MAHARSHI DAYANAND SARASWATI UNIVERSITY AJMER

पाठ्यक्रम

SYLLABUS

SCHEME OF EXAMINATION AND COURSES OF STUDY

FACULTY OF SCIENCE

M.Sc. CHEMISTRY

M.Sc. Semester I & II Examination

(w.e.f. 2018-19)

M.Sc.Semester III & IV Examination

(w.e.f. 2019-20)

महर्षिदयानंद सरस्वती विश्विद्यालय , अजमेर

M.Sc. CHEMISTRY
SEMESTER SCHEME OF EXAMINATION

1. The maximum marks of each Semester Examination will be 300 .There shall be two semesters in one year and four Semesters in all. It will necessary for a candidate to pass in the theory as well as in the practical examination separately.Criteria for pass percentage and division will be as per the university policy for Semester Scheme prescribed uniformly by the university.
2. There will be four papers in each of the four Semesters and 16 papers in all. Each paper will have maximum marks of 50 and examination will be of 3 hours duration. There will be one Practical Examination of 7 hours duration in one day with maximum of 100 marks in every Semester.
3. Each theory paper is assigned four hours per week of teaching. Practical classes are assigned three continuous periods of one hour each per day (18 hours per week). Seminars are assigned two hours per week which includes seminar presentation alongwith text submission.
4. Scheme of examination in Individual Semester and distribution of marks in each paper will be as under :

Curriculum & Scheme of Examination for M.Sc. Chemistry

Semester Number And Paper Nomenclature		**Total Marks**
Semester I		
Paper – I	Inorganic Chemistry	50
Paper-II	Reaction Mechanism – I	50
Paper-III	Physical Chemistry – I	50
Paper-IV	Computer and Diffraction Methods	50

Paper V	Practicals (including Seminar of 15 marks)	100
	Total	**300**

Semester II

Paper VI	Coordination Chemistry	50
Paper VII	Reaction Mechanism -II and Stereochemistry	50
Paper VIII	Physical Chemistry- II	50
Paper IX	Group Theory and Spectroscopy	50
Paper X	Practicals(including Seminar of 15 marks)	100
	Total	**300**

Semester III

Paper XI	Spectroscopy	50
Paper XII	Photochemistry and Solid State Chemistry	50
Paper XIII	Environmental Chemistry	50
Paper XIV	Chemistry of Life	50
Paper XV	Practicals (including seminar of 15 marks)	100
	Total	**300**

Semester IV

Group A

Paper XVI A	Contemporary Inorganic Chemistry	50
Paper XVII A	Bioinorganic Chemistry	50
Paper XVIII A	Advance Co-ordination Chemistry	50

Paper XIX A	Inorganic Polymers	50
		200

OR

Group B

Paper XVI B	Organic Synthesis- I	50
Paper XVII B	Organic Synthesis- II	50
Paper XVIII B	Heterocyclic Chemistry	50
Paper XIX B	Natural Products	50
		200

OR

Group C

Paper XVI C	Chemical Dynamics- I	50
Paper XVII C	Chemical Dynamics- II	50
Paper XVIII C	Electrochemistry- I	50
Paper XIX C	Electrochemistry- II	50
		200

OR

Group D

Paper XVI D	Forensic Chemistry	50
Paper XVII D	Anthropometry and Toxicology	50
Paper XVIII D	Methods of Instrumental Analysis	50
Paper XIX D	Instrumental and Biochemical Analysis	50
		200
Paper XX	Practicals (For each Group) (including Seminar of 15 marks)	**100**

Total = 300
Grand Total =1200

M.S$_C$.CHEMISTRY
SEMESTER-I
PAPER I- INORGANIC CHEMISTRY

Time: 3 Hours **Max. Marks:50**

Note : Each paper is divided into three independent units. The question paper is divided into three parts, Part – A, Part-B and Part-C. Part A (10 marks) is compulsory and contains 10 questions (50words each).Each question is of one mark. Part-B (10 marks) is compulsory and contains five questions at least one from each unit. Candidate is required to attempt all five questions. Each question is of two marks (100 words). Part-C (30 marks) contains six questions two from each unit. Candidate is required to attempt three questions - one from each Unit. Each question is of ten marks (400 words.).

Unit I

(a) Stereochemistry and Bonding in Main Group Compounds

VSEPR, Irregular Geometry of molecules.$d\pi$-pπ bonds, Bent rule and energetics of hybridization, some simple reactions of covalently bonded molecules.

(b) Metal Clusters

Higher boranes, carboranes, metalloboranes and metallocarboranes.

