VEER NARMAD SOUTH GUJARAT UNIVERSITY
M.Sc.Part-I CHEMISTRY
TO COME IN FORCE FROM JUNE-2008
PAPER-IV (ANALYTICAL)

Max. Marks: 54 **Total Periods: 90**

SECTION-I

UNIT-I : QUANTITATIVE ANALYSIS: (15 Periods)

(1) Steps of Analysis and Computations:

Role of analytical chemistry, Classification of analytical methods. Classical and instrumental, Types of instrumental analysis, Selecting an analytical method. Neatness and cleanliness. Selecting and handling of reagents. Safety in analytical laboratory.

Steps of chemical analysis: Planning, sampling drying, preparation of solution, Removal of interference, Methods of computations, Calculations in titrimetry and gravimetry, calculations of direct and back titrations using molarity and normality (Numericals).

(2) Organic Analysis:

Micro and semi-micro determination of carbon, hydrogen, nitrogen using elemental analysers (any one), Use of Schoniger's flask combustion method for semi-micro determination of halogen and sulfur.

Determination of functional groups -

(i) Carbonyl group by oxime formation method
(ii) Polyhydric alcohols
(iii) Esters
(iv) Nitro groups
(v) Amino group
(vi) Azo group
(Numerical)

UNIT-II : ORGANIC REAGENTS AND NON-AQUEOUS TITRATIONS:

(15 Periods)

(1) Use of Organic Reagents in Analytical Chemistry:

Use of Acetyl acetone, Dithiozone, Neo-cuproin, 8-hydroxy quinoline, 1,10-phenanthroline, Dimethyl glyoxime in the spectrophoto-metric determination of metal ions and in selective extraction of metal ions.

(2) Non-Aqueous Titrations:

Levelling effect and differentiating ability of solvents, need for non-aqueous titrations, criteria to be considered in selecting solvents, Acidic and basic titrants and their standardisation, Indicating systems - Karl-Fischer titrations - Applications - Numericals.

UNIT-III : UV-VISIBLE SPECTROSCOPY: (15 Periods)

Interaction of radiation matter - Photometric accuracy - Simultaneous determinations of two components in a mixture - pK_{In} of indicator - Photometric titrations, Determination of metal to ligand ratio, analysis of drugs by UV-VIS spectrophotometry.

Review of components of UV-visible spectrophotometer - Source - Monochromator (prism and grating) - Sample handling detectors (photo-tube, PM tube and Diode array detectors) - Single beam and double beam instruments - Working of Spectronic-20 Backman DU-2 Spectrophotometer.

Fluorescence, Phosphorescence, Turbidimetry - Naphelometry principles and applications.

Quantitative analysis - Numericals.

SECTION-II

UNIT-IV : DC-POLAROGRAPHY: (15 Periods)

Current voltage curves - Residual current, Kinetic current, Diffusion current, Migration current - Electrocapillary maxima - Maxima suppressors - Interference of oxygen.

Derivation of equation of cathodic and anodic waves - Tests of reversibility.

Half wave potential - Its determination and importance.

Effect of complexation on half wave potential - Determination of stability constants of complexes polarographically - Derivation of necessary equation.

Advantages and limitations of DME - Polarography with 2 and 3 electrodes - Polarography of organic compounds and its importance.

Ilkovic equation and terms involved - Quantitative analysis - Numericals.

Applications of DC polarography and its limitations.

UNIT-V : (15 Periods)

(1) Analytical methods based on electrolysis:

Electrolysis - Electrogravimetry - Factors affecting the quality of deposits - Applications.

Principle of coulometry - Controlled potential coulometry - Coulometric titrations (primary and secondary) applications - Acid-base titrations, Determination of arsenite, Mercaptants, Phenol.

(2) Amperometric titrations:

Principle of titrations - Titrations using DME & RPE - Nature of curves for different types of titrations - Biamperometric titrations - Karl-Fischer titration end point. Chronopotentiometry: Principle, apparatus and cell, applications.

(3) Statistical treatment of data:

Student's t-confidence limit - Testing for significance - Comparison of two means, two precisions - Criteria for rejection of an observation - The Q test - The control chart - Methods of least square - Numerical.

