PERIYAR UNIVERSITY

PERIYAR PALKALAI NAGAR

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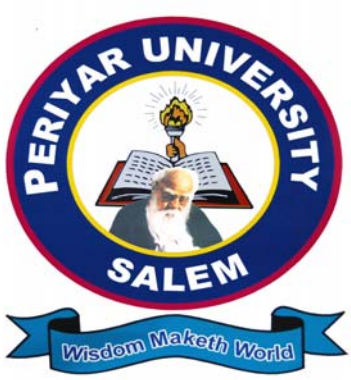

DEGREE OF MASTER OF SCIENCE

CHOICE BASED CREDIT SYSTEM

SYLLABUS FOR BRANCH IV (C) M.SC. ANALYTICAL CHEMSITRY

FOR THE STUDENTS ADMITTED FROM THE ACADEMIC YEAR 2012 – 2013 ONWARDS

Semester I

Code No.	Course	Subject	Work load per Semester (hours)
	Core Paper – I	Organic Chemistry I	75
	Core Paper – II	Inorganic Chemistry I	75
	Core Paper – III	Physical Chemistry I	75
	Elective Paper – I	Data treatment and Titrimetric Analysis	90
	Core Practical – I	Organic Chemistry Practical I	45
	Core Practical – II	Inorganic Chemistry Practical I	45
	Core Practical - III	Physical Chemistry Practical I	45

Semester	**Code**	**Course**	**Course Title**	**Hrs.**	**Credit**	**Marks**		
						CIA	**EA**	**Total**
I		Core Paper – I	Organic Chemistry I	5	4	25	75	100
		Core Paper – II	Inorganic Chemistry I	5	4	25	75	100
		Core Paper – III	Physical Chemistry I	5	4	25	75	100
		Elective Paper – I	Data treatment and Titrimetric Analysis	6	4	25	75	100
		Core Practical – I	Organic Chemistry Practical I	3	-	-	-	-
		Core Practical – II	Inorganic Chemistry Practical I	3	-	-	-	-
		Core Practical - III	Physical Chemistry Practical I	3	-	-	-	-

FIRST SEMESTER
Core Paper - I
ORGANIC CHEMISTRY – I
(75 Hours)

UNIT – I Nomenclature and Reaction Mechanism (15 Hours)

IUPAC Nomenclature for Aliphatic and Aromatic organic compounds and Heterocyclic compounds such as purine and pyrimidine.

Reaction Mechanisms : Types of mechanisms : Heterolytic, Homolytic and Pericyclic mechanisms – a general study.

Reaction intermediates : Formation, stability and structure of carbonium ions, carbanions, carbenes, nitrenes and free radicals.

Free radical reactions : Sandmeyer reaction, Gomberg-Bachmann reaction, Pschorr reaction and Ullmann reaction, mechanism of Hunsdiecker reaction.

UNIT – II Structure and Reactivity (15 Hours)

Effect of structure on reactivity – resonance and fields effects, steric effects, quantitative treatment – the Hammett equation and linear free energy relationship, substituent and reaction constant, Taft equation. Thermodynamic and kinetic requirements for reactions, thermodynamic and kinetic control reactions, Hammonds postulate, Microscopic reversibility. Potential energy diagrams, transition states and intermediates, methods of determining mechanisms – identification of products and determination of the presence of an intermediate, isotopic labeling, isotope effects.

UNIT – III Stereochemistry (15 Hours)

Homotopic, enantiotopic, diastereotopic H atoms, groups in organic molecules. Fischer, Newman and Sawhorse projections and their interconvertion. Optical activity in the absence of chiral carbon – biphenyls, allenes and spiranes – R and S notations. Chirality due to helical shape, trans cyclooctene. E – Z isomerism of olefins containing one double bond and more than one double bond. Stereospecific and stereoselective synthesis with suitable examples, asymmetric synthesis – Crams rule.

UNIT – IV Aliphatic Nucleophilic Substitution Reactions (15 Hours)

The S_N^2, S_N^1, mechanisms. The neighbouring group mechanism, neighbouring group participation by π and σ bonds, anchimeric assistance. Nucleophilic substitution at an allylic, aliphatic trigonal and vinylic carbon.

Reactivity effects of substrates structure, attacking nucleophile, leaving group and reaction medium, ambident nucleophile, regioselectivity. Williamson reaction, Von-braun reaction, hydrolysis of esters, Claisen and Dieckmann condensation.

UNIT – V Heterocyclic Compounds (15 Hours)

Synthesis and properties of imidazole, oxazole and thiazole.

Synthesis, properties and structural elucidation of flavones, isoflavones and anthocyanins.

Synthesis of pyrimidines, synthesis and structural elucidation of purines (uric acid and caffeine).

Text Books

1. Jerry March, **Advanced Organic Chemistry**-Reactions, Mechanisms and Structure, Fourth Edition, John Wiley & Sons (1992)
2. Francis A. Carey, **Organic Chemistry**, Third Edition, The McGraw-Hill Companies, Inc., 1996.
3. P.S. Kalsi, Organic Reactions and Mechanisms, Second Edition, New Age International Publishers, 2002.
4. Ernest L. Eliel, **Stereochemistry of Carbon Compounds**, T.M.H Edition, Tata McGraw-Hill Publishing Company, 1995.
5. P.S. Kalsi, **Stereochemistry – Conformation and Mechanism**, 6th Edition, Wiley Eastern Limited, 2005.
6. I.L. Finar, **Organic Chemistry**, Volume II, Fifth Edition, First Indian reprint, Pearson Education Asia Pte. Ltd., (2000)

Reference Books

1. P.S. Kalsi, **Stereochemistry and Mechanism through solved problems,** Second Edition, New Age International Publishers, 1994.
2. D. Nasipuri, **Stereochemistry of Organic Compounds**, 2nd Edition, New Age International Publishers, 1994.
3. S.M. Mukherji and S. P. Singh, **Reaction Mechanism in Organic Chemistry**, 1st Edition, Macmillan, 1976.
4. R.T. Morrison and R.N. Boyd, **Organic Chemistry**, 6th Edition, Prentice-Hall, 1992.
5. R.O.C. Norman, **Principles of Organic Synthesis**, Second Edition, Chapman and Hall, 1978.
6. R.M. Acheson, **Introduction to Chemistry of Heterocyclic Compounds**, 2nd Edition, Interscience Publishers, 1967.
7. J.A. Joule and G.F. Smith, **Heterocyclic Chemistry**, Van Notrand Reishord Co., London, 1978.

Core Paper - II

INORGANIC CHEMISTRY-I
(75 Hours)

UNIT-I Structure and Bonding (15 Hours)

Hard and Soft acids and bases-classifications, Acid-Base strength, hardness, symbiosis, Theoretical basis of Hardness and Softness, applications of HSAB.

Rings-Phosphazenes-Structure, Craig and Peddock model, Dewar model, polyorganophosphazenes, Polysulphur –nitrogen compounds.

Inorganic polymers-Silicates-structure, Pauling's rule, properties, correlation and application; Molecular sleves.

Polyacids- Isopolyacids of V, Cr, Mo and W; Heteropolyacids of Mo and W (only structural aspects).

UNIT-II Nuclear Chemistry-I (15 Hours)

Nuclear properties –Nuclear spin and moments, origin of nuclear forces, features of the liquid drop and the shell models of the nucleus; Modes of radioactive decay-orbital electron capture, nuclear isomerism, internal conversion; Detection and determination of activity-GM, Scintillation and Cherenkov counters.

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

UNIT III Nuclear Chemistry-II (15 Hours)

Applications relating to Nuclear Chemistry-Neutron activation analysis, Radio pharmacology, Radiation protection and safety precautions, Isotope dilution analysis.

Radiation Chemistry- radiation dosimetry, radiolysis of water, the hydrated electron.

UNIT IV Properties of Solids (15 Hours)

Electrical properties of solids – Band Theory, semiconductors, super conductors, solid state electrolytes; Magnetic properties – dia, para, ferro, antiferro and ferrimagnetism; hysterisis; Optical properties – solid – state lasers and Inorganic phosphors.

Reactions in solid state and phase transitions – diffusion coefficient, diffusion mechanism, vacancy and interstitial diffusions, formation of spinels; solid solutions, order-disorder transformations and super structure.

UNIT V Solid-State chemistry (15 Hours)

Defects in solids- Point defects, line defects and surface defects; Dislocations-Non-stoichiometric compounds; Use of X-ray powder data in identifying inorganic crystalline solids; details for cubic systems; Structures of NiAs, CdI_2 ,Pervoskite, rutile, fluorite and antifluorite-zinc blende and wurtzite.

Text books

1. J.E.Huheey, E.A.Keiter and R.L.Keiter, **Inorganic chemistry-principles of structure and reactivity**, 4th edition, Pearson-Education, 2002
2. F.A.Cotton and G.Wilkinson, **Advanced Inorganic Chemistry**, Wiley Eastern, 5th edition, 1988.
3. E.A.V.Ebsworth, D.WH.Rankine and S.Craddock, **Structural methods in Inorganic Chemistry**, Black well Scientific publication, 1987
4. R.S.Drago, **Physical methods in chemistry,** Reinhold, NewYork,1968
5. Charles A.Depuy and Orville L.Chapman, **Molecular reactions and photochemistry,** Prentice Hall, 1992
6. A.W.Adamson and P.Fleischauer, **Concepts of Inorganic Photochemistry**, Wiley, 1975.
7. H.J.Emelius and Sharpe, **Modern aspects of Inorganic chemistry**, Universal book stall, New Delhi, 1989
8. S.Glasstone, **Source book of Atomic Energy**, Van Nonstrand Co.,1969.
9. H.J.Arniker, **Essentials of Nuclear Chemistry**, 2nd edition Wiley eastern Co.,1987.
10. D.M.Adams, **Inorganic Solids**, John Wiley Sons, 1974
11. A.R.West, **Basic Solid State Chemistry**, John Wiley,1991.

Reference Books

1. N.H. Ray , Inorganic Polymers, Academic Press, 1978.
2. K.F. Purcell and J.C. Kotz, Inorganic Chemistry, WB Saunders Co., USA 1977.
3. G.S. Manku, Inorganic Chemistry, T.M.H. Co., 1984.
4. N.J.Turro, Modern moleculer photochemistry, Benjamin/Cummings, Menlo Park, California, 1978.
5. H.A.O. Hill and P.Day, Physical methods in advanced Inorganic chemistry, John Wiley, 1986.
6. A.K. Srivatsava and P.C. Jain, Elements of Nuclear Chemistry, S.Chand and Co., 1989.
7. G. Friedlander, J.W.Kennedy and J.M. Miller, Nuclear and Radio Chemistry, Wiley., 1964.
8. Mullor, Inorganic structural chemistry, Wiley, New York, 1993.

Core Paper - III
PHYSICAL CHEMISTRY – I
(75 Hours)

Unit – I Classical Thermodynamics – I (15 Hours)

Maxwell's relations and thermodynamic equations of state – applications in the evaluation of Cp – Cv for solids and for vanderwaals gases, Cp – Cv in terms of coefficient of expansion and coefficient of compressibility – Relation between Cp and Cv – Partial molar properties – Gibbs – Duhem equation – Partial molar free energy (Chemical Potential) – Determination of chemical potential [Direct Method and Method of Intercepts] and partial molar volume – variation of chemical potential with Temperature and Pressure

Unit – II Chemical Kinetics – I (15 Hours)

Theories of Reaction rates – Arrhenius theory – effect of temperature on reaction rate – Hard – Sphere collision theory of reaction rates – molecular beams – Reaction cross section – effectiveness of collisions – Probability factor.

Transition state theory of reaction rates – Potential energy surface – Partition functions and activated complex – Eyring equation – Comparison of collision theory and activated complex theory – Estimation of free energy, enthalpy and entropy of activation and their significance.

Unit – III Quantum Chemistry – I (15 Hours)

Black body Radiation – Experimental results of Black body radiation – Photoelectric effect – De – Broglie equation – Heisenberg uncertainty principle – Compton effect – operators and commutation relations – quantum mechanical postulates – Schrodinger equation and its solution to the problem of a particle in one and three dimensional boxes – the harmonic oscillator.

Unit – IV Group Theory – I (15 Hours)

Symmetry elements and symmetry operations – Point groups – identification and representation of groups – comparison of Molecular symmetry with Crystallographic symmetry – Reducible and irreducible representation – Direct product representation – Great orthogonality theorem and its consequences – Character Table and their uses.

Unit – V Spectroscopy – I (15 Hours)

Interaction of matter with radiation– Rotation spectroscopy – Rigid Rotor – Intensity of spectral lines – Molecular parameters from rotation spectra - Effect of isotopic substitution on the rotation spectra . Vibrational spectroscopy – harmonic oscillator – anharmonic oscillator – Hot bands – selection rules – Vibrational spectra of polyatomic molecules – Overtones and combination frequencies – Fermi Resonance.

Raman spectroscopy – Raman effect – Rotational and vibrational Raman Spectra – Mutual Exclusion Rule. Electronic spectroscopy – Electronic spectra of diatomic molecules – vibrational coarse structure – Franck – Condon Principle.

Text Books:

1. S.Glasstone, Thermodynamics for chemists, Affiliated East West press, New Delhi, 1960.
2. J. Rajaram and J.C. Kuriacose, Thermodynamics for students of chemistry, Lal Nagin Chand, New Delhi, 1986.
3. J. Rajaram and J.C. Kuriacose, Kinetics and mechanism of chemical transformation Macmillan India Ltd., 1993.
4. K.J.Laidlar, Chemical Kinetics, Harper and Row Newyork, 1987.
5. D.A. Mcquarrie, Quantum chemistry, University science books, Mill Valley, California (1983)
6. R.K. Prasad, Quantum Chemistry, Wiley Eastern, New Delhi, 1992.
7. V.Ramakrishnan and M.S.Gopinathan, Group theory in chemistry, Vishal Publications, 1988.
8. K.V.Raman, Group theory and its application to chemistry, Tata McGraw Hill Publishing Co., 1990.
9. Raymond chang, Basic principles of Spectroscopy, McGraw Hill Ltd., New York, 1971.
10. C.N. Banwell, Fundamentals of Molecular Spectroscopy, Mc Graw Hill, Newyork 1966.