Unit II

Fundamentals of Transition Metal Complexes

Energy profile of 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 mechanismdirect and indirect evidences in favor of conjugate mechanism.

Unit III

Reaction Mechanismof Transition Metal Complexes

Anation reactions, reactions without metal ligand bond cleavage. Substitution reactions in square planar complexes, the trans effect, mechanism of the

substitution reaction. Redox reaction, electron transfer reactions, mechanism of one electron transfer reactions, outer-sphere type reactions, cross reactions and Marcus-Hush theory, inner sphere type reactions.

Books Suggested

1. Advanced Inorganic Chemistry, F.A.Cotton and Wilkinson. John Wiley.
2. Inorganic Chemistry, J.E. Huhey, Harpes& Row.
3. Chemistry of the Elements, N.N. Greenwood and A. Earnshow, Pergamon.
4. Comprehensive Coordination Chemistry eds., G. Wilkinson, R.D. Gillars and J.A. McCleverty, Pergamon.
5. Reaction mechanism, Basalo Pearson, Academic Press.

PAPER II- REACTION MECHANISM-I

Time: 3 Hours **Max. Marks:50**

Note : Each paper is divided into three independent units. The question paper is divided into three parts Part – A, Part-B and Part-C. Part A (10 marks) is compulsory and contains 10 questions (50words each).Each question is of one mark. Part-B (10 marks) is compulsory and contains five questions at least one from each unit. Candidate is required to attempt all five questions. Each question is of two marks (100 words). Part-C (30 marks) contains six questions two from each unit. Candidate is required to attempt three questions- one from each Unit. Each question is of ten marks (400 words.).

Unit I

(a) Nature of Bonding in Organic Molecules

Delocalized chemical bonding-conjugation, cross conjugation, resonance, hyperconjugation, bonding in fullerenes,tautomerism.

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

Bonds weaker than covalent – addition compounds, Crown ether complexes and cryptands, inclusion compounds.

(b) Reaction Mechanism: Structure and Reactivity

Types of mechanisms, types of reactions, thermodynamic and kinetic requirements, kinetic and thermodynamic control, Hammond's postulate, Curtin-Hammett principle. Potential energy diagrams.

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

Effect of structure on reactivity-resonance and field effects, steric effect,the Hammett&Taft equation- linear free energy relationship., substituent and reaction constants.

Unit II

(a) Aliphatic Nucleophilic substitution

The S_N2 S_N1, mixed S_N1 and S_N2 and SET mechanism

(b) Aromatic Nucleophilic Substitution

The ArS_N1, ArS_N2, benzyne and $S_{RN}1$ mechanism.Reactivity-effect of substrate structure, leaving group and attacking nucleophile. The von Richter, Sommelet-Hauser andSmiles rearrangements.

(c)Aliphatic Electrophilic Substitution.

Bimolecular mechanism-S_E2 and S_Ei. The S_E^1 mechanism, electrophilic substitution accompanied by double bond shifts. Effect of substrates, leaving group and the solvent polarity on the reactivity.

(d) Aromatic Electrophilic Substitution

The arenium ion mechanism, orientation and reactivity, energy profile diagrams. The ortho/para ratio, ipso attack, orientation in other ring system.quantitative treatment of reactivity in substrates and electrophiles. Diazonium coupling, Vismeir reaction, Gattermann-koch reaction.

UNIT – III

Free Radical Reactions

Types of free radical reactions, free radical substitution mechanism, mechanism at an aromatic substrate, neighbouring group assistance.Reactivity for aliphatic and aromatic substrates at a bridgehead.Reactivity in the attacking radicals.The effect of solvent on reactivity.

Allylic halogenations (NBS), oxidation of aldehydes to carboxylic acids, auto-oxidation, coupling of alkynes and arylation of aromatic compounds by diazonium salts, Sandmeyer reaction. Free radical rearrangement, Hunsdiecker Reaction

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.K. Ingold Cornell University Press.
5. Organic Chemistry, T.R. Morrison and R.N. Boyd, Prentice-Hall
6. Modern Organic Reactions, H.O. Housee, 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. Stereochemistry of Organic Compounds, D. Nasipuri, New Age International.
11. Stereochemistry of Organic Compounds, P.S. New Age International.
12. Quantum Chemistry by Zimmerman Academic Press.

