THIRUVALLUVAR UNIVERSITY

MASTER OF SCIENCE

DEGREE COURSE

M.Sc. CHEMISTRY

UNDER CBCS

(with effect from 2008-2009)

The Course of Study and the Scheme of Examinations

Year / Semester	Subject	Paper	Title of the Paper	Ins. Hrs/ Week	Credit	Exam hrs	Max.Marks		
							IA	Uni. Exam.	Total
I Year I Semester	Core	Paper I	Organic Chemistry I	5	4	3	25	75	100
	Core	Paper II	Inorganic Chemistry I	5	4	3	25	75	100
	Core Practical		Organic Practical I	5	-	-	-	-	-
	Core Practical		Inorganic Practical I	5	-	-	-	-	-
			Physical Chemistry Practical I	5	-	-	-	-	-
	Elective I	Paper I	Physical Chemistry I	5	4	3	25	75	100
I Year II Semester	Core	Paper III	Organic Chemistry II	4	4	3	25	75	100
	Core	Paper IV	Inorganic Chemistry II	4	4	3	25	75	100
	Core	Paper V	Physical Chemistry II	4	4	3	25	75	100
	Core	Practical I	Organic Chemistry I	4	5	6	40	60	100
	Core	Practical II	Inorganic Chemistry I	4	5	6	40	60	100
	Core	Practical III	Physical Chemistry I	4	5	6	40	60	100
			Human Rights	2	2	3	25	75	100
	Elective II	Paper II	Synthetic Organic Chemistry and Chemistry of Natural Products	4	4	3	25	75	100
II Year III Semester	Core	Paper VI	Inorganic Chemistry III	5	4	3	25	75	100
	Core	Paper VII	Physical Chemistry III	5	4	3	25	75	100
	Core Practical		Organic Chemistry Practical II	4	-	-	-	-	-
	Core Practical		Physical Chemistry Practical II	4	-	-	-	-	-

Year / Semester	Subject	Paper	Title of the Paper	Ins. Hrs/ Week	Credit	Exam hrs	Max.Marks		
							IA	Uni. Exam.	Total
			Physical Chemistry Practical II	4	-	-	-	-	-
	Elective III	Paper III	Organic Chemistry III	4	4	3	25	75	100
	Elective IV (Non-Major Subject)	Paper IV	Applied Chemistry	4	4	3	25	75	100
II Year IV Semester	Core	Paper VIII	Organic Chemistry IV	5	4	3	25	75	100
	Core	Paper IX	Physical Chemistry IV	5	4	3	25	75	100
	Core	Paper X	Research Methodology	3	2	3	25	75	100
	Core	Practical IV	Organic Chemistry Practical II	4	5	6	40	60	100
	Core	Practical V	Inorganic Chemistry II	4	5	6	40	60	100
	Core	Practical VI	Physical Chemistry II	4	5	6	40	60	100
	Project (or) Elective V	Paper V	Inorganic Chemistry IV	5	4	3	25	75	100
			Total	120	90				2200

THIRUVALLUVAR UNIVERSITY

M.Sc. CHEMISTRY

SYLLABUS

UNDER CBCS

(with effect from 2008-2009)

I SEMESTER

PAPER I

ORGANIC CHEMISTRY I

Objective

To learn the concepts of stereochemistry, conformational analysis and their application in the determination of reaction mechanism. To understand the mechanism of nucleophilic and electrophilic substitution reactions.

UNIT-I: STEREOCHEMISTRY

Optical activity and chirality, Classification of chiral molecules as asymmetric and dissymmetric. A brief Study of dissymmetry of allenes, biphenyls, spiro compounds, trans cyclo octane and cyclononene and molecules with helical structures absolute configuration - R, S notation of biphenyls and allenes. Fischer projection. Inter conversion of Sawhorse, Newman and Fischer projections. Molecules with more than one asymmetric center (restricted to five carbons). e.g. Erythro and threo compounds. Asymmetric synthesis. Cram's rule.

Geometrical isomerism, E, Z - nomenclature of olefins, Geometrical and optical isomerism (if shown) of disubstituted cyclopropane, cyclobutane and cyclopentanes. Stereo specific and stereo selective reactions.

UNIT-II: CONFORMATIONAL ANALYSIS

Conformation of some simple 1, 2 - disubstituted ethane derivatives. Conformational analysis of disubstituted cyclohexane and their stereo chemical features (geometric and optical isomerism (if shown) by these derivatives). Conformation and reactivity of substituted cyclohexanol (oxidation and acylation), cyclohexanone. (reduction) and cycloehexane carboxylic acid derivatives (esterification and hydrolysis). Conformation and stereochemistry of cis and trans decalin and 9 - methyldecalin.

UNIT-III: ALIPHATIC NUCLEOPHILIC SUBSTITUTION REACTION

S_Ni, S_N2 and S_Ni mechanisms - Neighboring group participation - reactivity, structural and solvent effects - substitution in norbornyl and bridgehead systems - substitution at allylic and vinylic carbons - substitution by ambident nucleophiles - substitution at carbon doubly bonded to oxygen and nitrogen - alkylation and acylation of amines, halogen exchange, Von-Braun reaction, alkylation and acylation of active methylene carbon compounds, hydrolysis of esters, Claisen and Dieckmann condensation.

S_Ei, S_E2 and S_Ei mechanism, double bond shift - Reactivity. Migration of double bond, keto-enol interconversion, HVZ reaction, Stark-Enamine reaction, halogenation of aldehydes and ketones and decarboxylation of aliphatic acids.

UNIT-IV: AROMATIC ELECTROPHILIC SUBSTITUTION REACTIONS

The arenium ion mechanism. Orientation and reactivity (ortho, meta and para directing groups). Typical reactions - nitration, halogenation, alkylation, acylation and diazonium coupling, Formylation ,Reimer - Tieman reaction, Vilsmeyer - Hack, Gattermann, Gattermann - Koch ,Kolbe reaction, Synthesis of di and tri substituted benzene (symmetrical tribromo benzene, 2-amino 5-methylphenol, 3 nitro, 4-bromobenzoic acid, 3, 4-dibromonitrobenzene, 1,2,3 - trimethylbenzene) starting form benzene or any monosubstituted benzene. Electrophilic susbstitution of furan, pyrole, thiophene and pyridine-N-oxide.

UNIT-V: AROMATIC NUCLEOPHLILIC SUBSTITUTIONS AND DETERMINATION OF REACTION MECHANISM

Methods for the generation of benzyne intermediate and reactions of aryne intermediate. Nucleophilic substitution involving diazonium ions. Aromatic Nucleophilic substitution of activated halides. Ziegler alkylaiton. Chichibabin reaction.

Kinetic and non-kinetic methods of determining organic reaction mechanism.

Hammett and Taft equations - Simple Problems.

Recommended Books

1. Organic Synthesis by R.O.C. Norman, Chapman and Hall, NY, (1980)
2. Physical Organic Chemistry by Niel Isaacs, ELBS Publications (1987)
3. Organic Reaction Mechanism by S.M. Mukherji and S.P. Singh, MacMillan India Ltd., Chennai (1990)
4. Organic Chemistry IV Edition by Stanley Pines

5. Structures and Mechanism by E.S. Gould
6. Advanced Organic Chemistry, Part A and B, by Francis A. Carey and Richard J. Sundberg, 3rd Edition (1990), Plenum Press.
7. Aromatic Nucleophilic Substitution by J. Miller
8. Advanced Organic Chemistry III Edition by J. Miller
9. Reactive Molecules, C. Wentrup, John Wiley and Sons, New York (1984)
10. Advanced organic reaction mechanism and structure by J. March, Tata McGraw Hill.
11. Organic Chemistry, Marc London
12. Organic Chemistry, Mc Murray
13. Organic Chemistry, Graham Solomons
14. Carbenes, Nitrenes and Arynes by T.L. Gilchrist and C.W. Rees, Thomas Nelson and Sons Ltd., London.
15. Stereochemistry, Conformation analysis and Mechanism by P.S. Kalsi, 2nd Edition (1993), Wiley Eastern Limited, Chennai.
16. Stereochemistry of carbon compounds by Ernest Eliel
17. Stereochemistry and Mechanism through solved problems by P.S. Kalsi. Wiley Eastern Ltd., (1994)
18. Basic principles of Organic Stereochemistry by P. Ramesh - Madurai Kamaraj University.
19. Organic Reaction Mechanism by R.K. Bansal.
20. A Guide book to mechanism in organic chemistry by Longman.
21. Structure and mechanism in organic chemistry by C.K. Ingold, cornell University press.

PAPER II

INORGANIC CHEMISTRY I

Objective

To learn about the inorganic polymers. To study the concept of coordination Chemistry, stability of the complexes and stereochemistry of complexes. To study about structure and bonding.

UNIT-I: STRUCTURE AND BONDING I

Polyacids: Isopolyacids and hetereopolyacids of vanadium, chromium, molybdenum and Tungsten.

Inorganic Polymers: Silicates, structure - properties - correlation and applications - molecular sieves, polysulphur - nitrogen compounds and poly - organophosphazenes.

UNIT-II: STRUCTURE AND BONDING II

Boron hydrides: Polyhedral boranes, hydroboration, carboranes and metallo - carboranes

Metal clusters : Chemistry of low molecularity metal clusters (upto) trinuclear metal Clusters: multiple metal-metals.

UNIT-III: COORDINATION CHEMISTRY I

Stability of complexes; thermodynamic aspects of complex formation; factors affecting stability, HSAB approach.

Determination of stability constants by spectrophotometric, polarographic and potentiomteric methods.

UNIT-IV: COORDINATION CHEMISTRY II

Stereochemical aspects; Stereoisomerism in inorganic complexes; isomerism arising out of ligand and ligand conformation; chirality and nomenclature of chiral complexes; optical rotatory dispersion and circular dichroism.

UNIT-V: COORDINATION CHEMISTRY III AND MACROCYCLIC LIGANDS

Macrocyclic ligands; types; porphyrins; corrins, Schiff bases; crown ethers; crypts.

Crystal field theory and its limitations, d-orbital splittings, LFSE, spectro chemical series.

