FOLDER-12

बिलासपुर विश्वविद्यालय

बिलासपुर (छत्तीसगढ़)

पाठ्यक्रम

विज्ञान - संकाय

नियमित एवं पाठ्यक्रम

एम. एस. सी. (पूर्व) रसायन शास्त्र

परीक्षा : 2014

:: प्रकाशक ::

कुलसचिव बिलासपुर विश्वविद्यालय

बिलासपुर (छत्तीसगढ़)

Note:- Page No. 1 to 2 नहीं है।

5. Besides regular students and subject to other compliance with this ordinance, ex-students and non collegiate candidates shall be eligible for admission to the examination as per provision or ordinance No. 6 relating to Examination (General).

   Provided that non- collegiate candidate shall be permitted to offer only such subjects/papers as are taught to the regular students at any of the University teaching Department or College.

6. The Subject of the Examination shall be of the following :

   (i) Mathematics (ii) Physics
   (iii) Chemistry (iv) Zoology
   (v) Botany (vi) Geology

   A candidate who has passed the M.Sc. Examination of the University many subject shall be allowed to present himself for the M.Sc. Examination in any one of more of the optional papers in the subject not taken by him at the said examination and if successful will be given a certificate to that effect.

7. From the session 1986-87 for the Previous Examinatio, candidate must obtain for a pass atleast 20% in each theory and Practical and 36% of the aggregate marks in the Theory paper and Practical separetely in each examination. The above provision of 20% in each paper shall be applicable for Final Examination from the academic session of 1987-88 .

8. No division will be assigned on the result of the Previous Examination the division in which a candidate is placed shall be determined on the basis of aggregate of marks obtained in both. the M. Sc. Previous and M.Sc. Final Examination.

9. Successful candidates who obtain 60% or more of the aggregate marks shall be placed in the first Division, those obtaining less than 60% but not less 48% in the second Division and all other success full candidate obtaining less than 48% in the Third Division.

10. Candidates who have passed the M.Sc Examination of the University in any subject in Third or Second Division and desire to appear at the M.Sc. Examination in the same subject for improving division without attending a regular course of study in a College affiliated to the University or in a Teaching Department of the University be allowed to appear at the aforesaid examination as non-collegiate student on the following conditions.

    (i) There shall be only two Division for such candidates the First division and second Division. The Marks required for obtaining these division shall be the same as prescribed in the ordinance

    i.e. examinees who are successful in Final of the Examination. and have obtained 60% or more aggregate of the marks in Previous and Final Examination taken together shall be placed in the First Division and Examinees who are successful in Final Examination and have obtained less than 60% but not less than 48% of aggregate marks in previous and Final examination taken together shall be placed in the Second Division.

    (ii) The result of the candidates obtaining less than 48% of the agreegate marks in previous and Final Examination taken together shall not be declared.

    (iii) Candidates shall have the option to appear at both the previous and final examination in one and the same year and for being successfull at the examination, the candidates shall obtain 48% of the aggregate marks.

    Provided that such candidates who opt to appear in previous and final examination separately shall have to obtain minimum aggregate required for the previous examination but he will have to obtain atleast 48% in the aggregate of previous and final examination taken to gather or else his result will be canclled.

    (iv) The syllabus for the examination shall be same as prescribed for the year in which the examination is held.

    (v) Not more than to attempt shall be allowed to such a candidate. Failure of appearance at the examination after per permission has been accorded by the University shall be counted as an attempt.

    Provided however such candidates who to appear at the previous and final examination separately will be allowed only one attempt of the previous examination and two attempts as the final examination.

    (vi) Candidates who wish to avail the opportunity given in fore going pares will have to apply for permission as required in the Ordinance relating to admission of non - collegiate students to the University examination along with registration fee.

    (vii) In case, a student Improves his division under provision of this para, the fresh Degree will be issued after cancealling his first Degree.

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Guru Ghasidas University, Bilaspur (C.G.)
UGC Model Curriculum
(to be implemented from the session course 2005-2006)
M.Sc. Chemistry (Two years course)
M.Sc. Chemistry (Previous)

GENERAL SCHEME-

* There shall be four Theory papers, each of 100 Marks.
* There will be four Practicals/Laboratory courses, each of 50 mark.

  The effective teaching hours for each Theory and Practical paper are 135 hrs. in the entire session and should be taught-

  For 135 hrs. course - 4 to 5 hrs./week
  For 75 hrs. course - 2.5 hrs/week
  For 30 hrs. course - 1 hr./week
* Practical examination will be conducted at the end of the session.

THEORY PAPERS

Paper I Inorganic Chemistry Teaching duration 135 hrs.
Paper II Organic Chemistry Teaching duration 135 hrs.
Paper III Physical Chemistry Teaching duration 135 hrs.
Paper IV (a) Spectroscopy Teaching duration 135 hrs.
Diffraction methods Computers,
Biology and Mathematics
in Chemistry

PRACTICALS/LABORATORY COURSE

Laboratory Course I
(Inorganic) 50 marks Teaching duration 135 hrs.
Examination of 10 hrs.
spread over in two days

Laboratory Course II
(Organic) - 50 marks Teaching duration 135 hrs.
Examination of 5 hrs.

Laboratory Course III
(Physical) - 50 marks Teaching duration 135 hrs.
Examination of 5 hrs.

Laboratory Course IV
(Instrumental) - 50 marks Teaching duration 135 hrs.
Examination of 5 hrs.

UGC MODEL CURRICULUM
(to be implemented from the session 2003-04)

CHEMISTRY - M.SC. PREVIOUS
PAPER-1 CH-401 INORGANIC CHEMISTRY

M.M.100

1. Stereochemistry and Bonding in main group compounds:- 12 hrs.

VSEPR, Walsh diagram (Tri and penta atomic molecules); dribonds. Bent rule and energetics of hybridisation Some simple ractions of covaently bonded molecules,

2. Metal ligand Equilibria in Solution: 8 hrs.

Stepwise and overall formation constants and their interaction, trends in step-wise formation constants, factors affecting the stability of metal compelxes with reference to nature of metal ion and ligand, chelate effect and its thermodynamic origin, determiantion of binary formation constants by pH-metry and spectrophotometry.