PAPER III – PHYSICAL CHEMISTRY- I

Time: 3 Hours **Max. Marks:50**

Note : Each paper is divided into three independent units. The question paper is divided into three parts Part – A, Part-B and Part-C. Part A (10 marks) is compulsory and contains 10 questions (50words each).Each question is of one mark. Part-B (10 marks) is compulsory and contains five questions at least one from each unit. Candidate is required to attempt all five questions. Each question is of two marks (100 words). Part-C (30 marks) contains six questions two from each unit. Candidate is required to attempt three questions one from each Unit. Each question is of ten marks (400 words.).

Unit I

(a) Quantum Chemistry

Schrodinger equation to some model systems viz., harmonic oscillator, the rigid rotor, the hydrogen atom.Applications of variation method and perturbation theory to the Helium atom.

(b) Molecular Orbital Theory

Huckel theory of conjugated systems, bond order and charge density calculations. Applications to ethylene, butadiene, cyclopropeny1 radical, cyclobutadiene etc.

Unit II

Thermodynamics

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 for electrolytic solution; determination of activity and activity coefficient; ionic strength. Application of phase rule to three component system – acetic acid + chloroform + water.

Unit III

A. Chemical Dynamics

Collision theory of reaction rates, steric factor, activated complex theory, ionic reactions, kinetic salt effects, steady state kinetics, kinetic and thermodynamic control of reactions, methods of determining mechanism, isotope effects.

Dynamic chain (hydrogen-bromine reactions, pyrolysis of acetaldehyde, decomposition of ethane), photochemical (hydrogen-bromine reaction), acid base catalysis, kinetics of enzyme reactions, general features of fast reactions, study of fast reactions by flow method, flash photolysis, dynamics of unimolecular reactions (Lindemann Theory,Hinshelwood Modifications).

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Books Suggested :

1. Physical Chemistry, P.W. Atkins, ELBS
2. Introduction to Quantum Chemistry, A.K. Chandra, Tata McGraw Hill.
3. Quantum Chemistry, Ira N. Levine, Prentice Hall.
4. Coulson's Valance, R McWeeny, ELBS
5. Chemical Kinetics, K.J.Laidler, MacGraw-Hill
6. Kinetics and Mechanism of Chemical transformations, J. Rajaram and J. Kuriacose,McMillan.
7. Micelles, Theoretical and Applied Aspects, V.Moroi, Plenum.

8. Modern Electrochemistry Vol.I and Vol.II J.O.M. Bockris and A.K.N. Reddy, Plenum.
9. Introduction to Polymer Science, V.R. Gowarikar, N.V. Vishwanathan and J. Sridhar, Wiley Easterm.
10. Phase Rule by Bowden.
11. Phase Rule by Y.K. Gupta.

PAPER IV COMPUTERAND DIFFRACTION METHODS

Time: 3 Hours **Max. Marks:50**

Note : Each paper is divided into three independent units. The question paper is divided into three parts Part – A, Part-B and Part-C. Part A (10 marks) is compulsory and contains 10 questions (50words each).Each question is of one mark. Part-B (10 marks) is compulsory and contains five questions at least one from each unit. Candidate is required to attempt all five questions. Each question is of two marks (100 words). Part-C (30 marks) contains six questions two from each unit. Candidate is required to attempt three questions one from each Unit. Each question is of ten marks (400 words.).

Unit I

(a) Introduction to Computers and Computing

Basic structure and functioning of computers with a PC as an illustrative example.Memory, I/O devices.Secondary Storage.Computer language.Operating systems with DOS as an example.Introduction to UNIX and WINDOWS.Data Processing, principles of programming. Algorithms and flow-charts.

(b) Computer Programming in C

Overview of C, Constants., Variable and Data Types, Operators and Expression, Managing Input and output Operators, Decision Making and Branching, IF statement, IF….ELSE statement, GO TO statement, Decision Making and Looping, WHILE statement, DO statement and FOR Statement, Jumps in loop.

Unit-II

(a) Programming in Chemistry

Development of small computer codes involving simple formulae in chemistry, such as Vander waals equation, titration, kinetics, radioactive decay. Evaluation of lattice energy and ionic radii from experimental data.

(b) Electron Diffraction:

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.

(c) Neutron diffraction

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

Unit - III

X-ray Diffraction

Debye-Scherrer method of X-ray structural analysis of crystal, index reflections, identification of unit cells from systematic absences in diffraction pattern. Structure of simple lattices and X-ray intensities, structural factor and its relation to intensity and electron density, phase problem.Description of the procedure for an X-ray structure analysis, absolute configuration of molecules.Ramchandran diagram.