Text Books

1. Principles of Instrumental methods of Analysis - D.A. Skoog, Saunders College Publication, III Edition, 1985.
2. Instrumental methods of analysis, Willard Merrit, Dean and Settle, CBS Publication, VI Edition, 1986.
3. Text books of qualitative analysis - AI Vogel, CIBS Editions, 1976 and IV Edition 1985.
4. Fundamental of Analytical Chemistry, D.A. Skoog D.M. West, Holt Reinhert and Winston Publication, IV Edition 1982.
5. Computers in Chemistry - K.V. Raman, Tata McGraw Hill, New Delhi, 1993.
6. Computer Applications in Chemistry: K. Ebert, H. Ederes and T.L. Isenhowr, VCH.
7. J.E. Huheey, Inorganic Chemistry - Principles, Structure and Reactivity, Harper Collins, New York, IV Edition (1993)
8. F.A. Cotton and G. Wilkinson, Advanced Inorganic Chemistry - A Comprehensive Text, John Wiley and Sons, V Edition (1988)
9. K.F. Purcell and J.C. Kotz, Inorganic Chemistry - WB Saunders Co., USA (1977)
10. M.C. Day and J. Selbin, Theoretical Inorganic Chemistry, Van Nostrand Co., New York (1974)
11. J.E. Huheey, Inorganic Chemistry, Harper Collins NY IV Edition, (1993)
12. G.S. Manku, Inorganic Chemistry (1984)

Suggested References

1. Instrumental Analysis, G.D. Christian and J.E.G. Reily, Allegn Becon II Edition, 1986.
2. Chemical Instrumentation, H.A. Strobel, Addison - Wesley Pub!. Co., 1976.
3. Treatise on Analytical Chemistry, Kolthoff and Elwing (all series)
4. Comprehensive Analytical Chemistry, Wilson alld Wilson series.
5. Principles of Polarography, R.C. Kapoor and B.S. Aggarwal, Wiley Easter Limited, Ms. 1991
6. D.F. Shrivers, Pw. Atkins and C.H. Langford, Inorganic Chemistry, OUP (1990)
7. N.N. Greenwood and Earnshaw, Chemistry of the Elements, Pergamon Press, New York (1984)
8. EL. Mutterties, Polyhedral Boranes, Academic Press, New York (1975)
9. NH Ray, Inorganic Polymers, Academic Press, (1978)
10. S.F.A. Kettle, Coordination Chemistry, EIBS (1973)
11. K. Burger, Coordination Chemistry, Burter Worthy (1973)
12. F. Basolo and R.G. Pearson, Mechanism of Inorganic Reaction, Wiley NY (1967)
13. R. Sarkar, General and Inorganic chemistry, (Parts I and II), New Book Agency, Calcutta.

ELECTIVE

PAPER I

PHYSICAL CHEMISTRY I

Objective

To study the chemical potential and its significance. To study the effect of temperature on reaction rate. To study the elements of group theory and the applications of group theory.

UNIT-I: THERMODYNAMICS I

Partial molar properties-Partial molar free energy (Chemical potential) - Partial molar volume and Partial molar heat content - Their significance and determination of these quantities. Variation of chemical potential with temperature and pressure.

Thermodynamics of real gases - gas mixture - definition of fugacity - determination of fugacity - variation of fugacity with temperature and pressure - thermodynamics of ideal and non ideal binary solutions - dilute solutions.

UNIT-II: THERMODYNAMICS II AND CHEMICAL KINETICS

Excess functions for non ideal solutions and their determination - the concept of activity and activity coefficients - determination of standard free energies - choice of standard states - determination of activity and activity coefficients for non electrolytes.

Effect of temperature on reaction rates - collision theory of reaction rate - collision cross sections - effectiveness of collisions - probability factor.

UNIT-III: CHEMICAL KINETICS

Potential energy surfaces - partition function and activated complex - Eyring equation - estimation of free energy, enthalpy and entropy of activation and their significance.

Reactions in solutions - effect of pressure, dielectric constant and ionic strength on reactions in solutions - kinetic isotope effects - linear free energy relationships - Hammett and Taft equations.

UNIT-IV: CHEMICAL KINETICS AND ELEMENTS OF GROUP THEORY

Acid - Base catalysis - mechanism of acid - base catalysed reactions - Bronsted catalysis law.

Symmetry elements and symmetry operations - group multiplication table - sub groups, similarity transformation and classes - identifications of symmetry operations and determination of point groups - reducible and irreducible representations - direct product representation.

UNIT-V: APPLICATIONS OF GROUP THEORY

Orthogonality theorem and its consequences - construction of character table for C_{2V} and C_{3V} - hybrid orbitals in non linear molecules (CH_4,XeF_4,BF_3,SF_6 and NH_3). Determination of representations of vibrational modes in non linear molecules (H_2O,CH_4,BF_3, and NH_3).

Symmetry selection rules of infra-red and Raman spectra - application of group theory for the electronic spectra of ethylene and formaldehyde .

Text Books

1. S.Glasstone,Thermodynamics For Chemists, Affliated East West Press ,New Delhi, 1950.
2. J.Rajaram and J.C.Kuriacose, Thermodynamics For Students Of Chemistry, Lal Nagin Chand, New Delhi, 1986.
3. G.K.Vemulapalli, Physical Chemistry,Prenticall-Hall,2000.
4. Thomas Engel and Philp Reid, Physical Chemistry, Pearson Education,2006.
5. J.Rajaram and J.C.Kuriacose, Kinetics And Mechanism Of Chemical Transformations. Macmillan India Ltd,1993.
6. K.J.Laidler, Chemical Kinetics, Harpet And Row, New York, 1987.
7. K.L.Kapoor, Atext Book Of Physical Chemistry Macmillan India Ltd., 2001.
8. V. Ramakrishnan and M. S. Gopinathan, Group Theory In Chemistry, Vishal Publications, 1998.
9. K.V.Raman, Group Theory and It's Applications To Chemistry, Tata Mcgraw Hill Publishing. Co., 1990.
10. Bhattacharya: Group Theory And It's Applications.

Suggested Reference Books

1. W.J.Moore Chemistry, Orient Longman, London, 1972.
2. K.G.Denbiegh, Thermodyanamics Of Steady State, Methien And Co.Ltd, London, 1951.
3. L.K. Nash, Elements Of Chemical Thermodyanamics, Addision Wesley, 1962.
4. G.M.Barrow, Physical Chemistry, Mcgraw Hill, 1988.
5. R.G.Frost and Pearson, Kinetics And Mechanism, Wisely, New York, 1961.
6. C. Capellos and B.H.J.Bielski, Kinetics Systems, Wisely Interscience, New York, 1972.
7. Amdur and G.G.Hammes, Chemical Kinetics, Principles And Selected Topics, Mcgraw Hill, New York, 1968.
8. G.M. Harris, Chemical Kinetics, D.C.Health And Co., 1966.
9. F.A.Cotton, Chemical applications of Group Theory, John Wiley And Sonsinc., New York, 1971.
10. N.Thinkham, Group Theory and Quantum Mechanics, Mc Graw Hill Book Company, New York, 1964.
11. Strietweiser, Molecular Orbital Theory For Organic Chemists John Wiley And Sons, New York,1961.
12. D.S.Schonland, Molecular Symmetry, Vannorstrand, London, 1965.
13. Alan Vincent, Molecular Symmetry and Symmetry And Group Theory-Programme Introduction To Chemical Application, Wiley, New York, 1977.
14. Sandony, Electronic Spectra And Quantum Chemistry, Prentice Hall, 1964.

II SEMESTER

PAPER III

ORGANIC CHEMISTRY II

Objective

To learn the various types of reactions, rearrangements and their synthetic utility.

UNIT-I: ADDITION TO CARBON - CARBON AND CARNON - HETERO MULTIPLE BONDS

Electrophilic, nucleophilic and neighbouring group participation mechanisms - addition of halogen and nitrosyl chloride to olefins. Hydration of olefins and acetylenes. Hydroboration, hydroxylaions, Michaeal addition, 1, 3 - dipolar additions, Carbenes and their additions to double bonds - Simmon - Smith reaction. Mannich, Stobbe, Darzen, Wittig, Wittig - Horner and Benzoin reactions. Stereochemical aspects to be studied wherever applicable.

UNIT-II: ELIMINATION REACTIONS

E_1, E_2 and E_1cB mechanism - E_1, E_2 and E_1cB spectrum - Orientation of the double bond - Hoffman and Saytzeff rules - Competition between elimination and substitution. Typical eliminations reactions - dehydration, dehydrohalogenation and dehalogenation. Stereochemistry of E_2 eliminations in cyclohexane systems. Mechanism of pyrolytic eliminations. Chugaev and Cope eliminations.

UNIT-III: MOLECULAR REARRANGEMENTS

A detailed study with suitable examples of the mechanism of the following rearrangements: Pinacol - Pinacolone (examples other than tetramethylethylene glycol) - Wagner - Meerwein, Demjanov, dienone - phenol, Favorski, Baeyer - Villiger, Wolf, Stevens (in cyclic systems) and Von Richter rearrangements.

UNIT-IV: OXIDATION

Mechanism - study of the following oxidation reactions - oxidation of alcohols - use of DMSO in combination with DCC or acetic anhydride in oxidising alcohols - oxidation of methylene to carbonyl, oxidation of aryl methenes - allylic oxidation of olefins.

Formation of C=C, C-C bonds by dehydrogenation, dehydrogenation by quinones , SeO_2, $Hg(OAc)_2$ and $Pb(OAc)_4$, Formation of C-C bond in phenol coupling - acetylene coupling-allylic oxidation-oxidation of alcohol, glycols, halides and amines to aldehydes and ketones - Ozonolysis - oxidation of Olefinic double bonds and unsaturated carbonyl compounds-oxidative cleavage of C-C bond.

UNIT-V: REDUCTION, CARBENES AND NITRENES

Reduction : Selectivity in reduction 4-t-butylcyclohexanone using selected hydride reductions - Synthetic importance of Clemmenson and Wolf-Kishner reductions - Modification of Wolff-Kishner reduction - Birch reduction, MPV reduction. Catalytic hydrogenation, Sommelet reaction and selection in reduction . Clemmensen reduction. Reduction with $LiAlH_4$, $NaBH_4$, tritertiarybutyoxyaluminium hydride, sodium Cyanoborohydride, trialkyltin hydride, hydrazines.

Carbenes and nitrenes : Methods of generation , structure, addition reactions with alkenes - insertion reactions.

Recommended Books

1. Principles of organic synthesis R.O.C. Norman, Chapman and Hall, London. 1980.
2. Structure and Mechanism by E.S. Gould
3. Advanced Organic Chemistry - Part B by Francis A. Carey and Richard J, Sundberg, 3rd Edition 1990.
4. Organic Reaction Mechanism by S.M. Mukherji and S.P. Singh, MacMillan India Ltd., Chennai - 1990.
5. Organic synthesis by Michael Smith.
6. Carbenes, Nitrenes and Arynes by T.L. Gilchrist and C.W. Rees, Thomas Nelson and Sons Ltd., London.
7. Molecular Rearrangements Vol-I and Vol-II by Paul de Mayo.
8. Advanced Organic Chemistry III Edition by J. March.
9. Stereochemistry and Mechanism through solved problems by P.S. Kalsi, Wiley Eastern Ltd., 1994.
10. Some Modern Methods of Organic Synthesis by W Carruthers, III Edition, Cambridge University Press, 1993.
11. Modern Synthetic Reactions by H.O. House, The Benjamin Cummings Publishing Company, London, 1972
12. Advanced organic chemistry, Mc Murray, Thomas Pvt. Ltd.,
13. Organic reaction mechanisms: Parmer and Chawla, S. Chand and Co.,

PAPER IV

INORGANIC CHEMISTRY II

Objective

To study about the theories of coordination complexes, Chemistry of lanthanides, to learn about Nanotechnology and use of Inorganic Compounds in Biological Chemistry.

