FOLDER-11

बिलासपुर विश्वविद्यालय

बिलासपुर (छत्तीसगढ़)

पाठ्यक्रम

विज्ञान - संकाय

विषयवस्तु एवं पाठ्यक्रम

एम. एस. सी. (अंतिम) रसायन शास्त्र

परीक्षा : 2014

:: प्रकाशक ::

कुलसचिव बिलासपुर विश्वविद्यालय

बिलासपुर (छत्तीसगढ़)

ORDINANCE NO 39
MASTER OF SCIENCE EXAMINATION

1. The examination for the degree of Master of Science consist of two parts
   (A) The Previous examination and
   (B) The Final Examination.
2. A candidate who after obtaining the degree of Bachelor of science of the University or an examination of any statutory University in India which has been recognised by the University as equivalent to B.Sc. degree of the University and has completed a regular course of study in the teaching department of the University in the subject in which he offers himself for examination for one academic year shall be admitted to the previous examination for the degree of master of Science.

   Provided however every candidate shall offer for the Previous Examination one of the subjects offered by him/her for his her B.Sc. Degree.

   Provided further (i) for admission of M.Sc. Previous (Chemistry) and candidate must have offered Maths as one of the subject in B.Sc. (ii) for admission in M.Sc. Previous (Chemistry) preference will be given to those candidates who offered Maths as one of their subject in B.Sc.
3. A candidate who after passing the M.Sc .previous Examination of the University has completed a regular course of study for one academic year in a teaching department of the University or in a College affiliated to the University shall be admitted to the Final Examination for the degree of Master of Science in the subject in which he/she has passed the Previous examination.

   A Candidate who has passed the previous examination for the degree of Master of Science of another University may also be admitted to the final Examination for the degree of Master of Science after obtaining necessary permission from the Kulpati, provided that he offered for his previous Examination a course of study of an equivalent standard with almost identical syllabus as is required for the Previous Examination of this University, and has attended a regular course of study for one academic year in a College affiliated to the University teaching department of the University.
4. The examination shall be partly by means of papers and partly practical including sessionals, except in the case of Mathematics where the examination shall be paper only.

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 Examination, 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 separately in each examination. The above provision of 36% 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 aggregate 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 successful 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 canceled.

(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 cancelling his first Degree.

UGC MODEL CURRICULUM

(to be implemented from the session 2005-06)

Chemistry - M.Sc. (IInd year)

THEORY COURSES

There shall be Two General Papers (Paper I and II) in theory compulsory to all students. Two Elective papers (Paper III and IV)from any one group amongst Groups A, B, and C are Optional to students.

A student has to appear in Four Theory Papers as per above scheme.

Each theory paper will be of 100 marks.

(I) Compulsory Papers:

Paper -I Application of spectroscopy, photochemistry and solid state chemistry. 135 hours

Paper-II Bioinorganic, Bioorganic, Biophysical and Environmental Chemistry. 135 hours

(II) Elective Papers :

(a) Group 'A'

Paper - III Organotransition metal and Photo-inorganic Chemistry 135 hours.

Paper - IV Bio-inorganic and analytical Chemistry. 135 hours

(b) Group 'B'

Paper - III Chemistry of Natural Products and Medicinal Chemistry. 135 hours

Paper - IV Physical Organic Chemistry and Heterocyclic Chemistry. 135 hours

(c) Group 'C'

Paper - III Advanced Quantum Chemistry and Liquid State 135 hours

Paper - IV Chemistry of Materials and Polymers 135 hours

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MSc. Part - II Compulsory Papers
APPLICATION OF SPECTROSCOPY, PHOTOCHEMISTRY AND SOLID STATE CHEMISTRY

PAPER - I MM.----

A. Application of spectroscopy: 135 hours

Applicationin inorganic and organic chemistry

i Vibrational Spectroscopy : 5 hrs

Symmetry and shape of AB_2, AB_3, AB_4, AB_5, and AB_6. Mode of bonding and ambidentate ligands, ethylene diamine and diketonatocomplexes. Application of resonance Raman Spectroscopy particularly for the study of active sites of metallo-proteins.

ii Electron Spin Resonance Spectroscopy : 8 hrs

Hyperfine coupling Spin polarisation for atoms and transition metal ions spin orbit coupling and significance of g-tensors. application to transition metal complexes having one unpaired electron, including biological system and to inorganic free radical such as pH_4, F_2, BH_3.

iii Infra-red Spectroscopy : 5 hrs

Instrumentation and sample handling. Characteristic vibrational frequencies of alkanes, alkenes and alkynes, Aromatic compounds, alcohols, ethers phenols and amines. Detailed study of vibrational frequncies of carbony compounds (Ketones aldehydes, ester, amides, acids anhydrides and conjugated carbony system). Effect of hydrogen bonding vibrational frequencies, overtones.

iv Ultraviolet and Visible Spectroscopy : 3 hrs

Various electronic transitions (185-800 nm). Beer-Lambcrt Law, Effect of solvent on electronic transitions, ultraviolet bands for carbonyl compounds, unsaturated carbonyl compunds, dienes, conjugated polyenes, Fieser-Woodward rules for conjugated dienes and carbonyl compounds, Ultraviolet spectrum of heterocyclic compounds. Steric effect in biphenyls.

V. Nucler Magnetic Resonance Spectroscopy: 17 hrs

General introduction and definition, chemical shift, spin interaction, shielding mechanism mechanism, of measurement, chemical shift values and correlation for protons bonded to carbon (aliphatic, olefinic, aldehydic and aromatic) and other nuclei (alcohols, phenols, enols, carboxylic acid, amines, and mercapto). Chemical exchange. Effect of deuteration, complex spin-spin interaction between two, three four and five nuclei (First order spectra), Virtual coupling, stereochemistry. hindered rotation. Kar-plus curve variation of coupling constant with dihedral angle, simplification of complex spectra, Nuclear magnetic double resonance,

Contact shift reagents, solvent effects, Fourier transform technique, Nuclear Overhauser Effect (NOE), Resonance of other nuclei - F.P.

The contact and pseudo contact shift, Factors affecting nucler relaxation, some applications including biochemical system.An overview of NMR of metal nucleides with emphasis on ^{198} Pt and ^{119} Sn NMR.

vi. C-13 NMR Spectroscopy : 5 hrs

General consideration, chemical shift (aliphatic, olefinic, alkyne, aromatic hetero-aromatic and carbonyl carbon) coupling constants. two dimensional NMR spectroscopy.

Cosy, noesy dept, inept, apt and inadequate techniques.

vii. Mossabauer Spectroscopy: 8 hrs

Basic principles, spectral parameters and spectrum display. Application of technique to the studies of (i) bonding and structures of Fe^{+2} and Fe^{+3} Compounds - nature of M-L bond, coordination number, structure, and (iii) detection of oxidation state and inequivalent MB atoms.

viii. Optical Rotatory Dispersion (ORD) and Circular Dichroism (CD): 4hrs

Definition, deduction of absolute configuration, Octant rule for ketones

ix. Mass spectroscopy : 10 hrs

Introduction, ion production, EI, CI, FD and FAB Factors affecting fragmentation, ion analysis, ion abundance, Mass spectral fragmentation of organic compounds Common functional group, molecular ion peak, metastable peak. McLaffartey rearrangement. Nitrogen rule. High resolution mass spectrometry Examples of mass spectral fragmentation of organic compounds with respect to their structural determination.

B. PHOTOCHEMISTRY : 30 hrs

i Photochemical reactions : 4 hrs

Interaction of electromagnetic radiation with matter, type of excitations. fate of excited molecule, quantum yield, transfer of excitation energy actiometry.

ii. Determination of reaction mechanism : 4 hrs.

Classification, rate constants and life time of reactive energy states, determination of rate constant of reactions. Effect of light intensity on the rate of photochemical reactions. Types of photochemical reactions Photodissociation, gas phase photolysis.

iii. Photochemistry of Alkenes : 6 hrs.

Intermolecular reactions of olefinic bond, geometrical isomerism, cyclisation reactions, rearrangement of 1,4 - and 1,5 dienes.

iv. Photochemistry of Carbonyl compounds : 8 hrs.

Inter-molecular reactions of Carbonyl compounds, saturated cyclic and acyclic, B,Y -unsaturated and X,B -unsaturated compounds, cyclohexadienone intermolecular cycloaddition reactions, Dimerisations and oxetane formation.

v. Photochemistry of Aromatic compounds : 4 hrs

Isomerisation, Additions substitutions.

vi. Miscellaneous photochemical reactions : 4 hrs

Photo Fries reactions of anilides, photoFries rearrngement Barton reaction. singlet molecular oxygen reactions, photochemical formation of smog. Photochemistry of vision.

C. SOLID STATE CHEMISTRY.

i. Solid state reactions : 4hrs

General principles, experimental procedure, coprecipitation as a precursor to solid state reactions, Kinetics of Solid state rection.

ii. Crystal defects and Non-stochiometry : 6 hrs

Perfect and imperfect crystals, intrinsic and extrinsic defects, point defects, line and plane defects, vacancies, Schottky defects and Frankel defects. Thermodynamics of Schottky and Frenkel defect formation, colour centres, non-stochiometry and defects.

iii. Electronic properties and Band Theory : 15 hrs

Metals insulators and semiconductors, electronic structure of solids-band theory, band structure of metals, insulators and semi-conductors. doping semiconductors p-n junction, Superconductor, Optical properties - Optical reflectance. photoconduction photoelectric effects.