3. Reaction Mechanism of Transition metal compelxes 24 hrs.

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 evidences in favour of conjugate mechanism, anation reactions, reactions without metal ligand cleavage, substitution reactions in square planar complexes, the trans effect, mechanism of the substitution reaction, Redox reactions, electron transfer reactions, Mechanism of one electron transfer reaction, outer sphere type reactions, cross reactions and Marcus-Hush Theory, inner sphere type reactions.

4. Metal ligand bonding: 15 hrs.

Limitation of Crystal Field Theory, molecula, orbital theory, octahedral, tetrahedral, and square planar complexes, bonding and molecular orbital theory.

5. Metal - Complexes: 18 hrs.

Metal carbonyls, structure and bonding, vibrational spectra of metal Carbonyls for bonding and structural elucidation, important reactions of metal Carbonyls, preparation, bonding and structure and important reaction of transition metal nitrosyl, dinitrogen and dioxyen complexes; tertiary phosphine as ligand.

6. Electronic spectra and Magnetic properties of Transition metal complexes 24 hrs.

Spectroscopic ground states, correlation, Orgel and Tauable-Sugano diagrams for transition metal complexes (d1-d9 states, calculation Dq, B and P 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 spin crossover.

7. Metal Clustures **15 hrs.**

Higher boranes, carboranes, metalloboranes and metallo carboranes, Meatal carbonyl and halide clusters, compounds with metal-metal multiple bonds.

8. Crown ether complexes and cryptands, inclusion compounds. **3 hrs.**

9. Isopoly and Heteropoly acids and salts. **4 hrs.**

10. Symmetry and Group Theory in chemistry. **12 hrs.**

Symmetry elements and symmetry operation, definition of group, sub-group, relation between orders of a finite group and its sub-group. Conjugacy relation and classes, Point sysmmetry group, Schonfilies symbols, representations of groups by matrics (representation for Cnh, Cnv. Dnb. etc. groups to be worked out explicitly), character of a representation, The great orthogonality theorem (without proof) and its importance. character tables and their use, spectroscopy.

Books suggested:

1. Advanced Inorganic Chemistry-FA. Cotton and Wilkinson, John Wiley,
2. Inorganic Chemistry - J.E. Huhey, Harpes & Roin.
3. Chemistry of the Elements - N.N. Greenwood and A. Earnshow, Pergamon.
4. Inorganic Electronic Spectroscopy - A.B.P. Lever Elsevier.
5. Magnetochemistry - R.L. Carlin, Springer Verlag.
6. Comprehensive Coordination Chemisty eds., G. Wilkinson, R.D. Gillars and J.A. McCleverty, Pergamon.
7. Chemical Applications of Group Theory - F.A. Cotton.

CHEMISTRY - M.SC. PREVIOUS
PAPER-II CH-402 ORGANIC CHEMISTRY

M.M.: 100

1. Nature of Bonding in Organic Molecules **10 hrs.**

Delocalised chemical bonding-conjugation, cross conjugation resonance, hyperconjugation, bonding in fullerenes, tautomorism.

Aromaticity in benzenoid and non-benzenoid compounds, alternant and non-alternant hydrocarbons, Huckel's rule, energy level of -molecular orbitals, anulenes, antiaromaticity, -aromaticity, homoaromaticity, PMO approach.

2. Stereochemistry: **15 hrs.**

Conformational analysis of cycloalkanes, decalins, effect of conformation of reactivity, conformations of sugars, steric strain due to unavoidale crowding, Elements of symmetry, chirality, molecules with more than one chiral center, threo and erythro isomers, Methods of resolution, optical purity, enantiotropic and diastereotopic atoms groups and faces. stereospecific and stereoselective synthesis. Assymmetric synthesis. Optical activity in the absence of chiral carbon (biphenyl, allenes and spiranes), chiraity due to helical shape. Stereo-chemistry of the compounds containing Nitrogen, Sulphur and Phosphorus.

3. Reaction Mechanism: Structure and Reactivity **12 hrs.**

Types of mechanisms, types of reactions, Thermodynamic and kinetic requirements, kinetic and thermodynamic control, Hamond's postulate, Curtin Hammet Principle, Potential energy diagram, transition states and intermediates, methods of determining mechanism, isotope effects, Hard and Soft acids and bases. Effect of structure on reactivity - resonance and field effects, steric effect, Hammett equation and linear free energy relationship, substitution and reaction constants.

4. Reaction intermediates: **10 hrs.**

Generation, structure, stablity and reactivity of carbocation~carbanions, free radicals, carbenes, Nitrenes, and Benzynes. Application of NMR in detection of carbocations.

5. Electrophilic Substitution reactions: **10 hrs.**

(a) Alipahatic electrophilic substitution: Bimolecular mechanism S_E2, S_Ei and S_E1 mechanism electrophilic substituion acompanied by double bond shifts. Effect of substrates, leaving group and the solvent polarity on the reactivity.

(b) Aromatic electrophilic substitution: The treniumion mechanism, orientation and reactivity, energy profile diagrams, The ortholpara ratio, ipso attack, orientation in other ring system. Quantitative treatment of reactivity in substrates and electrophiles, Diazonium coupling, Gattermann Koch reaction, Vilsmeir reaction.

6. Nucleophilic Substitution reactions: **15 hrs.**

(a) Aliphatic nucleophilic substition: The S_N2, S_N1 mixed S_N1 and S_N2 and SET mechanisms. The neighbouring group mechanism, neighbouring group participation by a and B bonds.