UNIT-I: COORDINATION CHEMISTRY

Evidence for metal ligand orbital overlap, molecular orbital theory and energy level diagrams, concept of weak and strong field ligands, Jahn-Teller, distortion, charge - transfer spectra.

Term states for "d" - ions, energy diagrams, d-d transistions, Orgel and Sugano - Tunabe diagrams, spin orbit coupling, nephelauxetic effect, spectral and magnetic characteristics of transition metal complexes.

UNIT-II: THE CHEMISTRY OF SOLID STATE I

Structure of Solids; Comparison of X-ray and Neutron Diffraction; structure of Pyrovoskite, cadmium iodide and nickel arsenide; spinels; defects in solids, non-stoichometeric compounds.

Electrical, Magnetic and optical properties of solids, band theory, Semiconductors, superconductors, Solid state Electrolytes, Types of magnetic Behaviour, Dia, para, ferro, antiferro and ferrimagnetism: Hysterisis.

UNIT-III: THE CHEMISTRY OF SOLID STATE II

Solid state lasers, inorganic phosphors, Ferrites.

Reactions solid state and phase transitions, Diffusion, Diffusion coefficient Diffusion mechanisms, Vacancy and Interstitial Diffusion, Formation of spinels.

UNIT-IV: THE CHEMISTRY OF LANTHANIDES AND ACTINIDES AND NANOTECHNOLOGY

The Chemistry of solid state, lanthanides and actinides, oxidation state spectral, magnetic characteristics, coordination numbers, stereochemistry, nuclear and non-nuclear applications.

Nanotechnology - introduction - preparatory methods, characterization, application as sensors, biomedical applications, application in optics and electronics.

UNIT-V: BIO-INORGANIC CHEMISTRY

Transport proteins: Oxygen carriers, enzymes, carboxy peptidase, carbonic anhydrase, redox process, iron-sulphur proteins, chlorophyll, salient features of the photo synthetic process, vitamin B_{12} role of sodium, potassium, calcium, zinc and copper; fixation of nitrogen, nitrogen cycle.

Anti-cancer drugs and their mechanism of action, Natural and man made radio isotopes and their application.

Text Books

1. Principles of Instrumental Methods of analysis - D, A. Skoog and Saunder's College Publ. III Edition, 1985.
2. Instrumental methods of analysis, Willard Merrit, Dean and Settle, CBS Publ. VI edition, 1986.
3. Text book of qualitative Inorganic Analysis - Al. Vogel, ELBS III Edition, 1976.
4. Fundamental of Analytical Chemistry, D.A. Skoog and D.M. West Hold Reinhord and Winston Publication, IV Edition, 1982.
5. K.F. Purcell and J.C. Kotz, Inorganic Chemistry WB Saunders Co., USA, 1977
6. J.E. Huheey, Inorganic Chemistry, Harper and Collins, NY, IV Edition, 1993.
7. FA Cotton and G.W. Wilkinson, Advanced Inorganic Chemistry - Acomprehensive Text, John Wiley and Sons, 1988.
8. B.E. Dogulas DH McDaniel's and Alexander, Concepts and Models of Inorganic Chemistry, Oxford IBH, 1983.
9. WU. Mallik, G.D. Tuli, R.D. Madan, Selected topics in Inorganic Chemistry, S. Chand and Co., New Delhi, 1992.
10. A.R. West, Basic solid state chemistry, John Wiley, 1991.
11. W.E. Addison, structural principle in inorganic chemistry Longman, 1961.
12. D.M. Adams, Inorganic solids, John Wiley Sons, 1974.

Suggested References

1. Instrumental Analysis, G.D. Christian and J.E.O. Reily, AllegnRecon "Edition, 1986.
2. Chemical Instrumentation, H.A. Strobel, Addition - Wesley Pub!. Co., 1976.
3. Treatise on Analytical Chemistry, Kolthoff and Goning (All Series)
4. Comprehensive Analytical Chemistry, Willson Series.
5. S.F.A. Kettle, Coordination Chemistry, ELBS, 1973.
6. B.N. Figgis, Introduction to Ligand Fields, Interscience, 1966.
7. M.N. Hughes, The Inorganic Chemistry of Biological processes, Wiley London, 1982, II Edition.
8. D. Nicholas, Complexes of First Row Transition Elements, 1974.
9. M.C. Shrivers, P.W Atkins, CH. Langford, Inorganic Chemistry, OUP, 1990.
10. M.C. Day and J. Selbin, Theoretical Inorganic Chemistry, Van Nostrand Co., NY, 1974.
11. G.S. Manku, Inorganic Chemistry, 1 MH, 1984.
12. U. Sailiyanarayana, Essential of Biochemistry, Books and Apllied (P) Ltd.,
13. Bioinorganic chemistry: DE
14. AF Wells, Structural inorganic chemistry, Oxford, V Edition, 1984.
15. Azaroff Solid State Chemistry, John Wiley.

PAPER V

PHYSICAL CHEMISTRY II

Objective

To study the different types of molecular spectroscopy, enzyme catalysis and kinetics of complex reactions. To study the fundamental principles of Quantum Chemistry, Schrodinger wave equation and its applications.

UNIT-I: SPECTROSCOPY I

Interaction of matter with radiation - Einstein's theory of transition probability - rotational spectroscopy of a rigid rotator - non rigid rotator - diatomic and polyatomic molecules. Vibrational spectroscopy - harmonic oscillator - anhormonicity - vibrational spectra of poly atomic molecules - vibrational frequencies - group frequencies - vibrational coupling overtones - Fermi resonance. Raman Spectra. Electronic spectra - group symmetry of molecules and selection rules - types of transition - solvent effects.

UNIT-II: CHEMICAL KINETICS II

Catalysis by enzymes - rate of enzymes catalysed reactions - effect of substrate concentration, pH and temperature on enzyme catalysed reactions - inhibition of enzyme catalysed reactions.

Study of surfaces - Langmuir and BET adsorption isotherms - study of kinetics of surface reactions - catalysis by metals, semiconductor oxides - mechanism of heterogeneous catalytic reactions - the absorption coefficient and its significance.

UNIT-III: CHEMICAL KINETICS IV

Kinetics of complex reactions, reversible reactions, consecutive reactions, parallel reactions, chain reactions, general treatment of chain reactions - chain length - Rice Herzfeld mechanism - explosion limits.

Study of fast reactions - relaxation methods - temperature and pressure jump methods-stopped flow and flash photolysis methods.

UNIT-IV: QUANTUM CHEMISTRY I

Inadequacy of classical theory - Bohr's quantum theory and subsequent developments - the Compton effect - wave particle duality - uncertainty principle - waves - wave equation for electrons - quantum mechanical postulates-the operators - Hermitian property.

Schrodinger equation - application of Schrodinger's equation - the particle in a box (one, two and three dimensional cases).

UNIT-V: QUANTUM CHEMISTRY II

The harmonic oscillator - the rigid rotor - particle in a ring, Schrodinger equation for hydrogen atom (no derivation is required) and the solution - the origin of quantum numbers (angular momentum and spin) - their physical significance.

Text Books

1. C.N.Banwell and E.M.McCash, Fundamentals of Molecular spectroscopy IV Edition, Tata McGraw Hill, 2005.
2. D.N.Sathyanarayana, Vibrational Spectroscopy, New Age International publishers,2004.
3. J.Rajaram and J.C.Kuriacose,Kinetics and Mechanism Of Chemical Transformations.Macmillan India Ltd,1993.
4. R.J.Laidler,Chemical Kinetics,Harpet And Row,New York,1987.
5. D.A. Mcquarrie,Quantum Chemistry,University Science Books,Mil Valley,California,1983.
6. Quantum Chemistry,Allyn And Bacon,Boston,1983.
7. R.Anantharaman,Fundamentals Of Quantum Chemistry,Mamillan India Limited,2001.

Suggested Reference Books

1. Raymond Chang,Basic Priciples Of Spectroscopy,Mcgraw Hill Ltd.,New York,1971.
2. P.W.Atkins, Advanced Physical Chemistry, Oxford Press,1990.
3. G.Arul Doss, Molecular Structure and Spectroscopy, Prentice Hall,2002.
4. R.G.Frost and Pearson, Kinetics And Mechanism, Wiley, New York,1961.
5. W.J.Moore and R.G.Pearson, Kinetics And Mechanism,1981.
6. C.Capellos and B.J.J.Bielski,Kinetics Systems,Wisely Inter Science,New York, 1972.
7. Ambur and G.G.Hammes, Chemical Kinetics, Principles And Selected Topics, Mcgraw Hill, New York, 1968.

8. G.M.Harris, Chemical Kinetics, D.C.Heat And Co.,1966.
9. R.K.Prasad, Quantum Chemistry, University Science Books, Mil Valley, California,1983.
10. J.Goodisman, Contemporary Quantum Chemistry, An Introduction, Plenum Press, New York,1997.
11. R.Mcweeny, Coulon's Valence, Elbs Oxford University Press,1979.
12. F.J.Bockhoff, Elements Of Quantum Theory, Addision Wesley, Reading Mass,1976.
13. P.W.Atkins, Physical Chemistry, Oxford University Press, 1990.
14. H.Eyring, J.Walter and G.Gimball Quantum Chemistry, John Wiley And Sons, New York,1944.
15. Linus Pauling and Wilson Introduction To Quantum Mechanics, Mcgraw Hill Book Company, New York,1935.
16. P.W.Atkins, Molecular Quantum Mechanics, Oxford University Press,Oxford,1983.

PRACTICAL I

ORGANIC CHEMISTRY I

Identification of components in a two component mixture and preparation of their derivatives.

Determination of b.p. / m.p. for components and m.p. for the derivatives.

Any Six preparation form the following

(i) Preparation of o-benzyl benzoic acid

(ii) p-Nitrobenzoic acid from p-nitrotoluene

(iii) Anthroquinone from anthracene

(iv) Benzhydrol from Benzophenone

(v) m-Nitroaniline from m-dinitrobenzene

(vi) 1,2,3,4 - Tetrahydrocarbazole from cyclohexanone

(vii) p-chlorotoluene form p-toluidine

(viii) 2,3 - Dimethylindole from phenyl hydrazine and 2 - butanone (boiling acetic acid)

(ix) Methyl orange form sulphanilic acid

(x) Diphenyl methane from benzyl chloride

University Examination (60 MARKS)

Qualitative organic Analysis	30 Marks
Preparation	15 Marks
Record	05 Marks
Viva voce	10 Marks
Total	60 Marks

Internal Assessment (40 Marks)

1.	Two Tests	- 20 Marks
2.	Attendance / Regularity	- 10 Marks
3.	Results accuracy	- 10 Marks
	Total	**- 40 Marks**

PRACTICAL II

INORGANIC CHEMISTRY I

UNIT-I

Semimicro qualitative analysis of mixture containing two common and two rare cations.