Reference Books:

1. W.J. Moore, Physical Chemistry, Orient Longman, London, 1972.
2. K.G. Den beigh, Thermodynamics of Steady state, Meklien and Co., London, 1951.
3. L.K. Nash, Elements of Chemical Thermodynamics, Addison Wesley, 1962.
4. R.G.Frost and Pearson, Kinetics and Mechanism, Wiley, Newyork, 1961.
5. J.W. Moore and R.G. Pearson, Kinetics and Mechanism, 1981.
6. C.Capellos and B.H.J. Bielski, Kinetic systems, Willey interscience, Newyork, 1968.
7. G.M.Harris, Chemical Kinetics, D.C. Heath and Co., 1966.
8. I.N.Levine, Quantum chemistry, Allyn and Bacon, Boston, 1983.
9. J.Goodman, Contemporary Quantum Chemistry, An Introduction, Plenum Press, Newyork, 1977.

10. F.J.Bockhoff, Elements of Quantum theory, Addision Wesley, Reading, Mass, 1976.
11. P.W.Atkins, Physical Chemistry, Oxford University Press, Oxford., 1990.
12. P.W.Atkins, Molecular Quantum Mechanics, Oxford University Press, Oxford., 1983.
13. H.Eyring, J.Walter and G. Kimball, Quantum chemistry, John wiley and sons, Newyork, 1944.
14. L.S.Pauling and E.B.Wilsob, Introduction to Quantum Mechanics, Mc Graw Hill book Co., Newyork, 1935.
15. F.A. Cotton, Chemical Application of Group Theory, John wiley and Sons Inc., Newyork, 1971.
16. N. Tinkham, Group Theory and Quantum Mechanics, McGraw Hill Book Company, Newyork, 1964.
17. Alan Vincent, Molecular Symmetry and Group theory – Programmed Introduction to chemical applications, Wiley, Newyork, 1977.
18. G.M. Barrow, Introduction to Molecular Spectroscopy, Mc Grawhill, Newyork, 1962.
19. G.W.King, Spectroscopy and Molecular Structure, Holt, Rienehart and Winston, 1964.
20. E.B.Wilson, J.C. Decius and D.C.Cross, Molecular Vibrations, Mc Graw Hill Book Co., 1955.
21. B.P. Straughan and S.Walker, Spectroscopy Vol-I, Vol-II and Vol-III, Chapmann and Hall, 1976.

Elective Paper - I
DATA TREATMENT & TITRIMETRIC ANALYSIS
(90 Hours)

UNIT – I Treatment of Analytical Data (18 Hours)

Nature of quantitative measurements and treatment of data. Basic statistical concept-Frequency distribution, Average and measure of dispersion, Significance of Gaussian distribution curves, Null hypothesis, confidential interval of mean, Rejection data, student's t, Q and F tests, Regression and correlation, quality control and control chart.

Objectives, sampling-size of sample handling, transfer and storage samples.

UNIT – II Small Scale Manipulation and Chemical Equilibria (18 Hours)

Microchemical laboratory-Design, safety screen, fume chamber, heating, water supply, dry box/glove box, microbalance, quartz balance, fiber microgram balance.

Trace analysis in solution, Nature of trace analysis, scale of working sensitivity, sources of errors, Contamination control in trace analysis.

Activity concept, equilibrium constant and applications. Ionization constants of acids and bases.

Concept of pH, hydrolysis of salts, hydrolysis constant and degree of hydrolysis. Buffers-types, range and capacity. Dissociation of polyprotic acids, commonion effects, salt effect.

UNIT – III Titrimetric Analysis I (18 Hours)

Neutralization reactions – theory of acid-base titrations, mono and polyprotic systems, Titration curves and feasibility of reactions, Indicators-theory and choice, calculation of pH during titrations.

Homogeneous precipitation – Theory and applications of a few common gravimetric determinations (sulphate, chromate, oxalate and phosphate).

UNIT – IV Titrimetric Analysis II (18 Hours)

Redox titrations – Redox potentials, theory and feasibility of redox titrations, calculation of potentials at different stages of titrations, redox indicators, their choice and application.

Precipitation titrations – Theory and types, volhard, Mohr and Fejan's methods. Adsorption indicators – theory, choice and applications.

Complexometric titrations – Theory, stepwise and overall formation constants, titrations involving monodendate (Cl^-, CN^-) and multidendate ligands (EDTA). Metallochromic indicators – theory and choice. Masking and demasking and extractive methods. Direct, indirect (including substitution) titrations and applications.

UNIT – V Computer Applications in Chemistry (18 Hours)

Input and Output statements, Transfer and control statements, programming in BASIC only for calculation of equilibrium constants, pH of a buffer, potentiometric titrations and standard deviation.

MS-Word, MS-Excel, MS-Power Point and Internet usage.

Text Books

1. D.A. Skoog and D.M. West, **Fundamentals of Analytical Chemistry,** Holt Rinehart and Winston Publications, IV Edition, 1982.
2. D.A. Skoog, **Principles of Instrumental Analysis,** Saunders College Pub. Co, III Edition, 1985.
3. A.I. Vogel, **Text Book of Quantitative Inorganic Analysis,** ELBS III and IV Edition.
4. J.G. Dick, **Analytical Chemistry,** McGraw Hill Publishers, 1974.
5. T.S.Ma and V. Horak, **Microscale-Manipulations,** John, Wiley and Sons, 1976.
6. P.C. Jurns, T.L. Isenhour and C.C. Wilkins, **Basic Programming for Chemists,** JW & Sons, 1987.

Reference Books

1. K.V. Raman, **Computers in Chemistry,** Tata McGraw Hill, New Delhi, 1993.
2. Albert Paul Malvino, **BASIC Programming**, PMH Publishers, III Edition, 1984.
3. N. Subramanian, **Programming for BASIC**, A.H. Wheeler and Co. Pvt. Ltd III Edition, 1987.
4. Peter C. Jurs, T.L. Isenhour and C.L. Wilkins, **BASIC Programming for Chemist,** John Wiley and Sons, 1987.
5. Willard, Merit Dean and Settle, **Instrumental Method of Analysis**, CBS Publishers and Distributors, IV Edition, 1989.
6. G.D. Christian and J.E.O Reilly, **Instrumental Analysis**, Allyn and Bacon Inc, II Edition, 1986.
7. G.W. Ewing, **Instrumental Methods of Chemical Analysis**, McGraw Hill Pub., 1975.

FIRST YEAR
Semester II

Code No.	Course	Subject	Work load per Semester (hours)
	Core Paper – IV	Organic Chemistry II	75
	Core Paper – V	Physical Chemistry II	75
	Elective Paper – II	Co-ordination Chemistry	75
	Extra Disciplinary Course	Biological Chemistry	60
	Core Practical – I	Organic Chemistry Practical I	45
	Core Practical – II	Inorganic Chemistry Practical I	45
	Core Practical – III	Physical Chemistry Practical I	45
		Human Rights	30

FIRST YEAR
Semester II

Semester	**Code**	**Course**	**Course Title**	**Hrs.**	**Credit**	**Marks**		
						CIA	**EA**	**Total**
II		Core Paper – IV	Organic chemistry II	5	4	25	75	100
		Core Paper – V	Physical chemistry II	5	4	25	75	100
		Elective Paper – II	Co-ordination chemistry	5	4	25	75	100
		Extra Disciplinary course	Biological chemistry	4	4	25	75	100
		Core Practical – I	Organic chemistry practical I	3	4	40	60	100
		Core Practical – II	Inorganic chemistry practical I	3	4	40	60	100

		Core Practical - III	Physical chemistry practical I	3	4	40	60	100
			Human Rights	2	2			100

SECOND SEMESTER

Core Paper - IV

ORGANIC CHEMISTRY – II

[75 Hours]

UNIT – I Elimination Reactions (15 Hours)

E1, E2, E1cB mechanisms, Orientation of the double bond- Hofmann and Saytzeff rule, competition between elimination and substitution, dehydration and dehydrohalogenation reactions, stereochemistry of E2 eliminations in cyclohexane ring systems, mechanism of pyrolytic eliminations, chugaev reaction and Cope elimination.

UNIT II Aromaticity (15 Hours)

Aromaticity of benzenoid, heterocyclic and non-benzenoid compounds, Huckel rule, aromatic systems with pi electron compounds other than six pi electrons, non – aromatic (cyclooctatetraene, etc.,) and anti aromatic systems (cyclobutadiene, etc.,), systems with more than 10 pi electrons - annulenes.

UNIT III Aromatic electrophilic and nucleophilic substitution reactions (15 Hours)

The arenium ion mechanism, typical reactions like nitration, sulphonation, halogenation, Friedel – Crafts alkylation, acylation and diazonium coupling, electrophilic substitution on monosubstituted benzene, orientation and reactivity – ortho, meta and para directing groups, ortho-para ratio, ipso attack, Gatterman, Gatterman- Koch, Vilsmeir, Reimer – Tiemann reaction.

Aromatic nucleophilic substitution reactions, the S_NAr mechanism, the aryl cation mechanism, the benzyne intermediate mechanism, aromatic nucleophilic substitution of activated halides – Ziegler alkylation, Chichibabin reaction.

UNIT – IV Conformational Analysis (15 Hours)

Conformational analysis of simple cyclic (chair and boat cyclohexanes) and acyclic (n-butane) systems, conformation of simple 1,2 disubstituted derivatives – (ethylene chlorohydrin and ethylene glycol), Conformational analysis and stereochemical features of disubstituted cyclohexanes (1,2 ; 1,3 ; 1,4 dialkyl cyclo hexanes), conformation and stereochemistry of cis and trans decalins, effects of conformation on reactivity in acyclic and cyclohexanes, Oxidation and acylation of cyclohexanols, reduction of cyclohexanones, esterification and hydrolysis of cyclohexane carboxylic acid derivatives.

UNIT – V Reagents in Organic Synthesis (15 Hours)

Synthesis of simple organic molecules using standard reactions like acylation and alkylation of enamines and active methylene compounds. Sulphur ylides. Robinson annulation, protection and deprotection of functional groups (R-OH, R-CHO, RCOR, R- NH_2 and R-COOH) Reagents and their uses: DCC, trimethyl silyl iodide, trimethyl silyl chloride, 1,3 – dithiane (umpolung), diisobutylaluminium hydride (DIBAL), 9BBN, Baker's yeast and Gilman's reagent.

Text Books

1. Jerry March, **Advanced Organic Chemistry-Reactions, Mechanisms and Structure**, Fourth Edition, John Wiley & Sons (1992)
2. Francis A. Carey, **Organic Chemistry**, Third Edition, The McGraw-Hill Companies, Inc., 1996.
3. P.S. Kalsi, **Organic Reactions and Mechanisms**, Second Edition, New Age International Publishers, 2002.
4. P.S. Kalsi, **Stereochemistry – Conformation and Mechanism**, 6th Edition, Wiley Eastern Limited, 2005.
5. I.L. Finar, **Organic Chemistry**, Volume II, Fifth Edition, First Indian reprint, Pearson Education Asia Pte. Ltd., (2000)

Reference Books

1. S. H. Pine, J.B. Hendrickson, D.J. Cram and G.S. Hammond, **Organic Chemistry,** IV Edn., McGraw Hill Company, 1980.
2. S.M. Mukherji and S. P. Singh, **Reaction Mechanism in Organic Chemistry**, 1st Edition, Macmillan, 1976.

3. R.T. Morrison and R.N. Boyd, **Organic Chemistry**, Prentice-Hall, 1992.

1. R.O.C. Norman, **Principles of Organic Synthesis**, Second Edition, Chapman and Hall, 1978.
2. S.M. Mukherji and S.P. Singh, **Reaction Mechanism in Organic Chemistry,** III Edn. 1984. MacMillan.

Core Paper - V

PHYSICAL CHEMISTRY – II

[75 Hours]

UNIT – I Classical Thermodynamics – II (15 Hours)

Thermodynamics of ideal and real gases, gas mixtures – Fugacity – definition – Methods of determination of fugacity – Variation of fugacity with temperature and pressure.

Standard states for gases, liquids, solids and components of solutions – determination of activities and activity coefficient from Vapour pressure, Freezing point, Boiling point and EMF – measurements.

Solution of Electrolytes – mean ionic activity, mean ionic molality and mean ionic activity coefficients – determination of activity coefficient from Freezing Point, EMF and Solubility measurements – Concept of ionic strength.

UNIT – II Chemical Kinetics – II (15 Hours)

Reactions in solutions – comparison between gas phase and solution reactions – the influence of solvent, ionic strength, dielectric constant and pressure on reaction in solution – Kinetic isotope effects – Linear free energy relationship – Hammett and Taft equations.

UNIT – III Quantum Chemistry –II (15 Hours)

Schrödinger equation for the rigid rotator and Hydrogen atom – arriving solution for energy and wave function – the origin of quantum numbers and their physical significance – Probability distribution of electrons.

Approximation methods – Perturbation and Variation methods – application of Variation method to Hydrogen and Helium atom – Spin - orbit interaction – LS coupling

and JJ coupling – Term symbols and spectroscopic states. Ground state term symbols for simple atoms.

UNIT – IV Group Theory – II (15 Hours)

Symmetry selection rules for vibrational, Electronic and Raman Spectra – determination of representation of vibrational modes in non-linear molecules such as H_2O, CH_4 , XeF_4, SF_6 and NH_3 – symmetry of Hybrid orbitals in non-linear molecule (BF_3, CH_4, XeF_4, PCl_5 and SF_6) – Electronic spectra of formaldehyde.

UNIT – V Surface Chemistry and Catalysis (15 Hours)

Kinetics of surface reactions: Physical and chemical adsorption – adsorption isotherms – types of adsorption isotherms – Langmuir adsorption isotherm – B.E.T theory for multilayer adsorption – measurement of surface area – Mechanism of heterogeneous catalytic reactions – the adsorption coefficient and its significance.

