

**VEER NARMAD SOUTH GUJARAT UNIVERSITY**  
**M.Sc.-I (CHEMISTRY)**  
 TO COME IN FORCE FROM JUNE-2010  
**PAPER-I (INORGANIC CHEMISTRY)**

**Max. Marks: 60 ( External – 42 + Internal – 18 )**

**Total Periods: 45**

**SEMESTER-I**

**UNIT-I: QUANTUM CHEMISTRY:**

**(15 Periods)**

Discussion of solutions of Schrodinger equation to some model systems e.g. the one dimensional harmonic oscillator, two particle rigid rotator.

Ordinary angular momentum, generalized angular momentum, eigen functions of angular momentum, eigen values of angular momentum, different types of Operators and their uses, addition of angular momentum, spin, antisymmetry & Pauli exclusion principle using Ladder operators. Russel-Saunders terms and coupling scheme, Slater-Condon parameters, term separation energies of the  $p^n$  and  $d^n$  configuration, magnetic effect: spin orbit coupling and Zeeman effect (splitting).

**UNIT-II: SYMMETRY AND GROUP THEORY IN CHEMISTRY AND ITS APPLICATIONS:**

**(15 Periods)**

**Representation of groups:**

- Preparation of matrices and vectors.
- Matrix notations for geometrical transformations.
- Orthogonality theorem and its consequences.
- Reducible and irreducible representations and their relation.
- Preparation of character table for  $C_{2v}$  and  $C_{3v}$  point groups.

**Application of group theory to -**

- Transformation properties of atomic crystals.
- Hybridization scheme for  $\sigma$  and  $\pi$ -bonding.

**UNIT-III: INORGANIC REACTION MECHANISM**

**(15 Periods)**

**Introduction:**

Labile and inert complexes, factors responsible for lability and inertness of complexes.

**Experimental Techniques:**

- (i) Direct chemical analysis, (ii) Photometry, (iii) Electrometry, (iv) Polarimetry,
- (v) Isotopic tracer, and (vi) Fast reaction techniques.

**Reaction Mechanism of Transition Metal Complex:**

Reactivity of metal complexes, ligand replacement reaction: classification of mechanism and energy profile of reaction. Inert and labile complexes, interpretation of lability and inertness of transition metal complexes on the basis of VBT and CFT. Factors affecting the lability of a complex, transition state or activated complex, substrate, attacking reagents electrophilic and nucleophilic, Nature of central atom. Kinetic application of CFT.

Kinetics of octahedral substitution, acid hydrolysis, factor affecting acid hydrolysis, base hydrolysis, conjugate base mechanism, direct and indirect evidences in favor of conjugate mechanism, reaction without metal ligand bond cleavage, and reaction of coordinated ligands.

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**SEMESTER-II**

**UNIT-I: MAGNETIC PROPERTIES AND ELECTRONIC SPECTRA OF  
 TRANSITION METAL COMPLEXES: (15 Periods)**

**Introduction:**

Definitions of magnetic properties, types of magnetic bodies, the source of paramagnetism, diamagnetism and Pascal's constant.

**The Elementary theory of magnetochemistry:** properties of paramagnetic bodies.

**Determination of magnetic susceptibility:**

(a) Gouy method, (b) Faraday method and (c) Null deflection method.

**Magnetic moment:**

(I) intrinsic orbital contribution, (ii) Spin orbit coupling, and (iii) Temperature independent paramagnetism (T.I.P.).

**UNIT-II : METAL  $\pi$ -COMPLEXES: (15 Periods)**

Structure and Bonding, vibrational spectra of metal carbonyls for bonding and structure elucidation, important reaction of metal carbonyls, nitrosylating agents for synthesis of metal nitrosyls, vibrational spectra and X-ray diffraction studies of transition metal nitrosyls for bonding and structure elucidation, important reaction of transition metal nitrosyls, structure and bonding.

**UNIT-III : INORGANIC POLYMERS: (15 Periods)**

**Introduction:**

- Definition of polymers and their depiction.
- Types of characteristic of inorganic polymers.

**Characterization of inorganic polymers (Physical properties):**

- By molecular weights
- Number average
- Weight average
- Molecular weight distribution

**Structural features of polymers:**

- backbone bonding
- branching and cross-linking
- chemical and stereochemical variability

**Crystallinity:**

- Importance and requirements, Methods for determining percent crystallinity by Dilatometry, crystallography and X-ray diffraction.