Magnetic properties : Classification of materials, quantum theory of paramagnetics, co-operative phenomenon. 5 hrs

iv. Organic solids : Electrically conducting solids, organic charge transfer complex organic metals, new super-conductors.

Books Suggested

1. Physical methods for Chemistry, R.S.Drago, Saunders Company.
2. Structural Methods in Inorganic Chemistry, E.A.V. Ebsworth, D.W.H. Rankin and S. Cradock, ELBS.
3. Infrared and Raman Spectra Inorganic and Coordination Compounds. K.Nakamoto. Wiley.
4. Progress in inorganic Chemistry, vol. 8ed. F.A. Cotton vol, 15 ed S.J. Lippard. Willey.
5. Transition Metal Chemistry ed. R.L. Carlin vol. 3. Dekker.
6. Inorganic Electronic Spectroscopy, A.P.B. Lever, Elsevier.
7. NMR, NQR, EPR and Mossbauer Spectroscopy in Inorganic Chemistry. R.V. Parish. Ellis Horwood.
8. Practical NMRSpectroscopy, M.L. Martin,J.J. Delpeuch and G.J. Martin, Heyden.
9. Spectrometric Identification of Organic Compounds R.M. Silverstein, G.C. Bassier and T.C. Morrill, Jo' n Wiley.
10. Introduction to NMR Spectroscopy, R.J. Abraham, J. Fisher and p. Loftus, Wiley.
11. Application of Spectroscopy of Organic Compounds, J.R. Dyer Prentice Hall.
12. Spectroscopic Methods in Organic Chemistry, D.H. Williams, I. flemin, tata McGraw-Hill.
13. Fundamentals of Photochemistry, K.K. rohtagi-Mukherji, Wiley-Eastern.
14. Essentials of Molecular Photochemistry, a gilbert and J. Baggott. Blackwell Scientific Publication.
15. Molecular Photochemistry. N.J. Turro, W.A. Benjamin.
16. Introductory Photochemistry. A. Cox and T. Camp, McGraw-Hill.
17. Photochemistry. R.P. Kundall and A. Gilbert, Thomson Nelson.
18. Orgnic Photochemistry. J. Coxon and B. Halton. Cambride University Press.
19. Solid State Chemistry and its Application, A.R. West, Plenum.
20. Principles of the Solid state, H.V. Keer, Wiley Eastern.
21. Solid State chemistry N.B. Hannay.
22. Solid State Chemistry D.K. Chakrabarty, New Age International.

MSc. Part - II Compulsory Papers

BIOINORGANIC, BIOORGANIC, BIOPHYSICAL AND ENVIRONMENTAL CHEMISTRY

PAPER - II MM...

Note : The question paper will comprise of two questions each from part A,B,C, & D and there will be one short notes based on sections A,B,C & D Thus there shall be nine question in all. The examinee shall have to answer atleast one question from each part, i.e. A,B,C,D [(A) Bioinorganic, (B) Bioorganic, (C) Biophysical and (D) Environmental chemistry] and two 'short notes' shall have to be answered from the last question.

A. BIOINORGANIC CHEMISTRY : 35 hours

i Metal ions in biological systems : 2 hrs

Essential and trace metals

ii Na^+/K^+ Pump : 3 hrs

Role of metal ions in biological processes.

iii Bioenergetics and ATP cycle: 8 hrs

DNA polymerisation, glucose storage, metal complexes in transmission of energy, chlorophylls. photosystem I and photosystem II in cleavage of water Model systems.

iv Transport and storage of dioxygen: 10 hrs

Heme protein and oxygen uptake, structure and function of Hemoglobin myoglobin. Hemocyanins, hemerythren, model synthetic complexs of iron, co and Cu.

v. Electron transfer in biology : 6 hrs

Structure and function of metallo-proteins in electron transport processes Cytochromes and ion-sulphur proteins, synthetic models.

vi. Nitrogenase : 6 hrs

Biological nitrogen fixation, Mo-Nitrogenase spectroscopic and other evidences, Other nitrogenases and model systems.

B. BIOORANIC CHEMISTRY 35 hrs.

i. Introduction :

Basic considerations, Proximity effects and molecular adaptation.

ii. Enzymes : 8 hrs

Introduction and historical perspective, Chemical and biological catalysis remarkable properties of enzymes, like catalytic power, specificity and regulation Nomenclature and Classification, Extraction and purification, fischer's Lock and Key and Koshland's Induced Fit hypothesis; Concept and identification of active site by the use of inhibitors, affinity labelling and enzyme modification by site directed muttagenesis. Kinetics. Reversible and irreversible inhibition.

iii. Mechanism of Enzyme Action : 3 hrs

Transition-state theory, orientation and steric effect. acid-base catalysis covalent catalysis strain or distortion. Examples of some typical enzyme mechanism for chymotrypsin ribonuclease, lysozyme and carboxypeptidase A.

iv. Kinds of Reaction catalysed by Enzymes : 8 hrs.

Nucleophilic displacement on a phosphorus atom. multiple displacement reactions and the coupling of ATP cleavage to endergonic processes. Transfer of sulphate, addition and elimination reactions, enolic intermediates in isomerisation reactions, B - cleavage and condensation, some isomerisation and rearrangement reactions. Enzyme catalysed carboxylation and decarboxylation.

v. Co-enzyme chemistry : 4 hrs.

Cofactors as derived from vitamins, coenzymes, prosthetic groups, apoenzymes structure and biological functions of coenzyme A, thiamine, pyrophosphate, pyridoxal phosphate, NAD^+NADP^+, FMN, FAD, Lipoic acid, vitamin B_{12} Mechanism of reactions catalysed by above cofactors.

vi. Enzyme Models : 4 hrs.

Host-guest chemistry, chiral recognition and catalysis, Molecular recognition Molecular assymmetry and prochirality, Biomimetic chemistry, Crown ether cryptates. cyclodextrin, cyclodextrin-based enzyme models, calixarenes. ionophores, micelles synthetic enzymes or synzymes.

vii Biotechnological Applications of Enzymes : 5 hrs

Large scale production and purification of enzymes. techniques and methods of immobilization of enzymes, effect of immobilization on enzyme activity application of immobilized enzymes, use of enzymes in food and drink industry-brewing and cheese-making, syrups from corn starch, enzymes as targets for drug design. Clinical uses of enzymes, enzyme therapy, enzymes and recombinant DNA technology.

C. BIOPHYSICAL CHEMISTRY : 37 hrs

i Biological Cell and its Constituents : 4 hrs.

Biological cell, structure and functions of proteins, enzymes, DNA and RNA in living systems. Helix coil transtion.

ii. Bioenergetics : 4 hrs

Standard free energy change in biochemical reactions exergonic, endergonic hydrolysis of ATP, synthesis of ATP from ADP.

iii. Statistical Mechanics in Biopolymers : 6 hrs.

Chain configuration of macromolecules, Statistical distribution end to end dimensions, calculation of average dimensions for various chain structures, Polypeptide and protein structure, introduction to protein folding problem.

iv. Biopolymer Interactions : 6 hrs.

Force involved in biopolymer interactions, Electrostatic changes and molecular expansion, hydrophobic forces, dispersion force interactions. Multiple equilibria and various types of binding processes in biological systems, H^+ion titration.

v. Thermodynamics of biopolymer Solutions : 5 hrs

Thermodynamics of biopolymer solutions, osmotic pressure, membrane equilibrium, muscular contraction and energy generation in mechano-chemical systems.

vi. Cell membrane and transport of ions : 3 hrs

Structure and function of cell membrane, ion transport through cell membrane, ion transport through cell membrans, irreversible thermodynamic treatment of membrane transport. Nerve conduction.

vii. Biopolymers and their Molecular weights : 6 hrs.

Evaluation of size, shape, molecular weight and extent of hydration of biopolymers by various experimental techniques, sedimentation equilibrium hydrodynamic methods, diffusion, sedimentation velocity, viscocity, electrophoresis and totational motions.

viii. Diffraction Methods : 4 hrs.

Light scattering, low angle x-ray scattering, x-ray diffraction and photocorrelation spectroscopy.

D. ENVIRONMENTAL CHEMISTRY : 30 HRS

i. Environment : 8 hrs

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

ii. Hydrosphere : 12 hrs

Chemical composition of water bodies - lakes, streams, rivers and wetlands etc., Hydrological cycle, Aquatic Pollution : Inorganic, organic, pesticide, agricultural, industrial, and sewage, detergents, oil spills and oil pollutants.

Water quality parameters - dissolved oxygen, biochemical oxygen demand, solids, metals, sulphate, phosphate, nitrate, microorganism. Water quality standard. analytical methods for measuring BOD, DO, COD, F, oils metals (As, Cd, Hg, Pb) Residual chloride and chloride demands, Purification and treatment of water

iii. Industrial Pollution : 10 hrs

Cement, Suger, distillary, paper and pulp, Thermal power plants, Nuclear power plants, Radio Nucleide analysis, disposal of waste and their managemnt.

Books Suggested.