The following are the rare cations to be included. W, Ti, Te, Se, Ce, Th, Zr, V, U, Li, Mo, Be.

UNIT-II

a) Complexometric titrations (EDTA) - Estimation of Ca, :Mg and Zn.

b) Preparation of the following:

(i) Potassium tris (oxalate) aluminate (III) trihydrate
(ii) Tris (thiourea) copper (I) chloride
(iii) Potassium tris (oxalaato) chromate (III) trihydrate
(iv) Sodium bi (thioshophato) cuprate (I)
(v) Tris (thiourea) copper (I) sulphate
(vi) Sodium hexanitrocobaltate (iII)
(vii) Chloropentammine cobalt (III) chloride
(viii) Bis (acetylacetanato) copper (II)
(ix) Hexanrinennickel (II) chloride
(x) Bis (thicyanato) pyridine manganese (II)

c) Separation of zinc and magnesium on an anion exchange

University Examination (60 MARKS)

Qualitative organic Analysis (Semimicro)	20 Marks
Mixture if 4 cations (2 rare + 2 common)	
Preparation	10 Marks
EDTA complexometric titration	15 Marks
Record	05 Marks
Viva voce	10 Marks
Total	**60 Marks**

Internal Assessment (40 Marks)

1.	Two Tests	- 20 Marks
2.	Attendance / Regularity	- 10 Marks
3.	Results accuracy	- 10 Marks
	Total	**- 40 Marks**

PRACTICAL III

PHYSICAL CHEMISTRY I

Experiments in Thermodynamics, colligative properties, phase rule, chemical equilibrium and chemical kinetics.Typical examples are given and a list of experiments is also provided from which suitable experiments can be selected as convenient.

1. Heat of solution from Solubility measurements
2. Determination of molecular weight
3. Determination of activity and activity coefficient
4. Phase diagram construction involving two/three component systems
5. Determination of partial molar quantities
6. adsorption isotherm
7. Reaction rate and evaluation of other kinetic parameters using polarimetry,analytical techniques, conductometry, dilatometry
8. Verification of Beer Lambert law.

Detailed list of Experiments for Physical Chemistry Practical I

Typical list of possible experiments are given. Experiments of similar nature and other experiments may also be given. The list given is only a guidelines. Any 15 experiments have to be performed in a year.

1. Determine the temperature coefficient and energy activation of hydrolysis of ethyl acetate.
2. Study the kinetics of the reaction between acetone in iodine and - acidic medium by half life method and determine the order with respect to iodine and acetone.
3. Study the effect of solvent(DSMO-water, acetone-water system).On the rate of acid catalysed hydrolysis of acetal by dilatometry.
4. Study the Saponification of ethyl acetate by sodium hydroxide conductometrically and determine the order of the reaction.
5. Determine the order with respect to Silver (I) in the oxidation by spt and rate constant and for uncatalysed reaction.
6. Study the inversion of cane sugar in the presence of acid using Polarimeter .
7. Determine the rate constant and order of the reaction between potassium persulphate and potassium iodide and determine the temperature coefficient and energy of activation of the reaction.
8. Study the effect of ionic strength on the rate constant for the saponification of an ester.
9. Study the salt effect on the reaction between acetone and iodine.
10. Study the kinetics of the decomposition of sodium thiosulphate by mineral acid(0.5M HCl).

11. Study the primary salt effect on the kinetics of ionic reactions and test the Bronsted relationship (iodide ion is oxidized by persulphate ion).
12. Study the kinetics of enzyme catalysed reactions (Activity of tyrosinase upon tyrosine spectrophotometrically).
13. Study the salt effect ,the solvent effect on the rate law of alkaline hydrolysis of crystal violet.
14. Study the reduction of aqueous solution of ferric chloride by stannous chloride.
15. Determine the molecular weight of benzoic acid in benzene and find the degree of association.
16. Determine the activity coefficient of an electrolyte by freeing point depression method .
17. Study the phase diagram form-toluidine and glycerine system.
18. Construct the phase diagram for a simple binary system naphthalene - phenantherene and benzophenone-diphenyl amine.
19. Construct the boiling point composition diagram for a mixture having maximum boiling point and minimum boiling point.
20. Study the complex formation between copper sulphate and ammonia solution by partition method.
21. Study the simultaneous equilibria in benzoic acid - benzene water system.
22. Determine the degree of hydrolysis and hydrolysis constant of aniline hydrochloride by partition method.
23. Determine the molecular weight of a polymer by viscosity method.
24. Determine the viscosities of mixtures of different compositions of liquids and find the composition of a given mixture.
25. Determine the partial molal volume of glycine/methonal/formic acid/sulphuric acid by graphical method and by determining the densities of the solutions of different compositions.
26. Study the temperature dependence of the solubility of a compound in two solvents having similar inter molecular interactions (benzoic acid in water and in DMSO water mixture)and calculate the partial molar heat of solution.
27. Determine the polar molar volume of glycine/methonal/formic acid /sulphuric acid by graphical method and by determining the densities of solutions of different concentrations.
28. Construct the phase diagram of the three component of partially immiscible liquid system (DMSO-water-benzene;acetone-chloroform -water; chloroform-acetic acid-water)
29. Construct the phase diagram of a ternary aqueous system of glucose -potassium chloride and water
30. Study the surface tension - concentration relationship for solutions(Gibb's equation)
31. Study the absorption of acetic acid by charcoal(Fruendlich isotherm)

32. Study the complex formation and find the formula of silver-ammonia complex by distribution method.
33. Determine the dissociation constant of picric acid using distribution law.
34. Construct a chemical actinometry and determine the quantum yield and calibrate the lamp intensity.

University Examination (60 MARKS)

Procedure	10 Marks
Manipulation	15 Marks
Result	20 Marks
Record	05 Marks
Viva voce	10 Marks
Total	**60 Marks**

Internal Assessment (40 Marks)

1.	Two Tests	- 20 Marks
2.	Attendance / Regularity	- 10 Marks
3.	Results accuracy	- 10 Marks
	Total	**- 40 Marks**

HUMAN RIGHTS

COMPULSORY PAPER

UNIT-I

Definition of Human Rights - Nature, Content, Legitimacy and Priority - Theories on Human Rights - Historical Development of Human Rights.

UNIT-II

International Human Rights - Prescription and Enforcement upto World War II - Human Rights and the U .N .O. - Universal Declaration of Human Rights - International Covenant on Civil and Political Rights - International Convenant on Economic, Social and Cultural Rights and Optional Protocol.

UNIT-III

Human Rights Declarations - U.N. Human Rights Declarations - U.N. Human Commissioner.

UNIT-IV

Amnesty International - Human Rights and Helsinki Process - Regional Developments - European Human Rights System - African Human Rights System - International Human Rights in Domestic courts.

UNIT-V

Contemporary Issues on Human Rights: Children's Rights - Women's Rights - Dalit's Rights - Bonded Labour and Wages - Refugees - Capital Punishment.

Fundamental Rights in the Indian Constitution - Directive Principles of State Policy - Fundamental Duties - National Human Rights Commission.

Books for Reference:

1. International Bill of Human Rights, Amnesty International Publication, 1988.
2. Human Rights, Questions and Answers, UNESCO, 1982

3. Mausice Cranston - What is Human Rights
4. Desai, A.R. - Violation of Democratic Rights in India
5. Pandey - Constitutional Law.
6. Timm. R.W. - Working for Justice and Human Rights.

7. Human Rights, A Selected Bibliography, USIS.
8. J.C.Johari - Human Rights and New World Order.
9. G.S. Bajwa - Human Rights in India.
10. Amnesty International, Human Rights in India.
11. P.C.Sinha & K. Cheous (Ed) - International Encyclopedia of Peace, Security Social Justice and Human Rights (Vols 1-7).
12. Devasia, V.V. - Human Rights and Victimology.

Magazines:

1. The Lawyer, Bombay
2. Human Rights Today, Columbia University
3. International Instruments of Human Rights, UN Publication
4. Human Rights Quarterly, John Hopkins University, U.S.A.

ELECTIVE

PAPER II

SYNTHETIC ORGANIC CHEMISTRY AND CHEMISTRY OF NATURAL PRODUCTS

Objective

To know modern synthetic methods and synthetic strategies. This help in planning the synthesis of any types of organic compounds. To learn the synthesis and bio-synthesis of natural products.

UNIT-I: ALKALOIDS AND BIO ORGANIC CHEMISTRY

Total synthesis of quinine, morphine and reserpine.

Nucleic Acids: types of nucleic acids - DNA & RNA polynucleotide chain. Components - biological functions. Structure and role of (genetic code) DNA and RNA (Nucleotides only) Biosynthesis of Cholesterol

UNIT-II: PROTEINS

Peptides and their synthesis - synthesis of tripeptide. Merrifield synthesis, Determination of tertiary structure of proteins, Bio-synthesis of proteins.

UNIT-III: MODERN SYNTHETIC METHODS, REACTIONS AND REAGENTS

Principles and synthetic processes involving phase transfer catalysis, (Nitriles from Alkly halides, Alcohol from Alkyl halides) polymer supported reagents (synthesis of oligo saccharides), (micro oven, esterification, deacetification and hydrolysis).

Synthesis of simple organic molecules using standard reaction like acetylation alkylation of enamines and active methylene compounds, Grignard reactions, Phosphorus and sulphurylides Robinson annulation, Diels Alder reactions, protection and deprotection of functional groups (R-OH, R-CHO, RCO-R, R-NH_2 and R-COOH).

Uses of the following reagents: DCC, Trimethylsilyliodide, 1, 3-Dithiane (umpolung), diisobutylaluminimumhydride (DIBAL), 9BBN, Trimethylsilylchlorode.

UNIT-IV: PLANNING ORGANIC SYNTHESIS AND RETROSYNTHETIC ANALYSIS

(Synthesis of the following target molecules: longifolene, cubane, 5-hexenoic acid, trans-9-methyl I-decalone, bicyclo (4,1,0) heptan-2 one and onocerin.

An introduction to retrosynthesis - Synthon, Synthetic equivalent, Target molecule, Functional group interconversion - Disconnection approach - One group disconnection - Disconnection of alcohols, olefins and ketones - Logical and illogical disconnections, Two group disconnection - 1,2 - 1,3 - 1,4 - 1,5 - and 1,6 - deoxygenated skeletons and dicarbonyls. Retro Diels Alder reaction - pericyclic reactions - Retrosynthesis of some heterocycles containing two nitrogen atoms.