The S_Ni mechanism. Nucleophilic substitutior at an allylic aliphatic trigonal and at a vinylic carbon. Reactivity effects of substrate structure, attacking nucleophile, leaving group and reaction medium, amoident nucleophile, regioselectivity.

(b) Aromatic Nucleophilic Substitution: The S_NAr, S_N1, benzyne and $S_{RN}1$ mechanisms. Reactivity-effect of substrate structure. Leaving group and attacking nucleophile. The von Richter, Sommelet-Hauser and Smiles rearrangement.

7. Free Radical reactions **8 hrs.**

Types of Free radical reactions, Free radial substitution mechanism, mechanism at an aromatic substrate, neighbouring group assistance. Reactivity for aliphatic and aromatic substrates at a bridge head. Reactivity in attacking radicals. The effect of solvents on reactivity.

Allylic halogenation (NBS), Oxidation of aldehydes to carboxylic acids, auto-oxication, Coupling of alkynes and arlylation of aromatic compounds to diazonium salts, sandmeyer reaction. Free radical rearrangement. Hunsdiecker reaction.

8. Addition to carbon-Multiple Bonds: **7 hrs.**

Mecharnis and stereochemical aspects of addition reactions involving electrophiles, Nucleophiles and Free radicals, regio and chemoselectivity, Orientation and reactivity, Addition to cyclopropane ring. Hydrogenation of double and triple bonds. Hydrogenation of Aromatic rings, Hydroboration, Michael reaction, Sharpless assymmetric epoxidation.

9. Addition to carbon-Hetero Multiple bonds: **12 hrs.**

Mechanism of metal hydride reduction of saturated and unsaturated carbonyl compounds, acids, esters nitriles. Addition of Grignard's reagents, organozinc and organolithium reagents to carbonyl and unsaturated carbonyl compounds Mechanism of condensation reactions involving enolates Aldol, Knoevenagel, Claisen, Mannich, Benzoin Perkin and Stoboe reactions. Hydrolysis of ester and amides, Ammonialysis of esters.

10. Elimination reactions **5 hrs.**

The E_2, E_1 and E_{1cb} mechanism and their spectrum, orientation of double bond. Reactivity - effects of substrate, Structures, attacking base, the leaving group and the medium.

11. Molecular rearrangement reactions: **11 hrs.**

General mechanistic approach to molecular rearrangement reactions, Carbocation rearrangement, Migratory aptitude and Memory effects. Brief study of following rearrangement reactions Pinacol-Pinacolone, Favoroskii, Baeyer-Villigers oxidattion, Stork enamine reaction, Sharpiro reaction, Michael addition, Sommelet rearrangement, Witting's rearrangement. Grovenstein-zimmerman rearrangement.

12. Pericyclic Reactions: **20 hrs.**

Molecular orbital symmetry, Frontier orbitals of ethylene, 1,3-butadiene, 1,3,5-hexatriene and allyl system. Classification of Pericyclic re-

actions, Woodward- Hoffmann correlation diagrams, FMQ and PMO approach. Electrocyclic reactions. Controtatory motions, 4n, 4n+2 and allyl systems. 2+2 addition of ketenes, 1,3-dipolar cycloadditions and cheleotropic reactions. Sigmatropic rearrangements- suprafacial and antarafacial shifts of H, sigmatropics shifts involving carbon noieties, 3,3-and 5,5-sigmatropic rearrangements. Claisen, Cope and aza-Cope rearrangements. Fluxional tautomerism, Enereaction.

Books Suggested:

1. Advanced Organic Chemistry - Reactions, Mechanism and Structure, Jerry March, John Wiley.
2. Advanced Organic Chemistry - F.A. carey and R.J. Sundberg, Plenum.
3. A Guide Book to Mechanism in Organic Chemistry Peter Sykes, Longman.
4. Structure and Mechanism in Organic chemistry - C.S. Ingold, Cornell University Press.
5. Organic Chemistry - R.T. Morrison and R.N. Boyd, Prentice -Hall
6. Modern Organic Reactions - H.O., House, Benjamin
7. Principles of Organic Synthesis - R.O.C. Norman and J.M. Coxon, Blackie Academic & Professional.
8. Pericyclic Reactions - S.M. Mukherji Macmillan, India.
9. Reaction Mechanism in Organic Chemistry - S.M. Mukherji and S.P. Singh, Macmillan.
10. Stereo chemistry of Organic Compounds D. Naspri, New Age International.
11. Stereochemistry of Organic Compounds - P.S. kalsi, New Age International.

CHEMISTRY - M.Sc. PREVIOUS

PAPER-III CH-403 PHYSICAL CHEMISTRY

M.M.: 100

I. QUANTUM CHEMISTRY **30 hrs.**

A. Introduction to Exact Quantum Mechanical Results

The Schrodinger equation and the postulates of quantum mechanics. Discussion of soluions of the Schrodinger equation to some model systems, viz., particle in a box, the harmonic oscillator, the rigid rotor, the hydrogen atom.

B. Approximate Methods

The variation theorem, linear variation principle. Perturbation theory (first order and non-degenerate). Applications of variation method and perturbation theory to the Helium atom.

C. Angular Momentum

Ordinary angular momentum, generalized angular momentum, eigenfunctions for angular momentum, eigenfunctions of angular momentum, operator using ladder operators, addition of angular momenta. spin, antisymmetry and Pauli exclusion principle.

D. Electronic Structure of Atoms

Electronic configuration, Russell-Sauders terms and coupling schemes, Slater-Condon parameters, term Separation energies of the pn configuration, term separation energies for the D^n configurations, magnetic effects spin-orbit coupling and Zeeman splitting, introduction to the methods of self-considstent field, the virial theorem.

E. Molecular Orbital Theory

Huckel theory of conjugated system, bond order and charge density calculations. Applications to ethylene, butadience, cyclopropenyl radical, cyclobutadiene etc. Introduction to extended Hu'ckel theory.