1. Principles of Bioinorganic Chemistry, S.J. Lippard and J.M. Berg, university Science Books.
2. bioinorganic Chemistry. I. Bertini, H.B. Gray, S.J. Lippard and J.S. Valentine. University Science Books.
3. Inorganic Biochemistry vols. I and II ed. G.L. Eichhorn, Elsevier.
4. Progress in Inorganic Chemistry, vols 18 and 38 ed. J.J. Lippard. Wiley.

5. bioorganic Chemistry. A Chemical Approach to. Enzyme Action, Hermann Dugas and C Penny Springet Verlag.
6. Understanding enzymes, Trevor Palmer, Prentice hall.
7. Enzyme Chemistry : Impact and Applications, Ed. Collin J. Suckling, Chapman and Hall.
8. Enzyme Mechanisms Ed. M.I. Page and A. Williams, Royal Society of Chemistry.
9. Fundamentals of Enzymology, N.C. Price and L. Stevens. Oxford University Press.
10. Immobilized Enzymes : An Introduction and Applications in Biotechnology. Michael D. Trevan. John Wiley.
11. Enzymatic Reaction Mechanisms. C. Walsh, W.H. Freeman.
12. Enzyme stucture and Mechanism A. Fersht, W.H. Freeman.
13. Biochemistry The Chemical Reactions of Living Cells, D.E. metzier Academic Press.
14. Principles of biochemistry. A.L.lehninger, Worth Publishers.
15. Biochemistry. L. Stryer. W.H. Freeman.
16. Biochemistry. J. David Rawn Neil Patterson.
17. Biochemistry. Voet and Voet, John Wiley.
18. Outlines of biochemistry. E.E. Conn and P.K. Stumpf, John Wiley.
19. Bioorganic Chemistry A Chemical Approach to Enzyme Action, H. Dugas and C. Penn. Springer-Verlag.
20. Macromotecules Structure and Function, F.Wold, Prentice Hall.
21. Environmental Chemistry, S.E. Manahan, Lewis Publishers.
22. Environmental Chemistry, Sharma & Kaur, Krishna Publishers.
23. Environmental chemistry, A.K. De, Wiley Eastern.
24. Environmental Pollution Analysis,S.M. Khopkar, Wiley Eastern.
25. Standard Method of Chemical Analysis, F.J. Welcher. Vol. III Van Nostrand Reinhold Co.
26. Environmental Toxixology. Ed. J. rose, Gordon and Breach Science Publication.
27. Elemental Analysis of Airborne Particles, Ed. S. Landsberger and M. Creatchman Gordon and Breach. Science Publication.
28. Environmental Chemistry. C. Baird, W.H. Freeman.

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MSc. Part - II Optional Papers

GROUP 'A'

PAPER - III MM.

Following note is to be microporated in each optional Paper of Group A,B, and C.

The question paper shall contain in all 10 questions (five questions each from section A and B). The examines shall have to answer in all five questions selecting at least two questions from each section.

SECTION A

ORGANOTRANSITION METAL CHEMISTRY : 60 hours

i Alkyls and Aryls of Transition Metals : 5 hrs

Types, routes of synthesis, stability and decomposition patheways. organocopper in organic synthesis.

ii Compounds of transition Metal-Carbon Multiple bonds: 12 hrs

Alkylidenes, alkylidynes; low valent carbenes and carbynes- synthesis. nature of bond, structural chracteristics, nucleophilic and electophilic reactions on the ligands, role in organic synthesis.

iii. Transition Metal π -Complexes: 18 hrs

Transition metal π-complexes with unsaturated organic molecules, alkenes, alkynes, allyl, dience, dienyl, arene and trienyl complexes, preparations, properties nature of bonding and structural features, Import reactions relating to nucleophilic and electrophilic attack on ligands and to organic synthesis.

iv. Transition Metal Compounds with Bonds to Hydrogen : 8 hrs

Transition metal compounds with bonds to hydrogen.

v. Homogeneous Catalysis : 14 hrs

Stoichiometric reactions for catalysis, homogeneous catalytic hydrogenation, Zeigler-Natta polymerization of olefins, catalytic reactions involving carbon monoxide such as hydrocarbonylation of olefins (oxoreaction) oxopalladation reactions. actions of C-H bond.

vi. Fluxional Organometallic Compounds : 8 hrs

Fluxionality and dynamic equilibria incompounds such as n^2 olefin n^2allyl and dienyl complexes.

SECTION B

PHOTOINORGANIC CHEMISTRY 60 hrs.

i. Basics of Photochemistry : 10 hrs.

Absorption. excitation, photochemical laws, quantum yield. electronically excited states-life times-measurements of the times. Flash

photolysis, stopped flow techniques. Energy dissipation by radiative and non-radiative processes. absorption spectra. Franck-Condon principle, photochemical stages- primary and secondary processes.

ii. Properties of Excited States : 10 hrs.

Structure, dipole moment, acid-base strengths, reactivity. Photochemical kinetics -calculation of rates of radiative processes. Bimolecular deactivation quenching.

iii. Excited States of Metal Complexes : 8 hrs.

Excited states of metal complexes : Comparison with organic compounds. electronically excited states of metal complexes, charge-transfer spectra, charge transfer excitations, methods, for obtaining charge-transfer spectra.

iv. Ligand field Photochemistry : 8 hrs

Photosubstitution, photooxidation and photoreduction, lability and selectivity. Zero vibrational levels of ground state and excited state, energy content of excited state, zero-zero spectroscopic energy, development of the equations for redox potentials of the excited states.

v. Redox reactions by excited Metal Complexes : 16 hrs.

Energy transfer under conditions of weak interction and strong interaction exciplex formation : Conditions of the excited states to be useful as redox reactants. excited electron transfer, metal complexes as attractive candidates (e,2'-bipyridine and 1,10-phenonthroline complexes), illustration of reducing and oxidising character of Ruthenium^{2+} (bipyridal complex), comparison with fe $(bipy)_3$ role of spin-orbit coupling-life time of these complexes. Application of redox processes of electronically excited states for catalytic purposes transformation of low energy reactants into high energy products, chemical energy into light.

vi. Metal Complex Sensitizers : 8 hrs.

Metal complex sensitizer, electron relay, metal or oxide systems water photolysis, nitrogen fixation and carbon dioxide reduction.

Books Suggested

1. Principles and application of Organotransition Metal Chemistry, J.P. Collman. L.S. Hegsdus, J.R. Norton and R.G. Finke, University Science Books.
2. The Organometallic Chemistry of the Transition Metals, R.H. Crabtree, John Wiley.
3. Metallo-organic Chemistry, A.J. pearson, Wiley.
4. Organometallic Chemistry. R.C. Mehrotra and A. Singh. New Age Internation.
5. Concepts of Inorganic Photochemistry. A.W. Adamson and P.D.

Fleischaur. Wiley.
6. Inorganic Photochemistry. J. Chem. Educ., vol. 60 no. 10 1983.
7. Progress in Inorganaic Chemistry, vol. 30 ed. S.J. Lippard, Wiley.
8. Coordination Chem Revs., 1981. vol, 39, 121, 131, 1975. 15, 321, 1990, 97, 313.
9. Photochemistry of Coordination Compounds, V.Balzan and V. Carassiti Academic Press.
10. Elements of Inorganic Photochemistry, G.J. Ferraudi, Wiley.

MSc. Part - II Optional Papers

GROUP 'A'

PAPER - IV

M.M. ...

Section - A

BIOINORGANAIC CHEMISTRY : 60 hours

i Metal Storage Transport and Biomineralization : 5 hrs

Ferritin, Transferrin, and siderophores.

ii Calcium in biology : 6 hrs

Calcium in living cells, transport and reulation molecular aspects of intramolecular processes, extracellular binding proteins.

iii. Metalloenzymes : 20 hrs

Zinc enzymes - carboxypeptidase and carbonic anhydrase. Iron enzymes Catalase. peroxidase and cytochrome p-450. Copper enzymes - superoxide dismutase Molybdenum oxatransferase enzymes - xanthine oxidase. Coenzyme vitamm B12.

iv. Metal-Nucleic Acid Interactions : 6 hrs

Metal ions and metal complex interactions metal complexes - nucleic acids.

v. Metals in Medicin : 5 hrs

Metal deficiency and disease, toxic effects of metals, metals used for diagnosis and chemotherapy with particular reference to anticancer drugs.

vi. Concepts and language of Supramolecular Chemistry : 18 hrs

(A) Molecular recognition : Molecular receptors for different tpes of molecules including arisonic substrates, design and synthesis of coreceptor molecules and multiple recognition.

(B) Supramolecular reactivity and catalysis.

(C) transport processes and carrier design.

(D) Supramolecular divices. Supramolecular photochemistry, supramolecular electonic, ionic and switching devices. Some examples of self-assembly in supramolecular chemistry.

Section - B

ANALYTICAL CHEMISTRY 60 hrs

i. Introduction : 12 hrs.

