c) Column chromatography.

PAPER–106 : ANALYTICAL CHEMISTRY PRACTICALS

Maximum Marks : 100
(i) Semester Paper : 80 Time : 6 Hours
(ii) Internal Assessment : 20

SECTION-A

1. To determine the percentage purity of given sample of $ZnSO_4.7H_2O$ by complexo-metric titration.
2. Determine the percentage purity of the given sample of $NiSO_4.7H_2O$ by complexometric titration using Eriochrome black-T.
3. To determine the composition of Calcium and Magnesium in the mixture of the given solution.
4. To find the strength of ascorbic acid in the given solution of Vitamin C tablet by titrating against (I) Standard I_2 solution (II) Standard Sodium thiosulphate solution.
5. To determine the percentage purity of sample of KBr using adsorption indicator.
6. To determine the amount of H_2O_2 in the given solution by titrating against.

(I) Standard $KMnO_4$ (II) Standard Sodium thiosulphate solution.

7. To find out the percentage purity of KI by titrating it against standard KIO_3 solution.

SECTION-B

1. To determine the strength of HCl and acetic acid solution by titrating it against NaOH pH-metrically.
2. To determine the composition of the mixture of HCl & CH_2COOH by titrating it against NaOH pH^- metrically.
3. Determine the strength of HCl & CH_3COOH solution by titrating it against NaOH conductometrically.
4. To determine the composition ofthe mixture of HCl & CH_3COOH by titrating it against NaOH conductometerically.
5. Determine the strength of $FeSO_4.7H_2O$ solution by titrating it against $KMnO_4$ potentiometrically.
6. Determine the strength of $CuSO_4.7H_2O$ Colorimetrically.
7. Determine the strength of $K_2Cr_2O_7$ solution Colorimetrically.
8. Determine the strength of Titanium Colorimctcrically.

SEMESTER-II

PAPER–201 : INORGANIC CHEMISTRY

Maximum Marks : 75 *Lectures : 65*
(i) Semester Paper : 60 *Time : 3 Hours*
(ii) Internal Assessment : 15 *Pass Marks : 35%*

INSTRUCTIONS FOR THE PAPER-SETTER

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Character Table should be provided.

INSTRUCTIONS FOR THE CANDIDATES

Candidates are required to attempt five questions selecting one question from each section.

SECTION-A **15 Hrs.**

Chemistry of Main Group Elements

Group I A to IV A Group Elements

Hydrogen : transition metal hydrides, the group IA elements - organometallic compounds of alkali - metals, the group II A - organo-beryllium and organo-magnesium compounds, the group, III A elements - structure and bonding of polyhedral boranes, structural study by NMR, Wade's rules, carboranes and other hetro-boranes, organoboron compounds, organoalumium compounds, the group IV A element - compounds with C-N bonds, thiocarbonates, dithiocarbamates, zeolites, clays.

SECTION-B **15 Hrs.**

Chemistry of Main Group Elements

Group V A to VIII A Group Elements

The group V A elements - types of Covalence in nitrogen, stereochemistry, dinitrogen and nitrogen compounds as ligands, ammonia and amines phosphorus-nitrogen compounds, group VI A elements - chemical properties of dioxygen, singlet oxygen, dioxygen superoxo and peroxo ligands peroxy compounds of boron, carbon, sulphur and sulphur - nitrogen compounds, sulphur -

sulphur compounds as ligands, iso & heteropoly acids & anions of Mo and W. The group VII A elements the charge — transfer complexes of halogens, polyiodide anions, pseudohalogens, the group VIII A elements — the chemistry of xenon, krypton and radon.

SECTION-C

Group Theory

Order, classes of group, representation of a group, transformation of coordinates matrices, matrix. representation of symmetry operation, reducible and irreducible representations and C_{2v},C_{3v}, D_4, T_d, O_h, character tables, symmetry, the method of finding, the number of irreducible representation in a reducible representation, separation of d orbitals under influence of octaheral, tetrahedral, sq. planar and trigonal bipyramidal symmetry, the separation of P, D ,F etc. free ion terms into symmetry labelled electric field terms under the influence of octahedral field, the directed valence for T_d & O_h symmety, direct product for O_h, T_d, C_{3v}, D_{4h} & D_{5h} and the method of descending symmetry for d^2 configuration.

SECTION-D

Applications of Group Theory

Suitable metal orbitals and ligand or orbitals combination to form molecular orbitals in coordination complexes O_h, T_d & square planar complexes, symmetry consideration regarding selection rules and spectral intensties, vibronic coupling, vibronic polarization in centrosymmetric complexes O_h & D_{4h} and non centro symmetric complexes C_3V, T_d polarization of electronically allowed transitions, selection rules or fundamentals, overtones and combinations in virbrational spectroscopy — the symmetry symbols for normal modes of vibrations. IR and Raman activity of their fundamentals and nature of vibrations in terms of change in internal coordinates in simple molecules like trans N_2 F_2, SF_6, Fermi resonance.