**Classification, types of inorganic polymers, synthesis, properties, structures and uses in following polymers:** (i) Polyphosphazenes (ii) Polysiloxanes

**Reference Books:**

1. Quantum Chemistry by Ira N. Levine, Prentice-Hall of India Pvt. Ltd., New Delhi, 1994.
2. Introductory Quantum Chemistry (Third edition) by A. K. Chandra Tata McGraw Hill Pub. Co. Ltd., New Delhi, 1988.
3. Quantum Mechanics in Chemistry (3<sup>rd</sup> edition) by N. W. Hanna, Benjamin, Menlo Park, Calif, 1981.
4. Problems in Quantum Chemistry and Physics by C. S. Johnson and L. G. Pedersen, Addison-Wesley, Reading, Mass., 1974.
5. Problems in Quantum Chemistry by P. Jorgensen and J. Oddershede Addison-Wesley, Reading, Mass., 1983.
6. Quantum Chemistry and Spectroscopy by M. S. Pathania, Vishal Publications, India, 1981.
7. Chemical applications of group theory by F. A. Cotton (Second edition), Wiley Eastern Limited, 1976, New Delhi.
8. Group theory and its applications by P. K. Bhattacharya, Himalaya Publishing House, Mumbai, 1986.
9. Group theory and symmetry in Chemistry by L. R. Hall, McGraw Hill, New York, 1989.
10. Quantum Chemistry by I.N. Levine (4<sup>th</sup> edition), Prentice-Hall, New Delhi, 1994.
11. Introductory Quantum Chemistry by A. K. Chandra (4<sup>th</sup> edition), Tata McGraw Hill Pub. Co. Ltd., New Delhi.
12. 'Kinetics and Mechanism' by A. A. Frost and R. G. Pearson, Wiley, New York, 1953, 1961.
13. Mechanism of Inorganic Reactions by F. Basolo and R. G. Pearson, Second Edition, Wiley Eastern Limited, New Delhi, 1977.
14. Advanced Inorganic Chemistry and Radiochemistry, H. Taube, 1, 2 (1959), Review article. Inorganic Reaction Mechanism by S. G. Skyes.
15. Magneto chemistry by R. L. Carlin.
16. Introduction to Magneto chemistry by A. Carnshaw, Academic Press, London.
17. Magnetism and Transition Metal Complexes by F. E. Mabb and D. J. Machin, Chapman and Hall, London.
18. Advanced Inorganic Chemistry by F. A. Cotton and R. G. Wilkinson, John Wiley & Sons, N.Y.
19. Elements of Magnetochemistry by A. Syamal and R. L. Dutta, Affiliated East-West Press, New Delhi, 1993.
20. Introduction to metal pi-complex chemistry by M. Tsusui, M. Nlevy, M. Ichikwa, K. Mori, Plenum Press, New York.
21. Inorganic Polymers by James E. Mark, H. R. Allcock and Robert West, Prentice Hall of India Pvt. Ltd., New Delhi, 1992.
22. Text-book of Polymer Science, 2<sup>nd</sup> edition, by F. W. Jr. Billmeyer Jr., Wiley-Interscience, New York, 1971.
23. Inorganic and Organometallic Polymers by M. Zelding, K. J. Wynne and H. R. Allcock, ACS Symposium Series, American Chemical Society, Washington, DC, Vol. 360 (1988).
24. Introductory Polymer Chemistry by G. S. Mishra, Wiley Eastern Ltd., 1993.
25. Phosphorous-Nitrogen Compounds, H. R. Allcock, Academic, New York, 1972.
26. In Encyclopaedia of Polymer Science and Engineering, 2<sup>nd</sup> edn., by R. Baney and G. Chandra, Wiley-Interscience, New York, 1987.

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**Max. Marks: 60 ( External – 42 + Internal – 18 )**

**Total Periods: 45**

**SEMESTER-I**

**UNIT-I: REACTION MECHANISM & REACTIVE INTERMEDIATES (15 Periods)**

Detailed study of organic reaction intermediates. Generation, structure, stability and reactions of –

**Carbocations (Classical and non-classical):**

Phenonium ion, norbornyl system, common carbocation rearrangements. Application of NMR spectroscopy in detection of carbocations.

**Carbanions:**

Mechanism of condensation involving enolates - Aldol, Claisen, Mannich, Benzoin, Perkin, Dieckmann, Michael, Shapiro and Stobbe reactions.

**Carbenes:**

Mechanism of Arndt-Eistert reaction, Wolff rearrangement, Reimer-Tiemann reaction and Bamford Steven's rearrangement reaction.

**Free Radicals:**

Allylic halogenation (NBS), oxidation of aldehydes to carboxylic acids, auto-oxidation, coupling of alkenes and arylation of aromatic compounds by diazonium salts. Sandmeyer reactions. Free radical rearrangements, Hunsdiecker reaction.