UNIT-VI : SOLVENT EXTRACTIONS: (15 Periods)

Review of distribution law - Distribution coefficient - Distribution ratio - Equations for the solute dissociating or associating in one phase - Successive extractions.
Extraction of metal ion with chelating agent with necessary equation - Multiple extractions - Craig pseudo counter current extractions - Apparatus for Craig extractions - Continuous counter current extractions - Extraction involving association of ion pairs - Elementary idea of extraction with crown ethers - Cryptans, Numericals.

Reference Books:

1. "Quantitative Analysis" by Day & Underwood (Prentice Hall of India), 6^{th} edition.
2. "Analytical Chemistry" by Larry G. Hargis (Prentice-Hall International editions).
3. "Modern Methods of Analysis" by Packshok, Shields & Cains (Wiley International).
4. "Electroanalytical Chemistry" by Lingane.
5. "Vogel's text-book of Inorganic Quantitative Analysis" (5^{th} edition), Longmann.
6. "Quantitative Chemistry by Brown-Bailey" (Prentice-Hall).
7. "Fundamentals of Analytical Chemistry" by Skoog & West (Holt-Rinchard & Winston, Inc.).
8. "Instrumental Methods of Chemical Analysis" by Ewing (McGraw-Hill).
9. "Instrumental Methods of Analysis" by Willard, Merritt & Dean (Van Nostrand Reinhold Co.), 6^{th} edition.
10. "instrumental Methods of Analysis" by B. K. Sharma, Goel Publishing House, Meerut.
11. "Basic Concepts of Analytical Chemistry" (2^{nd} edition) by Prof. S. M. Khopkar, New Age International (P) Ltd., Mumbai.

VEER NARMAD SOUTH GUJARAT UNIVERSITY

M.Sc. PART-I

CHEMISTRY
TO COME IN FORCE FROM JUNE-2008
PAPER-IV (INORGANIC)

Max. Marks: 54 **Total Periods: 90**

SECTION-I

UNIT-I : UNIFYING PRINCIPLES AND MICROWAVE SPECTROSCOPY: **(15 Periods)**

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

Classification of molecules, rigid rotor model effect of isotropic substitution on the transition frequencies, intensities, non-rigid rotor. Stark effect, nuclear and electron spin interaction and effect of external field. Applications.

UNIT-II : VIBRATIONAL SPECTROSCOPY: **(15 Periods)**

(a) Infrared Spectroscopy:

Review of linear harmonic oscillator, vibrational energies of diatomic molecules, zero point energy, force constant and bond strengths; anharmonicity, Morse potential energy diagram, vibration-rotation spectroscopy, P,Q,R branches. Breakdown of Oppenheimer approximat- ion; vibrations of polyatomic molecules. Selection rules, normal modes of vibration, group frequencies, overtones, hot bands, factors affecting the band positions and intensities, far IR region, metal-ligand vibrations, normal co-ordinate analysis.

(b) Raman Spectroscopy:

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

UNIT-III : ELECTRONIC SPECTROSCOPY: **(15 Periods)**

(a) Atomic Spectroscopy:

Energies of atomic orbitals, vector representation of momenta and vector coupling, spectra of hydrogen atom and alkali metal atoms.

(b) Molecular Spectroscopy:

Energy levels, molecular orbitals, vibronic transitions, vibrational progressions and geometry of the excited states, Franck-Condon principle, electronic spectra of polyatomic molecules. Emission spectra; radiative and non-radiative decay, internal conversion, spectra of transition metal complexes, charge-transfer spectra.

(c) Photoelectron Spectroscopy:

Basic principles; photo-electric effect, ionization process, Koopman's theorem. Photoelectron spectra of simple molecules, ESCA, chemical information from ESCA. Auger electron spectroscopy - basic idea.

SECTION-II

UNIT-IV : MAGNETIC RESONANCE SPECTROSCOPY: (15 Periods)

(a) Nuclear Magnetic Resonance Spectroscopy:

Nuclear spin, nuclear resonance, saturation, shielding of magnetic nuclei, chemical shift and its measurements, factors influencing chemical shift, deshielding, spin-spin interactions, factors influencing coupling constant 'J'. Classification (ABX, AMX, ABC, A_2B_2 etc.), spin decoupling; basic ideas about instrument, NMR studies of nuclei other than proton - ^{13}C, ^{19}F and ^{31}P. FT NMR, advantages of FT NMR, use of NMR in medical diagnostics.

(b) Electron Spin Resonance Spectroscopy:

Basic principles, zero field splitting and Kramer's degeneracy, factors affecting the 'g' value. Isotropic and anisotropic hyperfine coupling constants, spin Hamiltonian, spin densities and McConnell relationship, measurement techniques, applications.