Acid – Base catalysis – mechanism – Bronsted catalysis Law – catalysis by enzymes – rate of enzyme catalysed reactions – effect of substrate concentration, pH and temperature on enzyme catalysed reactions –Michael – Merton's equation.

Text Books:

1. S.Glasstone, **Thermodynamics for chemists**, Affiliated East West press, New Delhi, 1960.
2. J. Rajaram and J.C. Kuriacose, **Thermodynamics for students of chemistry**, Lal Nagin Chand, New Delhi, 1986.
3. J. Rajaram and J.C. Kuriacose, **Kinetics and mechanism of chemical transformation,** Macmillan India Ltd., 1993.
4. K.J.Laidlar, **Chemical Kinetics**, Harper and Row, Newyork, 1987.
5. R.K. Prasad, **Quantum Chemistry**, Wiley Eastern, New Delhi, 1992.
6. M.W. Hanna, **Quantum mechanics in chemistry**, W.A. Benjamin INC, London (1965)
7. V.Ramakrishnan and M.S.Gopinathan, **Group theory in chemistry**, Vishal Publications, 1988.
8. K.V.Raman, **Group theory and its application to chemistry**, Tata McGraw Hill Publishing Co., 1990.
9. Gurudeep raj, **Advanced Physical Chemistry**, Goel Publishing House, Meerut.

Reference Books:

1. W.J. Moore, **Physical Chemistry**, Orient Longman, London, 1972.
2. K.G. Den beigh, **Thermodynamics of Steady state**, Meklien and Co., London, 1951.
3. L.K. Nash, **Elements of Chemical Thermodynamics**, Addison Wesley, 1962.
4. R.G.Frost and Pearson, **Kinetics and Mechanism**, Wiley, Newyork, 1961.
5. J.W. Moore and R.G. Pearson, **Kinetics and Mechanism**, 1981.
6. C.Capellos and B.H.J. Bielski, **Kinetic systems**, Willey interscience, Newyork, 1968.
7. G.M.Harris, **Chemical Kinetics**, D.C. Heath and Co., 1966.
8. A.K. Chandra, **Introductory Quantum Chemistry**, Tata Mc Graw Hill.
9. D.A. Mc Quarrie, **Quantum Chemistry**, University science books, Mill Valley, California (1983).
10. P.W.Atkins, **Molecular Quantum Mechanics**, Oxford University Press, Oxford., 1983.
11. I.N.Levine, **Quantum chemistry**, Allyn and Bacon, Boston, 1983.
12. F.J.Bockhoff, **Elements of Quantum theory**, Addision Wesley, Reading, Mass, 1976.
13. H.Eyring, J.Walter and G. Kimball, **Quantum chemistry**, John wiley and sons, Newyork, 1944.
14. L.S.Pauling and E.B.Wilsob, **Introduction to Quantum Mechanics**, Mc Graw Hill book Co., Newyork, 1935.
15. F.A. Cotton, **Chemical Application of Group Theory**, John wiley and Sons Inc., Newyork, 1971.
16. N. Tinkham, **Group Theory and Quantum Mechanics**, McGraw Hill Book Company, Newyork, 1964.
17. Alan Vincent, **Molecular Symmetry and Group theory – Programmed Introduction to chemical applications**, Wiley, Newyork, 1977.

Elective Paper - II

CO - ORDINATION CHEMISTRY

[75 Hours]

UNIT – I Metal - Ligand Bonding (15 Hours)

Crystal field theory – splitting of d- orbitals under various geometries, factors affecting splitting, CFSE, evidences for CFSE (Structural and thermodynamic effects), Spectrochemical series, Jorgensen relation, site preferences; Jahn – Teller distortion – Splitting pattern in trigonal pyramid, square pyramidal and cubic symmetries, Dynamic and Static J.T. effect, Jahn – Teller effect and Chelation; Limitations of CFT; Evidences for metal – ligand overlap; M.O. theory and energy level diagrams, concept of weak and strong fields, sigma and pi bonding in complexes, nephelauxetic effect, magnetic properties of complexes.

UNIT – II Stability and stereochemical aspects of complexes (15 Hours)

Stability of complexes – Factors affecting stability of complexes, thermodynamic aspects of complex formation, Stepwise and overall formation constants, stability correlations, statistical and chelate effects; Determination of stability constant – Polarographic, photometric and potentiometric methods.

Stereochemical aspects – Stereoisomerism in inorganic complexes, isomerism arising out of ligand distribution and ligand conformation, chirality and nomenclature of chiral complexes; application of ORD and CD in the identification of chirality of complexes.

Macrocyclic ligands – types – porphyrins, corrins, Schiff's bases, crown ethers and cryptates. (simple complexes)

UNIT – III Reaction mechanisms in Complexes (15 Hours)

Electron transfer reactions – Outer and inner sphere processes; atom transfer reaction, formation and rearrangement of precursor complexes, the bridging ligand, successor complexes; Cross reactions and Marcus – Hush theory (no derivation)

Reaction mechanism of coordination compounds – Substitution reactions, Labile and inert complexes. Substitution in square planar complexes – General mechanism; reactivity of Platinum complexes; influences of entering and leaving groups; the trans effect – theories, trans influence.

Substitution in octahedral complexes – general mechanism, discussion of A, D, I_A, I_D and DC_B mechanism, replacement of coordinated water; mechanism of acid hydrolysis and base hydrolysis – Conjugate base mechanism; direct and indirect evidences in favour of the mechanism; application of substitution reaction in the synthesis of Platinum and Cobalt complexes.

UNIT – IV Organometallic Chemistry (15 Hours)

Carbonyls – 18 electron rule, isolobal concept – application to structure of carbonyls (simple and polynuclear); Chain Carbon donors - Olefins, acetylene and allyl complexes – Synthesis, structure and bonding; Cyclic carbon donors -Metallocene – synthesis, structure and bonding (Ferrocene only). Nitrosyls – bridging and terminal nitrosyls, bent and linear nitrosyls;

Substitution – electrophilic and nucleophilic attack on ligands. Carbonylation and decarbonylation; oxidative addition and reductive elimination to organometallics; fluxional isomerism.

UNIT – V Catalysis (15 Hours)

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 oligomerization of acetylene using Nickel catalyst (Reppe's catalyst); polymer bound catalysts.

Text Books:

1. H.J.Emelius and Sharpe, **Modern aspects of Inorganic chemistry**, Universal book stall, New Delhi, 1989
2. F. Basolo and R.G. Pearson, **Mechanism of Inorganic Reactions**, Wiley Eastern, 1967.
3. J.E.Huheey, E.A.Keiter and R.L.Keiter, **Inorganic chemistry-principles of structure and reactivity**, 4th edition, Pearson-Education, 2002
4. F.A.Cotton and G.Wilkinson, **Advanced Inorganic Chemistry**, Wiley Eastern, 5th edition, 1988.
5. S.F.A. Kettle, **Coordination compounds**, ELBS, 1973.
6. K.F. Purcell and J.C. Kotz, **Inorganic Chemistry**, WB. Sanders Co. USA. 1977.

7. D.F. Shriver, P. W. Atkins and C.H. Longford, **Inorganic Chemistry**, ELBS, 2nd Edition, 1994.
8. R.B. Heslop and K. Jones, **Inorganic Chemistry**, Elsevier, 1976.

Reference Books

1. D. Bannerjea, **Coordination Chemistry**, Tata – McGraw Hill, 1993.
2. M.L. Tobe, **Inorganic Reaction Mechanism**, Nelson, 1972.
3. K. Burger, **Coordination Chemistry Experimental Methods**, Butterworths, 1973.
4. B.N. Figgis, **Introduction to Ligand Fields**, Wiley Eastern Ltd, NewDelhi, 1976.
5. W.E. Addision, **Structural Principles of Inorganic Chemistry**, Longman, 1961.

Extra Disciplinary Course

BIOLOGICAL CHEMISTRY

[60 Hours]

UNIT – I Bioorganic Chemistry – I (12 Hours)

Polypeptides and proteins – classification – the peptide linkage – sequential analysis of peptides – synthesis of polypeptides and synthesis of glutathione, oxytocin and thyroxine – solid phase synthesis (Merrifield synthesis).

Classification of proteins – primary, secondary, tertiary and quaternary structures of proteins – denaturation of proteins – determination of primary structure of proteins (end group assay).

UNIT – II Bioorganic Chemistry – II (12 Hours)

Nucleic acids – structure of nucleosides and nucleotides – synthesis of nucleosides and nucleotides – Structure and role of (genetic code) DNA and RNA. (Determination of structure is not required).

Biosynthesis of amino acids (phenylalanine, tyrosin, 3, 4 dopa, proline only) and cholesterol.

UNIT – III Bioinorganic Chemistry (12 Hours)

Metal ions in biological systems – essential and trace elements, Na^+ / K^+ Pump; Biologically important complexes of Iron (transport proteins) – haemoglobin, myoglobin, iron – sulphur proteins, cytochrome – C, Magnesium (chlorophyll), Cobalt (vitamin B_{12}), Zinc (carbonic anhydrase, carboxy peptidase); fixation of Nitrogen.

UNIT – IV Terpenoids **(12 Hours)**

Isoprene rule – Special isoprene rule, Classification of terpenoids with few examples. Structural elucidation and synthesis of menthol, Abietic acid, Squalene and Phytol.

UNIT – V Carotenoids **(12 Hours)**

Synthesis of α – carotene, β – carotene, γ – carotene, Vitamin A_1, and Vitamin A_2. Geometrical isomerism of Carotenes.

Text Books:

1. I.L. Finar, **Organic Chemistry**, Volume II, Fifth Edition, First Indian reprint, Pearson Education Asia Pte. Ltd., (2000)
2. G. Chatwal, **Organic Chemistry of Natural Products**, Vol. I & II, Himalaya Publishing House, 1988.
3. A.L. Leninger, **Biochemistry,** Nath Publishers
4. M.N. Hughes, **The Inorganic chemistry of Biological Processes**, Willy London (1982) II Edition.
5. S.J. Lippard and Berg, **Principles of Bioinorganic chemistry**, Univ. Science Books. 1994.
6. D.E. Fenton, **Biocoordination Chemistry**, Oxford Science Publication, 1995.

Reference Books:

1. J. Mann, R.S. Davidson, J.B. Hobbs, D.V. Banthropeand J.B. Harborne, Longman, Essex, **Natural Products: Chemistry and Biological Significane**.
2. Atta. Ur. Rahman and M.I. Choudhary, **New Trends in Natural product chemistry,** Harwood Academic Publishers.
3. J.A. Cowan, **Inorganic biochemistry**, wiley – VCH, New York, 1997.
4. Voet and Voet, **Biochemistry,** John Wilay & Son 1990.
5. R.K. Muray, D.K. Grammer, P.A. Mayer, V.W. Rodwell, **Biochemistry**, 24th Ed. 1990.
6. O.P. Agarwal, **Chemistry of Organic Natural Products**, Vol I & II, Goel Publishing House, 1988.

Core Practical - I
ORGANIC CHEMISTRY PRACTICAL - I

I. Identification of components in a two component mixture and preparation of their derivatives. Determination of boiling point/melting point for components and melting point for their derivatives.

II. Preparation

1. Beta naphthyl methyl ether from beta naphthol
2. s-Benzyl isothiuronium chloride from benzylchloride
3. Beta-glucose penta acetate from glucose
4. ortho-Benzoyl benzoic acid from phthalic anhydride
5. Resacetophenone from resorcinol
6. para-Nitrobenzoic acid from para nitrotoluene
7. meta – Nitroaniline from meta dinitrobenzene
8. Methyl orange from sulphanilic acid
9. Anthraquinone from anthracene
10. Benzhydrol from benzophenone

Distribution of Marks for Practical I

Qualitative organic analysis	: 30 marks
Preparation	: 15 marks
Viva-Voce in practical	: 10 marks
Record	: 5 marks
Total	**: 60 marks**
Duration	**: 6 Hours**

Core Practical - II
INORGANIC CHEMISTRY PRACTICAL - I

Part –I

Semimicro qualitative analysis of mixtures containing two common and two rare cations. The following are the rare to be included : W, Tl, Mo, Te, Se, Ce, Th, Be, Zr, V, U and Li..

Part – II

Preparation of the following

a) Potassium trioxalatoaluminate (III) trihydrate

b) Tristhioureacopper (I) chloride

c) Potassium trioxalatochromate (III) trihydrate

d) Sodium bis (thiosulphato) cuprate (I)

e) Tetramminecopper (II) sulphate

f) Potassium Tetrachlorocuprate (II)

Distribution of Marks for Practical – I

Semimicro qualitative analysis of a mixture containing two common (other than ammonium) and two rare cations : 30 marks

One preparation	: 15 marks
Record	: 5 marks
Viva-voce in practical	: 10 marks
Maximum marks	**: 60 marks**
Duration	**: 6 hours**

Core Practical - III
PHYSICAL CHEMISTRY PRACTICAL- I

LIST OF EXPERIMENTS

1. Study the kinetics of acid hydrolysis of an ester, determination of the temperature coefficient of the reaction and determination of the activation energy of the hydrolysis of ethylacetate.
2. Study the kinetics of the reaction between acetone and iodine in acidic medium by half life method and determine the order with respect to iodine and acetone.
3. Study the phase diagram for m-toluidine and glycerine system.
4. Construction of phase diagram for a simple binary system (naphthalene – phenanthrene and benzophenone – diphenylamine)
5. Construction of the phase diagram of the three component of partially immiscible liquid systems (DMSO-Water-Benzene; Water-Benzene-Acetic acid. Ethyl alcohol-Benzene-Water ; Acetone-Chloroform- Water ; Chloroform – Acetic acid-Water)
6. Determination of the rate constant and order of reaction between potassium persulphate and potassium iodide and determine the temperature coefficient and energy of activation of the reaction.
7. Study the primary salt effect on the kinetics of ionic reactions and test the Bronsted relationship (iodide ion is oxidized by persulphate ion).
8. Adsorption of oxalic, acetic, formic acids on activated charcoals-Freundlich isotherm
9. Determination of the partial molar volume of glycine/methanol/formic acid/sulphuric acid by graphical method and by determining the densities of the solutions of different compositions.