II. THERMODYNAMICS 30 hrs..

A. Classical Thermodynamics

Brief resume of concepts of laws of thermodynamics, free energy, chemical potential and entropies. Partial molar properties, partial molar free energy, partial molar volume and partial molar heat content and their significances. Determinations of these quantities. Concept of fugacity and determination of fugacity.

Non-ideal systems : Excess functions for non-ideal solutions. Activity, activity coefficient, Debye-Huckel theory for activity coefficient of electrolytic solutions; determination of activity and activity coefficients; ionic strength. Application of phase rule to three component systems; second order phase trasitions.

B. Statistical Thermodynamics

Concept of distribution, thermodynamic probability and most probable distribution. Ensemble averaging, postulates of ensemble averaging Canonical, grand canonical and microcanonical ensembles, corresponding distribution laws (using Lagrange's method of undetermined multipliers). Partition functions - translational, roational, vibrational and electronic partition functions, calculation of thermodynamic properties in terms of partition functions. Applications of partition functions.

Heat capacity behaviour of solids - Chemical equilibria and equilibrium constant in terms of partition functions Fermi-Dirac statistics, distribution law and applications to metal. Bose-Einstein statistics - distribution law and application to helium.

C. Non Equilibrium Thermodynamics

Thermodynamic criteria for non-equilibrium states, entropy pro-

duction and entropy flow, entropy balance equations for different irreversible processes (e.g., heat flow, chemical reaction etc.) transformations of the generalized fluxes and forces, non equilibrium stationary states, phenomenological equations, microscopic, reversibility and Onsager's reciprocity relations, electrokinetic phenomena, diffusion, electric conduction, irreversible thermodynamics for biological systems, coupled reactions.

III. CHEMICAL DYNAMICS 24 hrs.

Methods of determining rate laws, collision theory of reaction rates, steric factor, activated complex theory, Arrhenius equaiton and the activated complex theory; ionic reactions, kinetic salt effectt;, steady state kinetics, kinetic and thermodynamic control of reactions, treatment of unimolecular reactions. Dynamic chain (hydrogen-bromine reaction, pyrolysis of acetaldehyde, decomposition of ethane) photochemical (hydrogen-bromine and hydrogenchlorine reactions) and oscilaltory reactions (Belousov-Zhabotinsky reaction), homogeneous catalysis, kinetics of enzymes reactions, general features of fast reactions, study of fast reactions by flow method, relaxation method, flash photolysis and the nuclear magnetic rasonance method. Dynamics of molecular motions, probing the transition state, dynamics of barrierless chemical reactions in solution, dynamics of unimolecular reactions (Lindemann-Hinshelwood and Rice-Ramsperger-Kassel-Marcuss [RRKM] theories of unimolecular reactions.)

IV. SURFACE CHEMISTRY 20 hrs.

A. Adsorption

Surface tension, capillary action pressure difference across curved surface (Laplace equation), vapour prescure of droplets (Kelvin equation), Gibbs adsorption isotherm, estimation of surface area (BET equation), surface films on liquids (Electro-kinetic phenomenon) catalytic activity at surfacess.

B. Micelles

Surface active agents, classification of surface active agents. micellization, hydrophobic interation, critical micellar concentration (CMC), factors affecting the CMC of surfactants, counter ion binding to micelles, thermodynamics of micellization-phase separation and mass action models, solubilization, micro emulsion, reverse micellers.

C. Macromolecules

Polymer - difinition, types of polymers, electrically conducting, fire resistant, liquid crystal polymers, kinetics of polymerization, mechanism of polymerization. Molecular mass, number and mass average molecular mass, molecular mass determination (osmometry, viscometry, diffusion

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and light scattering sedimentation, chain configuration of macromolecules, calculation of average dimensions of various chain structures.

V. ELECTROCHEMISTRY **25 hrs**

Electrochemistry of solution. Debye-Huckel-Onsager treatment and its extension, ion solvent interactions. Debye-Huckel- Jeru mode. Thermodynamics of electrified interface equations. Derivations of electrocapillarity, Lippmann equations (sufrace excess), methods of determination. Structure of electrified interfaces. Guoy-Chapman, Stern, Graham-Devanathan-Mottwatts, Tobin, Bockris, Devanthan models.

Over potentials, exchange current density, derivation of Butler-Volmer equation, Tafel plot,

Quantum aspects of charge transfer at electrodes-soution interfaces, quantization of charge transfer, tunneling.

Semiconductor interfaces- theory of double layer at semiconductor, electrolyte solution interfaces, structure of double layer interfaces. Effect of light at semiconductor interface.

Electrocatalysis - influence of various parameters. Hydrogen electrode. Bioele. ctrochemistry, threshold membrane phEnomena, Nernst-Planck equation, Hodges-Huxley equations, core conductor models, electrocardiography. Plarography theory, iikovic equation; half wave potential and its significance Introduction to corrosion, homogenous theory, forms of corrosion, corrosion monitoring and prevention methods.

VI. ELECTRON /DIFFRACTION **3 hrs.**

Scattering intensity vs. scattering angle, Wierl equation, measurement technique, elucidation of structure of simple gas phase molecules. Low energy electron diffraction and structure of surfaces.

VII. NEUTRON DIFFRACTION **3hrs.**

Scattering of neutrons by solids and liquids, magnetic scattering, measurement techniques. Elucidation of structure of magnetically ordered unit cell.

Books Suggested:

1. Physical Chemistry - P.W. Atkins, ELBS
2. Introduction to Quantum Chemistry - A.K. Chandra, Tata Mc Graw Hill
3. Quantum chemistry - Ira N. Levine, Prentice Hall.
4. Coulson's Valence - R. Mcweeny, ELBS
5. Chemical Kinetics - K.J. Laidler, Mc Graw-Hill
6. Kinetics and Mechanism of chemical Transformation - J. Rajaraman and J. Kuriacose, McMillan.
7. Micelles, Theoretical and Applied Aspects - V. Moroj, Plenum.