UNIT-V: HETEROCYCLES, VITAMINS AND STEROIDS

Imidazole, oxazole, thiazole, flavones, isoflavones, anthocyanins, pyrimidines (cytocine and L racil only) and purines (adenine. Guanine only). Synthesis of parent and simple alkYI or aryl susbstitution derivatitives are expected. Synthesis of vitamin A1 (Reformatsky and Wittig reaction methods only). Conversion of cholesterol to progesterone, estrone and testosterone.

Recommended Books

1. Guide book to Organic synthesis by Ramond K. Mackie and David M. Smith, ELBS Publication.
2. Chemistry of alkaloids by Pelletier.
3. Introduction to Alkaloids by G.A. Swan
4. Organic Chemistry V Edition, 1986, VolII by I.L. Finar, ELBS Publication
5. Outlines of Biochemistry V Edition by Eric E. Conn, Paul. R. Stumpf, George Bruening and Roy H. Dole, John Wiley and Sons.
6. Principles of Biochemistry General aspects by L. Smith, Robert L. Hill I. Robert Lehman, Robert J. Let Rowitz, Philip Handlar and Abrahim white. McGraw Hill Int. (7th Edition)
7. Biochemistry by Lubert Stryer, WH. Freeman and Co., New York
8. Chemistry of organic natural products by Agarwal, Geol Publishing House.
9. Organic synthesis by R.E. Ireland, Prentice Hall of India, Geol Publishing House.
10. Principles of Organic synthesis by R.O.C. Norman, Champan and Hall, NY, 1980.
11. Advanced Organic Chemistry by Francis. A. Carey Richard J. Sundberg, 3rd Edition, Plenum, Press, New York, 1990.
12. Advanced Organic Chemistry by Jerry March, IV edition Wiley Eastern Ltd., New Delhi.
13. Organic Chemistry, 6th Edition, 1992. RT.Morrison, R.S. Boy, Prentice Hall of India Pvt. Ltd., New Delhi.

14. Organic synthesis by Michael Smith
15. Organic Chemistry by House.
16. Micheal B. Smith, Organic Syntheis, McGraw Hill, International Editor, 194.
17. Stuart Warren, Work book for organic synthesis, The Disconnection Approach John Wiley & Sons (Asia) Pvt. Ltd.,
18. W. Carruther, Jain Coldham, Modern Methods of organic synthesis, 4th Edition.

III SEMESTER

PAPER VI

INORGANIC CHEMISTRY III

Objective

To study about the Coordination complexes, Substitution in Coordination complexes, to study the Inorganic Photochemistry

.

UNIT-I: ORGANO METALLIC CHEMISTRY I

Carbon donors: Alkyls and aryls metalation, bonding in carbonyls and nitrosyls, chain and cyclic donors, olefins, acetylene and allyl system synthesis structure and bonding Metallocenes.

Reactions : Association substitution, addition and elimination ligand promotion, electrophilic and nucleophilic attack on ligands. Carbonylation. Decorboxylation, oxdative addition and fluxionality.

UNIT-II: ORGANO METALLIC CHEMISTRY II

Catalysis : Hydrogenation of olefins (Wilkinson's catalyst), hydroformylation of olefins using cobalt or rhodium catalysts (oxo process), oxidation of olefins to aldehydes and ketones (Wacker process) polymerization (Zeigler - Natta Catalyst); cyclo oligomerisation of acetylene using nickel catalyst (Repee's catalyst); polymer-bound catalysts.

UNIT-III: COORDINATION CHEMISTRY

Electron transfer reactions, outer and inner sphere processes; atom transfer reaction, formation and rearrangement of precursor complexes, the binding ligand, successor complexes, Marcus Theory.

Complementary, non-complementary and two electron transfer reactions.

UNIT-IV: COORDINATION CHEMISTRY

Substitution Reactions: Substitution in square planar complexes, reactivity of plantium complexes, influences of entering, leaving and other groups, the trans effect.

UNIT-V: COORDINATION CHEMISTRY AND INORGANIC PHOTOCHEMISTRY

Substitution of octahedral complexes of cobalt and chormium, replacement of corodinated water, solvolytic (acids and bases) reaction applications in synthesis (platinum and cobalt complexes only).

Inorganic Photochemistry: Photo-substitution, Photoredox and isomerisation process, application of metal complexes in solar energy conversion.

Text Books

1. F.A. Cotton and G. Wilkinson, Advanced Inorganic Chemistry, John Wiley and Sons (1988) V Edition.
2. K.F. Purcell and J.C. Katz, Inorganic Chemistry, Wesaunders Co., 1977.
3. R. Drago, Physical methods in inorganic Chemistry, Reeindhod, NY, 1968.
4. EAV. Blesworth, D.w.H. Rankin and S. Cradock, Structural methods in Inorganic Chemistry, Blackwell Scientific Publ., 1987.

Suggested References

1. G. Coates m.l. Green and K. Wade. Principles of Organo metallic chemistry, Methven Co., London. 11988.
2. R.B. Jordon, Reaction mechanism of Inorganic and Organo metallic system, OUP, 1991.
3. P. Powell, Principles of Organo metallic chemistry, Chappman and Han. 1998.
4. R.C. Mehrothra, A. Singh, Organo Metalic Chemistry, Wiley Eastern Co., 1992.
5. R.B. Heslop and K. Jones, Inorganic Chemistry, Elsevier Scientific Publ., 1976.
6. H.A. O Hill and P. Day, Practical methods in advanced inorganic chemistry, John Wiley, 1968.
7. K. Bwger, Coordinaiton Chemistry, Experimental methods, Butterworths, 1973.
8. C.N.R. Rao, I.R. Fell'alo, Spectroscopy in Inorganic Chemistry, Vol. I and Vol. II, Academic Press, 1970.
9. K. Burger, Coordination Chemistry, Experimental methods, Butterworths, 1973.
10. G. Aruldhas, Molecular Structure and Spectroscopy - Prentice Hall.

PAPER VII

PHYSICAL CHEMISTRY III

Objective

To study the application of Quantum Chemistry to chemical bonding. To study the ionic conductance, Electrode - Electrolytic interface. To study the kinetics of polymerization and to study NMR spectroscopy and its applications.

UNIT-I: QUANTUM CHEMISTRY II

Approximation methods - perturbation and variation methods - application to hydrogen and helium atoms.

Born - Oppenheimer approximation - Valence bond theory for hydrogen molecule - LCAO - MO theory for di- and polyatomic molecules. Concept of hybridization - Huckel theory for conjugated molecules (Ethelene, butadiene and benzene) - semi - empirical methods - Slater orbital and HF - SCF methods.

UNIT-II: ELECTROCHEMISTRY I

Mean ionic activity and mean ionic activity coefficient - concept of ionic strength, Debye - Huckel theory of strong electrolytes - activity coefficient of strong electrolytes - determination of activity coefficient by electrochemical method. Debye Huckel limiting law - qualitative and quantitative verification - limitation of Debye Huckel limiting law at appreciable concentrations of electrolytes - Huckel equation - Debye - Huckel - Bronsted equation .

UNIT-III: ELECTROCHEMISTRY II

Electrode - electrolyte interface - adsorption at electrified interface - electrical double layer - electro capillary phenomenon - Lippmann equation - Structure of double layers - Helmholtz - Perrin, Guoy - Chappmann and Stern model of electrical double layers.

Diffusion - Fick's law of diffusion - Effect of ionic association on conductance-electrokinetic phenomena-membrane potential.

UNI- IV: MACROMOLECULES

Polymerization in homogeneous and heterogeneous phases- Kinetics of polymerization (Ionic and Addition)-kinetics of copolymerization- Mechanism of Polymerization- Chain Initiation- Propagation - Termination-Transfer -Inhibition and Retardation.

Properties of polymers : Molecular weight of polymers - Mw, Mn determination - Light Scattering, Ultracentrifuge - Gel Permeation Chromatography.

UNIT-V: SPECTROSCOPY II

Resonance spectroscopy - Zeeman effect - equation of motion of spin in magnetic fields - chemical shift - spin spin coupling - NMR of simple AX and AMX type molecules - calculation of coupling constants - ^{13}C, ^{19}F, ^{31}P NMR spectra - applications - a brief discussion of Fourier transformation resonance spectroscopy.

Text Books

1. R.K.Prasad,Quantum Chemistry,Wiley Eastern,New Delhi,1992.
2. M.W.Hanna,Quantum Mechanics In Chemistry,W.A.Benjamin Inc.London,1965.
3. S.Glasstone,Introduction To Electrochemistry,Affliated East West Press ,New Delhi,1960.
4. D.R.Crow,Principles And Applications To Electrochemistry,Chapman And Hall,1991.
5. J.Rajaram And J.C.Kuriacose,Thermodynamics For Students Of Chemistry,Lal Nagin Chand,New Delhi,1986.
6. F.W.Billmeyar,Text Book Of Polymer Science,Wiley Interscience,1984.
7. A.Rudin,The Elements Of Polymer Science And Engineering,An Introductory Text For Engineers And Chemists,Academic Press,New York,1973.
8. G.Odian Principles Of Polymerization,Mc Graw Hill Book Company,New York,1973.
9. Caringtion and Ad.Mclachlan,Introduction To Magnetic Resonance Harper And Row,New York,1967.
10. M.S. Bhetnager, Polymers, S. Chand company volume I, II and III.

Suggested Reference for Books

1. R.L.De Koch And H.B.Gray,Chemical Structure and Bonding,Benjamin/Cumming,Menlo Park,California.
2. A.K.Chandra,Introductory Quantum Chemistry,Tata Mcgraw Hill.
3. J.M.Murrell,S.F.A.Kettle and J.M.Tedder,The Chemical Bond,Wiley,1985.
4. D.A.Mc Quarrie,Quantum Chemistry,University Science Books, Mill Valley,California,1983.
5. P.W.Atkins,Molecular Quantum Mechanics,Oxford University Press,Oxford,1983.
6. J.O.M.Bokris and A. K. N Reddy,Electrochemistry,Vols land 2 Plenum,New York,1977.