Books Suggested

1. Modern Spectroscopy, J.M. John Wiley.
2. Applied Electron Spectroscopy for chemical Analysis Ed. H. Windawi and F.L. No, Wiley Interscience.
3. NMR, NQR, EPR and Mossbaur Spectroscopy in Inorganic Chemistry, R.V. Parish, Ellis Harwood.
4. Physical Methods in Chemistry R.S. Drago, Saunders College.
5. Chemical Application of Group Theory, F.A. Cotton.
6. Introduction to Molecular Spectroscopy, R. Chang, McGraw Hill.
7. Basic Principles of Spectroscopy, R. Chang, McGraw Hill
8. Theory and Applications of UV Spectroscopy, H.H. Jaffe and M. Orchin, IBH-Oxford.
9. Introduction of Photoelectron Spectroscopy, P.K. Ghosh, John Wiley.
10. Introduction to Magnetic Resonance., A Carrington and A.D. Carrington and A.D. Maclachalan, Harper & Raw.
11. Programming inAnsiC-E. Balagursamy

PAPER V -PRACTICALS

Time : 07 Hours **Max Marks-100**

A. INORGANIC

PREPARATIONS (At least seven preparations)

(1)Tris(thiourea)copper (II)sulphate.

(2)Cis –Potassium Dioxalatediaquachromate(III).
(3)Sodium Diamminetetrathiocynatochromate(III).
(4) Trans-potassium dioxalatediaquachromate(III)
(5)Potassium Trioxalatoferrate(III)hydrate
(6) Potassium trioxalato chromate (III) trihydrate
(7)Purssian Blue.
(8)Hexamminecobalt(III) hexanitrocobaltate(III).

(9)Dichloridebis(pyridine)cobalt(II).
(10)Hexamminenickle(II) chloride.
(11)Bis(dimethylglyoximato)nickel (II).
(12)Tetramminecopper(II) sulphate monohydrate
(13) Mercury tetrathiocyanatocobaltate (II)
(14)Cis$[Co(trien)(NO_2)_2]Cl.H_2O$

B. ORGANIC

(a)QUALITATIVE ANALYSIS (At least seven mixtures)

Separation, purification and identification of compounds of binary mixture (two solids) by water, ether, $NaHCO_3$ and NaOH.Prepare derivative(s) where possible.

(b)QUANTITATIVE ANALYSIS (At least five)

(i) Estimate amines by acetylation method.
(ii) Estimate phenols using acetylation method.
(iii) Determine Iodine Value of an oil sample.
(iv) Determine Saponification Value of a fat or oil sample.
(v) Determine Saponification equivalent of an ester
(vi) Determine Acid Value of a fat or oil sample
(vii) Determine Aniline Point of an oil sample.
(viii) Determine the number of hydroxyl groups in an organic compound by acetylation method.
(ix) Determine the neutralization equivalent of the given carboxylic acid.

C.PHYSICAL CHEMISTRY (Perform at least seven experiments)

1.Determination of the effect of change of temperature on the velocity constant of hydrolysis of an ester.
2.Determination of the effect of change of concentration of reactants and catalyst on the velocity constant of hydrolysis of an ester

3.Determination of the effect of Ionic strength on the velocity constant of hydrolysis of an ester
4.Determination of strength of strong acid in gm/l conductmetricallyby titrating with strong base.
5.Determination of strength of strong acid in gm/l conductmetrically by titrating with weak base.
6.Determination of strength of weak acid in gm/l conductmetrically by titrating with strong base.
7.Determination of strength of weak acid in gm/l conductmetrically by titrating with weak base.
8.Determination of strength of strong and weak acid in gm/l in a given mixture conductmetrically by titrating against a strong base.
9.Determination of strength of strong and weak acid in gm/l in a given mixture conductmetrically by titrating against a weak base.
10.Determination of the dissociation constant of monobasic/ dibasic acid.
11. To find the relative and absolute viscosity of given liquid at room temperature using Ostwald's Viscometer.
12. To determine the composition of the given mixture consisting of two miscible liquids A and B by viscosity measurement.
13. To determine the parachor of carbon and hydrogen atoms by drop weight method using stalagmometer

Books Suggested :

1. Vogel's Textbook of Quantitative Analysis, revised, J. Bassett, R.C. Denney, GH. Jeffery and J. Mendham, ElBS.
2. Synthesis and Characterization of Inorganic Compounds, W.L. Jolly, Prentice Hall.
3. Experiments and Techniques in Organic Chemistry, D.Past, C.Johnson and M. Miller, Prentice Hall.
4. Macroscale and Miicroscale Organic Experiments, K.L. Williamson, D.C. Health.
5. Systematic Qualitative Organic Analysis, H. Mideleton, Adward Arnold.
6. Handbook of Organic Analysis-Qualitative and Quantitative, H. Clark, Adward Arnold.
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. Experiments inPhysical Chemistry, R.C. Das and B. Behera. Tata McGraw Hill.