8. Modern Electrochemistry Vol. I and Vol. II - J.O.M. Bockri and A.K.N. Reddy, Plenum
9. Introduction to Polymer Science - V.R. Gowavkar, N.V. Vishwanathan and J. Sridhar, Wiley Eastern.

CHEMISTRY - M.SC. PREVIOUS PAPER-IV

Based on UGC Model Curriculum-2001 ~~AL-6589~~

To be implemented from session 2003-2004 onwards

Spectroscopy, Diffraction, Method's Computer's Biology and Mathematics in Chemistry ~~AM-1556~~

The Fourth questation paper of M.Sc. Prev. chemistry shall compose of three sections viz. A, B, and C. the formate of this paper shall be as under. A-1496 ~~1518~~

~~3538~~ **Section-A**

Spectroscopy and Diffraction Methods

There will be six questions in the question paper from this section and examinees shall be required to answer any three questions from this section.

1. Unifying Principles. **(10 hrs.)**

Electromagnetic radiation, interaction of electromagnetic radiation with matter -absorption emission, transmission, reflection, referaaction, dispension. polarizaion and scattering. Uncertainty relation and natural line width and natural line broadening, transition probability, results of the time dependent perturbation theory, transition moment selection rules, intensity of spectral lines, Born-Oppeheimer approximation, rotational, vibrational and electronic energy levels.

2. Microwave Spectroscopy: **(3 Hours)**

Classification of molecules, rigid rotor model, effects of isotopic substitution on the transition frequencies, intensities, non rigid rotor, Slark effect, nuclear and electron spin interactions and effect of external field. Applications.

3. Vibraion Spectroscopy **(15 Hours)**

(a) Infrared Spectroscopy - Review of linear harmonic oscillator, vibrational energies of diatomic molecules zero point energy, force constant and bond strengths, anharmonicity, Morse potential energy diagram, vibrational-rotational spectroscopy, P.Q.R. branches, breakdown of Oppenheimer approximation, vibrations of poly-atomic molecules, selection rules, normal modes of birations, group frequencies, overtones, hot bands, factors affecting the band position and intensities, far IR region, metal-ligand vibrations, normal co-ordinate analysis.

(b) Raman Spectroscopy - Classicial and quantum theories of Raman effect, pure rotational, vibrational and birational-rotational Raman spectra, selection rules, mutual exclusion principle, Resonance Raman spectroscopy, coherent anti stroke Raman spectroscopy (CSRS).

4. Electronic Spectroscopy (12 Hours)

(a) Atomic Spectroscopy - Energies of atomic orbitals vector representation of momenta and vector coupling, spectra of hydrogen and alkali metal atoms.

(b) Molecular Spectroscopy - Energy levels, molecular orbitals, vibrational transitions, vibrational progressions and geometry of the excited states, Frank-Condon principle, electronic spectra of poly-atomic molecules, emission spectra, radiative and non radiative decay, internal conversion, spectra of transition metal complexes, charge transfer spectra,

(c) Photo Electron Spectroscopy - Basic principles, Photo-electric effect, ionization process, Koopman's theorem, Photo-electron spectra of simple molecules., ESCA, Chemical information fom ESCA, Auger Electron Spectroscopy (basic idea)

5. Magnetic Resonace Spectroscopy - (20 Hours)

(a) Nuclear Magnetic Resonance Spectroscopy - Nuclear spin, nuclear resonance, saturation, shielding of megnetic nuclei, chemical shift and its measurements, factors influencing the chemical shift, deshielding, spin-spin interactions, factors influencing the coupling constant 'J', classification (ABX, AMX, ABC, A_2B_2 etc.) spin decoupling, basis idea of instrument, NMR studies of nuclei other than proton - ^{13}C, ^{19}F and ^{31}P, FT NMR, use of NMR in medical diagnostics.

(b) Electron Spin Resonance Spectroscopy - Basic Principles, Zero field splitting and Kramer's degeneracy, factors affecting the 'g' value, isotropic and anisotropic hyperfine coupling constants, spin Hamiltonian, spin intensities and McConnell relationship, measurement techniques and applications.

(c) Nuclear Quadrupole Resonance Spectroscopy - Quardrupole nuclei, Quardrupole moments, electric field gradient, coupling constant, splitting, Appliations.

6. Photo-acoustic Spectroscopy (3 hours)

Basic Principles of Photo-acoustic Spectroscopy (PAS), PAS-gases and condensed systems, chemical and surface applications.

7. X-Ray Diffraction (12 Hours)

Bragg's condition, Miller indices, Laue's Method, Bragg's method, Debye-Scherrer method of X-Ray structural analysis of crystals, index

reflections, identification of unit cell from systematic absences in diffraction patterns, structures of simple lattices and X-Ray intensities, Structural factors and it's relation to intensities and electron densitires, phase problem, description of the procedure for a X-Ray structural analysis, absolute configuration of the molecules, Ramchandran diagram.

Section - B
Computers in Chemistry

Two questions shall apper in question paper from this section and examinees shall answer one question.

8. Introduction to Computers and Computer Programming in 'C' (15 Hours)

(a) Computer Fundamentals- Introduction to Computer organization, Operating Systems, DOS, Introduction to UNIX and Windows, Computer languages, principles of programming, Algorithm and flow charts.

(b) Programming in 'C' - Structure of a 'C' programme, constants, variables, operators and expressions, data input and output, decision making, branching and looping, statements, arrays, user defined functions, pointers, structures and unions.

9. Programming in Chemistry and use of Computer programmes (15 hours)

(i) Development of small computer codes involving simple formula in Chemistry such as vender Wall equation, pH titrations, Kinetics, Radioactive dacay, evalutionm of lattice energy and ionic radii, Secular equation (within Huckel Theory) Elementary structural features such as bond length, bond angies, di-hederal angles etc. of molecule extracted from a data base such as Cambridge data base.