7. P.Dalahay,Electrode Kinetics And Structure Of Double Layer,Inter Science,New York,1965.
8. J.Robbins,Ions In Solution-An Introduction In Electrochemistry,Clarendon Press,Oxford,1993.
9. H.Reiger,Electrochemistry,Chapman And Hall,New York,1994.
10. I.C.E.H.Brawn,The Chemistry Of High Polymers,Butterworth And Co.,London,1948.
11. E.A.Coolins,J.Bares And E.W.Billmeyer,Experiments In Polymer Science,Wiley Interscience,New York,1973.
12. G.S.Krishenbaum,Polymer Science Study Guide,Gordon Breach Science Publishing,New York,1973.
13. P.J.Flory,Principles Of Polymer Chemistry,Cornell Press,Ithaca,1971.
14. G.M.Barrow,Introduction To Molecular Spectroscopy,Mcgraw Hill,New York,1962.
15. W.Kemp,NMR In Chemistry,Mc Millan Ltd.,1986.
16. G.W.King,Spectroscopy and Molecular Structure,Holt Reinheart And Winston,1964.
17. E.B.Wilson,J.C.Decious and D.C.Cross,Molecular Vibrations,Mc Graw Hill Book Oo.,1955.
18. D.Mclauchlan, Magnetic Resonance, Oxford Chemistry Series,Oxford,1970.
19. B.P.Staughan and S.Walker,Spectroscopy Vol I,Ii,Iii,Chapman And Hall,1976.
20. Rw.Cook and K.Jone, Aprogrammed Introduction To Infra Red Spectroscope,Heydon And Son Ltd.,1972.
21. F.A.Rushworth and D.P.Tunstal Nuclear Magneticresonance Gordon and Breaqch Science Publishing,New York,1973.
22. J.K.Sanders and B.K.Hunther,Modern NMR Spectrodcopy,A Guide For Chemists,Oxford University Press,Oxford,1987.
23. Jk.M.Sanders,E.C.Constable and B.K.Hunther M.Modern NMR Spectroscope,A World Book Of Chemical Problems,Oxford,1989.
24. C.N.Banwell, Fundamentals Of Molecular Spectroscopy,Mc Graw Hill,1966.

ELECTIVE
PAPER III
ORGANIC CHEMISTRY III

Objective

To understand the concepts of spectral techniques and to apply these techniques for the quantitative and structural analysis of organic compounds. To learn free radicals reactions, antibiotics and their importance.

UNIT-I: UV AND IR SPECTROSCOPY AND ITS APPLICATIONS

Ultraviolet - Visible spectroscopy - types of electronic transitions - chromophores and auxochromes - factors influencing positions and intensity of absorption bands - absorption spectra of dienes, polyenes and unsaturated carbonyl compounds - Woodward - Fiser rules.

IR Spectroscopy - vibrational frequencies and factors affecting them - identification of functional groups - intra and inter molecular hydrogen bonding - finger print region - Far IR region - metal ligand stretching vibrations.

UNIT-II: NMR SPECTRA AND ITS APPLICATIONS

Nuclear spin - magnetic movement of a nucleus - nuclear energy levels in the presence of magnetic field relative populations of energy levels - macroscopic magnetization - basic principles of NMR experiments - CW and FT NMR - ^{1}H NMR - chemical shift and coupling constant - factors influencing proton chemical shift and vicinal proton - proton coupling constant - ^{1}H NMR spectra of simple organic molecules such as CH_3CH_2Cl, CH_3CHO etc. AX and AB spin system - spin decoupling - nuclear overhauser effect- chemical exchange. ^{13}C NMR - proton decoupled and off - resonance ^{13}C NMR spectra - factors affecting ^{13}C chemical shift - ^{13}C NMR spectra of simple organic molecules. Problem solving (for molecules with a maximum number of C_{10}).

UNIT-III: PHYSICAL METHODS OF STRUCTURAL DITERMINATION

Mass Spectroscopy - Principles - measurement techniques - (EI, CI, FD, FAB, SIMS) - presentation of spectral data - molecular ions - isotope ions - fragment ions of odd and even electron types - rearrangement ions - factors affecting cleavage patterns -

simple and multicentre fragmentation - McLafferty rearrangement. Mass spectra of hydrocarbons, alcohols, phenols, aldehydes and ketones. Octant rule, cotton effect, axial halo ketone rule, ORD and its applications.

UNIT-IV: ANTIBIOTICS

Introduction, structural elucidation and synthesis of pencillin, streptomycin, chloromycetin and tetracyclines.

UNIT-V: FREE RADICALS

Long and short-lived free radicals, methods of generation of free radicals. Addition of free radicals to olefinic double bonds. The following aromatic radical substitutions are to be studied: decomposition of diazocompounds, phenol - coupling - Sandmeyer reaction Gomberg reaction, Pschorr reaction, Ulmann reaction, mechanism of Hunsdiecker reaction Detection of free radicals by ESR.

Recommended Books

1. Application of absorption spectroscopy of organic compounds by J. Dyer, Prentice and Hall of India, Pvt., New Delhi.
2. Spectrometric identification of organic compounds by R.M. Silverstein, G.d. Bassler and Monsu. John Wiley and Sons, New York.
3. Introduction to the spectroscopic methods for the identification organic compounds - 2 volumes, Schiemann Pergamman Press.
4. Organic Chemistry, Vol. II, I.L. Finar, 5th edition ELBS publication.
5. Spectroscopy of Organic compounds by P.S. Kalsi, Wiley Eastern Ltd., Chennai.
6. Advanced organic chemistry III Edition by J. March.
7. Advanced organic Chemistry by Francis A. Carey and Richard J. Sundberg, 3rd Edition (1990).
8. Physical organic chemistry by Neil S. Issac, ELBS publication 1987.
9. Organic reaction mechanism, Macmillan India, 1999.
10. Spectroscopy W. Kemp, Macmillan Ltd.,
11. Structural identification of organic compounds Y.R. Sharma, S. Chand & Co.
12. Chemistry of organic Natural Products by Dr.O.P. Agarwal, Goel Publishing House, Meerut.

ELECTIVE
NON MAJOR SUBJECT

PAPER IV
APPLIED CHEMISTRY

UNIT-I: CHEMISTRY OF WATER:

Water quality parameters - Total dissolved solids - hardness - dissolved oxygen - Physical, Chemical, Biological contaminants in water - Municipal water treatment - sterilization - Chlorination - Ozonisation - Conversion of seal water into drinking water - Reverse Osmosis - Deionization.

UNIT-II: CHEMISTRY OF DRUGS:

Classification of drugs - Administration of Drug - Absorption of drugs - Elimination of drug by Kidney - Some important drugs - Antibiotics, Anti malarials, anti asthmatic drugs - Anti bacterial drugs, anti septics, anesthetics, analgestics and anti pyretic drugs. (Role and examples in each type) - Misuse of drugs.

UNIT-III: CHEMISTRY OF POLYMERS

Classification of polymers - Addition and condensation polymers - Polymerisation reaction - co-polymers - homopolymers - Thermoplastics and thermosetts - Molecular weight of polymers - Rubbers - Inorganic polymers - Biopolymers - Domestic and industrial application of polymers.

UNIT-IV: CHEMISTRY OF MATERIALS:

Cement - Manufacture of cement - Setting of cement - Paint - Varnishes - Enamel and Lacquers - Refractories - Properties - Manufacturing methods - adhesives - types - Adhesive action - Preparation of adhesives - Soaps and Detergents.

UNIT-V: CHEMISTRY OF ENVIRONMENTAL POLLUTANTS:

Gaseous pollutants - Effect of gaseous pollutants on human health - Method of Control - Water pollutants - types - Removal methods - Soil pollutants - types - Control methods - nuclear wastes - Adverse effects - Control methods.

Text books & References:-

1. Engineering chemistry, Jain and Jain, Dhanpat Rai Publishing company.
2. Fundamental concepts of applied chemistry by Jayashree Ghosh, S. Chand & Company Ltd.
3. Introductory polymer chemistry, G.S. Mistra - New age international Pvt. Ltd.
4. Environmental science - Koushik and Ambau Koushik. New age international Publishers.

IV SEMESTER

PAPER VIII

ORGANIC CHEMISTRY - IV

Objective

To understand the concepts of Photochemical Reactions, Aromaticity Carbohydrates Terpenes, Applications and Techniques of Dyeing.

UNIT-I: AROMATICITY

Aromaticity of benzenoid, heterocyclic, and non-benzenoid compounds, Huckel's rule - Aromatic systems with pi electron numbers other than six - non-aromatic (cyclo octatetraene etc,) and anti aromatic system (cyclobutadiene etc.) - system with more than 10pi electrons - Annulenes upto C_{18} (synthesis of all these compounds is not expected).

UNIT-II:

Photochemical excitation - fate of the excited molecules - joblonski diagram - study of photochemical reactions of ketone - photoreduction - photocyclo addition - Paterno - Buchi reaction - di pi-methane rearrangement - Pericyclic Analysis of electrocyclic, cyclo addition and sigmatropic reactions - correlation diagrams for butadiene - cyclobutene system hexatriene to cyclohexadiene system. Structure of bulvalene, a fluxional molecule - Cope and Claisen rearrangement.

UNIT-III: CARBOHYDRATES

Introduction, structure determination of disaccharides - Maltose, Sucrose, Cellobiose and lactose. Polysaccharides, structure determination of cellulose and starch.

UNIT-IV: TERPENES

Introduction, classification, isoprene rule, structural determination of terpenoidscitral, Geraniol, Linalool, Farnesol, α-pinene and camphor

UNIT-V: DYES

Introduction, various methods of dyeing, classification of dyes, nitroso dyes, Azodyes, - Fast green, Methyl Orange, Methyl Red, Fast Red, tripheylmethane dyes -

Malachite green, Rosaniline, Aniline blue, Crystal violet, Xanethene dyes - Fluorescein, Rhodamine B, Anthroquinone dyes – Alizarin – Preparation and uses.

Recommended Books:

1. Molecular Reaction and Photochemistry by Charles H. Depuy and Orville, L. Champman, Prentice Hall of India Pvt., Ltd., New Delhi.
2. Organic Chemistry, Vol. II, I.L. Finar, 5th edition ELBS publication.
3. Advanced organic chemistry III Edition by J. March.
4. Structural identification of organic compounds Y.R. Sharma, S. Chand & Co.
5. Chemistry of organic Natural Products by Dr. O.P. Agarwal, Goel Publishing House, Meerut.
6. Advanced Organic Chemistry by Francis A. Carey and Richard J. Sundberg, Plenum Press, New York.
7. Terpene Chemistry - James verghese.

PAPER IX

PHYSICAL CHEMISTRY IV

Objective

To study the electrochemical kinetics, over potential, corrosions and fuel cells. To study statistical thermodynamics, Quantum statistics and reversible thermodynamics. To study the principle of photochemical reactions, kinetics - Stern - Volmer Analysis.

UNIT-I: ELECTROCHEMISTRY III

Mechanism of electrode reactions - polarization and overpotential - the Butler-Volmer equation for one step and multistep electron transfer reactions - significance of electron exchange current density and symmetry factor - transfer coefficient and its significance - mechanism of the hydrogen and oxygen evolution reactions.

Corrosition and passivation of metals - Pourbaix diagram - Evan's diagram - fuell cells - electrodeposition - principle and applications.

UNIT-II: STATISTICAL THEMODYNAMICS I

Objectives of statistical thermodynamics - concept of thermodynamics and mathematical probabilities - distribution of distinguishable and non-distinguishable particles.