BOOKS

1. *Advanced Inorganic Chemistry* by Cotton & Wilkinson (5th Ed.)
2. *Chemical Applications of Group Theory* – F. A. Cotton.
3. *Introductory Group Theory For Chemists* – George Davidson.
4. *Introduction to Ligand Fields* – B. N. Figgis.
5. *Inorganic Chemistry* – Shriver, Atkins & Langford.

PAPER–202 : ORGANIC CHEMISTRY

Maximum Marks : 75 *Lectures : 65*
(i) Semester Paper : 60 *Time : 3 Hours*
(ii) Internal Assessment : 15 *Pass Marks : 35%*

INSTRUCTIONS FOR THE PAPER-SETTER

The question paper will consist of five Sections A, B, C, D and E. Section A, B, C and D each will have two questions from the respective sections of the syllabus and will carry 12 marks each. Section E will consist of 8 short-answer question (two from each section) and each part will be of 1½ marks.

INSTRUCTIONS FOR THE CANDIDATES

Candidates are required to attempt five questions selecting one question from each section.

SECTION-A **16 Hrs.**

1. Stereochemistry

(a) Stereoisomerism : Introduction and different types of stereoisomers.
Fischer, Newman and saw horse representations for organic Molecules.

Optical Isomerism : Requirement for a compound to be optically active, compounds with one asymmetric centre. Dissymmetry as a cause of optical activity. Compounds with two asymmetric centres. Racemic Modification Racemisation : Thermal, anionic, cationic, free radical, epimerisation, Mutarotation Racemic compounds, mixtures and solid solutions.

(b) Disastereoisomerism : Resolution of acids, bases, aminoacids, alcohols, aldehydes and ketones, Absolute and Relative configuation, Different systems of rotation. Assymetric induction, methods of determining the configuration. Cram's Rule and Prelog's Rule.

SECTION-B **16 Hrs.**

2. Conformation Isomerism : Meaning of conformation, Conformation and reactivity in alicyclic compounds. Conformation and Physical properties, dipole moment, NMR, IR and X-rays, conformational effects on stability and reactivity. Ionic elimination. Intra molecular rearrangement, Neighbouring group participation. Elimination. Pyrolysis of acetate, Xanthates and amine oxide. Relation of conformation to reactivity. Optical Isomerism due to restricted rotation in biphenyls allenes, Alkylidenes and spiranes.

(a) Systems : Conformational studies in Cycloalkanes; mono and disubstituted Cycloalkanes. Its stability and reactivity. Energy determination in chair and boat form. Studies in fused systems. Decalins and Perhydrophenanthrenes.

(b) Geometrical Isomerism : Nomenclature (E & Z) Nature of geometrical isomerism and determination of Configuration Curtin – Hammet Principle Study of Physical properties of the isomers, Relative stability and interconversion of Geometrical isomers.

SECTION-C **16 Hrs.**

(a) Addition to carbon – carbon multiple bond :

Mechanistic and stereochemical aspects of addition reactions involving electrophiles, nucleophiles and freeradicals. Regio and chemoselectivity. Orientation and reactivity. Addition to overlonropane ring, Hydrogenation of double and Triple bond, hydrogenation of aromatic rings. Hydroboration, Michael-reaction, sharpless asymmetric epoxidation.

(b) Addition to Carbon – Hetero multiple bond :

Mechanism of metal hydride reduction of carbonyl compounds and other functional groups. Dissolving metal reductions of carbonyl functions and conjugated systems.

SECTION-D **17 Hrs.**

(a) Wolf Kishner reduction; Clemmenson reduction, and Meerwein Pondroff Varley reduction. Wittig's Reaction. Addition of Grignard's reagent, organozinc and organo lithium reagents to carbonyl and unsaturated carbonyl compounds.

(b) Mechanism of condensation reactions involving enolates – Aldol, knoevengel, Claisen, Mannich, Benzoin, Perkin and stobbe reactions, Hydrolysis of esters and amides. Ammonloysis of esters.

TEXT BOOKS

1. *Stereochemistry of Carbon Compounds* by Ernest, L. Eliel, Tata McGraw-HilI.
2. *Stereochemistry of Organic Compounds*, D. Nasipuri, New Age International.
3. *Stereochemistry of Organic Compounds*, P.S. Kalsi, New Age, International.
4. *Modern Organic Reactions*, H.C. House, Benjamin.