(ii) Introduction and use of computer packages like MS. Work and Excel, preparation of graphs and charts.

Section - C
Biology, Mathematics for Chemists

The question paper shall contain two questions from "Biology for chemists" part of this section and two questions from "Mathematics for chemists" part of this section. In all there will be four questions in this section of question paper. The examiniers shall answer any one question out four.

10 (a). Carbohydrates (8 Hours)

Conformation of mono saccharides, Structures and functions of important derivatives of mono saccharides like glycosides, deoxy sugars, myoinositol, amino sugars, N-acetylmuramic acid, sialic acid, dis-

accharides and poly-saccharides, structural poly-saccharides-cellulose and chitin, storage poly-saccharides-starch and glycogen, Structural and biological functions of glucosaminoglycans or muco poly-saccharides 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.

10 (b). Lipids **(6 Hours)**

Fatty acids, essential fatty acids, structure and functions of triglycerols, glycerophospholipids, sphingolipids, cholesterol, bile acids, prostaglandins, lipoproteins-composition and functions, role in atherosclerosis, properties of lipid aggregates-micelles, bi layers, liposomes and their possible biological functions Biological memebranes, Fluid mosaic model of membrane structure. Lipid metabolism, ß-oxidation of fatty acids.

10 (c). Nucleic Acids **(5 Hours)**

Purine and pyrimidine base of nucleic acids, base pairing via H-bonding, Structure of Ribonucleic acids (RNA) and deoxyribonucleic acids (DNA), double helix model of DNA and forces resonsible for holding it, Chemical and enzymatic hydrolysis of nucleic acids. The DNA basis of heredity, an overview of replication of DNA, transcription, translation and genetic code. Chemical synthesis of mono and trinucleosides.

11. (a) Vector and Vector Algebra: **(6 Hours)**

Vector, dot, cross and triple product etc. The gradient, divergence and curl, vector calculus, Gauss' theorem, divergence theorem etc.

11. (b). Differential Claculus: **(6 Hours)**

Functions, continuity and differentiability, Rules of differentiation, applications of differential calculus including maxima and minima (examples related to maximally populated rotational energy levels, Bohr's radius and most probable velocity from Maxwell's distribution etc.,), Exact and inexact differential with their applications to the thermodynamics.

11. (c). Integral Calculus: **(6 Hours)**

Basic rules of integration, integration by parts, partial fractions and substitution, reduction formulae. Applications of integral calculus to the problems related to chemistry.

Functions of several variables, partial differentiation, co-ordinate transformations (eg. Cartesian to spherical polar), curve sketching.

Books Suggested for Spectroscopy:

1. Modem Spectroscopy - J.M. Hollas, john Wiley.

2. Applied Electro Spectroscopy for chemical Analysis Ed. H. Windawi and F.L.Ho, Willeylnter science.
3. NMR. NQR and Mossbauer Spectroscopy in Inorganic Chemis try - R.V. Parish, Ellis Harwood.
4. Physical Methods in Chemistry - R.S. Drago, Saunders college.
5. Introduction to Molecular Spectroscopy - G.M. Barrow, McGraw Hiill.
6. Basic Principles of Spectroscopy - R. Chang, McGraw Hill.
7. Theory and Applications of UV Spectroscopy - H.H. Jaffe and M. Orchin, IBH-Oxford.
8. Introduction to Photo-electron Spectroscopy - P.K. Ghosh, john Wiley.
9. Introduction to Magnetic Resonance - A Carrington and A.D. Maclachalan, Harper & Row.

Computer Books Suggested:

1. Computers and Common Sense - R. Hunt and J. Shelley, Prentice Hall.
2. Computational chemistry - A.C. Noms.
3. Microcomputer Quantum Mechanics - J.P. Kilingbeck, A lam Huger.
4. Computer Programming in Fortran IV-V. Rajaraman, Prentice Hall.
5. An Introduction to Digital Computer Design - V. Rajaraman and T. Radhakrishnan, Prentice Hall.

Books for Mathematics for Chemists

1. The Chemistry Mathematics Book - E. Steiner, Oxford University Press.
2. Mathematics for Chemistry - Doggett and Sutcliffe, Long nan.
3. Mathematical Preparation for Physical Chemistry - F. Diniels, McGraw Hill.
4. Chemical Mathematics - D.M. Hirst, Longman.
5. Applied Mathematics for Physical Chemistry - J.R. Barrainte, Prentice Hall.
6. Basis Mathematics for Chemists - Tebbutt, Wiley.

Books for Biology for Chemists:

1. Principles of Biochemistry - A.L. Lehninger, Worth Pubi shers.
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, lohn Wiley.

CHEMISTRY - M.Sc. Previous
LABORATORY COURSE - I INORGANIC CHEMISTRY

1. Qualitative analysis of mixture containing eight radicals including some less commonmetal ions from among the following by common method (preferable semi-micro)

Basic radicals -

Ag, Pb, Hg, Cu, Cd, Bi, As, Sb, Sn, Fe, Al, Cr, Zn, Mn, Co, Ni, Ba, Sr, Ca, Mg, Na, K, NH4, Ce, Th.. Zr, W, Te, Ti, Mo, U, V, Be, Li, Au, Pt,

Acid radicals -

Carbonate, Sulphate, Sulphite, Nitrite, Acetate, Fluoride, Chloride, Bromide, Iodide, Nitrate, Sulphate, Borate, Oxalate, Phosphate, Silicate, Thiosulphate, Ferrocyanide, Ferricyanide, Chromate, Arsenite, Arsenate, Permanganate.

2. Quantitative Analysis - Involving two of the following in ores, alloys or mixture in solution - one by Volumetric and other by Gravimetric method Ag Cu, Fe, Cr, Mn, Ni, Zn, Ba, Ca, Wg, Chloride, Sulphate.