10. Study the surface tension – concentration relationship of solution (Gibb's equation)
11. Determination of the viscosities of mixtures of different composition of liquids and find the composition of a given mixture.

Distribution of Marks for Practical –I

Experiment	: 45 marks
Viva-voce in practical	: 10 marks
Record	: 5 marks
Total	**: 60 marks**
Duration	**: 6 hours**

Distribution of Marks

Theory

University Examinations (UE) : 75 Marks

Internal Assessment (IA) : 25 Marks

Classification of Internal Assessment Structure

Test	-	10 Marks
Attendance	-	5 Marks
Assignment	-	5 Marks
Seminar	-	5 Marks

Total - 25 Marks

Passing Minimum : IA : 50% - 12 Marks

Passing Minimum : UE : 50% - 38 Marks

Total Passing Minimum : - 50 Marks

PRACTICALS

University Examination (UE) : 60 Marks

Internal Assessment (IA) : 40 Marks

Passing Minimum (IA) : 50 % 20 Marks

Passing Minimum (UE) : 50 % 30 Marks

Total Passing Minimum : 50 Marks

Distribution of Internal Assessment Structure

No of Experiments	-	10 Marks
Experimental Skill	-	10 Marks
Test	-	20 Marks

Total - 40 Marks

Everything should be supported by proper record

Question Paper Pattern

Time : 3 Hours **Max Marks : 75**

PART – A : 5 X 5 = 25

(Answer all questions)

(One question from each unit with internal choice)

PART – B : 5 X 10 = 50

(Answer all questions)

(One question from each unit with internal choice)

Model Question Paper

(For the candidate admitted from 2012 – 2013 onwards)

M.Sc. DEGREE Branch – IV (C) – Analytical Chemistry

First Semester

Core Paper - I

ORGANIC CHEMISTRY – I

Time : Three Hours **Maximum : 75 Marks**

PART – A (5 X 5 = 25 Marks)

Answer all the questions

All questions carry equal marks

1.a) How do you classify the given reaction as substitution, addition or elimination reaction? give an example for each of the reactions.

Or

b) Write notes on the following reaction:

i) Ullmann reaction

ii) Hunsdiecker reaction

2. a) With chosen example, illustrate the terms kinetic and thermodynamic control of reactions.

Or

b) State and explain Hammonds postulate with potential energy diagram.

3. a) Discuss briefly the optical activity of spiranes and allenes.

Or

b) Explain what is meant by Fischer projection and state an example.

4. a) What are known as ambident nucleophiles and mention some important ambident nucleophiles?

Or

b) Explain the nature of attacking nucleophile and mention the important principles.

5 a) Give the synthesis and properties of Imidazole.

Or

b) Give the synthesis of purines.

PART – B (5 X 10 = 50 Marks)

Answer all the questions

6. a) (i) How do you explain the stability of t-butyl and benzyl cations ? (4)

(ii) Discuss the mechanism of Hunsdiecker reaction (6)

Or

b) (i) Give any two methods of generation of carbenes and nitrenes (4)

(ii) Discuss Sandmeyer reaction (3)

(iii) Discuss the characteristics of pericyclic reactions. (3)

7. a) i) State the Hammett equation and explain the significance of σ and ρ (3)

ii) Discuss the principle of microscopic reversibility. (3)

iii) Draw the potential energy diagrams for the reactions involving (a) no intermediate (b) an intermediate. (4)

Or

b) Explain the usefulness of the following methods in determining the mechanism of a reaction. Give suitable examples.

i) Isotopic labelling

ii) Primary isotope effect

iii) Determination of the presence of an intermediate. (3 + 3 + 4)

8. a) i) Explain the homotopic, enantiotopic, and diastereotopic H atoms with examples. (6)

ii) Discuss the optical activity in transcyclooctene and biphenyls. (4)

Or

b). (i) Draw the Fischer projection, Newman and Sawhorse formulae of meso – tartaric acid. (6).

(ii) Give examples for Stereo selective and Stereo specific reactions. What is the difference between them. (4)

9) a) i.) Briefly discuss the effects of substrates structure, attacking nucloephile, leaving group and reaction medium on the SN^1 and SN^2 reaction . (6)

ii) Describe the mechanism of Von-braun reaction. (4)

Or

b) Account for the following

i) SN^i reaction proceeds with retention of configuration.

ii) Nucleophilic substitution at allylic substrate gives mixture of products.

iii) Vinyl chloride is not easily hydrolysed by NaOH. (4+3+3)

10 a) i) Give the synthesis and structural elucidation of flavones. (7)

ii) Give the synthesis of uric acid. (3)

Or

b) i) Write the synthesis of thiazole and oxazole (6)

ii) Give the synthesis of Caffeine (4).

Model Question Paper
(For the candidate admitted from 2012 – 2013 onwards)
M.Sc. DEGREE Branch – IV (C) – Analytical Chemistry
First Semester
Core Paper - II
INORGANIC CHEMISTRY – I

Time : Three Hours **Maximum : 75 Marks**

PART – A (5 X 5 = 25 Marks)

Answer all the questions

All questions carry equal marks

1) a) Briefly explain any one theory of Hardness – Softness of acid bases

Or

b) What are Phosphazenes? Give their formulae and shape.

2. a) Give the features of liquid drop model of the nucleus.

Or

b) Describe the construction and working of G.M. Counter.

3. a) Give a brief account of neutron activation analysis.

Or

b) Briefly explain the radiolysis of water

4. a) Explain photoisomerisation with an example

Or

b) Discuss the PES of a HBr molecule.

5. a) Distinguish between spinels & inverse spinels.

Or

b) What are Frenkel and Schottky defects. Explain with examples.

PART – B (5 x 10 = 50 Marks)

Answer all questions.

6. a) Draw and explain the various silicate structure in detail (10)

Or

b) Write briefly about the heteropoly acids of molybdenum and tungsten (10)

7 a) i) Write notes on Compound nuclear theory (5)

ii) Discuss the types of photonuclear reaction. (5)

Or

b) i) Explain orbital electron capture with an example. (5)

ii) Discuss briefly the types of nuclear isomerism encountered in the radio elements. (5)

8. a) Write a note on

i) Radiation dosimetry (5)

ii) Isotope dilution analysis. (5)

Or

b) Write a note on

i) Radio Pharmacology (5)

ii) Radiation protection and safety precautions. (5)

9. a) i) Discuss the photochemistry of Ruthenium III complexes. (5)

ii) How does PES of oxygen molecule differ from that of nitrogen molecule (5)

Or

b) i) In what respects XPES differ form uv-visible PES ? Illustrate with

suitable example. (5)

ii) Discuss the applications of metal complexes in solar energy conversions (5)

10 a) i) Illustrate the use of X-ray powder technique in determining the structure of sodium chloride (5)

ii) What are the three types of cubic lattices ? How are they distinguished using X- ray diffraction. (5)

Or

b) Outline the features of the crystal structures.

i) Pervoskite

ii) Rutile

iii) Zinc blende (6)

iv) How do the crystal structure of Nickel arsenide differ from Cadmium iodide (4)

Model Question Paper
(For the candidate admitted from 2012 – 2013 onwards)
M.Sc. DEGREE Branch – IV (C) – Analytical Chemistry
First Semester
Core Paper - III
PHYSICAL CHEMISTRY – I

Time : Three Hours **Maximum : 75 Marks**

PART – A (5 X 5 = 25 Marks)

Answer all the questions

All questions carry equal marks

1. a) Write the maxwell's relationships

Or

b) Using Maxwell's relation derive the thermodynamic equations of state.

2. a) List out the postulates of transition state theory.

Or

b) Explain the significance of enthalpy and entropy of activation.

3. a) When lithium is irradiated with light, the kinetic energy of the ejected electron is 2.935×10^{-19} J for $\lambda = 300$ nm. Calculate the threshold frequency of Lithium atom ($h = 6.626 \times 10^{-34}$ JS)

Or

b) Discuss the properties of a Hermitian Operator.

4. a) Define the different types of symmetry elements present in a molecule.

Or

b) Compare molecular symmetry with crystallographic symmetry.

5. a) Discuss the effect of isotopic substitution on the rotation spectra.

Or

b) Define (i) Overtone (ii) Fermiresonance.

Part – B (5 x 10 = 50 Marks)

Answer all questions.

6. a) Define chemical potential. Explain its dependence on pressure and temperature (2 + 4 + 4)

Or

b) (i) Explain the use of thermodynamic equation of state in the evaluation of Cp – Cv for solids. (5)

(ii) Derive Gibbs Duhem equation. (5)

7 a) i) Explain the effect of temperature on reaction rate. (3)

ii) Give a detailed account on collision theory. (7)

Or

b) (i) Write notes on potential energy surfaces. (5)

(ii) Deduce Eyring equation under thermodynamic considerations. (5)

8 a) i) Apply Schrodinger wave equation and find the solution for a particle in one dimensional box. (6)

ii) Explain Heisenberg's uncertainty principle. (4)

Or

b) i) Explain the Postulates of quantum mechanics. (5)

ii) Define a black body? Discuss the experimental results of a black body radiation. (5)

9 a) i) Explain the construction of C_{3v} character table. (5)

ii) What is a character table? What do the various areas of the character table represent? (5)

Or

b) i) Write notes on direct product representation. (5)

ii) Arrive at the point group for the following molecules : Allene and XeF_4 (5)

10 a) (i) Bring out the differences between IR and Raman Spectra. (4)

(ii) Explain Franck Condon Principle (3)

(iii) Discuss the selection rule for rotational transition (3)

Or

b) i) Discuss the rotational – vibrational Raman spectrum of a diatomic molecule (7)

ii) Calculate the force constant for $H^{35}Cl$ from the fact that its fundamental vibrational frequency is 8.667×10^{13} sec^{-1}. (3)

Model Question Paper
(For the candidate admitted from 2012 – 2013 onwards)
M.Sc. Degree – Branch – IV(C)
Analytical Chemistry
First Semester
Elective Paper - I
Data Treatment and Titrimetric Analysis

Time : Three Hours **Maximum : 75 Marks**

PART – A (5 X 5 = 25 Marks)

Answer all the questions

All questions carry equal marks

1. a) Consider the following sets of replicate measurements:

   3.5, 3.1, 3.1, 3.3, 2.5

   Calculate the (i) mean, (ii) median; (iii) spread or range; (iv) standard deviation; (v) coefficient of variation

Or

b) Explain

(i) Upper control limit (UCL) and lower control limit (LCL) in the control chart

(ii) Null hypothesis.

2. a) Define (i) Coning and quartering

   (ii) Gross sample and sub sample.

Or

b) Explain the term Pitfalls

3. a) Distinguish between

(i) The equivalence point and the end point of titration.

(ii) Primary standard and secondary standard.

Or

(b) The changes in ionic concentration, which occur during the titration of 100 ml of 0.1 M NaCl with 0.1 M $AgNO_3$. The solubility product of AgCl at the laboratory temperature is 1.2×10^{-10}. The initial concentration of chloride ions $[Cl^-]$ is mol L^{-1}, $P^{Cl-} = 1$. When 50 ml of 0.1 M $AgNO_3$ have been added, 50 ml of 0.1 M Nail remains in a total volume of 150 ml. At this point calculate the Cl^- ion concentration.

4 (a) Account for the fact that the step – wise formation constants of an MLn complex decrease progressively.

Or

(b) What are complexometric titrations ? Discuss the advantages and uses of EDTA titrant in complexometric titration.

5. (a) Compare IF – THEN and IF-THEN- ELSE with one example.

Or

(b) Explain the purpose of INPUT and LET statements with one example.

Part – B

(5x 10 = 50 Marks)

Answer All Questions.

6 (a). (i) Apply the Q test to the following data set to determine whether the outlying result should be retained or rejected at the 95% confidence level.

41.27, 41.61, 41.84, 41.70 (5)

Note : Q_{crit} for 4 observations at 95 % confidence = 0.829

(ii) An atomic absorption method for the determination of the amount of iron present in used jet engine oil was found, from pooling 30 triplicate analysis, to have a standard deviation s = 2.4 μg Fe/ml. If s is a good estimate of σ, calculate the 95% confidence interval for the result, 18.5 μg Fe/ml, if it was based on (a) single analysis, (b) the mean of two analysis (c) the mean of four analysis. (5)

Or

(b) Distinguish between

(i) accuracy and precision

(ii) sample standard deviation and population standard deviation.

(iii) random error and systematic error

(iv) mean and median

(v) sample variance and population variance (5 x 2 = 10)

7. (a) Why should the sampling process is important and what are the different methods of sampling process (10)

Or

(b) Enumerate the methods and equipments needed for micro scale manipulation. (10)

8. (a) Derive an expression for the relationship between stepwise stability constants and overall stability constants of a complex MLn (10)

Or

(b) (i) What is masking agent? With suitable example explain how masking is useful in qualitative and quantitative analysis. (7)

(ii) Write a short note on replacement titration. (3)

9. (a) Construct a curve for the titration of 50 ml of a 0.01 M solution of HCl with a 0.01 M solution of NaOH in the following volumes. During the course of the titration calculate the pH after addition of 0.00, 25.00, 30.00, 35.00, 40.00, 45.00, 47.00, 49.00, 49.50, 49.80, 49.90, 50.00, 50.01, 50.05, 50.10, 50.20, 50.50, 60.00, 70.00, 80.00, 100.00 ml of NaOH. (10)

Or

(b) Explain in what respect is the Fejans method superior to Volhard method for the titration of chloride ion?

10 (a) (i) Write a program in BASIC to calculate the pH of an acidic buffer. (4)

(ii) Write a program in BASIC to calculate the equilibrium constant of a chemical reaction. (6).