Maxwell - Boltzmann didribution law - Partition function - evalution of translational, vibrational and rotational partition functions for mono, diatomic ideal gases - thermodynamic functions in terms of partition functions-application of partition function to heat capacity of ideal gases - nuclear partition function - contribution to heat capacity of ortho and para hydrogen. Heat capacity of solids — Einstein and Debye models.

UNIT-III: STATISTICAL THEMODYNAMICS II

Fermi - Dirac and Bose - Einstein statistics - comparison with Maxwell -Boltzmann distribution law and their applications - radiation law - electron gas in metals.

Irreversible Thermodynamics - Forces and fluxes - linear force, flux relation - phenomenological equations .

UNIT-IV: PHOTOCHEMISTRY I

Absorption and emission of radiation - Franck - Condon Principle - decay of electronically excited states - Jablonsky diagram - radiative and non radiative processes - fluorescence and phosphorescence - spin forbidden radiative transition - internal conversion and intersection crossing - energy transfer process - kinetics of unimolecular and bimolecular photophysical processes-excimers and exciplexes - static and dynamic quenching - Stern-Volmer analysis.

UNIT-V: PHOTOCHEMISTRY II

Experimental methods - quantum yield and life time measurements - steady state principle - quantum yield and chemical actinometry. kinetics of photochemical reactions : hydrogen and halogen reactions, photoredox, photosubstitution, photoisomerization and photosensitized reactions - photovoltaic and photogalvanic cells, photoelectrochemical cells, photo assisted electrolysis of water, aspects of solar energy conversion.

Radiation chemistry - Interaction of high energy radiation with matter - primary and secondary processes - G value - radialysis of water - hydrated electron.

Text Books

1. S.Glasstone,Introduction To Electrochemistry, Affliated East West Press ,New Delhi, 1960.
2. R.Crow, Principles and Applications to Electrochemistry, Chapman And Hall,1991.
3. P.H.Rieger, Electrochemistry, Chapman And Hall, New York, 1994.
4. M.C.Gupta, Statistical theromdynamics, Wiley Easter, New Delhi, 1990.
5. R.Hasee, Thermodynamics Of Irreversible Process, Addition Wesley, Reading, Mass, 1969.
6. N.J.Turro, Modern Molecular Photochemistry, Benjamin, Cumming, Menlo Park, California, 1978.
7. K.K.Rohatgi Mukherjee, Fundamentals Of Photochemistry, Wiley Eastern Ltd., 1978.
8. S.Glasston, Text Book Of Physical Chemistry.

Suggested Reference for Books

1. J.O.M.Bokris And Ak.N Reddy, Electrochemistry, Vols. 1 and 2 Plenum, New York, 1977.
2. P.Dalahay, Electrode Kinetics And Structure Of Double Layer, Inter Science, New York, 1965.
3. J.Robbins, Ions In Solution - An Introduction In Electrochemistry, Clarendon Press, Oxford, 1972.
4. C.M.A.Brett And As.Ms O.Brett, Electrochemistry Principles, Methods And Applications, Oup., Oxford, 1993.
5. Dole, Themodyanamics, Prentice Hall, New York, 1954.
6. B.J.Mc Clenlland, Statistical Thermodyanamics, Chapman And Hall,London,1973.
7. I.Prigogine, Introduction To Themodyanamics Of Irreversible Process, Interscience, New York,1961.
8. N. O. Smith, Elementary Statistical Thermodyanamics, A Problem Approach, Plenum Press, New York, 1961.
9. Cleyde, Physical Chemistry, Schaum Series, Mc Graw Hill, 1976.
10. Seans, Statistical Thermodyanamics, Salinyar And Tangodie.
11. J.G.Clavert and J.N.Pitts, Photochemistry, Wiley, London, 1966.
12. R.P.Wayne, Photochemistry, Butterworths, London, 1970.
13. R.Cundell and A.Gilbert,Photochemist Thomas Nelson, 10

PAPER X

SCIENTIFIC RESEARCH METHODOLOGY

Objective

To study about the importance of research, literature survey, error analysis, statistical treatment. To study about the conventions of writing thesis.

UNIT-I: INTRODUCTION

Nature and importance of research - aims, objective, principles and problems - selection of research problem - survey of scientific literature - primary and secondary sources - citation index for scientific papers and journals - patents.

UNIT-II: CONDUCT OF RESEARCH WORK

Physical properties useful in analysis and methods of separation prior to analysis - Isolation techniques - extraction - Soxhlet extraction, crystallization, sublimation - methods for vacuum sublimation and distillation under reduced pressure.

Chemistry of working with hazardous materials - acid / water sensitive, corrosive, toxic, expolsive and radioactive materials.

UNIT-III: EVALUATION OF ANALYTICAL DATA

Precision and accuracy - Reliability - determinate and random errors - distribution of random errors - normal distribution curve.

UNIT-IV: STATISTICAL TREATMENT OF ANALYTICAL DATA

Statistical treatment of finite samples - the students test and F test - Criteria for rejection of an observation - the Q test, significant figures and computation rules - data plotting - least square analysis.

UNIT-V: THESIS AND ASSIGNMENT WRITING

Conventions of writing - the general format - page and chapter format - use of quotations and footnotes - preparation of tables and figures - referencing - appendices - Revising editing and evaluating the final product - proof reading - Meanings and examples of commonly used abbreviations.

Reference

1. Advanced organic chemistry - reactions, Mechanism & Structure. J. March, McGraw Hill Student Edition.
2. Vogel's textbook of quantitative chemical analysis, ELBS edition.
3. Thesis and assignment writing - J. Anderson, H.M. Durston and M.Poole, Wiley Eastern Ltd., (1970).
4. Fundamental of analytical chemistry, Donglas A. Skoog & Donald, M. Wast, Halt Saundersons International Edition.

PRACTICAL IV

ORGANIC CHEMISTRY II

ANY SIX PREPARATIONS FROM THE FOLLOWING INVOLVING TWO STAGES

1. sym-Tribromo benzene from aniline.
2. Benzanilide from benzophenone
3. m-Nitro benzoic acid from methyl benzoate
4. 2,4.- Dinitrobenzoic acid from p-nitrotoluene
5. m-Nitro benzoic acid from benzaldehyde
6. Benzil form benzaldehyde
7. Anthraquinone from phthalic anhydride
8. Phthalide from phthaic anhydride
9. 2-Phenyl indole from phenyl hydrazine
10. 2, 4 dinitrophenyl hydrazine from p-nitrochlorobenzene

ANY TWO EXERCISES IN THE EXTRACTION OF NATURAL PRODUCTS

1. Caffeine from tea leaves
2. Lactose from milk
3. Citric acid from lemon
4. Piperine from black pepper

CHROMATOGRAPHIC SEPARATIONS

1. Column chromatography - separation of anthracene and picric acid from anthracene picrate.
2. Thin layer chromatography separation of green leaf pigments.
3. Paper chromatography-Identification of amino acid.

ANY FIVE ESTIMATION

1. Estimation of aniline
2. Estimation of phenol
3. Estimation of glucose
4. Estimation of amino group
5. Estimation of amide group
6. Sapanification of fat or an oil
7. Iodine value of an oil
8. Estimation of sulphur in an organic compound
9. Estimation of methyl ketone

IV SPECIAL INTERPRETATION OF ORGANIC COMPOUNDS UV, IR, PMR AND MASS SPECTRA OF 15 COMPOUNDS

1. 1,3,5- Trimethyl benzene
2. Pinacolane
3. n-Propylamine
4. p-Methoxy benzyl alchol
5. Benzyl bromide
6. Phenylacetone
7. 2-Methoxyethyl acetate
8. Acetone
9. Isoopropyl alcohol
10. Acetaldehyde diacetate
11. 2-N,N-Dimethylamino ethanol
12. Pyridine
13. 4-Picoline
14. 1,3-dibromo - 1, 1- dicholoropropene
15. Cinnamaldehyde

Quantum of marks in respect of the University Practical Examinations (60 Marks)

Preparation	15 Marks
Estimation	20 Marks
Record	05 Marks
Interpretation of spectra	10 Marks
Practical Viva	10 Marks
Total	60 Marks

Internal Assessment (40 Marks)

1.	Two Tests	- 20 Marks
2.	Attendance / Regularity	- 10 Marks
3.	Results accuracy	- 10 Marks
	Total	- 40 Marks

Recommended Books

1. A text book of Practical Organic Chemistry by Arthur I.Vogel
2. Laboratory Manual of Organic Chemistry Raj K. Bansal, Wiley Eastern limited.
3. Laboratory manual of Organic Chemistry by Mann and Saunders.

PRACTICAL V
INORGANIC CHEMISTRY II
QUANTITATIVE ANALYSIS OF COMPLEX MATERIALS

A. Analysis or ores

1. Determination of percentage of calcium and Magnesium in dolomite.
2. Determination of percentage of MnO_2 in pyrolusite.
3. Determination of percentage of lead in galena.

B. Analysis of alloys

1. Estimation of tin and lead in solder.
2. Estimation of copper and zinc in brass.
3. Estimation of chromium and nickel in stainless steel.

D. Analysis of inorganic complex compounds

1. Preparation of cis and trans potassium bis (Oxalato) diaquochromate and analysis of each of these for Chromium.
2. Preparation of potassium tris (Oxalato) ferrate (III) and analysis for iron and oxalate.

QUANTITATIVE ANALYSIS

Quantitative analysis of mixtures of iron and Magnesium; iron and nickel; copper and nickel and copper and zinc.

E. CALORIMETRIC ANALYSIS

(Using) Photoelectric method: Estimation of iron, nickel, manganese, copper,

F. BIAMPEROMETRIC TITRATIONS

(With dead stop endpoint) thiosulpate - iodine system and Iron (II) - cerium (IV) system

G. LIST OF SPECTRA TO BE GIVEN FOR INTERPRETATION.

1. 31p NMR Spectra of methylphosphate
2. 31p NMR Spectra of HPF2
3. 19F NMR Spectra of ClF3
4. 1H NMR Spectra of Tris (ethythioacctoacetanato) cobalt (III)
5. Explained high resolution I H NMR spectra of (N-propylisonitrosoacctylacetoneuninato) (acetylacetoneinato) Nickel (II)
6. ESR Spectra of the aqueous $ON(SO_3)^{2-}$ ion.
7. ESR Spectra of the H atoms in CaF_2.