3. Estimation of:-

(a) Phosphoric acid in commercial orthophosphoric acid (b) Boric acid in Borax (c) Ammonium ion in ammonium salt (d) MnO2 in Pyrolusite (e) Available chlorine in bleaching powder. (f) H_2O_2 in commercial sample.

4. Preparation of selected inorganic compounds and study of their properties by various methods including IR, Electronic spectra, Mossbaur, ESR spectra and Magnetic susceptibility etc.

(i)	$VO(acac)_2$	(ii)	Cis-$K[Cr(C_2O_4)_2(H_2O)_2]$
(iii)	$Na[Cr(NH_3)(SCN)_4]$	(iv)	$Mn(acac)_3$
(v)	$K_3[Fe(C_2O_4)_3]$	(vi)	Pressiar Blue, Thumbull's Blue
(vii)	$[Co(NH_3)_6][Co(NO_2)_6]$	(viii)	$Hg[Co(SCN)_4]$
(ix)	$[Ni(NH_3)_4]Cl_2$	(x)	Ni(dmg)
(xi)	$[Cu(NH_3)_4]So_4H_2O$		

CHEMISTRY - M.Sc. previous
LABORATORY COURSE-II - ORGANIC CHEMISTRY

1. Qualitative Analysis-

Separation purification and identification of binary mixture (one liquid and one solid) using TLC and column chromatography. Chemical test IR spectra may be used for functional group identification.

2. Organic synthesis -

Acetylation : of Chloresterol and separation of holesteryl acetate

by Column Chromatography.

Oxidation : Adipic acid by chromic acid, oxidation of cyclohexanol.

Grignard's reaction : Triphenyl methanol from Benzoic acid

Aldol condensation : Dibenzalacetone from Benzaldehyde

Sandmeyer reaction : p-chloro Toluene from Toluidine

Friedie Craft's reaction : p-Benzoyl propanoic acid from succinic anhydride and Benzene

Aromatic electrophilic substitution : p-nitro aniline from p-bromo aniline.

Products may be characterised by Spectral techniques.

3. Quantitative analysis:

Determination of the percentage number of hydroxyl groups by acetylation method.

Estimation of amine/phenols using Bromate Bromide method or Acetylation method.

Estimation of Caronyl group by hydrazone method.

Estimation of Glycine by titration.

Determination of equivalent weight of carboxyllc compounds.

Estimation of carboxyl group by titration/Silver salt method.

CHEMISTRY - M.SC. PREVIOUS
LABORATORY COURSE-III PHYSICAL CHEMISTRY

Adsorption:

To study surface tension - concentration Relationship for solutions (Gibbs equation)

Phase Equilibria.

(i) Determination of congruent composition and temperature of a binary system (e.g. diphenylamin benzophenone system)

(ii) Determination of glass transition temperature of a given salt (e.g. CaC12) conductometrically.

(iii) To construct the phase diagram for three component system (e.g., chloroform-acetic acid-water).

Chemical Kinetics:

(i) Determination of the effect of (a) Change of temperature (b) Change of concentration of reactants and catalyst and (c) Ionic strength of the media on the velocity constant of hydrolysis of a ester/ionic reactions.

(ii) Determination of the velocity constant of hydrolysis of an ester/ ionic reaction in micellar media.

(iii) Determination of the rate constant for the oxidation of iodide ions by hydrogen peroxide studying the kinetics as as an iodine clock reaction.

(iv) Flowing clock reactions (Rer. Experiments in Physical Chemistry by Showmaker)

(v) Determination of the primary salt effect on the kinetics of ionic reactions and testing of the Bronsted relationship (iodide ion is oxidised by persulphate ion)

(vi) Oscillatory reaction

Solutions:

(i) Determination of molecular weight of non-volatile and non-electrolyte/electrolyte by crysocopic method and to determine the activity coefificient of an electrolyte.

(ii) Determination of the degree of dissociat on of week electrolyte and to study the deviation from ideal behaviour that occurs with a strong electrolyte.

A - Conductometry

(i) Determination of the velocity constant, order of the reaction and energy of activation for saponification of ethyl acetate by sodium hydroxide conductometrically.

(ii) Determination of solutility and solutility product of sparingly soluble salts (eg. PbSO4' BaSO4) conductometrically.

(iii) Determination of the strength of strong and weak acids in a given mixture conductometrically.

(iv) To study the effect of solvent on the conductance of $AgNO_3$/ acetic acid and to Determine the degree of dissociation and equilibrium constant in different solvents and in their mixtures (DMSO, DMG, dioxane.', acetone, water) and to test the validity of Debye-Huckel-Onsager theory.

(v) Determination of the activity coefficient of zinc ions in the solution of 0.002 M zinc sulphate using Debye Huckel's limiting law.

B. Potentiometrylpl metry

(i) Determination of strengths of halides in a mixture potentiometrically

(ii) Determination of the valency of mercurous ions potentiometrically.

(iii) Determination of the strength of strong and weak acids given

mixture using a potentiometer/pH meter.

(iv) Determination of temperature dependence of EMF of a cell.

(v) Determination of the formation constant of silver-ammonia complex and stoichilometry of the complex potentiomerically.

(vi) Acid-base titration in a non-aqueous media using a pH meter.

(vii) Determination of activity and activity coefificient of electrolytes.

(viii) Determination of the dissociation constant of acetic acid in DMSO, DMF, acetone and dioxane by titrating it with KOH.

(ix) Determination of the dissociation constant of monobasic/dibasic acid by Albert-Serjeant method.

(x) Determination of thermodynamic constant Δ,ΔG, ΔS and ΔH for the reaction by e.m.f. method.

$Zn+H_2SO_4=ZnSO_4+2H$

Polarimetry:

(i) Determination of rate constant for hydrolysis/inversion of sugar using a polarimeter.

(ii) Enzyme kinetics - inversion of sucrose.