INSTRUCTIONS FOR PRACTICALS

Max Marks: 100 **Time:07 Hours**

The Board of Examiners will constitute of one External Examiner and one Internal Examiner**.**

			Marks
(A)Inorganic			
Inorganic Preparation			- 15
(B)Organic			
(a)Qualitative Analysis		- 15	
(b) Quantitative Analysis	- 15		
(C) Physical			
1. One experiment is to be performed			- 20
(D)Viva			**- 10**
(E)Record			**- 10**
(F)Seminar		**- 15**	
Grand Total			**100**

M.Sc.CHEMISTRY
SEMESTER-II

PAPER VI – COORDINATION CHEMISTRY

Time: 3 Hours **Max. Marks:50**

Note : Each paper is divided into three independent units. The questions paper is divided into three parts Part – A, Part-B and Part-C. Part A (10 marks) is compulsory and contains 10 questions (50words each).Each question is of one mark. Part-B (10 marks) is compulsory and contains five questions at least one from each unit. Candidate is required to attempt all five questions. Each question is of two marks (100 words). Part-C (30 marks) contains six questions two from each unit. Candidate is required to attempt three questions one from each Unit. Each question is of ten marks (400 words.).

Unit I
(a) Metal-Ligand Equilibria in Solution

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

(b) Metal Ligand Bonding

Limitation of crystal field theory, molecular orbital theory, octahedral, tetrahedral and square planar complexes, $\pi -$ bonding and molecular orbital theory.

Unit II

Electronic Spectra and Magnetic Properties of Transition Metal Complexes

Spectroscopic ground state, correlation, Orgel and Tanabe-Sugano diagrams for transition metal complexes (d^1-d^9States). Calculations of Dq,B and β parameters, charge transfer spectra, anomalous magnetic moments, magnetic exchange coupling and spin crossover.

Unit III

Metal π-Complexes.

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

Books Suggested

1. Advanced Inorganic Chemistry, F.A.Cotton and Wilkinson. John Wiley.
2. Inorganic Chemistry, J.E. Huhey, Harpes& Row.
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 Chemistry eds., G. Wilkinson, R.D. Gillars and J.A. McCleverty, Pergamon.
7. Reaction mechanism, Basalo Pearson, Academic Press.

PAPER VII –REACTION MECHANISM- II AND STEREOCHEMISTRY

Time: 3 Hours **Max. Marks:50**

Note : Each paper is divided into three independent units. The question paper is divided into three parts Part – A, Part-B and Part-C. Part A (10 marks) is compulsory and contains 10 questions (50words each).Each question is of one

mark. Part-B (10 marks) is compulsory and contains five questions at least one from each unit. Candidate is required to attempt all five questions. Each question is of two marks (100 words). Part-C (30 marks) contains six questions two from each unit. Candidate is required to attempt three questions- one from each Unit. Each question is of ten marks (400 words.).

Unit I

a) Addition to Carbon-Hetero Multiple Bonds

Mechanism of metal hydride reduction of saturated and unsaturated carbony1 compounds, acids, estersand nitriles. Addition of Grignard reagents, organozinc and organolithium reagents to carbonyl and unsaturated carbonyl compounds. Wittig reaction.

Mechanism of condensation reaction involving enolates-Aldol, Knoevenagel.Claisen, Mannich, Benzoin, Perkin and Stobbe reactions.Hydrolysis of esters and amides, ammonolysis of esters.

b) Addition to Carbon-Carbon Multiple Bonds

Mechanism and stereochemical aspects of addition reactions involving electrophiles, nucleophiles and free radicals, regio-and chemo-selectivity, orientation and reactivity.

Addition to cyclopropane ring.Hydrogenation of double and triple bonds, hydrogenation of aromatic rings.Hydroboration.Michael reaction.Sharpless asymmetric epoxidation.

Unit II

(a)Stereochemistry Elements of symmetry, Chirality, molecules with more than one chiral center, threo and erythroisomers, methods of resolution, optical purity, enantiotopic and diastereotopic atoms,groups and faces,stereospecific and stereroselective synthesis .Asymmetric synthesis. Optical activity in the absence of chiral carbon (biphenyls, allenes and spiranes), chirality due to helical shape.