(c) Nuclear Quadrupole Resonance Spectroscopy:

Quadrupole nuclei, quadrupole moments, electric field gradient, coupling constant, splittings. Applications.

UNIT-V : QUANTUM CHEMISTRY: (15 Periods)

(1) Approximate Methods:

- General Time independent perturbation theory
- The application of perturbation method with examples
- The variation theorem
- The application of variation method
- Application of the variation method to other states
- Examples of variation and perturbation calculations.

(2) Electron Spin and Pauli Principle:

- Electron spin
- Spin and the hydrogen atom
- The Pauli principle, The Pauli exclusion principle
- Perturbation treatment of the lithium ground state
- Variation treatments of the lithium ground state
- Spin magnetic moment
- Ladder operators for electron spin

(3) Many electron atoms:

- The Hartree-Fock self consistant filled model
- Orbitals and periodic tables
- Electron correlations
- Addition of angular momenta
- Angular momentum in many electron - The atom Hamiltonian - The Slater rules

- Spin orbit interactions

UNIT-VI : STEREOCHEMISTRY AND BONDING IN MAIN GROUP COMPOUNDS: (15 Periods)

VSEPR, Walsh diagrams (tri- and penta-atomic molecules), dπ-pπ bonds, Bent rule and energetics of hybridisation, some simple reactions of covalently bonded molecules.

Books Suggested:

1. Introduction to Quantum Chemistry, A. K. Chandra, Tata McGraw Hill.
2. Quantum Chemistry, Ira N. Levine, Prentice Hall.
3. Modern Spectroscopy, J. M. Hollas, John Wiley.
4. Applied Electron Spectroscopy for Chemical Analysis, ed. By H. Windawi and F. L. Ho, Wiley Interscience.
5. NMR, NQR, EPR and Mossbauer Spectroscopy in Inorganic Chemistry, R. V. Parish, Ellis Harwood.
6. Physical Methods in Chemistry, R. S. Drago, Saunders College
7. Chemical Application of Group Theory, F. A. Cotton.
8. Introduction to Molecular Spectroscopy, G. M. Barrow, McGraw Hill.
9. Basic Principles of Spectroscopy, R. Chang, McGraw Hill.
10. Theory and applications of UV Spectroscopy, H. H. Jaffe and M. Orchin, IBM-Oxford.
11. Introduction to Photoelectron Spectroscopy, P. K. Ghosh, John Wiley.
12. Introduction to Magnetic Resonance, A Carrington and A. D. Maclachalan, Harper & Row.

VEER NARMAD SOUTH GUJARAT UNIVERSITY
M.Sc.-I (CHEMISTRY)
TO COME IN FORCE FROM JUNE-2008
PAPER-IV (ORGANIC CHEMISTRY)

Max. Marks: 54 **Total Periods: 90**

SECTION-I

UNIT-I : REARRANGEMENTS: (15 Periods)

General mechanistic considerations, Nature of migration, Migratory aptitude, Memory effects in respect of the following:

1,2-Rearrangements: Carbon to carbon migrations of R, H and Ar:

(i) Pinacol-Pinacolone rearrangement
(ii) Wagner-Meerwein rearrangement
(iii) The Dienone-Phenol rearrangement
(iv) Demjanov
(v) Acid catalysed rearrangements of aldehydes and ketones
(vi) Benzil-Benzilic acid rearrangement
(vii) Favorskii rearrangement
(viii) Neber rearrangement
(ix) Migrations of halogen, hydroxy, amino etc.

Carbon to oxygen migration of R and Ar:

(i) Baeyer-Villiger rearrangement
(ii) Rearrangement of hydroperoxide

Non 1,2 Rearrangement:

(i) Claisen rearrangement
(ii) Benzidine rearrangement

UNIT-II : SUBSTITUTION REACTIONS AND ELIMINATION REACTIONS: (15 Periods)

Aliphatic Nucleophilic Substitution:

The SN^i mechanisms. Reactions of Allylic halides, The neighbouring group mechanism, neighbouring group participation by -OH, $-NH_2$, $-COO^-$, -RS, -halogen, π-bond, aromatic ring, etheral oxygen.