Role of analtical chemistry. Classification of analytical methods - classical and instrumental. types of instrumental analysis. Selecting an analytical method. Neatness and cleanliness. Laboratory operation and practices. Analytical balance. Techniques of weighing errons. Volumetric glassware - cleaning and calibration of glassware Sample Preparation - dissolution and decompositions. Gravimetric techniques. Selecting and handling of reagents, Laboratory notebooks. Safetry in the analytical laboratory.

ii. Errors and Evaluation : 7 hrs

Definition of terms in mean and median, Precision - standard deviation. relative standard deviation. Accuracy - absolute error, relative error, relative error. Types of error in experimental data-determinate (systematic), indeterminate (or random) and gross Sources of errors and the effects upon the analytical results. Methods for reporting analytical data. Statistical evalution of data - indeterminate errors. The uses of Statistics.

iii. Food Analysis : 12 hrs

Moisture, ash, crude protein, fat, crude fibre, carbohydrates calcium. potassium, sodium and phosphate. Food adulteration - common adulterants in food, contamination of food stuffs. Pesticide analysis in food products. Extraction and purification of sample. HPLC. Gas chromatography for organophosphates. Thin-layer chromatography for identification of chlorinated pesticides in food products.

iv. Anlysis of Water Pollution : 12 hrs

Origin of waste water, types, water polluants and their effects. Sources of water pollution - domestic, industrial, agricultural soil and radioactive wastes as sources of pollution. Objectives of analysis - parameter for analysis - colour, turbidity. total solids, conductivity acidity, alkalinity, hardness, chloride, sulphate, fluoride, silica phosphates and different froms of nitrogen. Heavy metal pollution - public health significance of cadmium, chromium, copper, lead, zinc, manganese, mercury and arsenic. General survey of instrumental technique for the analysis of heavy metals in aqueous systems.

v. Analysis of Soil Fuel : 17 hrs

(a) Analysis of soil : moisture, pH, total nitrogen, phosphorus, silica, lime, magnesia, manganese, sulphur and alkali salts.

(b) Fuel analysis : solid, liquid and gas. Ultimate and proximate

analysis heating values-grading of coal. Liquid fuels - flash point. aniline point octane number and carbon residue. Gaseous fuels - producer gas and water gas - calorific value.

Books Suggested

1. Principles of Bioinorganic Chemistry, S.J.Lippard and J.M. Berg, University Sceience Books.
2. Bioinorganic Chemistry, I. Bertini, H.B. Gray, S.J. Lippard and J.S. Valentine University Science Books.
3. Inorganic Biochemistry vols. I and II ed. G.L. Eichhorn, Elsevier.
4. Progress in Inorganic Chemistry, Vols. 18 and 38 ed . J.J. Lippard, Wiley.
5. Supramolecular Chemistry, J.M. Lehn, VCH.
7. Analytical Chemistry, G.D. Christian, J. Wiley.
8. Fundamentals of Analytical Chemistry, D.A. Skoog, D.M. West and F.J. Holler, W.B. Saunders.
9. Analytical Chemistry - Principles, J.H. Kennedy, W.B. Saunders.
10. analytical Chemistry - Principles and Techniques. L.G. Hargis, Prentice Hall.
11. Principles of Instrumental Analysis, D.A. Skoog and J.L. Loary, W.B. Saunders.
12. Principles of Instrumental Analysis, D.A. Skoog, W.B. Saunders.
13. Quantitative Analysis, R.A. Day, Jr, and A.L. Underwood. Prentice Hall.
14. Environmental Solution Analysis, S.M. Khopkar, Wiley Eastern.
15. Basic Concepts of analytical Chemistry, S.M. Khopkar, Wiley Eastern.
16. Handbook of Instrumental Techniques for Analytica Chemistry, F.settle, Prentice Hall.

MSc. Part - II Optional Papers

GROUP 'B'

PAPER - III

MM.--

Section - A

CHEMISTRY OF NATURAL PRODUCTS : 60 hours

i Terpenoids and Carotenoids : 20 hrs

Classification, nomenclature, occurrence, isolation, general methods of structure determination, isoprene rule.

A-1501

10

Structure, determination, stereochemistry, biosynthesis and synthesis of the following representative molecules; Citral, Geraniol, a-Terpeneol, Menthol, Famesol. Zingiberene, Santonin, Phytol, Abietic acid and B- Carotene.

ii Alkaloids : 20 hrs

Definition, nomenclature and physiological action, occurrence, isolation general methods of structure elucidation, degradation, classification based on nitrogen heterocyclic ring. role of alkaloids in plants.

Structure, stereochemistry, synthesis and biosynthesis of the following ephedrine, (+) - Coniine, Nicotine, Atropine, quinine and Morphine.

iii. Steroids : 20 hrs

Occurrence, nomenclature, basic skeleton, Diel's hydrocarbon and stereochemistry. Isolation, structure determination and synthesis of Cholesterol, Bile acids. Androsterone, estosterone, Estrone, Progestrone, Aldosterone. Biosynthesis of steroids.

iv Plant Pigments : 10 hrs

Occurrence, nomenclature and general methods of structure determination Isolation and synthesis of Apigenin, Luteolin, Quercetin, Mycrcetin, Quercetin-3-glucoside Vitexin, Diadzein, Butein, Aureusin, Cyanidin - arabinoside, Cyanidin, Hirsutidin biosynthesis of flavonoids : Acetate pathway and shikimic acid pathway.

Section - B

MEDICINAL CHEMISTRY : 60 hrs

i. Pharmacokinetics : 10 hrs

Introduction to drug absorption, disposition, elimination using pharmasokinetics. important pharmacokinetic parameters in defining drug disposition and in therapeutics. Mention of uses of pharmacokinetics in drug development process.

ii. Antineoplastic Agents : 5 hrs

Introduction cancer chemotherapy, special problems, role of alkylating agents and antimetabolites in treatment of cancer. Mention of carcinolytic antibiotics and mitotic inhibitors. synthesis of mechlorethamine,cyclophosphamide, melphalan, uracil, mustards, and 6-mercaptopurine. Recent development in cancer chemotherapy. Hormone and natural products.

iii. Cardiovascular Drugs : 10 hrs

Introduction, cardiovascular diseases, drug inhibitors of peripheral sympathetic function central intervention of cardiovascular output. Direct acting arteriolar dilators. Synthesis of anyl nitrate, sorbitrate, diltiazem, quinidine, verapamil, methyldopa, atenolol oxyprenolol,

iv. Local Antiinfective Drugs : 13 hrs

Introduction and general mode of action. Synthesis of sulphonamides, furazolidone, nalidixic acid, ciprofloxacin, norfloxacin, dapsone, amino salicylic acid, isoniazid. ethionamide, ehtambutal, fluconazole, econozole, griseofulvin, cholroquin and primaquin.

v. Psychoactive Drugs - The Chemotherapy of Mind : 1 5 hrs

Introduction, neurotransmitters, CNS depressants, general anaesthetics, mode of action of hypnotics, sedatives, anti-anxiety drugs, benzodiazipines, buspirone neurochemistry of mental diseases. Antipsychotic drugs - the neuroleptics, antidperessants, butyrophenones, seredipity and drug development, stereochemical aspects of psychotropic drugs.

synthesis of diazepam, oxazepam, chlorazepam, alprazolam, phenytoin, ethosuximide. trimethadione, barbitrates, thiopental sodium, glutethimide.

vi. Antibiotics : 15 hrs

Synthesis of penicillin G, penicillin v, ampicillin, chloramphenicol, cephalosporin, tetracyclin and streptomycin.

Books Suggested

1. Natural products Chemistry and Biological Significance, J.Mann, R.S. Davidson J.B. Hobbs, d.V. Banthrope and J.B. Harborne, Longman, Essex.
2. Organic Chemistry, vol. 2 I.L. Finar, ELBS.
3. Stereoselective Synthesis : A Practical Approach, M. Nogradi, VCH.
4. Rodd's Chemistry of Carbon Compounds, Ed. S. Coffey, Elsevier.
5. Chemistry. Biological and Pharmacological Properties of Medicinal Plants from the Americas. ED. Kurt Hostettmann, M.P. Gupta and A. Marston, Horwood Academic Publishers.
6. Introduction to Flavonoids, B.A. Bohm, Harwood Academic Publishers.
7. New trends in Natural Product Chemistry, Atta-ur-Rahman and M.L. Choudhary, Harwood Academic Publishers.
8. Insecticides of Natural Origin, Sukh Dev, harwood Academic Publishers.
9. Introduction to Medicinal Chemistry, A Gringuage, Wiley-VCH.
10. Wilson and Gisvol's Text Book of Organic Medicinal and Pharmaceutical Chemistry. Ed. robert F.Dorge.
11. an Introduction to Drug Design, S.S Pandeya and J.R. Dimmock, New Age Internation.

12. Burger's Medicinal Chemistry and Drug Discoverty, vol 1 (Chapter - 9 and Ch- 14), Ed. M.E. Wolff, John Wiley.
13. Goodman and Gilman's Pharmacological Basis of Therapeutics, McGraw-Hill.
14. The Organic chemistry of Drug Design and Drug Action. R.B. Silverman Academic Press.
15. Strategies for organic Drug Synthesis and Design. D. Lednicer, John Wiley.