Or

(b) (i) Discuss briefly the essential requirements for the preparation of a research report (4)

(ii) Out line the method of creating Excel format file. (6)

Model Question Paper

(For the candidate admitted from 2012 – 2013 onwards)

M.Sc. Degree – Branch – IV (C) Analytical Chemistry

Second Semester

Core Paper - IV

ORGANIC CHEMISTRY - II

Time : Three Hours **Maximum : 75 Marks**

PART – A (5 X 5 = 25 Marks)

Answer all the questions

All questions carry equal marks

1.a) Account for the orientation of double bond in E2 eliminations under Hofmann and Saytzeff conditions.

Or

b) What is Chugaev reaction? Explain what are its advantages over conventional methods of alkene preparation.

2. a) Write down the structure of [18] annulene. Comment on whether it is aromatic or not. Give reasons for your answer.

Or

b) With suitable examples, bring out the differences between a non – aromatic and an anti – aromatic substance.

3. a) What is Zeigler alkylation? Comment on the uses of this reaction.

Or

b) Describe the chichibabin reaction. Explain its importance in synthesis of organic compounds.

4. a) Draw the energy profile diagram for cyclohexane as a function of conformation and explain the stability of the different conformations.

Or

b) Discuss the conformation and stability of decalins.

5. a) What is DIBAL? Mention any one application for this reagent

Or

b) Illustrate the utility of Osmium tetroxide in the synthesis of organic compounds.

PART – B (5 X 10 = 50 Marks)

Answer all the questions

All questions carry equal marks

6. a) Discuss the effect of changes of E2 elimination with respect to the following: substrate, base, leaving group and medium (10)

Or

b) i) Discuss the E1 mechanism (4)

ii) What is cope elimination ? Give its mechanism (3)

iii) Discuss the salient features of dehydrohalogenation reactions. (3)

7. a) Explain the aromaticity of five heterocyclic compounds of your choice. (10)

Or

b) Discuss the aromaticity of non - benzenoid aromatic compounds (10)

8. a) i) Discuss the evidences in support of arenium ion mechanism in aromatic electrophilic substitution reaction. (5)

ii) Explain the mechanism of sulphonation of benzene. (5)

Or

b) (i) Discuss the evidences in favour of the SNAr mechanism for the nucleophilic aromatic substitution. (5)

(ii) Explain ortho, meta and para directing groups with examples. (5)

9. a) i) Discuss the conformation, relative stability and optical activity of cis and trans – 1, 3 dimethyl cyclohexanes. (5)

ii) Discuss the effect of conformation on reactivity in cis – and trans 4-t – butyl cyclohexanol during acetylation (5)

Or

b) Draw the preferred conformation of the following and justify your answer:

i) 2-Fluoroehanol

ii) cis – 4- methyl cyclohexanol

iii) 2- Chlorocyclo hexanone

iv) trans – 1, 3-Di – t – butylcyclo hexane.

v) Ethylene glycol (10)

10. a) i) Write short notes on Robinson annulation reaction. (5)

ii) What are ylides? Give an example of sulphur ylide and explain the nature of bonding in it. (5)

Or

b) Discuss the synthetic applications of the following reagents with suitable examples.

i) 9BBN

ii) DDQ

iii) Trimethyl silyl iodide (4 + 3 + 3)

Model Question Paper
(For the candidate admitted from 2012 – 2013 onwards)
M.Sc. Degree – Branch – IV (C) Analytical Chemistry
Second Semester
Core Paper - V
PHYSICAL CHEMISTRY – II

Time : Three Hours **Maximum : 75 Marks**

PART – A (5 X 5 = 25 Marks)

Answer all the questions

All questions carry equal marks

1.a) Explain how the fugacity varies with temperature and pressure.

Or

b) How activity coefficient of an electrolyte in a solution is determined from Emf measurements.

2. a) Deduce Hammett equation.

Or

b) Discuss the influence of pressure on reactions in solutions.

3. a) Solve Schrodinger equation for rigid rotor

Or

b) Write notes on Term Symbols.

4. a) Give the symmetry selection rules for vibrational, electronic and Raman spectra.

Or

b) Determine the representation of vibrational modes of H_2O molecule.

5. a) Derive Langmuir Adsorption isotherm. What are its limiting cases?

Or

b) Calculate how long a hydrogen atom will remain on the surface of the solid at 298 K if its desorption activation energy is (i) 15 KJ mol^{-1} ii) 150 KJ mol^{-1}. Assume that $T_o = 10^{-13}$ S.

PART – B (5 X 10 = 50 Marks)

Answer all the questions

All questions carry equal marks

6.a) Describe any two methods of determining fugacity. (10)

Or

b) i) Define ionic strength (2)

ii) Define the terms activity, mean ionic activity and mean ionic activity coefficient How are they related. (8)

7. a) i) Write briefly about Taft relationship (5)

ii) Explain the influence of ionic strength on the rate constant of a reaction (5)

Or

b) i) Compare gas phase reaction with solution reactions. (4)

ii) Write an account of kinetic isotope effects (6)

8. a) Derive Schrodinger wave equation for hydrogen atom. (10)

Or

b) i) Outline how variation method is used for the solution of helium atom problem (5)

ii) Explain the application of variation method to hydrogen atom. (5)

9 a) How will you find the IR and Raman activity of the vibrational modes of NH_3 molecule. (10)

Or

b) With the help of D_4h character table find the set of orbital suitable for hybridisation in XeF_4 (10)

10 a) Derive the rate expression for enzyme catalysed reaction following Michaelis – Menton kinetics. How the Michaelis parameters are evaluated. (10)

Or

b) i) Tabulate the distinction between physisorpton and Chemisorption (4)

ii) Discuss Langmuir – Hinshel wood and Langmuir – Rideal mechanism for heterogeneous catalytic reactions. (6)

Model Question Paper
(For the candidate admitted from 2012 – 2013 onwards)
M.Sc. Degree – Branch – IV (C) Analytical Chemistry
Second Semester
Elective Paper - II
CO-ORDINATION CHEMISTRY

Time : Three Hours **Maximum : 75 Marks**

PART – A (5 X 5 = 25 Marks)

Answer all the questions

All questions carry equal marks

1.a) Explain the following term :

i) CFSE and

ii) Spectrochemical series

Or

b) Give a comparative account of MO and CFT.

2. a) Discuss the thermodynamic aspects of complex formation

Or

b) Discuss the importance of porphyrins.

3. a) Explain the substitution reactions occurring in square planar platinum complexes.

Or

b) Write the applications of substitution reactions used for the synthesis of Cobalt complexes.

4. a) Apply the EAN rule and 18 electron rule to $Fe(CO)_5$.

Or

b) Explain with an example oxidative addition reaction.

5. a) Write the mechanism of conversion of olefin into aldehyde in Wacker process

Or

b) Write notes on the application of polymer bound catalysts.

PART – B (5 X 10 = 50 Marks)

Answer all the questions

All questions carry equal marks

6. a) Draw and explain M.O diagrams of $[Fe\ F_6]^{3-}$ and $[Fe(CN)_6]^{3-}$ complexes (10)

Or

b) Discuss the MO treatment for octahedral complexes. (10)

7. a) i) Bringout the relationship between stepwise stability constants and over-all stability constants. Taking the complex MLn, derive them. (5)

ii) How are the absolute configurations of optically active complexes determined by ORD and CD curves? (5)

Or

b) i) What do you understand by the term chirality? How are chiral complexes named? (5)

ii) Describe the polarographic method of determination of stability constant of a complex. (5)

8. a) Discuss the A and DC_B mechanism for the substitution reactions of octahedral complexes (10)

Or

b) i) Explain the atom transfer process occurring in electron transfer reactions. (5)

ii) Give the general mechanism for the substitution reactions taking place in octahedral complexes. (5)

9. a) i) Draw a qualitative MO energy level diagram for ferrocene indicating the occupancy of the orbitals and comment on the bonding. (10)

Or

b) i) Write an account on the preparation and stereochemistry of allyl complexes (5)

ii) Write an account on the alkene complexes of platinum (5)

10. a) i) Explain the use of Wilkinson's catalyst in the hydrogenation of alkenes (5)

ii) Write a note on Hydroformylation of olefins. (5)

Or

b) i) Outline the mechanism of Zeigler – Natta Polymerisation and point out the importance of the reaction. (6)

ii) What is Reppe's catalyst? Explain its use in the cyclooligomerisation of acetylene (4)

Model Question Paper
(For the candidate admitted from 2012 – 2013 onwards)
M.Sc. Degree – Branch – IV (C) Analytical Chemistry
Second Semester
Extra Disciplinary Course
BIOLOGICAL CHEMISTRY

Time : Three Hours **Maximum : 75 Marks**

PART – A (5 X 5 = 25 Marks)

Answer all the questions

All questions carry equal marks

1.a) How is solid phase peptide synthesised

Or

b) What is denaturation of protein ? How is it brought about? What happens to the structure of the protein during denaturation.

2. a) Discuss the biological function of RNA and DNA.

Or

b) Schematically outline the biosynthesis of L – Phenylalanine and proline.

3. a) Discuss the role of magnesium in photosynthesis.

Or

b) Write a short note on Cytochorme – C

4. a) How are the terpenoids classified.?

Or

b) Bring out the method of synthesis of squalene.

5. a) Write the synthesis of vitamin A_1.

Or

b) Write briefly about the synthesis of γ – Carotene.

PART – B (5 X 10 = 50 Marks)

Answer all the questions

All questions carry equal marks

6. a) i) Give an account of determination of the primary structure of proteins (5)

ii) Comment on the need for protection of $-NH_2$ and –COOH groups in peptide synthesis. (5)

Or

b) i) Write an account of the two possible secondary structure of proteins advanced by Pauling. (5)

ii) Discuss the tertiary structure of proteins (5)

7. a) i) Discuss the structure of RNA (6)

ii) In what way is DNA different from RNA. (4).

Or

b) i) Write notes on biological importance of nucleotides (4)

ii) How is cholesterol biosynthesized from acetic acid? (6)

8. a) i) Explain the functions of haemoglobin and myoglobin (5)

ii) Discuss the principal similarities in their structures. (5)

Or

b) i) Discuss the bioinorganic chemistry of nitrogen fixation. (6)

ii) Write a short note on the structure of Vitamin B_{12}. (4)

9. a) i) Indicate a method of synthesis of abietic acid. (7)

ii) State and explain isoprene rule (3)

Or

b) Elucidate the structure of menthol (10)

10. a) i) Draw the molecular structures of β – carotene. How is its structure confirmed by synthesis. (6)

ii) Write an account of geometrical isomerism of carotenes. (4)

Or

b) Write briefly about the following

i) Syntheis of vitamin A_2 (5)

ii) Synthesis of α - carotene (5)

SECOND YEAR
Semester III

Code No.	Course	Subject	Work load per Semester

			(hours)
	Core Paper – VI	Analytical Chemistry I	75
	Core Paper – VII	Analytical Chemistry II	75
	Core Paper – VIII	Analytical Chemistry III	75
	Elective Paper – III	Optical methods and Thermal analysis	90
	Core Practical – IV	Analytical Chemistry Practical I	45
	Core Practical – V	Analytical Chemistry Practical II	45
	Core Practical - VI	Analytical Chemistry Practical III	45

SECOND YEAR

Semester III

Semester	Code	Course	Course Title	Hrs.	Credit	Marks		
						CIA	EA	Total
III		Core Paper – VI	Analytical Chemistry I	5	5	25	75	100
		Core Paper – VII	Analytical Chemistry II	5	5	25	75	100
		Core Paper – VIII	Analytical Chemistry III	5	5	25	75	100
		Elective Paper – III	Optical methods and Thermal analysis	6	4	25	75	100
		Core Practical – IV	Analytical Chemistry Practical I	3	-	-	-	-
		Core Practical – V	Analytical Chemistry Practical II	3	-	-	-	-
		Core Practical - VI	Analytical Chemistry practical III	3	-	-	-	-

Core Paper - VI
ANALYTICAL CHEMISTRY – I
[75 Hours]

UNIT – I Conductometric Titrations (15 Hours)

Conductometric titrations – General concept and basis of conductometric titrations, apparatus and measurement of conductivity, Applications of direct conductometric measurements.

High frequency methods – Theory, apparatus, merits of low and high frequency analysis (oscillometry), determination of non-ionic species in process control and zone detector.

Dielectrometry – Theory, methods, equipment and applications.

UNIT – II Potentiometric Titration (15 Hours)

Standard and formal potentials, types of electrodes. Glass membrane, precipitate and solid state electrodes, liquid membrane electrodes, mechanism of electrode, response and evaluation of selectivity coefficient, application of ion-selective electrodes. Methods – manual titrimeters and automated titrators, Direct potentiometry and potentiometric titrations including differential methods, acid – base titrations in non-aqueous systems.

Bipotentiometry – Principle, instrumentation and applications.

UNIT – III D.C. Polarography & Voltammetry (15 Hours)

Polarography – Theory, apparatus, DME, diffusion and kinetic and catalytic currents, current – voltage curves for reversible and irrerversible systems, qualitative and quantitative applications of polarography to organic and inorganic systems. Derivative polarography, Test polarography, Pulse polarography – Normal and derivative, square wave polarography and AC polarography.

Linear sweep and cyclic voltammetry, anodic and cathodic stripping voltammetry.

UNIT – IV Amperometry (15 Hours)

Amperometric titrations – Theory, apparatus, types of titration curves, successive titrations and two indicator electrodes – applications. Technique of amperometric titrations with the dropping mercury electrode – Titration with the rotating platinum microelectrode. Examples of amperometric titrations using a single polarized electrode, biamperometry – Theory and applications.

UNIT – V Coulometric and Electrogravimetric Analysis (15 Hours)

Theory. Faraday's laws, coulometers – types of macro and micro techniques, coulometric titrations, external and insitu generation, coulogravimetry and applications, Elementary aspects of chronocoulometry.

Electrogravimetry – Theory of electrogravimetry , order of deposition, over potential, polarization curves, constant potential and consecutive deposition, selective deposition, constant current deposition, assembly of electrode and deposition of complex ions.

Microelectrode deposition including radioactive metal ions. Autoelectrogravimetry, Principle and instrumentations, electrography and its applications.