PAPER–203 : PHYSICAL CHEMISTRY

Maximum Marks : 75 *Lectures : 65*
(i) Semester Paper : 60 *Time : 3 Hours*
(ii) Internal Assessment : 15 *Pass Marks : 35%*

INSTRUCTIONS FOR THE PAPER-SETTER

The question paper will consist of five Sections A, B, C, D and E. Section A, B, C and D each will have two questions from the respective sections of the syllabus and will carry 12 marks each. Section E will consist of 8 short-answer question (two from each section) and each part will be of 1½ marks.

INSTRUCTIONS FOR THE CANDIDATES

Candidates are required to attempt five questions selecting one question from each section.

SECTION-A 17 Hrs.

Quantum Chemistry

Introduction to exact quantum mechanical result

Fundamental concepts of quantum mechanics, setting up of operators for different observables, Hermitian, unitary and linear operators, postulates of quantum mechanics. Discussion of solution of Schrodinger equation to some model systems. (viz. particle in a box, the harmonic oscillator, the rigid rotator).

Hydrogen and hydrogen like atoms

Solution of Schrodinger equation for hydrogen and hydrogen like atoms, physical representation of s and p orbitals, radial plots, angular plots, probability functions and plots.

Approximate Methods

The variation principle, perturbation theory (first order and non degenerate), applications of variation method and perturbation theory to the helium atom.

SECTION-B 16 Hrs.

Angular Momentum

Ordinary angular momentum, the quantum mechanical operators for angular momentum. Eigen function and eigen values of angular momentum using ladder operators, addition of angular momentum.

Electronic Structure of Atom

Electtonic states of complex atoms, anti-symmetry and Pauli's exclusion principle, Hartree method, Russel Saunder's terms and coupling schemes, term separation energies for p^2 and d^2 configurations.

Molecular Orbital Theory

Huckel Theory of conjugated systems, bond order and charge density calculation, applications of Huckel molecular orbital theory to ethylene, butadiene, cyclopropenyl radical, cyclobutadiene systems. Introduction to extended Huckel theory.

SECTION-C 16 Hrs.

Chemical Kinetics

1. Introduction : Rate of reaction, empirical rate-equation, order and molecularity of a reaction, effect of temperature on reaction rates.
2. Theories of reaction rates : Number of bimolecular collisions and derivation of rate constant from it, steric factor & its calculation, factors determining effectiveness of collisions, Lindemann mechanism, statistical derivation of rate equation (Eyring equation), transmission co-efficient, tunnelling effect, partition functions for translation, rotation & vibration, comparision of collision and transition state theories.

3. Fast reactions : Study of fast reactions by stopped flow technique, relaxation methods, magnetic resonance technique.

SECTION-D **16 Hrs.**

1. Thermodynamic treatment of reaction rates : free energy of activation, heat of activation and its relationship with various kinds of activation energies, relationship between steric factor and entropy of activation.
2. Kinetics in solution : Primary and secondary salt effects, effect of polarity and nature of solvent on rate of reaction.
3. Complex reactions : Various types of complex reactions, parallel first order reactions producing a common product, parallel higher order reactions, reactions approaching equilibrium, Michaelis-Menten mechanism for enzyme catalysis, consecutive reactions, oscillating reactions.

TEXT BOOKS

1. *Kinetics and Mechanism* by A.A. Frost & R.G. Pearson, John-Wiley & Sons, Inc., New York.
2. *Physical Chemistry* by P.W. Atkins.
3. *Chemical Kinetics Methods* by C. Kalidas, New Age International Publishers.
4. *The Foundation of Chemical Kinetics* by S.W. Benson.
5. *Introduction to Quantum Chemistry*, A.K. Chandra, Tata McGraw Hill.
6. *Quantum Chemistry* by I.N. Levine, Prentice Hall.
7. *Quantum Chemistry* by W. Kauzmann.
8. *Quantum Chemistry* by Eyring, Walter and Kimball.

PAPER–204 : COMPUTER FUNDAMENTALS AND PROGRAMMING WITH C

Maximum Marks : 75 *Lectures : 65*
(i) Semester Paper : 60 *Time : 3 Hours*
(ii) Internal Assessment : 15 *Pass Marks : 35%*

INSTRUCTIONS FOR THE PAPER-SETTER

The question paper will consist of five Sections A, B, C, D and E. Section A, B, C and D each will have two questions from the respective sections of the syllabus and will carry 12 marks each. Section E will consist of 8 short-answer question (two from each section) and each part will be of 1½ marks.

INSTRUCTIONS FOR THE CANDIDATES

Candidates are required to attempt five questions selecting one question from each section.

SECTION-A **17 Hrs.**

Computer organization : Hardware, Software, Programming languages with special reference to BASIC, Fortran and C.