MSc. Part - II Optional Papers

GROUP 'B'

PAPER - IV

MM. --

Section - A

PHYSICAL ORGANIC CHEMISTRY : 60 hours

i Concepts in Molecular Orbital (MO) and Valence Bond (VB) Theory : 15 hrs

Introduction to Juckel molecular orbital (MO) method as a means to explain modern theoretical methods. Advanced techniques in PMO and FMO theory. Molecular mechanics, semi empirical methods and ab inito and density functional methods. Quantitative MO theory - Huckel molecular orbital (HMO) method as applied to ethene allyl and butadiene. Qualitative MO theory - ionisation potential. Electron affinities MO energy levels. Orbital symmetry. Orbital interaction diagrams. MO of simple organic systems such as ethene, allyl, butadiene, methane and methyl group Conjugation and hyperconjugation. Aromaticity. Valence bond (VB) configuration mixing diagrams. Relationship between VB configuration mixing and resonance theory. Reaction profiles. Potential energy diagrams Curve-crossing model - nature of activation barrier in chemical reactions.

ii. Principles of Reactivity : 8 hrs

Mechanistic significance of entropy, enthalpy and Gibb's free energy. Arrhenius equation. Transition state theory. Uses of activation parameters. Hammond's postulate. Bell-Evans-Polanyi principle. Potential energy surface model. Marcus theory of electron transfer. eactivity and selectivity principles.

iii. Solvation and Solvent Effects: 12 hrs

Qualitative understanding of solvent-solute effects on reactivity. Thermodynamic measure of solvation. Effects of solvation on reaction rates and equilibria Various empirical indexes of solvation based on physical properties solvent-sensitive reaction rates. spectroscopic properties and

scales for specific solvation. Use of solvation scales in mechanistic in mechanistic studies. Solvent effects from the curve-crossing model.

iv. Acids, Bases, Electrophiles, Nucleophiles and Catalysis : 8 hrs

Acid-base dissociation, Electronic and structural effects, acidity and basicity. Acidity functions and their applications. Hard and soft acids and bases. Nucleophilicity scales. Nucleofugacity. The a-effect. Ambivalent nucelophiles. Acid-base catalysis specific and general catalysis. Bronsted catalysis. Nucleophilic and electrophilic catalysis. Catalysis by non-covalent binding-micellar catalysis.

v. Steric and Conformational Properties : 8 hrs

Various types of steric strain and their influence on reactivity. Steric acceleration. Molecular measurements of steric effects upon rates. Steric LFER. Conformational barrier to bond rotation-spectroscopic detection of individual conformers. Acyclic and monocyclic systems. Rotation around partial double bonds. Winstein-Holness and Curtin-Hammett principle.

vi. Nucleophilic and Electrophilic Reactivity : 15 hrs

Structural and electronic effects on S_N^1 and S_N^2 rectivity. Solvent effects. Kinetic isotope effects. Intramolecular assistance. Electron transfer nature of S_N^2 reaction Nucleophilicity and S_N^2 reactivity based on curve-crossing model. Relationship between polar and electron transfer reactions. S_{RN}^2 Mechanism. Electrophilic reactivity. general mechanism. Kinetic of $S_E^{2\text{-}Ar}$ reaction. Structural effects on rates and selectivity. Curve-crossing approach to electrophilic reactivity.

vii. Radical and Pericyclic Reactivity : 11 hrs

Radical stability, polar influences, solvent and steric effects. A curve crossing approach to radical addition, factors affecting barrier heights in additions. redioselectivity in radical reactions.

Reactivity, specificity and periselectivity in pericyclic reactions

Section - B

HETEROCYCLIC CHEMISTRY : 60 HRS

i. Nomenclature of Heterocycles : 4 hrs

Replacement and systematic nomenclature (Hantzsch-Widman system) for monocyclic, fused and bridged heterocycles.

ii. Aromatic heterocycles : 5 hrs

General chemical behaviour of aromatic heterocycles. Classification (structural type) criteria of aromaticity (bond lengths, ring current and chemical shifts in ^1H NMR - spectra, empirical resonance energy, delocalization energy and Dewar resonance energy, diamagnetic susceptibility exaltations).

Heteroaromatic reactivity and tautomerism in aromatic heterocycles.

iii. Non-aromatic Heterocycles : 6 hrs

Strain-Bond angle and torsional strains and their consequences in small ring heterocycles.

Conformation of Six-membered heterocycles with reference to molecular geometry. barrier to ring inversion, pyramidal inversion and 1,3-diaxial interaction.

Stereo-electronic effects - anomaric and related effects. Attractive interactions hydrogen bonding and intermolecular nucleophilic - electrophilic interactions.

iv. Heterocyclic Synthesis : 4 hrs

Principles of heterocylic sysnthesis involving cyclization reactions and cyclo addition reactions.

v. Small ring Heterocycles : 5 hrs

Three-membered and four-membered heterocycles-synthesis and reactions of aziridines, oxiranes, thiiranes, azetidines, oxetanes and thietanes.

vi. Benzo-Fused Five-Membered Heterocycles : 5 hrs

synthesis and reactions including medicinal applications of benzopyrroles benzofurans and benzothiophenes.

vii. Six-membered Heterocycles with One Heteroatom : 11 hrs

Synthesis and reactions of pyrylium salts and pyrones and their comparison with pyridinium and thiopyrylium salts and pyridones.

Synthesis and reactions of quinolizinium and benzopyrylium salts, coumarins and chromones.

viii. Six-Membered heterocycles with two or More Heteroatoms : 10 hrs.

Synthesis and reactions of diazines, triazines, tetrazines and thiazines

ix. Seven - and large membered Helerocycles : 5 hrs

Synthesis and reactions of azepines, oxepines, thiepines, diazepines, thiazepines, azocines, diazocines, dioxocines and dithiocines.

Books Suggested.

1. Molecular Mechanics, U.Burkert and N.L. Allinger. ACS Monograph 177,1982.
2. Organic Chemists Book of Orbitals, L.Salem and W.L. Jorgensen. Academic Press.

3. Mechanism and Theory in Organic Chemistry, T.H. Lowry and K.K. richardson Harper and Row.
4. Introduction to Theoretical Organic Chemistry and Molecular Modelling. W.B. Smith. VCH Weinherm.
5. Physical Organic Chemistry. N.S. Isaacs, ELBS/Longman.
6. Supramolecular Chemistry : Concepts and Perspectives, J.M. Lehn. VCH.
7. The Physical Basis of Organic Chemistry. H. Maskill. Oxford University Press.
8. Heterocyclic Hemistry Vol. 1-3, R.R. Gupta, M.Kumar and V.Gupta, Springer verlag.
9. The Chemistry of Heterocycles, T.Eicher and S. Hauptmann, Thieme.
10. Heterocyclic Chemistry, J.A. Joule, K. Mills and G.F. Smith, Chapman and Hall.
11. Heterocyclic Chemistry, T.L. Filchrist, Longman Scientific Techinal.
12. An Introduction to the Heterocyclic Compounds, R.M. Acheson John Wiley.
13. Comprehensive heterocyclic Chemistry, A.R. Katritzky and C.W. Rees eds Pergamon Press.

MSc. Part - ii Optional Papers

GROUP 'C'

PAPER - III

MM. - -

Section - A

A-1503

ADVANCED QUANTUM CHEMISTRY: 60 hours

(Pre-requisite : mathematics at least up to First Year B.Sc. level is necessary. At least one PC among 4 students should be available)

i. Theoretical and computational Treatment of Atoms and Molecules, Hartree-Fock Theory : 20 hrs

Review of the principles of quantum mechanics, Born- Oppenheimer approximation. Slater-Condon rules, Hartree-Fock equation. Koopmans and Brilouin theories, Roothan equation, Gaussion basis sets.

ii. Configuration Interaction and Mc-SCF : 12 hrs

Introduction to CL; full and truncated CI theories, size consistency. Introductory treatment of coupled cluster and MC-SCF methods.

iii. Semi-Emprirical Theories : 12 hrs

Areview of the Huckel, EHt and PPP treatments. ZDO approximation detailed treatment of CNDO and INDO theories. A discussion of electronic energies and properties. An introduction to MOPAC and AMI

with hands on experience on personal computers.

iv. Density Functional Theory : 12 hrs

Derivation of Hohenberg-Kohn theorem, Kohn-Sham formulation, N- and V-representabilities; review of the performance of the existing local (e.g. Slater Xa and other methods) and non-local functionals, treatment of chemical concepts concepts with the density functional theory.

v. Computer experiments : 12 hrs

Computer experiments using quantum chemistry - software packages such as GAUSSIAN/GAMESS/MOPAC and modelling software e.g. MM2/AMBER/CHARM etc.

Section - B

LIQUID STATE : 60 hrs

i. General Properties of Liquids : 13 hrs

(a) Liquids as dense gases, Liquids as disordered solids, some thermodynamic relations, internal pressure and its significance in liquids equations of state, critical constants, Different types of intermolecular forces in liquids, different potential functions for liquids additivity of pair potential approximation.

(b) A classical partition function for liquids, correspondence principle. configuration integral configurationproperties.

ii. Theory of iquids : 9 hrs

Theory of liquids, partition function methods of model approach, single cell models, communal energy and entropy, LTD model, significant structure model.

iii. Distribution Function and Related Equations : 14 hrs

Radial distribution function methods, equation of state in terms of RDF molecular distribution functions, pair distribution function. Relationship between pair distribution function and pair potential function. The IBG equation, the HNC equation the PY equation, cluster expansion.

iv. Methods for Structure Determination and Computational Techniques : 12 hrs

Spectroscopic techniques for liquid dynamic structure studies, Neutron and X-ray scattering spectroscopy.