**UNIT-II: PERICYCLIC REACTIONS (15 Periods)**

**Introduction** - Definition, Characterization and Classification of Pericyclic reactions Molecular orbital symmetry, conservation orbitals of ethylene, 1,3-butadiene, 1,3,5-hexatriene and allyl system. Application 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  $4n+2$  Systems FMO and PMO approach.  $2 + 2$  addition of ketenes, 1, 3- dipolar cycloadditions.

**Sigmatropic rearrangements:** Suprafacial and antarafacial shifts involving H & C moieties. 3, 3 – and 5, 5- Sigmatropic rearrangements.

**UNIT-III: STEREOCHEMISTRY AND CONFORMATIONAL ANALYSIS (15 Periods)**

**Concept of isomerism:** Dynamic stereochemistry, prochiral relationships, Resolution of racemic modifications, Stereospecific and stereoselective synthesis, Optical activity in the absence of chiral carbon (biphenyls, allenes and spiranes), Chirality due to helical shape.

**Conformational analysis of cyclohexanes:** Axial and equatorial bond, conformation of monosubstituted cyclohexane derivatives, decalins, perhydro-phenanthrenes, Effect of conformation on reactivity, stereochemistry of the compounds containing N and S.

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**SEMESTER-II**

**UNIT-I: 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) Michael reaction
- (vi) Willgerodt reaction
- (vii) Reimer-Tiemann reaction
- (viii) Wittig reaction
- (ix) Vilsmeier-Hack reaction
- (x) Hell-Volhard-Zelinski reaction
- (xi) Ulmann reaction
- (xii) Pechmann condensation.

**UNIT-II; SUBSTITUTION AND ELIMINATION REACTIONS**

**(15 Periods)**

**Aliphatic Nucleophilic Substitution:**

The  $SN^1$ ,  $SN^2$ , mixed  $SN^1$  and  $SN^2$ , SET mechanisms. Reactions of Allylic halides, the neighbouring group mechanism, neighbouring group participation by  $-OH$ ,  $-NH_2$ ,  $-COO^-$ ,  $-RS$ ,  $-halogen$ ,  $\pi$ -bond, aromatic ring, ethereal oxygen.

**Aromatic Nucleophilic Substitution:**

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

**UNIT-III: STRUCTURE-REACTIVITY PRINCIPLES**

**(15 Periods)**

Types of mechanisms, 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.

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. Comprehensive Organic Chemistry by Barton and Ollis (Eds.) (Pergamon Press, 1979), Volume 1: Chapters 2, 7 and 2.8, Volume 2, Chapter 6.6).
2. Reaction Mechanism and Reagents in Organic Chemistry by C. R. Chatwal (Himalaya Publishing House, Bombay, 1987).
3. Organic Chemistry Reactions and Reagents by O. P. Agrawal (Goel Publishing House, Meerut, 1986).
4. The Chemistry of Free Radicals by R. L. Hudang, S. H. Goh and S. H. Ong (Edward Arnold, 1974).
5. Principles of Ionic Organic Reagents by E. R. Alexander (John Wiley & Sons, Inc.).
6. Carbenes, Benzynes and Nitrenes by Gilchrist, T. L. and Rees.
7. Advance Organic Chemistry by Jerry March Principles.
8. Reaction Mechanism in Organic Chemistry by S. M. Mukherji and S. P. Singh (McMillan India Ltd., 1976).
9. Molecular Reactions and Photochemistry by Charles H. Depuy and Orville L. Chapman (Prentice Hall of India Pvt. Ltd., 1975).
10. Fundamentals of Photochemistry by K. K. Rohatgi-Mukherjee (Eastern Limited, New Delhi-110 002, 1978).
11. Organic Chemistry (3/e) by J. B. Hendrickson, Donald J. Crem and George S. Rammond (McGraw-Hill Book Co. & Kogekusha Co. Ltd., 1970).
12. Organic Chemistry by Finar, I. L., Vol. II (5/e) (London, ELBS).
13. Organic Chemistry (5/e) by Morrison & Boyd (Prentice Hall).
14. The Carbohydrates by S.F. Dyke, Volume V in the series, 'The Chemistry of Natural Products', edited by K. W. Bentley (Interscience Publishers).
15. An Introduction to the Chemistry of Carbohydrates by Guthrie and Honeyman [Clarendon Press, 1964, (2/e)].
16. A guide to IUPAC nomenclature of Organic Compounds, R. Fanico, W. R. Powell and Jean-Claude Richard, Jain Interscience Press, New Delhi.
17. Organic Chemistry by Francis A. Carey (McGraw-Hill Book Co., 1987).
18. Principles of Organic Chemistry by R.C.C. Norman (Chapman and Hall, 1986).
19. Organometallic Chemistry by P. L. Pauson (Edward Arnold, 1968).
20. Principles of Organometallic Chemistry by Coats, Green, Powell & Wade (Chapman and Hall, 1977).
21. Guide Book to Organic Synthesis by R. K. Mackie & D. M. Smith (Longman, 1983).
22. Organic Synthesis via Poranos by H. C. Brown (John Wiley & Sons, New York, 1975).
23. Advanced Organic Chemistry by Carey & Sundberg (3<sup>rd</sup> edition).
24. A Guide Book to Mechanism in Organic Chemistry, Peter Sykes, Longman.
25. Structure and Mechanism in Organic Chemistry, C. K. Ingold, Cornell Uni.Press.
26. Principles of Organic Synthesis, R.O.C. Norman and J. M. Coxon, Blackie Academic and Professional.
27. Reaction Mechanism in Organic Chemistry, S. M. Mukherji and S. P. Singh, Macmillan.