Aromatic Nucleophilic Substitution:

The SN^2, SN^1, benzyne and SRN^1 mechanisms, Reactivity - effect of substrate structure, leaving group and attaching nucleophile, The Von Richter, Sommelet-Hauser and Smiles rearrangement.

UNIT-III : ORGANIC REACTIONS: (15 Periods)

General nature, method, mechanism and synthetic applications of the following reactions:

(i) Arndt-Eistert synthesis
(ii) Dakin reaction
(iii) Darzen's glycidic ester synthesis

(iv) Leuckart reaction
(v) Mannich reaction
(vi) Michael reaction
(vii) Willgerodt reaction
(viii) Reimer-Tiemann reaction
(ix) Knoevenagel reaction
(x) Wittig reaction
(xi) Vilsmeyer-Hack reaction
(xii) Oppenauer oxidation
(xiii) Elb's persulphate oxidation

SECTION-II

UNIT-IV : PERICYCLIC REACTIONS: (15 Periods)

Defination, Characterization and Classification of Pericylic reactions Molecular orbital symmetry, conservation orbitals of ethylene, 1,3- butadiene, 1,3,5- hexatrieneand alyl system.

Aplication of symmetry properties, correlation diagram and derivation of selection rules for Electrocyclic reactions- Conrotatory and disrotatory motions, FMO and PMO approach 4n, 4n+2 and allyl systems.

Cyclo addition Reactions – antarafacial and suprafacial additions. 4n and 4n+2 Syntems FMO and PMO approach. 2 + 2 addition of ketenes, 1,3- dipolar cydoadditions.

Sigmatropic rearrangements. Suprafacial and antarafacial shifts involving H & C moieties. 3,3 – and 5,5- Sigmatropic rearangements. Claisen, Cope and aza cope rearrangements. Ene reactions.

UNIT-V : (15 Periods)

(A)NATURE OF BONDING IN ORGANIC MOLECULES AND AROMATICITY:

Aromaticity and aromatic character, Frost circle diagram for cyclo-butadiene, benzene and others. Concepts of aromaticity resonance and chemical stabilization – aromatic character based on NMR-criteria to check aromatic character.

Huckel rule, energy level of π molecular orbitals, Huckel molecular orbitals (HMO) method, orbital symmetry, MO of simple organic systems such as ethene, allyl and butadiene.

Aromaticity in benzenoid and non-benzenoid compounds and charged rings, annulenes, antiaromaticity, homoaromaticity.

(B) SUPRAMOLECULAR CHEMISTRY AND NANO TECHNOLOGY :

Concepts, molecular recognition, supramolecular reactivity and catalysis., Crown ether complexes, inclusion compounds, Cryptands, Calixeranes, cyclodextrins, catenanes and rotaxanes. molecular devices,

An introduction to nanotechnology.

UNIV-VI : STRUCTURE-REACTIVITY PRINCIPLES: (15 Periods)

Types of mechanisms, types of reactions, thermodynamic and kinetic requirements, kinetic and thermodynamic control, Hammonds postulate, Curtian-Hammet principle, potential energy diagrams, transition state and intermediates, methods of determining mechanisms, isotope effect, Hard and soft acids and bases.

Effect of structure on reactivity - resonance and field effect, steric effect, quantitative treatment. The Hammet equation and linear free energy relationships, substituent and reaction constants, positive and negative deviation from Hammet equation, Taft equation, Solvent effect.

Reference Books:

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

VEER NARMAD SOUTH GUJARAT UNIVERSITY
M.Sc. Part-I CHEMISTRY
TO COME IN FORCE FROM JUNE-2008
PAPER-IV (PHYSICAL CHEMISTRY)

Max. Marks: 54 **Total Periods: 90**

SECTION-I

UNIT I (15 Periods)

(A) LIQUIDS:

The gas-like and solid-like approach to liquid, internal pressure and its significance in liquids, equation of state, general nature of intermolecular forces in liquids, ionic liquids, complex fluids.

(B) LIQUID CRYSTALS:

Mesomorphic behavior, thermotropic liquid crystals, positional order, bond orientational order, nematic and sematic mesophases; optical properties of liquid crystals, Lyotropic phases and their description of ordering in liquid crystals, liquid crystalline polymers, Applications of liquid crystals.

UNIT II (15 Periods)

(A) SOLIDS:

Electronic structure of solids-band theory, band structure of metals, insulators and semiconductors. Intrinsic and extrinsic semiconductors, doping of semiconductors, electrically conducting organic solids, Fullerenes, superconductors.