Computation Techniques - Monte Carlo and Moleculardynamics methods.

v. Supercooled and Ionic Liquids : 12 hrs

Supercooled and Ionic liquids, theories of transport properties non-Arrhenius behaviour of transport properties, Cohen-Turnbull free volume model Configurational entropy model, Macedo-Litovitz hybrid model glass

transition in super cooled liquids.

Books Suggested

1. Modern Quantum Chemistry, N.S. Ostlund & A. Szabo, mcGraw Hill.
2. Methods of Molecular Quantum Mechanics, R. McWeeny and B.T. Sutcliffe Academic Press.
3. Density Functional Theory of Atoms and Molecules, R.G. Parr and W. Yang. Oxford.
4. Exploring chemistry with Electron Structure Methods, J.B.Foresman and E.Frisn. Goussian Inc.
5. Semi-emprirical MO Theory, J. Po;le and D.L. Beveridge.
6. An Introduction to Liquid State, P.A. Egelstaff, Academic Press.
7. The Dynamic Liquid State A.F.M. Barton, Longman.
8. Introduction to Statistical Thermodynamics, T. Hill, Addison Wiley
9. The Liquid State, J.A. Pryde.
10. Significant Liquid Structures, H.Eyring and M.S. John.

MSc. Part - II Optional Papers

GROUP 'C'

PAPER - IV

MM. - -

Section - A

CHEMISTRY OF MATERIALS : 60 hours

i. Multiphase Materials : 5 hrs

Ferrous alloys; Fe-C phase transformations in forrous alloys; stainless steels. non-ferrous alloys, properties of ferrous and non-ferrous alloys and their applications.

ii. Glasses, Ceramics, Composites and Nanomaterials : 5 hrs

Glassy state, glass formers and glass modifiers, applications, Ceramic structures mechnical properties, clay products. Refractories, characterizations, properties and applications.

Microscopic composites; dispersion-strengthened and particle-reinforced. fibrereinforced composites, macroscopic composites. Nanocrystaline phase, preparation procedures, special properties, applications.

iii. Thin Films and Langmuir-Blodgett Films : 5 hrs

Preparation techniques; evaporation/sputtering. Chemical processes

MOCVD sol-gel etc. Langmuir-Blodgett (LB) film, growth techniques, photolithography, properties and application of thin and LB films.

iv. Liquid Crystals : 10 hrs

Mes morphic behaviour, thermotropic liquid crystals positional order, bond orientational order, nematic and smectic mesophases, smectic-nematic transition and clearing temperature - homeotropic, planar and schlieren textures, twisted nematics. chiral nematics, molecular arrangement in smectic A and smectic C phases, optical properties of liquid crystals. Dielectric susceptibility and dielectric constants. Lyotropic phases and their description of ordering in liquid crystals.

v. Poly materials : 5 hrs

Molecular shape, structure and configuration, crystallinity. stress-strain behaviour thermal behaviour, polymer types and their application, conducting and ferro-electric polymers.

vi. Ionic Conductors : 8 hrs

Types of Ionic conductors, mechanism of ionic conduction. Interstitial Jumps (Frenkel) vacancy mechanism, diffusion superionic conductors: phase transitions and mechanism of conduction in superionic conductors, examples and applications of ionic conductors.

vii. High Tc Materials : 10 hrs

Defect perosovkites, high Tc superconductivity in cuprtales, preparation and characterization of 1-2-3 and 2-1-4 materials, normal state properties; anisotropy, temperature dependence of electrical resistance; optical phonon modes; superconducting state; heat capacity; coherence length, elastic constants, position lifetimes, microwave absorption-pairing and multigap structure in high Tc materials. applications of high Tc materials.

viii. Materials for Solid State Devices : 3 hrs

Rectifiers, transistors, capacitors - IV-V compounds,low-di-mensional quantum structures; optical properties.

ix. Organic Solids, Fullerenes, Molecular Devices : 9 hrs

Conducting organics, organic superconductors, magnetism in organic materials. fullerenes-doped fullerenes as superconductors.

Molecular rectifiers and transistors, artificial photosynthetic devices, optical storage memory and switches-sensors.

Nonlinear optical materials : nonlinar optical effects, second and third order - Molecular hyperpolarisability and second order electric susceptibility - materials for second and third harmonic generation.

Section - B

POLYMERS : 60 hrs

i. Basics : 8 hrs

Importance of polymers. Basic concepts : Monomers, repeat units, degree of polymerization. Linear, branched and network polymers. Classification of polymers. Polymerization : Condensation, addition, radical chain-ionic and co-ordination and co-polymerization. Polymerization conditions and plmer reactions. Polymerization in homogeneous and heterogeneous systems.

ii. Polymer Characterization : 14 hrs

Polydispersion-average molecular weight concept. Number, weight and viscocity average molecular weights. Polydispersity and molecular weight distritution. The practical significance of molecular weight. Measurement of molecular weights. End-group, fiscocity, light scattering, osmotic and ultracentrifugation methods. Analysis and testing of polymers-chemical analysis of polymers. Spectroscopic methods, X-ray diffraction study. Microscopy. Thermal analysis and physical testing - tensile strength, Fatigue, impact. Tear resistance. Hardness and abrasion resistance.

iii. Structure and Properties : 14 hrs

Morphology and order in crystalline polymers - configurations of polymer chains. Crystal structures of polymers. Morphology of crystalline polymers. straininduced morphology, crystallization and melting Polymer structure and physical properties - crystalline melting point Tm-melting points of homogeneous series, effect of chain flexibility and other steric factors, entropy and heat of fusion. The glass transition temperature, Tg - Relationship between Tm and Tg, effects of molecular weight, diluents, chemical structure, chain topology, branching and cross linking. Property requirements and polymer utilization.

iv. Polymer Processiong : 12 hrs

Plastics, elastomers and fibres, Compounding. Processing techniques calendering, die casting, rotational casting, film casting, injection moulding, blow moulding, extrustion moulding, thermoforming, foaming, reinforcing and fibre spinning.

v. Properties of Commercial Polymers : 12 hrs

Polyethylene, polyvinyl chloride, polyamides, polyesters, phenolic resins. epoxy resins and silicone polymers. Functional polymers - Fire retarding polymers and electrically conducting polymers. Biomedical polymers - contact lens. dental polymes, artificial heart, kidney, skin and blood cells.

Books Suggested -

1. Solid State Physics. N.W. ashcroft and N.D. Mermin, Saunders College.
2. Materials Science and Engineering An Introduction, W.D. Callister, Wiley.
3. Principles of the Solid State, H.V. Keer. Wiley Eastern.
4. Materials Science, J.C. Anderson, K.D. Leaver, J.M. Alexander and R.D. Rawlings, ELBS.
5. Thermotropic Liquid Crystals, Ed. G.W. Gray. John Wiley.
6. Handbook of Liquid Crystals, Kelker and hatz, Chemie Verlag.
7. Textbook of Polymer Science, F.W. Billmeyer Jr., Wiley.
8. Polymer Science V.R. govariker, N.V. viswanathan and J. Sreedhar, Wiley-Eastern.
9. Functional Monomers and Polymers. K. Takemoto, Y. Inaki and R.M. Otranbrite.
10. Contemporary Polymer Chemistry. H.R. Alcock and F.W. lambe, Prentice Hall.
11. Physics and Chemistry of Polymes. J.M.G. Cowie, Blackie Academic and Professional.

LABORATORY COURSE - GENERAL

12 hrs. (spread over two days) **100 marks**

Note : The laboratory course (General) will be of 12 hrs duration spread over two days. The examinee will have to perform three exprimments (one each from Section A,B, and C) . These experiments will be of 20 marks each. 20 marks each will be alloted for vivavoce and sessional work.

SECTION - A [INORGANIC CHEMISTRY]

Instrumental methods and Analytical Techniques :

A. Spectrophotometric Determinations

i. Mar:aganese/Chromium/Vanadium in steel sample.
ii. Nickel/Molybdenum/Tungsten/Vanadium/Uranium by extractive spectrophotometric method.
iii. Fluoride/Nitrite/Phosphate/Nitrate
iv. Iron-phenanthroline complex : Job's Method of continuous variations.
v. Zirconium-alizarin Red-S complex : Mole-Ratio method.
vi. Copper-Ethylene diamine complex : Slope-ratio method.

B. pH metry -

stepwise proton-ligand and metal-ligand stability constant of complexes by Irving-Rossoti methods.

C. Polarography

Composition and stability constant of complexes.

D. Flame Photometric Determinations

i. Sodium and potassim when present together.

ii. Lithium/Calcium/Barium/Strontium.

iii. Cadmium and magneium in tap water.

E. Nephelometric Determinations

i. Sulphate

ii. Phosphate

iii. Silver

F. Separation and Quantitative Estimation of binary and Ternary Mixtures by the use of following Separation Techniques :-

i. Paper chromatograph - Cadmium and Zinc. Zinc and Magnesium.

ii. Thin-layer chromatography-separation of nickel, manganese. co balt and zinc. Determination of R_f values.

iii. Ionexchange.

iv. Solvent extraction.

v. Electrophoretic separation.