Text Books:

1. Willard, Merit Dean and Settle, **Instrumental Methods of Analysis,** CBS Publishers and Distributors, IV Edn. 1986.
2. D.A. Skoog, **Principles of Instrumental Analysis,** Saunders College Pub. Co, III Edn., 1985.
3. A.I. Vogel, **Text Book of Quantitative Inorganic Analysis,** ELBS III and IV Edn.
4. J.O.M. Bockris and AKN Reddy, **Modern Electrochemistry,** Plenum, 1970.
5. D.A. Skoog and D.M. West, **Fundamentals of Analytical Chemistry,** Holt Rinehart and Winston Publications, IV Edn, 1982.
6. H. Kaur, **Instrumental Methods of Chemical analysis**, Pragati Publishers, 2006.

Reference Books

1. Albert Paul Malvino, **Electronic Principles**, PMH Publishers, III Edn, 1984.
2. J.G. Dick, **Analytical Chemistry**, McGraw Hill Publishers, 1974.
3. G.W. Ewing, **Instrumental Methods of Chemical Analysis**, McGraw Hill Pub, 1975.
4. B.H. Vassos and G.W. Ewing, **Electroanalytical Chemistry**, John Wiley and Sons, NY, 1983.
5. R. Greef, R. Peat, L.M. Peter, D. Pletcher and J. Robinson, **Instrumental methods in Electrochemistry**, Ellis Horwood, Chichester, 1985.
6. A.J. Bard and L.R. Faulkner **Electrochemical methods, Fundamentals and Applications**, J. Wiley and Sons, NY, 1980.
7. I.M. Kolthoff and P.J. Elving, **Treatise on Analytical Chemistry**, Part I, Vol 4, Wiley, NY, 1959.

Core Paper - VII

ANALYTICAL CHEMISTRY – II

(SEPARATION TECHNIQUES) [75 Hours]

UNIT – I Basic Separation Technique – I (15 Hours)

General aspects of separation techniques – Role of separation technique in analysis, Classification choice of separation method distribution processes, discrete and continuous equilibria, distribution behaviour and chemical structure, errors resulting from separation process.

Fractionation by evaporation – Distillation and sublimation – Basic Principles of distillation, theory of fractional distillation operation variables and their effect, relative volatility, reflux ratio, theoretical plates and HEDP, Batch and continuous process, Columns – types and choice, applications, Molecular distillation – theory, setup and applications, Sublimation – apparatus and applications.

Extraction – Distribution law and derivation, solvents and their choice, tenchniques – batch and continuous, multiple extraction, column and their choice, extraction of solids and their applications.

UNIT – II Basic Separation Technique – II (15 Hours)

Complexation – scope of complexation in separation processes, complexing agents and their choice, methods and scope of masking and demasking, synergism.

Precipitation and crystallization – Theory and mechanism of fractional precipitation and crystallization, Variables and control of variables, type of precipitation, organic precipitation and their application.

Dialysis – Theory, membranes and their choice, techniques and applications.

Diffusion – Barrier and thermal process, theory, techniques and application.

Floatation – Theory, cell and their operation, collectors, ion – floatation, applications.

Ultra centrifuge – Development, Description of apparatus, sedimentation velocity, molecular weight determination.

UNIT – III Chromatographic Techniques (15 Hours)

Chromatograpic Methods – General aspects of chromatography, classification, mechanism – adsorption, partition, ion-exchange, ion – association, gel permeation and molecular sieving.

Column chromatography – Construction and operation of column, choice of adsorbents and eluents, techniques of elution, methods of detection, analytical and industrial applications.

Paper chromatography – Construction and operation of column, choice of separation, types of papers and their choice, different techniques, qualitative measurements, source of errors in analytical and industrial applications.

Thin Layer chromatography – Techniques and applications, Modified stationary phases.

Ring oven Technique – Principle and application

Ion – exchange chromatography – Techniques and applications

UNIT – IV Gas Chromatography (15 Hours)

Gas chromatography – Types and nature of stationary and mobile phase, solid supports and their choice, columns – packed, open and capillary, sampling methods instrumentation, detectors – types sensitivity, limits of detection operative principles of TCD, FID and ECD, Comparison of detectors temperature programming, derivative chromatography, hyphenated techniques with GSGC qualitative and quantitative applications.

UNIT – V Gel Permeation Chromatography and HPLC (15 Hours)

Gel permeation chromatography – Instrumentation, heterogeneity factor, determination of molecular weights - weight average and number average, analytical and industrial applications.

Liquid chromatography – High pressure liquid chromatography. Theory and equipment, type of pumps and their choice, types of columns, large scale separation, application in analytical chemistry and in industry.

New development in chromatography – Plasma chromatography, super critical fluid chromatography.

Text Books

1. Willard, Merit Dean and Settle**, Instrumental Methods of Analysis**, CBS Publishers and Distributors, IV Edn, 1986.
2. D.A. Skoog, **Principles of Instrumental Analysis**, Saunders College Pub. Co, III Edn., 1985.

3. A.I. Vogel, **Text Book of Quantitative Inorganic Analysis**, ELBS III and IV Edn.
4. D.A. Skoog and D.M. West, **Fundamentals of Analytical Chemistry,** Holt Rinehart and Winston Publications, IV Edn, 1982.
5. H. Kaur, **An Introduction to Chromatography**, Pragati Publishers, 2006.

Reference Books

1. Frank A. Settle, (Ed.) **Handbook of Instrumental techniques for analytical chemistry**, Pearson Education, 1997.
2. J.G. Dick, **Analytical Chemistry**, McGraw Hill Publishers, 1974.
3. G.W. Ewing, **Instrumental Methods of Chemical Analysis**, McGraw Hill Pub, 1975.
4. J.S. Fritz, D.T. Gjerde and C. Phlandt, **Ion Chromatography**, Huthing, Heidelberg, 1982.
5. R. Paterson, **An Introduction to Ion Exchange**, Heydon – Sadtler, London, 1970.
6. J.H. Knox (Ed), **High Performance Liquid Chromatography**, Edinburgh University Press, Edinburgh, 1982.

Core Paper - VIII

ANALYTICAL CHEMISTRY – III

(SPECTRAL ANALYSIS - I)

[75 Hours]

UNIT – I Absorption Spectroscopy (15 Hours)

Absorption spectrometry – Beer Lambert's law, filter photometry, spectrophotometry – UV visible, photometric titrations, reaction rates, complex studies, Fluorometry, turbidimetry and nephelometry.

Flame Photometry – Theory, instrumentation and a few important applications.

Atomic absorption spectroscopy – Theory, instrumentation and applications. Atomic fluorescence, flameless atomization.

UNIT – II Microwave and Infra Red Spectroscopy (15 Hours)

Microwave spectroscopy – Theory, instrumentation – source, monochromators, detectors, sample handling, qualitative analysis and quantitative applications.

Infra – red spectroscopy – Theory, instrumentation – source of monochromators, detectors, dispersive and non dispersive instruments, sample handling techniques, internal reflection spectroscopy, qualitative analysis and quantitative applications.

UNIT – III Raman Spectroscopy (15 Hours)

Raman spectroscopy – Theory, Instrumentation – source of radical detectors, application of Raman spectra to inorganic, organic and biological species, quantitative applications, Resonance Raman spectroscopy.

UNIT – IV ^{1}H NMR (15 Hours)

Nuclear Magnetic Resonance Spectroscopy – Theory, spin – spin relaxation, spin – lattice relaxation and saturation processes. Environmental effects, instrumentation – type of magnets, source, detector, sample handling, application of photon NMR, qualitative and quantitative analysis. FT- NMR, Lanthanide compounds as shift reagents.

UNIT – V ^{13}C NMR (15 Hours)

^{13}C NMR spectroscopy – Comparison of ^{1}H and ^{13}C NMR, factors affecting intensity of signals, chemical shifts, Factors affecting the chemical shift. Broadband and off resonance decoupling MRI spectra. Hetero nuclear NMR basic (ideas). Applications of ^{13}C NMR in qualitative and quantitative analysis.

Text Books

1. A.I. Vogel, **Text Book of Quantitative Inorganic Analysis**, ELBS III and IV Edn.
2. William Kemp, **Organic Spectroscopy**, ELBS, II Edition, Spectroscopy of organic compounds.
3. P.S. Kalsi, **Organic Spectroscopy**, Wiley Eastern Ltd., Madras.
4. C.F. Banwell, **Fundamentals of Molecular Spectroscopy**, McGraw Hill, New York, 1966.

Reference Books

1. J. Dyer, **Application of absorption spectroscopy of organic compounds**, Prentice Hall of India Pvt. Ltd., New Delhi.
2. R.M. Silverstein, C.G. Bassler and Monsil, **Spectrometric identification of organic compounds**, John Wiley & Sons, New York.

3. G.M. Barrow, **Introduction to Molecular Spectroscopy**, McGrawHill, New York, 1962.
4. W. Kemp, **NMR in Chemistry**, MacMillan Ltd, 1986.
5. G.W. King, **Spectroscopy and Molecular Structure**, Holt, Rienehart and Winston, 1964.
6. Raymond chung **Basic Principles of Spectroscopy**, McGraw Hill Ltd, New York.
7. Willard, Merit Dean and Settle, **Instrumental Methods of Analysis**, CBS Publishers and Distributors, IV Edn. 1986.
8. D.A. Skoog, **Principles of Instrumental Analysis**, Saunders College Pub. Co, III Edn, 1985.
9. A.I. Vogel, **Text Book of Quantitative Inorganic Analysis**, ELBS III & IV Edn.
10. D.N. Sathyanarayana, **Spectroscopy**, New Age Publishers.

Elective Paper - III
OPTICAL METHODS AND THERMAL ANALYSIS
[90 Hours]

UNIT – I Thermal and Magnetic Methods of Analysis (18 Hours)

DTA / DSC – Principle and instrumentation, Different techniques. Application to organic and inorganic compounds.

TGA – Principle, instrumentation of TGA curves, Application to organic and inorganic compounds.

Magneto chemical Analysis – Magnetic susceptibility and its measurements, Guoy's, Quink's, Curie's and Ranking's balances. Application to simple compounds, ranking's transition metal complexes, Lanthanides and Actinides.

UNIT – II Electron Spectroscopy (18 Hours)

Introduction, ESCA, X- ray photoelectron and electron impact spectroscopy – instrumentation, sample preparation and application.

X – ray Theory of generation, secondary fluorescence and X- ray spectroscopy, instrumentation and application to analysis of alloys, minerals and antiques.

Comparison with optical spectroscopy, X- ray absorption – theory and measurements, microradiology and its application to the analysis of alloys.

Auger electron spectroscopy – Theory, instrumentation and general applications.

UNIT – III Optical and Reasonance Techniques (18 Hours)

Emission Techniques – Theory, techniques of excitation, electrodes and their shapes, flame emission and plasma emission spectrometry – instrumentation and applications.

Ion cyclotron resonance – Introduction, theory and techniques – analytical applications – analysis of gases and neutral compounds.

ORD and CD – Cotton effect – axial haloketone rule and Octant rule – conformation and configuration determination.

UNIT – IV Microscopy (18 Hours)

Chemical microscopy – Microscope – Parts and optical path: Numerical aperture and significance. Techniques – Kofler's hot stage microscope, fluorescence, polarizing, interference and phase microscopy, application and qualitative and quantitative study.

Electron microscopy – Principle, Microscope and its operation, sample preparation, replicas, shadowing, application to analysis, electron probe analyzer, ion microscope metallography – metallurgy, microscopic examination, specimen preparation and examination, interpretation of micrographs.

UNIT – V Polarimetry & Refractometry (18 Hours)

Polarimetry – Theory and instrumentation, specific and molecular rotations, applications, spectropolarimetry.

Refractometry – Theory, instrumentation, specific and molecular refraction, Abbe, Pulfrich and immersiton types, applications.

Light scattering – Theory of inter and intraparticular interferences, description of a simple scatterometer, determination of molecular weights.

Text Books

1. H.A. Stobel Addison, **Chemical Instrumentation**, Wesley Pub. Co. 1976. Chapman & Hall, 1986.
2. D. Kealey, Blackie**, Experiments in Modern Analytical Chemistry**, Chapman & Hall, 1986.

3. Willard, Merit Dean and Settle, **Instrumental Methods of Analysis**, CBS Publishers and Distributors, IV Edn. 1986.
4. D.A. Skoog, **Principles of Instrumental Analysis**, Saunders College Pub. Co, III Edn, 1985.

Reference Books

1. J.G. Dick, **Analytical Chemistry**, McGraw Hill Publishers, 1974.
2. G.W. Ewing, **Instrumental Methods of Chemical Analysis**, McGraw Hill Pub, 1975.
3. R.C. Mackeniz, **Differential Thermal Analysis**, Acad Press, 1970.
4. E.M. Chamot & C.W. Mason, **Hand Book of Chemical Microscopy**, John Wiley Vol I and II, 1944.
5. R. Drago, **Physical methods in Inorganic chemistry**, Reinhold, NY, 1968.
6. G.W. King, Holt, **Spectroscopy and Molecular Structure**, Rienehart and Winston 1964.
7. C.N.R. Rao, **Spectroscopy in inorganic chemistry**, Methven Co., London 1968.

SECOND YEAR
Semester IV

Code No.	Course	Subject	Work load per Semester (hours)
	Core Paper – IX	Analytical Chemistry IV	90
	Elective Paper – IV	Analysis of Materials	90
	Core Practical – IV	Analytical Chemistry Practical I	60
	Core Practical – V	Analytical Chemistry Practical II	60
	Core Practical – VI	Analytical Chemistry Practical III	60
	Project	Dissertation / Project work in Analytical Chemistry	90

SECOND YEAR
Semester IV

Semester	Code	Course	Course Title	Hrs.	Credit	Marks		
						CIA	EA	Total
IV		Core Paper – IX	Analytical Chemistry IV	6	6	25	75	100
		Elective Paper – IV	Analysis of Materials	6	4	25	75	100
		Core Practical – IV	Analytical Chemistry Practical I	4	4	40	60	100
		Core Practical – V	Analytical Chemistry Practical II	4	4	40	60	100
		Core Practical – VI	Analytical Chemistry practical III	4	4	40	60	100
		Project	Dissertation / Project work in Analytical Chemistry	6	5			200

Core Paper - IX

ANALYTICAL CHEMISTRY – IV

(SPECTRAL ANALYSIS – II)

[90 Hours]

UNIT – I Mass Spectra (18 Hours)

Principles of mass spectrometry – resolution – description of single focusing and double focusing electron impact mass spectrometers, ion – cyclotron resonance analyzer and Fourier transform mass spectrometers.