8. ESR Spectra of the (Mn $(H_2O)_6)^{2+}$.
9. ESR Spectra of the bis (salicyladiminato) copper (II)
10. IR Spectra of the sulphato ligand.
11. IR Spectra of the dimethylglyoxime ligand and its Nickel (II) complex.
12. IR Spectra of carbonyls
13. Mossbauer spectra of $FeSO_4$ $7H_2O$
14. Mossbauer spectra of $FeCl_3$.
15. Mossbauer spectra of $(Fe(CN_6)^{3-}$
16. Mossbauer spectra of (Fe (CN_6)

UNIVERSITY EXAMINATION (60 MARKS)

I. **Estimation of Mixture Containing two Metal Ions**

Volumetric	10 Marks
Gravimetric	10 Marks
Procedure	03 Marks

II. **Calorimetric estimation / amperometric titration**

Estimation	10 Marks
Procedure	02 Marks
III. Interpretation of Spectra	10 Marks
IV. Practical Record Notebook	05 Marks
Practical viva-voce	10 Marks
Total	**60 Marks**

Internal Assessment (40 Marks)

1.	Two Tests	- 20 Marks
2.	Attendance / Regularity	- 10 Marks
3.	Results accuracy	- 10 Marks
	Total	**- 40 Marks**

Recommended Books

1. Laboratory manual of Organic Chemistry by Mann and Saunders.

PRACTICAL VI

PHYSICAL CHEMISTRY II

Experiment in electrochemistry, conductometry, potentiometry pH metry and spectroscopy.

Conductivity measurements

1. Determination of equivalent conductance of a strong electrolyte and verification of Debye - Huckel - Onsager Equation
2. Verification of Debye-Huckel limiting law
3. Verification of Ostwald's Dilution law for a weak electrolyte. Determination of pK values of weak acids and weak bases.
4. Conductometric titrations between acid (simple and mixture of strong and weak acids) - base , precipitation titrations including mixture of halides.

E.M.F measurements

Determination of standard potentials (Copper & Zinc)

1. Determination of thermodynamic quantities from EMF measurements - potentiometric titrations.
2. Determination of p^H and calculation of pK_a.
3. Determination of stability constant of a complex.
4. Determination of solubility product of a sparingly soluble salt. Redox titrations.
5. Precipitation titration of mixture of halides by E.M.F measurements.

Spectroscopy

Experiments given only to familiarize the interpretation of spectra provided. Interpretation of simple UV-visible spectra of simple molecules for the calculation of molecular data and identification of functional groups (5 typical spectra will be provided).

IR and NMR spectral calculations of force constant - identification and interpretation of a spectra (5 each in IR and NMR will be provided).

List of experiments suggested for Physical Chemistry Practical II

Typical list of possible experiments are given. Experiments of similar nature and other experiments may also be given. The list given is only a guidelines. Any 15 experiments have to be performed in a year.

1. Determination of the equivalent conductance of a weak acid at different concentrations and verify Ostwalds dilution law and calculate the dissociation constant of the acid.
2. Determination of equivalent conductance of a strong electrolyte at different concentrations and examine the validity of the Onsager's theory as limiting law at high dilutions.
3. Determination of the activity co-efficient of Zinc ions in the solution of 0.002M Zinc sulphate using Debye-Huckel limiting law.
4. Determination of the solubility product of silver bromate and calculate its solubility in water and in 0.01 M $KBrO_3$ using Debye-Huckel limiting law.
5. Conductometric titrations of a mixture of HCl, CH_3COOH and $CuSO_4$ and NaOH.
6. Determination of the dissociation constant of an acid at different dilution.
7. Determination of the solubility of the lead iodide in water , 0.04 M KI and 0.04 M $Pb(NO_3)_2$ at 298 K
8. Determination of the solubility product of lead iodide at 298 K and 308 K and calculate the molar heat of solution of lead iodide.
9. Compare the relative strength of acetic acid and monochloroacetic acidby conductance method.
10. Determine the basicity of organic acids (oxalic /benzoic) .
11. Determine the electrode potentials of Zn and Ag electrodes in 0.1M and 0.001M solutions at 298 K and fine the standard potentials for these electrodes and test the validity of Nernst equation.
12. Determine the activity co-efficient of an electrolyte at different molalities by EMF measurements.
13. Determine the dissociation constant of acetic acid titrating it with sodium hydroxide using quinhydrone as an indicator electrode and calomel as a reference electrode.
14. Study of the electrolytic separation of metals (Ag, Cu, Cd and Zn)
15. Determine the strength of a given solution of KCl using differential potentiometric titration technique.

16. Determine the dissociation constant of acetic acid in DMSO, DMF, acetone and dioxane by titrating it with KOH.
17. Determine the transport number of Ag ions and nitrate ions by Hittorf's method.
18. Determine the transport number of cadmium ions and sulphate ions by measuring emf of concentration cells with and without transference.
19. Determine the dissociation constant of monobasic or dibasic acid by all the Alber-Serjeant method.
20. Determine the pH of the given solution with the help of indicators using buffer solutions and by colorimetric method.
21. Perform acid-base titration in a non aqueous medium.
22. Determine the pH of a given solution by emf method using glass and calomel electrodes and evaluate pK_a value of an acid.
23. Determine the pH of a given solution by emf methods using hydrogen electrode and quinhydrone electrode.
24. Estimate the concentration of cadmium and lead ions by successive reduction in polarography.
25. Verify Illkovic equation
26. Determine lead ion by amperometric titrations with potassium dichromate.
27. Determine ferric ion by amperometric titration.
28. Determine pH value of an acid –base indicator(methyl red) by colorimetry
29. Determine the composition and instability constant of a complex by mole ratio method.
30. By colorimetry determine simultaneously Mn and Cr
31. Study the effect of solvent on the conductivity of $AgNO_3$/acetic acid and determine the degree of dissociation and equilibrium constant in differenrt degree of dissociation and mixtures (DMSO, DMF, dioxane, acetone, water) and test the validity of Debye-Huckel Onsager's equation.
32. Determine the solubility of $Ca[TiO_3]_2$ in deionised water and in dilute solution of KCl at 298 K. Determine the solubility product graphically.
33. Determine the equivalent conductivity of a Ca electrolyte and dissociation constant of the electrolyte.
34. Determine the equivalent dissociation constant of a polybasic acid.
35. Calculate the thermodynamic parameters for the reaction $Zn + H_2SO_4 \rightarrow ZnSO_4 + H_2$ by emf method.

36. Determine the formation constant of silver-ammonia complex and stochiometry of the complex potentiometrically.
37. Determine the stability constant of a complex by polarographic method.
38. Determine the g value from a given ESR spectrum.

Quantum of marks in respect of Practical Examinations

University Examination (60 MARKS)

Procedure	05 Marks
Manipulation	20 Marks
Result	10 Marks
Interpretation of spectra	10 Marks
Record	05 Marks
Viva voce	10 Marks
Total	**60 Marks**

Internal Assessment (40 Marks)

1.	Two Tests	- 20 Marks
2.	Attendance / Regularity	- 10 Marks
3.	Results accuracy	- 10 Marks
	Total	**- 40 Marks**

ELECTIVE
PAPER V

INORGANIC CHEMISTRY IV

Objective

To study about the Inorganic Spectroscopy and Nuclear Chemistry.

UNIT-I: INORGANIC SPECTROSCOPY I AND MAGNETIC PROPERTIES

Applications to inorganic systems of the following: ultra violet, visible, infra-red and Raman spectra of metal complexes, organo-metalic and simple inorganic compounds with special reference to coordination sites, isomerism.

Magnetic Susceptibility and measurements - Guoy method, Faraday method; applications.

UNIT-II: APPLICATION TO INORGANIC SYSTEMS OF THE FOLLOWING

NMR, NQR and Mossbaur spectra - NMR of 31P, 19F, NMR shift reagents. NQR - Nitrosyl compounds. Mossbauer spectra of Fe and Sn systems.

UNIT-III: INORGANIC SPECTROSCOPY

ESR Introduction - Zeeman equation, g-value, nuclear hyperfine splitting, interpretations of the spectrum, simple carbon centered free radicals. Anisotropy - g-value and hyperfine splitting constant. Mcconnel's equation, Kramers theorem. ESR of transition metal complexes of copper, manganese and vanadyl complex.

Photoelectron spectroscopy (UV and X-ray) - photo electron spectra - Koopman's therorem, time structure in PES, chemical shift and correlation with electronic charges. (5 Hrs.)

UNIT-IV: NUCLEAR CHEMISTRY I

Nuclear properties : Nuclear spin and moments, origin of nuclear forces, salient features of the liquid drop and the shell models of the nucleus.

Models of Radioactive Decay : Orbital electron capture: nuclear isomerism, intenal conversion, detection and determination of activity by cloud chamber, nuclear emulsion, bubble chamber, G.M., Scintillation and Cherenkov counters.

Nuclear Reaction : Types, reactions, cross section, Q-value, threshold energy, compound nucleus theory: high energy nuclear reactions, nuclear fission and fusion reactions as energy sources; direct reactions; photonuclear and thermo nuclear reactions.

UNIT-V: NUCLEAR CHEMISTRY II

Stellar energy: synthesis of elements, hydrogen burning, carbon burning.

Nuclear Reactors: fast breeder reactors, particle accelerators, linear accelerators, cyclotron and synchrotron.

Radio Analytical Methods : Isotope dilution analysis, Radiometric Titrations, Radio immuno assay, Neutron activation analysis.

Text Books

1. K.F. Purcell and J.C. Kotz, Inorganic Chemistry, W.B. Saunders Co., 1977.
2. J. Huheey, Inorganic Chemistry, Harper and Collins, NY IV Edition, 1993.
3. H.J. Arnikar, Nuclear Chemistry, Wiley Eastern Co., II Edition, 1987.
4. A.B. Jordan, Reaction Mechanism of inorganic and Organomettalic Systems, OUP, 1991.
5. FA Cotton and G Wilkinson, Advanced Inorganic Chemistry, John Wiley and Sons, 1988, V Edition
6. FA Cotton, FA Hart, The Heavy Transition Elements McMillan Co., 1975.

Suggested References

1. F. Basolo and RG Pearson, Mechanism of Inorganic Reaction Wiley, 1967.
2. D. Benson, Mechanism of Inorganic Reactions in Solution, McGraw Hill Co., 1968.
3. S. FA Kettle, Coodination Chemistry, ELBS, 1973.

4. S. Glasstone, Source Book on Atomic Energy, Van Nostrand Co., 1969
5. G. Frielander, J.w. Kennedy and J.M. Miller, Nuclear and Radiochemistry, John Wiley and Sons, 1964.
6. A.W. Adamson and P. Fleischauer Concepts of Inorganic Photochemistry, Wiley, 1975.
7. N. Greenwood and A. Earnshaw, Chemistry of Elements pergamon, NY, 1984.4.
8. G.T. Seaborg, J. J. Katz, The Chemistry of Acitinide Elements, Metheun, 1957.
9. G.T. Seaborg, Transuranium elements, Dowden Hitchinson and Ross, 1978.
10. R.B. Heslop and K. Jones, Inorganic Chemistry, Elsevier, Co., 1976.
11. B.E. Douglas, D.H. McDaniels and Alexander, Oxford I Bh II Edition, 1983.
12. Environmental Chemistry by De.

✲✲✲✲✲✲✲