SECTION - B [ORGANIC CHEMISTRY]

A. Quantitative Organic Analysis

i. Estimation of sulphur by Messenger;s Method.

ii. Estimation of nitrogen by Kjeldahl Method.

iii. Estimation of halogen by Fusion Method.

B. Functional Group Estimation

iv. Estimation of Aniline.

v. Estimation of Amino group by acetylation method.

vi. Estimation of Hydroxyl group by acetylation method.

vii. Estimation of Carbonyl group by hydrazone formation method.

C. Chromatography

Separation and identification of the sugars present in the given mixture of glucose, fructose and sucrose by paper chromatography and determination of R_f values.

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SECTION - C [PHYSICAL AND ANALYTICAL CHEMISTRY]

Physical Chemistry :

A. Conductometry

i. To verify debye Huckel and Onsager limiting law for strong electrolyte.

ii. To determine the degree of hydrolysis and hydrolysis constant of NH4Cl/Aniline hydrochloride at room temperature.

iii. To determine the basicity of a organic acid.

iv. to determine the equivalent conductance of an electrolyte at infinite dilution and determine the dissociation constant.

B. Colorimetry

i. To determine the indicator constant pKin of methyl red spectraphotometrically.

ii. To verify additivities of absorbances of a mixture of a coloured substance in a solution using $KMnO_4$ and $K_2C_{r2}O_7$ solutions.

C. pH metry

i. To determine pK of given dibasic and tribasic acid.

ii. To determine the pH of various mixtures of acetic acid and Na-acetate in aqueous solutions and hence determine the dissociation constant of the acid.

D. Potentiometry

i. Titrate ferrous ammonium suphate against. $K_2C_{r2}O_7/KMnO_4$ and determine redox potential of ferric system.

ii. to determine ionization constant of polybasic acid.

E. Distribution Coefficient

i. To determine the formula of the complex formed between curpicion and ammonia by distribution method.

ii. To determine the equilibrium constant of the following reaction :

$$KI + I_2 - KI_3$$

F. Partial Molar Volume

i. Determine the partial molar volume of Nacl in aq. solution at room temperature.

Analytical Chemistry :

1. Preparation of homo-and hetero-polyacids of Sb,V, Nb, Ta, Cr,Mo, W etc. and study their properties.

2. Determination of Pk_a of weakacids by pH metric and spectrophotometric methods.
3. Determination of distribution ratio and distribution coefficient of organic and inorganic compounds.
4. Separation of organic compounds by the chromatographic techniques i.e. TLC paper chromatography, column chromatography, electrophoresis etc.
5. Analysis of carbohydrates, amino acids, protein, alkaloids, etc.
6. analysis of pharmaceutical materials, preservatives, flavor,, additives, etc.
7. Application of redox titration for analysis of Sn(IV), Fe(III), Cr(VI) and Mn(VII).
8. analysis of ore, mineral, alloys.
9. Determination of equilibration constant and composition of complexes.
10. Determination of dimerization/polymerization constant.

Books

1. Text Book of quantitative Chemiscal Analysis by A.I. vogel.
2. Experimental Physical Chemistry by Das & Behra.
3. Practical Physical Chemistry by Alexander Findlay.

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SPECIAL PRACTICAL COURSE FOR GROUP 'A' PHOTO INORGANAIC & ORGANO-TRANSITION CHEMISTRY

12 hrs. (in two days) 100 marks

Note : Special Practical Course for Group 'A' will be of 8 hrs duration spread over two days. The examinee will have to perform three experiments (one each from Section A,B, and C). These experiments will be of 20 marks each 20 marks each will be alloted for viva-voce and sessional work.

SECTION - A

A. Preparation :

Preparation of selected inorganic comounds and their study by IR, electronic spectra, Mossbauer, ESR, and magnetic susceptibility measurements. Handling of air and moisture sensitive compounds involving vacuum lines. Selection can be made from the following.

1. Sodium amide. Inorg. Synth., 1946, 2, 128
2. Synthesis and thermal analysis of group II metal oxalate hy drate, J. Chem. Ed., 1988. 65, 1024.
3. Atomic absorption analysis of Mg and Ca.
4. Trialkoxyboyboranes - Preparation, IR, and NMR spectra.
5. $PhBCl_2$ Dichlorophenylborane -Synthesis in vacuum line.
6. Preparation of Tin (IV) iodide, Tin(IV) chloride and Tin (II) iodide Inorg. Synth. 1953. 4. 119.
7. Relative stability of Tin (IV) and Pb (IV). Preparation of ammonium hexachlorostannate $(NH_4)_2\ SnCl_6$, ammonium hexachloroplumbate $(NH_4)\ PbCl_6$.
8. Hexa - bis (4- nitrophenoxy) cyclotriphosphazene.
9. Synthesis of Trichlorodiphenylantimony (V) hydrate. Inorg. Synth. 1985, 23, 194.
10. Sodium tetrathionate $Na_2\ S_4O_6$.
11. Metal complexes of Dimethyl sulfoxide (IR) : $CuCl_2$ 2 DMSO, $pdCl_2$. 2DMSO, $RuCl_2$, 4DMSO, Chem. Edu, 1982 59.57.
12. Synthesis of metal acetylacetonate : Magnetic moment, IR, NMR Inor, Synth. 1957. 5. 130: 1963. 1. 183.
13. Bromination of Cr $(acac)_2$, J.Chem. Edu., 1986,63,90.
14. Magnetic moment of $Cu(acac)_2H_2O$
15. Cis and Trans $[Co(en)_2Cl_2]$.
16. Separation of optical isomer of cis-[Co(en)2 Cl2] J.Chem. Edu. 1960, 4369
17. Ion Exchange separation of oxidation state of vanadium. J. Chem.

Edu., 1980, 57 316; 1978, 55,55.

18. Determination of Cr (III) complexes. $[Cr(H_2O_6]\ NOl_3 3H_2O$; $[Cr(H_2O)_4]\ Cl.2H_2O$; $[Cr(en)_3]\ Cl_3$, $Cr\ (acac)_3$, Inorg. Synth., 1972. 13. 184.
19. Preparation of N, N bis (salicyldehyde) ethylene, salen H_2, Co(Salen) J. chem. Educ., 1977, 54, 443; 1973, 50,670.. Determination of O_2 absorption by Co(salen) Acct. Cem.Res., 1975, 8,384. Reaction of oxygen adduct with $ChCl_3$ (deoxygenation).
20. Preparation of Fe(II) Chlorine use it as Friedel-Craft chlorination source. J.Org.Chem., 1978, 43, 2423; J. Che. Edu., 1984, 61, 645; 1986, 63, 361.
21. Reaction of Cr (III) with a multidentate ligand : a kinetic experiment (visible spectra Cr - EDTA complex) J.A.C.S., 1953, 75, 5670.
22. Preparation of [Co (phenonthroline - 5, 6-quinone)]. J. Chem.Soc., A., 1970, 447. J. Chem. Edu., 1977, 54, 710.
23. Preparation and use of Ferrrocene. J. Chem.edu., 1966, 43, 73; 1976, 53, 730.
24. Preparation of copper glycine complex - cis and trans bis]glycinato Copper (II)] J. Chem. Soc. Dalton, 191979, 1901, J.Chem. Edu., 1982, 59, 1052.
25. Preparation of phosphine Ph3P and its transition metal complexes.
26. Any other experiment such as conversion of p-xylene to terephthalic acid catalyzed by CoBr2 (homogeneous catalysis).

SECTION - B

1. **Inorganic Reaction Mechanism :**

   Kinetics and mechanism of folowing reactions :

   i. Substitution reactions in octahedral complexes (acid hydrolysis and base hydrolysis).
   ii. Redox reaction in octahedral
   iii. Isomerisation reaction of octahedral.

2. **Bio-Inorganic chemistry :**

   i. Extraction of chlorophyll from green leaves of students choice. Separation of chlorophylls and their electronics spectral study.
   ii. Complexation study of Cu(II) ion with biologically important aminoacids.

3. **Inorganic Photochemistry :**

   i. Synthesis of potassium ferrioxalate and determination of the intensity of radiation.

ii. Photo-oxidation of oxalic by UO2 sensitization.
iii. Photodecomposition of HI and Determian of its quantum yield.

Books Suggested -

1. A.W. Adamson and P.D. Fleischaner : Concept of inorganic Photo chemistry.
2. V. Balani and V.Carassili : Photocheistry of coordination compounds.
3. K.K. Rohatgi Mukhergee : Fundamentals of Photochemistry.
4. Quarterly Reviews 21,213 (1967)
5. Coordination Chemistry Reviews : 3,169(1968)
6. Quarterly Reviews : 8,422 (1954)
7. G.L. Eichhorn : Inorganic Biochemistry, Vols. I,II.
8. M.W. Hughes norganic Chemistry of Biological Process.
9. Purchell and Kotz: Inorganic Chemistry.
10. R.C. Mehrotra and A Singh : Organometallic Chemistry : An Introduction.
11. J.J. Lagoswski : Modern Inorganic Chemistry.
12. Cotton and Wilkinson (Vth) Edition : Advanced Inorganic Chemistry.