(B) GASES:

Berthelot equation, Dietrice equation, Redlich-Kweng equation, Virial equation, Brigham-Bittice-Kammerling Onnes equations. calculation of collision diameter, collision frequencies, mean free path and viscosity co-efficients.

UNIT III (15 Periods)

(A) SCATTERING AND DIFFRACTION TECHNIQUES:

Principles, working and applications of Static and dynamic light scattering, X-ray scattering, small angle neutron scattering, X-ray and electron diffraction

(B) BIOPHYSICAL CHEMISTRY

Chemical processes in living in living systems, Metabolic reactions, ATP hydrolysis, ATP as energy currency of cell, Glycolysis, Biomembranes: Passive and active transport, Acid-base equilibria in amino acids and proteins

SECTION-II

UNIT IV (15 Periods)

(A) POLAROGRAPHY:

Principle of voltammetry, Dropping mercury electrode and its advantage, Residual current, migration current, diffusion current, Ilkovic equation, polarographic maxima and its suppression, half wave potential. Factors affecting diffusion current, Derivation of cathodic polarographic wave equation and its interpretation, interference of oxygen. Quantitative determination of unknown metal ions.

(B) ELECTROLYTIC SOLUTIONS

Ionic atmosphere, its thickness, Debye-Huckel-Onsagar equation, its validity in aqueous solution, Debye-Falkenhager effect, Wien effect.

UNIT V **(15 Periods)**

(A) NUCLEAR CHEMISTRY:

Nuclear reactions- conservation laws, energetics of nuclear reaction, Threshold energy, reaction cross-section, compound nucleus mechanism for nuclear reactions. Types of nuclear reaction, Nuclear fission as a source of energy, nuclear chain reaction, condition for controlled chain reaction, principle nuclear reactors and types of reactors, thermal nuclear reactor, Breeder reactor, energy from nuclear fusion, thermo nuclear reactions, Stellar energy, Thermo nuclear reaction on earth. Biological effect of radiation, effect of radiation on body, units of radiation energy.

(B) FAST REACTIONS:

General features of fast reactions, Stopped flow method, relaxation method, flash photolysis, molecular beam method.

UNIT VI **(15 Periods)**

(A) SURFACE AND COLLOID CHEMISTRY:

Surface tension, Adsorption on solid and from solution, Insoluble monolayers, Langmuir film balance, details of instrument and its working, Orientation of molecules in films & phase changes from pressure area curve. Transfer of speed monolayers, LB films, Application of adsorption from solution.

(B) CATALYSIS:

Characteristic of a catalyst, Homogeneous catalysis: Kinetics, acid-base, effect of pH and catalytic coefficients, Heterogeneous catalysis and its Mechanism, Enzymatic catalysis, Industrial catalyst: carrier, prompter, inhibitor and poison, Theories of catalysis.

Books Recommended:

1) Liquid and their properties by Temperley and Trevana.
2) An introduction to liquid state, P. A. Egestaff, Academic Press.
3) Introduction to Statistical Thermodynamics, T. L. Hill, Addison Wiley.
4) Molecular thermodynamics of fluid phase equilibria, J. M. Prausnitz, R. N. Lichtenthaler and E. G. Azevedo, Prentice-Hall, Inc, Englewood Cliffs, N. J
5) Physical Chemistry by Berry, Rice and Ross.
6) Physical Chemistry by R. P. Verma
7) Principle of the Solid state by H. V. Keer
8) Solid State Chemistry by N. B. Hannuy
9) Solid State Chemistry by L. Smart and Elaine Moore
10) Solid State Chemistry, D.K. Chakrabarty, New Age International
11) Thermotropic liquid Crystals by G. W. Gray, John Wiley
12) Solid State Chemistry and its applications, A. R. West, Plenum
13) Thermodynamics for Chemists, Glasstone
14) An Introduction to Electrochemistry by S. C. lantone
15) Modern Electrochemistry Vol I & II, J.O.M Bockris and A. K. N. Reddy, Plenum
16) Essential of Nuclear Chemistry by Arnikar H. J. (Wiley Eastern ltd)
17) Introduction to Nuclear Science, M. N. Shastri, East-West Press Pvt. Ltd.
18) Chemical Kinetics, K.J. Laidler, 3rd Edition, Harper and Row, 1987
19) Chemical Kinetics, Ira N. Levine, Prentice Hall.