Stereochemistry of the compounds containing nitrogen, sulphur and phosphorus.

(b) Conformational analysis of cycloalkanes, decalins, effect of conformation on reactivity, conformation of sugars, steric strain due to unavoidable crowding.

Unit III

Pericyclic Reactions

Molecular orbital symmetry, Frontier orbitals of ethylene, 1,3-butadiene,1,3,5-hexatriene and allyl system. Classification of pericyclic reaction. Woodward-Hoffmann correlation diagrams. FMO and PMO approach Electrocyclic reactions- conrotatory and disrotatory motions, 4n, 4n+2 andallyl

systems. Cycloadditions-antarafacial and suprafacial additions, 4n, 4n+systems, 2+2 addition of ketenes, 1,3 dipolar cycloaddition and cheleotropic reactions.

Sigmatropic rearrangements-suprafacial and antarafacial shifts of P sigmatropic shifts involving carbon moieties, 3,3-and 5,5-sigmatropic rearrangements. Claisen, Cope and aza-Cope rearrangements,Ene reaction.

Books Suggested:

1. Advanced Organic Chemistry-Reactions, Mechanism and Structure, Jerry March, John Wiley.
2. Advance 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.K. Ingold Cornell University Press.
5. Organic Chemistry, T.R. Morrison and R.N. Boyd, Prentice-Hall
6. Modern Organic Reactions, H.O. Housee, Benjamin.
7. Principles of Organic Synthesis, R.O.C. Norman and J.M. Coxon, Blackie Academic &Profesional.
8. Pericyclic Reactions S.M. Mukherji, Macmillan, India.
9. Reaction Mechanism in Organic Chemistry, S.M. Mukherji and S.P. Singh, Macmillan.
10. Stereochemistry of Organic Compounds, D. Nasipuri, New Age International.
11. Sterochemistry of Organic Compounds, P.S. New Age International.
12. Quantum Chemistry by Zimmerman Academic Press.

PAPER VIII –PHYSICALCHEMISTRY - II

Time: 3 Hours **Max. Marks:50**

Note : Each paper is divided into three independent units. The questions paper is divided into three parts Part – A, Part-B and Part-C. Part A (10 marks) is compulsory and contains 10 questions (50words each).Each question is of one mark. Part-B (10 marks) is compulsory and contains five questions at least one from each unit. Candidate is required to attempt all five questions. Each question is of two marks (100 words). Part-C (30 marks) contains six questions two from each unit. Candidate is required to attempt three questions one from each Unit. Each question is of ten marks (400 words.).

Unit I

Electrochemistry

Electrochemistry of solutions, Debye-Huckel-Onsager treatment and its extension, ion solvent interactions.Debye-Huckel-Bjerrum

model.Thermodynamics of electrified interface equations, methods of determination. Semiconductor interfaces-theory of double layer at semiconductor, electrolyte solution interfaces, structure of double layer interfaces. Effect of light at semiconductor solution interface.
Overpotentials, exchange current density, derivation of Butler-Volmer equation, Tafel Plot.
Polarography theory, Ilkovic equation; half wave potential and its significance.
Corrosion – Types, mechanism and inhibition.

Unit II
Surface Chemistry
(a) Adsorption

Pressure difference across curved surface (Laplace equation), vapour pressure of droplets (Kelvin equation), Gibbs adsorption isotherm, estimation of surface area (BET equation without derivation), mechanismof surface catalytic reactions.

(b) Micelles

Surface active agents, classification of surface active agents, micellization, hydrophobic interaction, critical micellar concentration (CMC), factors affecting the CMC of surfactants, counter ion binding to micelles, thermodynamics of micellization, solubilization, micro emulsion, reverse micelles.

(c) Macromolecules
Electrically conducting, fire or heat resistant, liquid crystal polymers

UNIT III
(a) Statistical Mechanics
Concept of distribution, thermodynamic probability and most probable distribution.Ensemble averaging, postulate of ensemble and averaging.Canonical, grand canonical and micro canonical ensembles.
(b)**Statistical Thermodynamics**
Partition functions-translational, rotational, vibrational and electronic partition functions, calculation of thermodynamic properties in terms of partition functions. Applications of partition functions.Chemicalequilibria and equilibrium constant in terms of partition functions
(c)Quantum Mechanics
Fermi-Dirac statistics,Bose-Einstein statistics-distribution law and application to helium in brief.

Books Suggested :
1. Physical Chemistry, P.W. Atkins, ELBS
2. Introduction to Quantum Chemistry, A.K. Chandra, Tata McGraw Hill.