Presentation and analysis of spectra. Determination of molecular formulae. Nitrogen rule. Isotope abundance analysis of metastable ions and peaks – the molecular ion peak.

Fragmentation processes. Symbolism (scission only) even and odd electron ions. Scission with rearrangement. Retro – Diels Alder rearrangement. McLafferty rearrangement.

Fragmentation associated with functional group – aliphatic compounds – aldehydes and ketones, carboxylic acids, esters, amides, alcohols, thiols, amines, ethers, suphides and halides.

Aromatic compounds (eliminations due to ortho groups) solving problems.

UNIT – II Electron Spin Resonance Spectroscopy (18 Hours)

ESR : Line shapes and line width. The 'g' values – shift in g values. Factors affecting the magnitudes of g and A tensors in metal species – zero field splitting and Kramer's degeneracy – spectra of V(II), Mn(II), Be(II), Co(II), Ni(II) and Cu(II) complexes – applications of EPR to a few biological molecules containing Cu(II), Fe(II) and Fe(III) – John-Teller distortions in Cu (II) complexes.

UNIT – III Organic Spectra : UV – VIS, and IR Spectra (18 Hours)

UV – VIS : Woodward – Fieser rules for dienes, enones. Calculation of λmax for organic molecules. Chromophores and effect of conjugation, substituents with unshared electrons and their capability of π - conjugation. Colour in compounds.

IR : characteristic group frequencies of organic molecule, Factors influencing vibrational frequencies, interpretation of IR spectra of organic molecules.

UNIT – IV Organic Applications (18 Hours)

Application of UV, VIS, IR, NMR and MS spectral data for the structural elucidation of organic molecules. Problems involving the above spectral data to be worked out in detail.

UNIT – V Mossbauer and NQR Spectroscopy (18 Hours)

Principle – Doppler effect – isomer shift – electron – neutron hyperfine interactions, Quadrupole interactions and magnetic interactions, simple applications to Iron and Tin compounds.

NQR spectroscopy: Theory of NQR – instrumentation – nuclear quadrupole coupling constants – applications of NQR spectra to simple inorganic molecules.

Text Books

1. J. Dyer, **Application of absorption spectroscopy of organic compounds,** Prentice Hall of India Pvt. Ltd., New Delhi.
2. R.M. Silverstein, C.G. Bassler and Monsil, **Spectrometric identification of organic compounds**, John Wiley & Sons, New York.
3. William Kemp, **Organic Spectroscopy**, ELBS, II Edition, Spectroscopy of organic compounds, P.S. Kalsi, Wiley Eastern Ltd, Madras.
4. C.F. Banwell, **Fundamentals of Molecular Spectroscopy**, McGraw Hill, New York, 1966.

5. R.S. Drago, **Physical methods in Inorganic chemistry**, Reinhold, NY, 1968.
6. Willard, **Instrumental Methods of Analysis**, Merit Dean and Settle CBS Publishers and Distributors, IV Edn. 1989.

Reference Books

1. G.M. Barrow, **Introduction to Molecular Spectroscopy**, McGrawHill, NewYork, 1962.
2. W. Kemp, **NMR in Chemistry**, MacMillan Ltd, 1986.
3. G.W. King, **Spectroscopy and Molecular Structure**, Holt, Rienehart and Winston, 1964.
4. C.N. R. Rao, J.R. Ferraro, **Spectroscopy in Inorganic Chemistry**, Methven Co, London. 1968.
5. Raymond chang, **Basic Principles of Spectroscopy**, McGraw Hill Ltd, New York.
6. A. Carrigton and A.D. McLachlan, **Introduction to Magnetic Resonance**, Harper and Row, New York, 1967.

Elective Paper - IV

ANALYSIS OF MATERIALS

[90 Hours]

UNIT – I Sampling (18 Hours)

Preparing the sample for analysis: The effect of sampling uncertainities, gross sample, determination of the size of the sample, analytical sample.

Sampling of solids – Preparation of laboratory sample from gross sample, moisture in the sample, sampling of gases and liquids.

Decomposition and dissolving the sample – Decomposition of sample by fluxes, wet digestion, dry ashing, combustion with oxygen, microwave decomposition.

UNIT – II Biological Sample (18 Hours)

Composition of blood – collection and presentation of samples. Clinical analysis – Serum electrolytes, blood glucose, blood urea, nitrogen, uric acid, albumin, globulins, barbiturates, acid and alkaline phosphatases.

Drug analysis – Narcotics and dangerous drugs. Classification of drugs – screening by gas and thin layer chromatography and spectrophotometric measurements.

UNIT – III Fertilizers, Pesticides, Soil and Water (18 Hours)

Fertilizer analysis : Analysis of nitrogen and mixed fertilizers.

Pesticides – Analysis of organophosphorous pesticides and their degradation products.

Soil moisture, pH, total nitrogen, phosphorous, silica, sulphur, manganese and other metals in soil.

Water and sewage analysis.

UNIT – IV Industrial Samples (18 Hours)

Fuel and Gaseous fuels – sampling procedure, ultimate and proximate analysis, specific volatile index, ash content, calorific value by bomb calorimeter, and junker's calorimeter.

Liquid fuels – Flash point, viscosity, carbon residue, aniline point, pour point etc.,

Gaseous fuels – Analysis of producer gas, water gas and industrial gases. Chemical and physical methods of analysis.

Ore and cement analysis – Oxides, sulphides and carbonate ores, one/examples of each cement, silicate and glass.

UNIT – V Food and Food Additives (18 Hours)

Food analysis – Moisture, ash, crude, protein, fat crude, fibre, carbohydrates calcium, potassium, sodium and phosphate. Food adulteration, common adulterants in food, contamination of foodstuffs. Microscopic examination of foods for adulterants.

Chemical and instrumental analysis of food additives – Preservatives, Food colorants, antioxidants, sweeteners, stabilizers, thickeners, clarifying and bleaching agents.

Text Books:

1. I.G. Harge, **Analytical Chemistry Principles and Techniques**, Prentice Hall.
2. G.D. Christan, **Analytical Chemistry**, J. Willey,
3. A.I. Vogel, **Text Book of Quantitative Inorganic Analysis**, ELBS III and IV Edn.
4. Alka L. Gupta, **Analytical Chemistry**, Pragati Edn., 2006.
5. H. Kaur, **Instrumental Methods and Chemical Analysis**, Pragati Edn., 2006.

Reference Books:

1. J.H. Kennedy, **Analytical Chemistry Principles and Techniques**, W.B. Saunders.
2. D.A. Skoog, **Principles of Instrumental Analysis**, Saunders College Pub. Co, III Edn., 1985.

3. G.W. Ewing, **Instrumental Methods of Chemical Analysis**, McGraw Hill Pub. 1975.

Core Practical - IV

ANALYTICAL CHEMISTRY PRACTICALS – I

(CONDUCTOMETRIC EXPERIMENTS)

1. Determination of equivalent conductance of a weak acid at different concentrations and verify Ostwald's dilution law and calculation of the dissociation constant of the acid.
2. Determination of equivalent conductivity of a strong electrolyte at different concentrations and examine the validity of the Onsager's theory as limiting law at high dilutions.
3. Conductometric titrations of a mixture of HCl and CH_3COOH against Sodium hydroxide.
4. Compare the relative strength of acetic acid and monochloroacetic acid by conductivity method.
5. Determination of the activity coefficient of an electrolyte at different molalities by emf measurements.
6. Determination of the dissociation constant of acetic acid by titrating it with sodium hydroxide using quinhydrone as an indicator electrode and calomel as a reference electrode.
7. Determination of the strength of a given solution of KCl using differential potentiometric titration technique.
8. Determination of the P^H of the given solutions with the help of the indicators using buffer solutions and by colorimetric method.
9. Determination of the P^H of a given solution by emf method using hydrogen electrode and quinhydrone electrode.
10. Determination of the formation constant of silver ammonia complex and stoichiometry of the complex potentiometrically.
11. Solubility and solubility products by emf method.
12. Determination of the activity coefficient of Zinc ions in the solution of 0.002M Zinc sulphate using Debye - Huckel Limiting law.

13. Determination of solubility product of Silver bromide and calculate its solubility in water and 0.1 M and 0.01 M $KBrO_3$ using Debye- Huckel limiting law.
14. Determination of the electrode potentials of Zn and Ag electrodes in 0.1 M and 0.001M solutions at 298 K and find the standard potentials for these electrodes and test the validity of Nernst equations.
15. Determination of Hardness of water by titrimetric method.
16. Determination of COD and BOD.
17. Determination of $p^H - p^{k_1}$ and p^{k_2} of dibasic acids (Oxalic acid)
18. Determination of $E_{½}$ potentials of metal ions by polarography.

Distribution of Marks

Experiment	45 Marks
Viva voice in practical	10 Marks
Record	5 Marks
Total	**60 Marks**

Core Practical - V

ANALYTICAL CHEMISTRY PRACTICALS – II

I. Organic Estimation

Estimation of the following organic compounds:

1. Phenol
2. Aniline
3. Methyl Ketone
4. Glucose
5. Iodine value of an oil
6. Saponification value of an oil

II Extraction of Natural Products:

1. Caffeine from tea leaves.
2. Citric acid from lemon.

III Chromatographic Separations

1. Column chromatography : separation of a mixture of ortho and para-Nitroanilines.

2. Thin layer – Chromatography: separation of a mixture of ortho and para – Nitroanilines.
3. Paper chromatography – identification of natural alpha amino acids.

IV Quantitative analysis of complex materials

A) Quantitative analysis:

Quantitative analysis of the following mixture

1. Iron and magnesium
2. Iron and nickel
3. Copper and nickel
4. Copper and Zinc

B) Analysis of 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.

C) Analysis of Alloys

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

References:

1. G. Svehla, **Vogel's Practical organic chemistry**, ELBS, IV Edition 1985.
2. **Vogels's Qualitative Inorganic analysis**, VI Edition, orient Longmax (1987).
3. J. Basset, R.C. Denney, G.H. Jeffery and J. Mendham, **Vogel's Text book of quantitative inorganic Analysis**, ELBS, IV Edition. 1985.
4. W.G. Palmer, **Experimental Inorganic Chemistry**, Van Nostrand Reinhold Co., London. 1972.
5. D.N. Grindley, **An advanced course in practical Inorganic Chemistry,** Butterworths 1964.
6. J.N. Gurtu & Gurtu, **Advanced Physical chemistry experiments**, Pragati Publishers, 2006.

Distribution of Marks

Organic Estimation 20 Marks

Inorganic Estimation 25 Marks

Viva voice in practical 10 Marks

Record 5 Marks

Total 60 Marks

Core Practical - VI

ANALYTICAL CHEMISTRY PRACTICALS – III

I. Chromatographic Techniques

1. Column chromatography – Separation of chlorophyll
2. Thin layer chromatography – Separation of cation and anions, dyes in ink.
3. Paper chromatography – Separation of cations
4. Ion-exchange chromatography – Separation of Zn and Mg Separation of Cd and Zn.
5. Ring – oven Technique – Separation of cations and inorganic complex.

II. Flame Photometry

1. Determination of sodium, potassium and calcium.
2. Determination of potassium in combined fertilizer.
3. Determination of calcium in wine.

III. Nephelometry

1. Determination of sulphate.
2. Determination of halides

IV. Biamperometry & Bipotentiometry

1. Iodine – hypo titration
2. Fe(II) vs. Ce (IV) titration
3. Estimation of nitrite
4. Determination of copper.

V Polarimetry

1. Study the inversion of cane sugar in presence of acid.

VI. Spectrophotometry

1. Determination of Iron/Cobalt.
2. Determination of dissociation constant of an indicator
3. Determination of binary mixture
4. Determination of Mn in steel.

Distribution of Marks

Experiment	45 Marks
Viva voice in practical	10 Marks
Record	5 Marks
Total	**60 Marks**

Model Question Paper
(For the candidate admitted from 2012 – 2013 onwards)
M.Sc. Degree – Branch – IV C Analytical Chemistry
Third Semester
Core Paper - VI
ANALYTICAL CHEMISTRY - I

Time : Three Hours **Maximum : 75 Marks**

PART – A (5 X 5 = 25 Marks)

Answer all the questions

1. a) Write about the general concept and basis of conductometric titrations.

Or

b) Explain the theory of Dielectrometry

2. a) Write about Standard and formal potentials.

Or

b) What are different types of electrodes ? Write the working of any two electrodes.

3. a) Explain theory of Polarography

Or

b) Write about qualitative applications of polarography to organic and Inorganic systems.

4. a) Write about the Technique of amperometric titrations with the dropping mercury electrode.

Or

b) Explain the titration with the rotating platinum micro electrode.

5. a) What is coulogravimetry? Give its applications.

Or

b) Write about coulometric Titrations.

PART – B (5 X 10 = 50 Marks)

Answer all the questions

6. a) i) Write in detail about Oscillometry

ii) What are the applications of direct conductometric measurements

Or

b) i) Explain the determination of non-ionic species in process control and zone detector

ii) What are the applications of dielectrometry?

7. a) Write in detail about Bipotentiometry

Or

b) Explain i) Direct potentiometry

ii) Acid – base titrations in non – aqueous systems

8. a) Write about i) DME ii) Diffusion and Kinetic currents.