SECTION - C

1. **Complete analysis of alloys, ores and mineral -**

   (a) Ni Al Alloy (b) Ag, Cu, Ni and Zn alloy
   (c) Cu, Ni and Zn Allo (d) Stainless steel
   (e) Dolomite Silica Sesquioxide, Ca, Mg
   (f) Haematite, Silica, Al, Ca & Mg.
   (g) Bauxite Silica Fe, Be.

2. **Inorganic preparation of advanced nature :**

Complex salt of Cobalt and chromium with various coordination spheres. Barium tetrathio corbonate, Ammonium tetrathio cupprato potassium perchlorate Red. Mercuric sulphide, Ammonium meta Vanadate, tin (VI) Iodide, Silicotungestic acid.

3. **Experiments baed on the following instrumental techniques :**

(a) Colorimetry and spectrophotometry, Beer's law, stimation of inorganic ions, pH various of indicators and study of complexes by various methods Absorption spectra in visible and ultraviolet region.

(b) Potentiometry - Dissociation constant of acids, Redox potentials and study of complex formation.

(c) pH metry - Dissociation constants of acids, study of complex.

(d) Conductometry Determination of solubility and solubility product, Dissociation constants of acids and quantitative determination of mixture of halides.

(e) Polarography. Use of dropping mercury and rotating platinum electrodes half wave potentials of Zn and cadmium and their determination in trace amount and study of complex.

(f) Dipole moment measurement of dielectric constants of liquids, calculation of dipole moment.

(g) Other experiments of Advanced Nature.

Books Suggested.

1. Cotton and wilkinson Advanced inorganic Chemistry 3rd Ed.
2. Dey and Selbin Theoretical Inorganic Chemistry 3rd Ed.
3. Emeleus and Anderson Modern Aspects of Inorganic Chemistry.
4. Barnar J. Theoretical Principles of Inorganic Chemistry.
5. Pauling The Nature of Chemical Bond
6. Gilerath Fundamental Concepts in Inorganic Chemistry.
7. Dongilas & Mecdanial Concepts and Models in Inorganic Chemistry.
8. Harvey and Borter Introduction of Physical Inorganic Chemistry.
9. Durrant and Durrant Introduction to Advanced Inorganic Chemistry.
10. Drago, R.S. Physical Methods in Inorganic Chemistry.
11. Weddington Non Aqueous Solvent System Part I & II
12. Chemistry in Non-aqueous Solvents.
13. Satya Prakash Advanced Chemistry of Ray elements
14. Moeller Advanced Inorganic Chemistry.
15. Rabinso and Helsop Inorganic Chemistry.
16. Glenn and Seaorg The Transuranium Elements
17. Moeller The Chemistry of Lanthanides
18. Jully N. Synthetic Inorganic Chemistry.
19. Sheeds Maynard Comprehensive Inorganic Chemistry Vol. I to XIV
20. Enediander & Keennedy Introduction to Radio Chemistry Chemistry of Nuclear & Radiation Chemistry
21. Overman Basic Concepts of Nuclear Chemistry.
22. Vogel Text Book of Quantative Inorganic Analysis 4th Ed.
23. Meits and thoms Advanced Analytical Chemistry.
24. Ayres Quantitative Chemistry Analysis
25. Treadwell and hall Analytical Chemistry vol. I and II
26. Busev/poliankit The use of Organic Reagents in Inorganic Analysis
27. Figgis Introduction to Ligand Fields
28. Nettre Co-ordination Compounds

29. Jones Elementary Co-ordination Chemistry.
30. Bailer Chemistry of the Co-ordination Compounds
31. Liwis & Wilkins Modern Co-ordination Chemistry
32. Basalo & Perason Mechanism of Inorganic Reaction
33. Martell & Calvin Chemistry of Chelete compounds
34. Hahan University Chemistry
35. Malik tuli and Madan Selected topics of Inorganic Chemistry.
36. Benerjee Fundamental principles of Inorganic Chemistry.
37. Emeleus & Sharpe Modern Aspects of Inorganic Chemistry.
38. Bailars, Emeleus Comprehensive Inorganic chemistry Vol. I to V
39. Emeleus Inorganic Chemistry series on Vol. I to x.

SPECIAL PRACTICAL LABORATORY COURSE WITH GROUP 'B'

12 hrs. (in two days) 100 marks

Note : Laboratory course with Group 'B' will be of 12 hrs duration spread over two days. The examinee will have to perform three experiments (one each from section A,B and C) These experiments will be of 20 marks each, 20 marks each will be alloted for viva-voce and sesional work.

SECTION - A

A. Multi-step Synthesis of Organic Compounds :

i. Beckmann Rearrangement :Benzanilide form benzene (Benzene Benzophenone Bnzophenone oxine Benzanilide)

ii. Benzilic Acid Rearrangement : Benzilic acid from Benzoin (Benzoin Benzil Benzilic acid)

iii. Skaraup's synthesis (Synthesis of heterocyclic compounds) Quinoline from 0 - Amono phenol.

iv. p-Bromoaniline from Aniline
(Aniline Acetanilide p-bromoacetanilide p-bromoaniline)

v. p-Nitroacetanilide from Acetanilide
(Aniline Acetanilide p-Nitroactanilide p-Nitroaniline)

vi. m-Nitroaniline from Benzene
(Benzene Nitrobenzene m-dinitrobenzene m-Nitroaniline)

vii. Acridone from Anthranilic acid
(Anthranilic acid o - Chlorobenzoic acid N - Phenylanthranilic acid Acridone)

viii. Enzymatic Synthesis

Enzymatic reduction : Reduction of ethylacetoacetate using baker;s yeast to yield enantiomeric exces of S(+) ethyl-3hydroxybutanone and determine its optical purity.

SECTION - B

B. Extraction of Organic Compounds from Natural Sources :

i. Isolation of caffeine from leaves.
ii. Isolation of Casein from milk.
iii. Isolation of lactose from milk.
iv Isolation of nicotine dipicrate from tobacco.
v. Isolation of Cinchonine from cinchona bark.
vi. Isolation of Piperine from blackpepper.
vii. Isolation of Lycopene from tomatoes.
viii. Isolation of B- Carotene from carrots.

C. Spectroscopy

Indentification of organic compounds by the analysis of their spectral data. (UV, IR, PMR, CMR and MS)

D. Spectrophotometric Estimations :

i. Amino acids
ii. Carbohydrates
iii. Ascorbic acid
iv. Aspirin
v. Caffeine

SECTION - C

1. Estimations : Any one of the following estimations -

i. Halogen (ref. 2, p. 416)
ii. Hydroxy group (ref. 2,p,450)
iii. Amino group (ref.2,p,463)
iv. Carboxy group (ref. 2,p,445)
v. Methoxyl Group (ref.2,p, 497)
vi. Sugars (ref.2,p,460)

2. Preparation of dyes -

i. Indigo (ref. 1,p.980)
ii. Alizarin (ref. 1,p.928)
iii. Malachite green (ref. 3,p.3440)
iv. Methyl orange (ref.1,p.624, ref.2,p.214, ref,3,243)

20

v. Henyl axo B-naphthol (ref.1,p.622)
vi. Other dyes of industrial importance
vii. Identificatiion of a dye on textile fibres (ref 6.p.391, 402)
viii. Quantitative estimation of a dye in textile fibres (ref. 5,p.519)

Ref. Books

1. A.I. Vogel, Practical Organic, Chemistry 3rd Ed. Longman Group Ltd., 1956.
2. F.G. Mann and B.G. Saunders, Practical Organic Chemistry 4th ed. Longman Group Ltd. 1974.
3. R.D. Brewster. C. Vannerweo, W.E. McQuwan United Experiments in Organic Chemistry, 2nd Ed.D. Van Noster and Co.Inc., 1954.

SPECIAL PRACTICAL LABORATORY COURSE WITH GROUP 'C'

12 hrs (in two days) 100 marks

Note : Laboratory course with Group 'C' will be of 12 hrs duration spread over two days. The examinee will have to perform three experiments (one each from section A,B, and C) These experiments will be of 20 marks each. 20 marks each will be alloted ffor viva-voce and sessional work.

SECTION - A

1. Polymers :

i. Preparation and characterisation of plymers, Degree of polymerisation.
ii. Molecular weight determination of polymers.

2. Kinetics of polymerisation.
3. Reaction in micellar media. Kinetic study of Redox Reactions.
4. Glass transition temperature.
5. Viscosity and Surface Tension of polymers.

SECTION - B

Material Science

1. Growth of Single Crystal
   i. by Melt Growth
   ii. by Solution Growth
   iii. by Gel Growth.
2. **Doping in Alkali halide crystals.**

3. X-ray diffraction studies of single crystals
4. Chemical itching studies and itching patterns
5. Luminescence studies with alkali halide crystals.
6. Preparation and characteristisation of 1-2-3 high t.material
7. Study of temperature dependence of Electrical Resistance.

SECTION - C

Quantum Mechanics and Computers -

(a) Density function theory and computers
   i. Density function study using Gaussian
   ii. ab initio theoretical model and ab initio calculations

(b) Use of advanced scientific packages like-GAUSSIAN/GAMES/ MOPEC/AMBER/QUANTA/MM2 and problem solving with these packages.

Note : Other additional experiments of advanced nature may be included for the practice of students if sufficient infrastructure is not avail able in some of the institution opting the Group 'C'

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