3. Quantum Chemistry, Ira N. Levine, Prentice Hall.
4. Coulson's Valance, R McWeeny, ELBS
5. Chemical Kinetics, K.J.Laidler, MacGraw-Hill
6. Kinetics and Mechanism of Chemical transformations, J. Rajaraman and J. Kuriacoose, McMillan.
7. Micelles, Theoretical and Applied Aspects, V.Moroi, Plenum.
8. Modern Electrochemistry Vol.I and Vol.II J.O.M. Bockris and A.K.N. Reddy, Plenum.
9. Introduction to Polymer Science, V.R. Gowarikar, N.V. Vishwanathan and J. Sridhar, Wiley Easterm.
10. Phase Rule by Bowden.
11. Phase Rule by Y.K. Gupta.

PAPER IX – GROUP THEORY AND SPECTROSCOPY

Time: 3 Hours **Max. Marks:50**

Note : Each paper is divided into three independent units. The question paper is divided into three parts Part – A, Part-B and Part-C. Part A (10 marks) is compulsory and contains 10 questions (50words each).Each question is of one mark. Part-B (10 marks) is compulsory and contains five questions at least one from each unit. Candidate is required to attempt all five questions. Each question is of two marks (100 words). Part-C (30 marks) contains six questions two from each unit. Candidate is required to attempt three questions one from each Unit. Each question is of ten marks (400 words.).

Unit I

(a) Symmetry and Group Theory in Chemistry

Symmetry elements and symmetry operation, definitions of group, sub-group, relation between orders of a finite group and its subgroup Conjugacy relation and classes.Point symmetry group.

(b) Raman Spectroscopy

Classical and quantum theories of Raman effect. Pure rotational, vibrational and vibrational-rotational Raman spectra, selection rules, mutual exclusion principle.Resonance Raman spectroscopy, coherent anti Stokes Raman spectroscopy (CARS).

Unit II

(a)Molecular spectroscopy

Energy levels, molecular orbitals, vibrational transitions, vibration progression and geometry of the excited states, Franck-Condon Principle, electronic spectra

of polyatomic molecules, Emission spectra, radiative and non-radiative decay, internal conversion, spectra of transition metal complexes, charge-transfer spectra.

(b) Photoelectron Spectroscopy

Basic principles; photo-electric effect, ionization process, Koopman's theorem.Photoelectron spectra of simple molecules.ESCA.Chemical information from ESCA. Auger electron spectroscopy-basic idea.
Photoacoustic Spectroscopy:, Basic principle of photoacoustic spectroscopy (PAS), PAS-gases and condensed systems, chemical and surface applications.

Unit III

Electron SpinResonance Spectroscopy

Basic principles, zero field splitting and Kramer's degeneracy, factors affecting the "g" value Isotropic and anisotropic hyperfine coupling constants, spin Hamiltonian, spin densities and McConnell relationship, measurement techniques, spin polarization 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 systems and to inorganic free radicals such as PH_4 F_2 and $[BH_3]$.

Books Suggested

1. Modern Spectroscopy, J.M. John Wiley.
2. Applied Electron Spectroscopy for chemical Analysis Ed. H. Windawi and F.L. No, Wiley Interscience.
3. NMR, NQR, EPR and Mossbauer Spectroscopy in Inorganic Chemistry, R.V. Parish, Ellis Harwood.
4. Physical Methods in Chemistry R.S. Drago, Saunders College.
5. Chemical Application of Group Theory, F.A. Cotton.
6. Introduction to Molecular Spectroscopy, R. Chang, McGraw Hill.
7. Basic Principles of Spectroscopy, R. Chang, McGraw Hill
8. Theory and Applications of UV Spectroscopy, H.H. Jaffe and M. Orchin, IBH-Oxford.
9. Introduction of Photoelectron Spectroscopy, P.K. Ghosh, John Wiley.
10. Introduction to Magnetic Resonance., A Carrington and A.D. Carrington and A.D. Maclachalan, Harper & Raw.