Binary representation : Binary numbers, Conversion of decimal to binary and binary to decimal, Idea of Octal and hexa-decimal numbers.

Problem solving : Problem analysis, Algorithm development, Program Coding, Program Compilation and execution.

SECTION-B **16 Hrs.**

Introduction to C : Historical development of C, The C character set, Constants, variables and keywords, Types of C constants and variables, C keywords.

C instructions : Type declaration instruction, Arithmetic instructions, Integer and float conversion, Type conversion in assignment, Hierarchy of operations, Writing of a first program in C, Control Instructions in C. Simple problems with sequential structure.

SECTION-C **16 Hrs.**

Decision and control structure : The if statement, The if-else statement, The nested if-else statement, Use and hierarchy of logical operators, Conditional operators.

Loop control structure : The while loop, The for loop, Nesting of loops, The do-while loop, Break and continue statements.

Case control studies : Decision using switch, The go to statement, Simple problems with Selective and repetitive structures.

SECTION-D **16 Hrs.**

Functions : What is function, why use functions, Passing values between a functions, Role of functions.

Advanced features of functions : Function declaration and prototypes, Call by values and call by reference, An introduction to pointer, Pointer notion.

Arryas : What are arrays, Initialization of arrays.

SUGGESTED BOOKS

1. *Let Us C* by Yashavant Kanetkar, (BPB Publications, New Delhi).
2. *Programming in ANSI* by E. Balgurusamy, Tata McGraw-Hill Publishing Co. I.T., New Delhi.
3. *Programming with Fortran-77* by Ran Kumar, Tata McGraw-Hill Publishing Co. I.T., New Delhi.

PAPER–205 : ORGANIC CHEMISTRY PRACTICALS

Maximum Marks : 100 *Time : 3 Hours*

(i) Semester Paper : 80

(ii) Internal Assessment : 20

1. Qualitative Organic Analysis

Separation and purification of components of binary mixture (Solid/solid, solid/liquid and liquid/liquid) on the basis of solubility behaviour and solvent extraction and their identification and conformation by chemical tests and preparation of suitable derivative. Preparative TLC separation for IR and PMR spectral studies of the respective component.

2. Organic Synthesis

Benzoylation	:	Hippuric acid
Oxidation	:	Adipic acid/p-Nitrobenzoic acid
Aldol condensation	:	Dibenzalacetone/Cinnamic acid
Sandmeyer's reaction	:	p-Chlorotoluene
Benzfused Heterocycles	:	Benzimidazole
Cannizzaro's reaction	:	p-Chlorobenzaldehyde as substrate
Friedel Crafts reaction	:	S-Benzoylpropionic acid
Aromatic electrophilic substitution	:	p-Nitroaniline / p-Iodoaniline

The products may be characterized by spectral techniques.

BOOKS

1. *Vogels's Textbook of Practical Organic Chemistry*, 5th Edition ELBS (Longman), 1996.

2. *Practical Organic Chemistry* by F.G. Mann and B.C. Saunders, 5th Edition, Orient Longman Limited, 1986.

PAPER–206 : PHYSICAL CHEMISTRY PRACTICALS

Maximum Marks : 100 Time : 6 Hours
(i) Semester Paper : 80
(ii) Internal Assessment : 20

1. To determine the Molecular weight of given polymer by viscosity method.
2. To find out the value of coefficient of expansion for the given liquid with the help of Pyknometer.
3. To determine the atomic Parachors of C, H & O.
4. To compare the cleansing powers of two samples of detergents by surface tension method.
5. To determine the interfacial tension between two immiscible solvents.
6. To find out the equilibrium constant for the reaction,
   $K I + I_2 \leftrightarrow KI_3$ by partition method.
7. To determine the rate constant of the hydrolysis of ethyl acetate catalysed by an acid and also find out the half life period of the reaction.
8. To determine the order of saponification of ethylacetate with sodium hydroxide.
9. To find out the molar refractivities of homologous series of alcohols & also find out the atomic refractivities of C & H.
10. To find out the molar refractivity of the given solid.
11. To study the adsorption of acetic acid on activated charcoal & prove the validity of Freundlich Adsorption Isotherm.
12. To find out the molecular weight of benzoic acid in bezene cryoscopically & hence find out its degree of association.
13. To find out the degree of hydrolysis of sodium acetate cryoscopically.
14. To determine the density of given liquids with the help of Pyknometer.

BOOKS

1. *Practical Physical Chemistry*, A. M. James and F. E. Prichard, Longman.
2. *Advanced Physical Experiments*, Gurtu - Gurtu, Pragati Prakashan, Meerut.
3. *Practical Physical Chemistry*, Alexander and Findley.