CHEMISTRY-M.Sc. Previous LABORATORY COURSE- IV ANALYTICAL CHEMISTRY (INSTRUMENTATION AND COMPUTERS)

1. Error analysis & Statistical data analysis

Error, types of errors, minimization of errors, minimization of arrors statistical treatment for error analysis - Standard deviation, Realtive standard deviation, Linear Least Squares. Callbration of volumetric apparatus, burettes, pipette,standard flask, weight box etc.

2. Volumetric analysis

Basis principles. Determination of iodine and saponifaction values of oil sample. Determination of Do, COD, BOD, Hardness O^2 water samples.

3. Gravimetric analysis

Determination of metal ions eg. Ni, Cu etc. by gravimetric methods using organic precipitants such as dimethyglyoxime, dithizone, 8-hydroxyg uinoline, etc.

4. Chromatography

Separation of cations and anions by-

(a) Paper chromatography (b) Column chromatography

5. PH metry/potentiometry : Determination of strength of acids etc.

6. Flame photometry/AA/FIA/Colorimetry

Determination of cations/anions and metal ion.',, e.g.Na', Fe, Mc Ni, Cu, Zn, etc. K', Ca2', SO42~, NO2-,

7. Spectrophotometry

Verification of Beer-Lambert Law. Molar absorptivity calculation plotting graph to obtain h max' etc. Effect of pH in aqueous coloure systems. Determination of metal ions, e.g. Fe, Cu, Zn, Pb, etc. usin inorganic reagent like SCN and organic chelating agent like dithizone cuferron, 8-hydroxyquinoline, etc. in aqueous/organic phase in the pres ence of surface active agents.

8. Nephelometry/Turbidimetry

Determination of chloride, sulphate, phosphate, turbidity, etc.

9. Application of computers in chemistry

as specified in theory paper in Sect. II (a)

Books Suggested:

1. Vogel's Textbook of Quantitative Analysis, revised, J. Bassett, R.C. Denney, G.H. Jeffery and J. Mentham, ELBS
2. Synthesis and Characterization of inorganic Compounds, N.L. Jolly, Prentice Hall.
3. Experiments and Techniques in Organic Chemistry, D. Pasto, C Johnson and M. Miler, Prentice Hall.
4. Macroscale and Microscale Organic Experiments, K.L. Williamson, D.C. Health.
5. Systematic Qualitative Organic Analysis, H. Middleton, Ed ward Arnold.
6. Handbook of Organic Analysis - qualitative and Quantitati'e, H. Clark, Edward Amold.
7. Vogel's Textbook of Practical Organic Chemistry, A.R. Tatchell, john Wiley.
8. Practical Physical Chemistry, A.M. James and F.E. Prichard Longman.
9. Findley's Practical Physical Chemistry, B.P. Levitt, Longman.
10. Experimental Physical Chemistry, R.C. Das and B. Beher Tata McGraw Hill.

Instructions to Practical Examiners in Chemistry:

1. The Board of Examiners - one external and one internal for each branch - Will meet to decide the exercises and other matter in connection with the conduct of Practical examinations.

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S.No.		Branch	Marks	Duration
1.	Lab Course-I	Inorganic	50	10 hours
2.	Lab Course-II	Organic	50	5 hours
3.	Lab Course-III	Physical	50	5 hours
4.	Lab Course-IV	Analytical	50	5 hours
		Total	**200**	**25 hours**

2. Sessional marks will be awarded by External Examiner in consultation with the Internal Examiner.

3. Marks for Ex-students are given in parentheses.

1. INORGANIC CHEMISTRY:

(a) Qualitative analysis of mixture containing not more than 8 radicals by semi-micro method only. 16 (20) marks

(b) Quantitative Analysis (ir.volving separation) of a solution containing 2 metals, one of these is to be determined gravimetrically and the other volumetrically. 14 (10) marks

(c)	Viva voce and manipulation	10	(10) marks
(d)	Sessional	10	(---) marks
Total		**50**	**(50) marks**

Award of Marks:

(a) Deduct one marks for each radical wrongly reported (No negative marks).

(b) Gravimetric - error upto 1% of the true value, award full marks ie. 7(10). For each additional error of 0.20%, deduct 1 mark.

(c) Volumetric - error upto 1.5%, award full marks i.e. 7(10). For each additional error of 0.20%, deduct 1 mark.

2. ORGANIC CHEMISTRY:

(a)	Qualitative analysis of mixture containing two organic compds.	18(23) marks
(b)	Two stage preparation.	12(17) marks
(c)	Viva-voce and manipulation	10(10) marks
(d)	Sessional	10(--) marks
Total		**50(50) marks**

Awards of Marks:

(a) Separation of mixture 5(6) marks. names of compounds 3(4) marks, fo using correct method and writting systematic procedure of indentification of each compound 10(13) marks.

(b) First stage 5(7) marks, Second stage 7(10) marks.

3. PHYSICAL CHEMISTRY

(a)	One Practical exercise	30(40) marks
(b)	Viva voce and manipulation	10(10) marks
(c)	Sessional	10(--) marks
	Total	**50(50) marks**

As far as possible all the exercises, as laid down in the syllabu be set. The scale of marking will be deterined by examiners in acco dance with the nature of exercise.

4. INSTRUMENTAL /ANALYTICAL CHEMISTRY:

(a)	Two exercises at least one of these will be based on Instr mental Analysis.	30(40) marks
(b)	Viva voce and manipulation	10(10) marks
(c)	Sessional	10(-) marks
	Total	**50(50) marks**

As far as possible all the exercises, as laid down in the syllabus may be set. The scale of marking will be determined by the examiners i accordance with the nature of exercise.

EXAMINER'S REPORT:

External examiner should send report on the conduct of examina tion giving the comments on following points.

1. Standard and performance of examinees
2. Experimental work done by students during te academic session in the context of prescribed syllabi.
3. Laboratory facilities.
4. Suggestions, if any.

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