PAPER X-PRACTICALS

Time : 07 Hours **Max Marks-100**

A. INORGANIC

Separation and determination of two metal ions involving volumetric and gravimetric methods.
Both Gravimetrically :Cu-Ni, Ag-Zn, Fe-Ni, Ag-Ni,Cu-Mg (At least any two)
Both Volumetrically :Ca-Zn, Ca-Mg, Zn-Mg (Any two)
One Gravimetrically and one volumetrically : Ba-Cu, Ag-Cu,Ni-Mg,Pb-Cu, Fe-Cu, Ni-Cu (At least any three)

B.ORGANIC

(a)ORGANIC SYNTHESIS (At least seven synthesis)

(i) Acetylation: Acetylation of salicylic acid using acetyl chloride
(ii) Oxidation: Adipic acid by chromic acid oxidation of cyclohexanol.
(iii) Aldol condensation: Dibenzal acetone from benzaldehyde.
(iv) Sandmeyer reaction: p-chlorotoluene from p-toluidine.
(v) Cannizzaro reaction: 4-chlorobenzaldehydeor benzaldehydeas substrate.
(vi) Prepare p-nitroacetanilide
(vii) Prepare p-bromoacetanilide
(viii) Benzoylation of phenol
(ix) Benzoylation of aniline
(x) Benzoylation of glycine
(xi) Aromatic Electrophilic substitutions: Synthesis of p-nitroaniline
(xii) Aromatic Electrophilic substitutions:Synthesis of p-bromoaniline
(xiii) Oxidation : Phenanthroquinine from phenanthrene
(xiv) Diazotization and coupling reaction
(xv) Methyl orange from sulphanilic acid and dimethyl aniline
(xvi) Benzene azo-β-naphthol from aniline and β-naphthol
(xvii) Sulphonation: Sulphanilic acid from aniline
(xviii) Prepare methylsalicylate (oil of wintergreen)

(b)QUANTITATIVE ANALYSIS (At least five)

(i) Determine Dissolved Oxygen(DO)of a water sample.
(ii) Determine Chemical Oxygen Demand (COD) of a water sample.
(iii) Determine Biological or Biochemical Oxygen Demand(BOD) of a water sample.
(iv) Estimate paracetamoltitrimetrically.
(v) Estimate ascorbic acid titrimetrically.
(vi) Estimate aspirin titrimetrically.
(vii) Estimate sulpha drug titrimetrically
(viii) Determine Fe in vitamins /tablets/powder spectrophotometrically
(ix) Estimate amines using bromate bromide mixture
(x) Estimate phenol using bromate bromide mixture
(xi) Estimate formaldehyde

C.PHYSICAL CHEMISTRY(Perform at least seven experiments)

1. To construct the phase diagram for three component systemcontaining ethanol, benzene and water.
2. Determine the velocity constant and order of reaction of saponification of ethyl acetate by sodium hydroxide conductometrically
3. Determination of strengths of halides in a mixture (KBr, KI, KCl) potentiometrically.
4. Determine the strength of strong acid by titration against a strong base using a potentiometer/pH meter.
5. Determine the strength of strong acid by titration against a weak base using a potentiometer/pH meter.
6. Determine the strength of weak acid by titration against a weak base using a potentiometer/pH meter.
7. Determine the strength of weak acid by titration against a weak base using a potentiometer/pH meter.
8. Determine the strength of strong acid and weak acid in a mixture of HCl and CH_3COOH by titration against a strong base using a potentiometer/pH meter.
9. Perform Acid-base titration in a non-aqueous media using a pH meter and determine strength of acid.
10. Determine partition coefficient of benzoic acid between water and benzene
11. Determine partition coefficient of iodine between water and carbon tetrachloride
12. Study the complex formation between copper sulphate and ammonia
13. Study and determine the equilibrium constant of reaction of iodine and potassium iodide to form potassium triiodide
14. Determine the concentration of amino acid spectrophotometrically
15. Study the adsorption of acetic acid on charcoal and prove the validity of Freundlich's adsorption isotherm and Langmuir's adsorption isotherm
16. Study the kinetics of reaction between potassium iodide and potassium persulphate at equal concentrations
17. Study the kinetics of reaction between potassium iodide and potassium persulphate at unequal concentrations
18. Study the kinetics of reaction between potassium iodide and potassium persulphate at comparable concentrations
19. Determine the solubility and solubility product of sparingly soluble salts (eg $PbSO_4$, $BaSO_4$) conductometrically
20. Determine the basicity of organic acids conductometrically.

INSTRUCTIONS FOR PRACTICALS

Max Marks: 100 **Time:07 Hours**

The Board of Examiners will constitute of one External Examiner and one Internal Examiner**.**

Marks

(A)Inorganic

Separation and determination of two metals involving volumetric and gravimetric methods. - 20

(B)Organic

(a)Organic Synthesis - 10

(b) Quantitative Analysis - 15

(C) Physical

1. One experiment is to be performed - 20

(D)Viva - 10

(E)Record - 10

(F)Seminar - 15

Grand Total 100