Or

b) Write note on i) Derivative Polarography

ii) AC Polarography

9. a) i) Explain amperometric titrations using single polarized electrode

ii) Write important applications of amperometric titrations

Or

b) Write in detail about biamperometry

10. a) Write note on i) Auto electro gravimetry

ii) Instrumentation and applications of electrography

Or

b) Explain in detail i) Polarisation curves

ii) Constant current deposition

iii) Faraday's Laws

Model Question Paper
(For the candidate admitted from 2012 – 2013 onwards)
M.Sc. Degree – Branch – IV C Analytical Chemistry
Third Semester
Core Paper - VII
ANALYTICAL CHEMISTRY - II
(Separation Techniques)

Time : Three Hours **Maximum : 75 Marks**

PART – A (5 X 5 = 25 Marks)

Answer all the questions

1. a) Explain Role of separation techniques in analysis

Or

b) Write about the importance of solvents in extraction Techniques.

2. a) Write about complexation in separation process.

Or

b) Explain the mechanism of fractional precipitation and crystallization

3. a) Write about the principles of i) adsorption chromatography ii) ion – exchange chromatography

Or

b) Write about the importance of solvents in chromatographic Techniques.

4. a) Explain types and nature of stationary and mobile phase and sampling methods

Or

b) Write about Instrumentation of gas chromatography

5. a) What is gel permeation chromatography? Explain heterogeneity factor

Or

b) Write note on Super critical fluid Chromatography

PART – B (5 X 10 = 50 Marks)
Answer all the questions

6. a) i) Derive distribution law

ii) Write about techniques in multiple extraction

Or

b) Write note on i) Theory of fractional distillation

ii) Applications of Molecular distillation

7. a) Write in detail about Theory and mechanism of fractional precipitation and crystallisation

Or

b) Write note on i) Dialysis

ii) Diffusion

iii) Centrifuge

8. a) Write in detail about paper chromatography and analytical and industrial applications.

Or

b) Thin Layer chromatography and its applications.

9. a) Write note on i) TCD ii) FID iii) ECD

Or

b) Instrumentation and applications of GSGC

10. a) Write in detail about HPLC and its applications.

Or

b) Write a note on New development in chromatography

Model Question Paper
(For the candidate admitted from 2012 – 2013 onwards)
M.Sc. Degree – Branch – IV C Analytical Chemistry
Third Semester
Core Paper - VIII
ANALYTICAL CHEMISTRY - III
SPECTRAL ANALYSIS - I

Time : 3 Hours **Maximum : 75 Marks**

PART – A (5 X 5 = 25 Marks)

Answer all the questions

1. a) State Lambert's and Beer's law and explain its importance.

Or

b) Write a note on photometric titrations

2. a) Explain the principle of infra-red spectroscopy

Or

b) Carbondioxide is microwave inactive while IR active – rationalise.

3. a) Describe the basic principles of Raman Spectroscopy.

Or

b) Explain the origin of stokes and antistokes lines in Raman Spectrum.

4. a) Explain the principle of NMR spectroscopy.

Or

b) Explain the instrumentation in NMR spectrum.

5. a) How does ^{13}C – nmr differ from ^{1}H-nmr? Explain the factors which influence chemical shift in NMR.

Or

b) Write notes on coupled and decoupled spectrum in ^{13}C NMR.

PART – B (5 X 10 = 50 Marks)

Answer all the questions

6. a) Give a comparative account of nephelometry and turbidimetry.

Or

b) Give block diagram of AAS and label the various parts. Give the merit and demerits of AAS.

7. a) i) Explain the instrumentation in IR spectroscopy. (5)

ii) Explain the principle of microwave spectroscopy (5)

Or

b) Give the applications of IR spectroscopy in qualitative and quantitative analysis

8. a) i) Compare Raman Spectroscopy with infra red spectroscopy (5)

ii) Explain Resonance Raman Spectroscopy. (5)

Or

b) Write notes on the application of Raman spectra to inorganic, organic and biological species.

9. a) i) Give the applications of ^{1}H – nmr

ii) Give an account of "Lanthanide shift reagent" used in NMR spectroscopy.

Or

b) What are the basic principles and advantages of FT- NMR ?

10. a) i) The separation between the two absorption lines for the chemical shift scale is independent of the applied magnetic field. Justify this statement. (5)

ii) Write notes on off resonance coupling. (5)

Or

b) Give the applications of ^{13}C – nmr in qualitative and quantitative analysis.

Model Question Paper
(For the candidate admitted from 2012 – 2013 onwards)
M.Sc. Degree – Branch – IV C Analytical Chemistry
Third Semester
Elective Paper - III
OPTICAL METHODS AND THERMAL ANALYSIS

Time : 3 Hours **Maximum : 75 Marks**

PART – A (5 X 5 = 25 Marks)
Answer all the questions

1. a) Explain the principle of DSC analysis ? How is it different from DTA?

Or

b) Explain the magnetic behaviour of actinides

2. a) List out some application of ESCA ?

Or

b) Explain the principle of Auger electron spectroscopy

3. a) How do you prepare the electrodes for the emission spectroscopy?

Or

b) What is octant rule? Explain it.

4. a) Explain the Electron probe analyser?

Or

b) Write notes on Kofler's hot stage microscope.

5. a) What is specific rotation ? List out the factors affecting the angle of rotation

Or

b) Discuss the theory of inter and intraparticular interferences.

PART – B (5 X 10 = 50 Marks)

Answer all the questions

6. a) i) Give the principle of TGA and DTA? Discuss the DTA and TGA curve of calcium oxalate monohydrate

ii) List out the information obtained from a DTA curve

Or

b) Explain the Curie's balance of measuring the magnetic susceptibility? Calculate the spin – only magnetic moment of the following complexes $[Fe(CN)_6]^{3-}$, $[Co(H_2O)_6]^{2+}$ and $[Co(NO_2)_6]^{3-}$

7. a) Discuss the instrumentation of XPES and the principle of electron impact spectroscopy

Or

b) Discuss the instrumentation of X-ray spectroscopy and list out its few applications.

8. a) Discuss the principle of Ion cyclotron resonance and discuss its applications.

Or

b) Give the importance of ORD and CD in conformation and configuration determination? What is cotton effect?

9. a) How do you prepare the sample for electron microscopy and how do you interpret the micrograph.

Or

b) Discuss the significance of Numerical aperture? Give the importance of interference and phase microscopy

10. a) What is molecular refraction? Discuss the application of Refractometry and Abbe type of Refractometer.

Or

b) Discuss the principle of spectropolarimetry? How do you determine the molecular weight using scatterometer.

Model Question Paper
(For the candidate admitted from 2012 – 2013 onwards)
M.Sc. Degree – Branch – IV C Analytical Chemistry
Fourth Semester
Core Paper - IX
ANALYTICAL CHEMISTRY - IV
SPECTRAL ANALYSIS - II

Time : Three Hours **Maximum : 75 Marks**

PART – A (5 X 5 = 25 Marks)
Answer all the questions

1. a) Mention the basic sections of a mass spectrometer. What is the function of each of these sections?

Or

b) Illustrate how mass spectra can be interpreted in arriving molecular weight and molecular formula of compounds

2. a) Write about esr spectra of V(II), Co (II) and Cu(II) complexes.

Or

b) Write applications of EPR to biological molecules containing Fe(II), Cu (II) and Fe(III).

3. a) How is λ_{max} calculated for organic molecules?

Or

b) Explain the term chromophore giving few examples.

4. a) The mass spectrum of methanol is represented as m/e (RA) = 32, 31, 17 and 15. What is the molecular ion for this compound? What are the possible structures for the ion located at m/e : 31. ? **Or**

b) i) Sketch the NMR spectrum of ethanol and account for the peaks in it.

ii) Which of the following nuclei show nuclear magnetic resonance. ^{12}C, ^{13}C, ^{14}N, ^{15}N, ^{16}O.

5. a) Write about the theory and instrumentation of NQR spectroscopy

Or

b) Discuss applications of NQR spectra

PART – B (5 X 10 = 50 Marks)

Answer all the questions

6. a) Illustrate i) Retro – Diels Alder rearrangement ii) McLafferty rearrangement

Or

b) Write in detail about fragmentation associated with the following functional groups i) aliphatic aldehydes and ketones ii)esters iii) thiols iv) amides

7. a) What is 'g' value and shift in 'g' values in ESR spectra?

Or

b) Write about zerofield splitting and Kramer's degeneracy.

8. a) i) Discuss characteristic group frequencies of organic molecules

ii) Write about Woodward – Fieser rules for dienes and enones.

Or

b) Write in detail about interpretation of IR spectra of organic molecules.

9. a) Write about the applications of IR and uv spectral data for structural elucidation of organic molecules

Or

b) Three compounds of molecular formula C_4H_8O have the following ^{13}C spectra, and the described features in their IR spectra

Compound 1: IR : 1730 cm^{-1}

^{13}C NMR : 13.3, 15.7, 45.7, 201.6 ppm

Compound 2 : IR : 3200 (broad) cm^{-1}

^{13}C NMR : 36.9, 61.3, 117.2, 134. 7 ppm

Compound 3: IR : no peaks except CH and fingerprint,

^{13}C NMR: 25.8 and 67.9 ppm

Suggest a structure for each compound, and then see whether your suggestions are compatible with the following information. Compound 1 reacts with $NaBH_4$ to give compound 4 $C_4H_{10}O$, IR 3200 (broad) cm^{-1} and ^{13}C NMR 15.2, 20.3, 36.0, and 62.9 ppm. Compound 2 reacts with hydrogen over a palladium catalyst to give the same product 4, while compound 3 reacts with neither reagent.

10. a) Explain i) Doppler effect ii) Quadrupole interaction

Or

b) Applications of Mossbauer spectroscopy to Iron and Tin compounds

Model Question Paper
(For the candidate admitted from 2012 – 2013 onwards)
M.Sc. Degree – Branch – IV (C) Analytical Chemistry
Fourth Semester
Elective Paper - IV
ANALYTICAL CHEMISTRY
ANALYSIS OF MATERIALS

Time : Three Hours **Maximum : 75 Marks**

PART – A (5 X 5 = 25 Marks)
Answer all the questions

1. a) Explain the effect of sampling uncertainities

Or

b) Explain how the size of the sample is determined.

2. a) Write about the composition of the blood.

Or

b) Write about the estimation of blood glucose through clinical analysis. Explain its significance.

3. a) Write short note on fertilizers.

Or

b) Briefly explain the test of soil pH, soil moisture and other minerals.

4. a) What are fuels? Explain different types of fuels with suitable examples.

Or

b) Explain how calorific value is determined by bomb calorimeter.

5. a) Write about the importance of carbohydrates, proteins, calcium and others minerals in food analysis.

Or

b) What are preservatives. How is it used in food preservation.

PART – B (5 X 10 = 50 Marks)

Answer all the questions

6. a) i) How laboratory samples are prepared from gross sample

ii) Write an account of sampling of gases and liquids.

Or

b) Explain different methods used in decomposition of sample by

i) fluxes ii) Wet digestion iii) Dry ashing

7. a) Through clinical analysis, how the following are analysed

i) Serum electrolyes.

ii) Blood glucose

iii) albumin

iv) globulins

Or

b) Explain the classification of durgs. How drugs are screened by gas and thin layer chromatography measurements

8. a) Explain the analysis of organophosphorous pesticides and their degradation products.

Or

b) Explain the methods of water and sewage analysis

9. a) Explain how producer gas and water gases are analysed by chemical and physical methods.

Or

b) Explain the preparation, properties and give one example for each of the following

i) Cement

ii) Silicate

iii) glass

10. a) Write notes on food adulteration. Explain microscopic examination of foods for adulterants

Or

b) Explain how thickeners, Clarifying and bleaching agents are used as food additives.

M. Sc. DEGREE
Branch IV (C) ANALYTICAL CHEMISTRY
REGULATIONS AND SYLLABUS
(For the Candidates admitted from the academic year 2012 – 2013 and onwards)

Course of Study

FIRST YEAR

Semester I

Code No.	Course	Subject	Work load per Semester (hours)
	Core Paper – I	Organic Chemistry I	75
	Core Paper – II	Inorganic Chemistry I	75
	Core Paper – III	Physical Chemistry I	75
	Elective Paper – I	Data treatment and Titrimetric Analysis	90
	Core Practical – I	Organic Chemistry Practical I	45
	Core Practical – II	Inorganic Chemistry Practical I	45
	Core Practical - III	Physical Chemistry Practical I	45

Semester	**Code**	**Course**	**Course Title**	**Hrs.**	**Credit**	**Marks**		
						CIA	**EA**	**Total**
I		Core Paper – I	Organic Chemistry I	5	4	25	75	100
		Core Paper – II	Inorganic Chemistry I	5	4	25	75	100
		Core Paper – III	Physical Chemistry I	5	4	25	75	100
		Elective Paper – I	Data treatment and Titrimetric Analysis	6	4	25	75	100
		Core Practical – I	Organic Chemistry Practical I	3	-	-	-	-
		Core Practical – II	Inorganic Chemistry Practical I	3	-	-	-	-
		Core Practical - III	Physical Chemistry Practical I	3	-	-	-	-

FIRST YEAR
Semester II

Code No.	Course	Subject	Work load per Semester (hours)
	Core Paper – IV	Organic Chemistry II	75
	Core Paper – V	Physical Chemistry II	75
	Elective Paper – II	Co-ordination Chemistry	75
	Extra Disciplinary Course	Biological Chemistry	60
	Core Practical – I	Organic Chemistry Practical I	45
	Core Practical – II	Inorganic Chemistry Practical I	45
	Core Practical – III	Physical Chemistry Practical I	45
		Human Rights	30

FIRST YEAR
Semester II

Semester	**Code**	**Course**	**Course Title**	**Hrs.**	**Credit**	**Marks**		
						CIA	**EA**	**Total**
II		Core Paper – IV	Organic chemistry II	5	4	25	75	100
		Core Paper – V	Physical chemistry II	5	4	25	75	100
		Elective Paper – II	Co-ordination chemistry	5	4	25	75	100
		Extra Disciplinary course	Biological chemistry	4	4	25	75	100
		Core Practical – I	Organic chemistry practical I	3	4	40	60	100
		Core Practical – II	Inorganic chemistry practical I	3	4	40	60	100

		Core Practical - III	Physical chemistry practical I	3	4	40	60	100
			Human Rights	2	2			100