28. Stereochemistry of Organic Compounds, D. Nasipuri, New Age International.
29. Stereochemistry of Organic Compounds, P. S. Kalsi, New Age International.
30. Advanced Organic Chemistry-Reactions, Mechanism and Structure, Jerry March, John Wiley.
31. Advanced Organic Chemistry, F. A. Carey and R. J. Sundberg, Plenum.
32. A Guide Book to Mechanism in Organic Chemistry, Peter Sykes, Longman.
33. Structure and Mechanism in Organic Chemistry, C. K. Ingold, Cornell University Press.
34. Organic Chemistry, R. T. Morrison and R. N. Boyd, Prentice-Hall.
35. Modern Organic Reactions, H. O. House, Benjamin.
36. Principles of Organic Synthesis, R.O.C. Norman and J. M. Coxon, Blackie Academic & Professional.
37. Pericyclic Reactions, S. M. Mukherji, Macmillan, India.
38. Reaction Mechanism in Organic Chemistry, S. M. Mukherji and S. P. Singh, Macmillan.
39. Stereochemistry of Organic Compounds, D. Nasipuri, New Age International.
40. Stereochemistry of Organic Compounds, P. S. Kalsi, New Age International.

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**PAPER-III (PHYSICAL CHEMISTRY)**

**Max. Marks: 60 ( External – 42 + Internal – 18 )**

**Total Periods: 45**

**SEMESTER-I**

**UNIT-I: POLYMER CHEMISTRY**

**(15 Periods)**

Types of polymers, Stereochemistry of polymers, Mechanism of polymerization (free radical, anionic and cationic), Kinetics of free radical polymerization, Thermodynamics of polymerization, Phase techniques of polymerization (Bulk, solution, suspension and emulsion), Number & mass average molecular mass, Molecular mass determination (Osmometry and Viscometry), Thermal transitions in polymer: glass transition temperature and its significance, Numericals

**UNIT-II: CHEMICAL KINETICS**

**(15 Periods)**

Collision theory of reaction rates, steric factor, activated complex theory, ionic reactions, Factors affecting reaction rates in solution. Effect of ionic strength on the rate constant.

Kinetics and mechanism of following complex reactions in details: i) Reversible, ii) Parallel, iii) Consecutive, iv) Chain and v) Enzyme catalysed reactions, Photochemical reactions (Hydrogen-bromine and hydrogen-chlorine reactions), Numericals.

**UNIT- III : THERMODYNAMICS**

**(15 Periods)**

Brief resume of concepts of laws of thermodynamics, free energy and entropy, Partial molar properties: Partial molar free energy, Partial molar volume, Partial molar heat content, Chemical Potential, and their significances, determination of these quantities.

Non-ideal systems: Basic idea on Excess functions of non-ideal solutions

Thermodynamic probability and most probable distribution, Boltzmann Distribution law, Partition function and its significance, Rotational, Vibrational & translational: Relation between Partition function and entropy. Partition function and equilibrium constant, Partition function and heat content, Numericals.

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**Total Periods: 45**

**SEMESTER-II**

**UNIT-I: ELECTROCHEMISTRY (15 Periods)**

Debye-Huckel theory of interionic attraction (qualitative account only), relaxation effect and electrophoretic effect. Ionic strength, Activity coefficient and its determination by solubility and EMF method. Dissociation constant, relation between thermodynamic dissociation constant and dissociation function. Determination of dissociation constant of monobasic acid by conductance method and approximate EMF method, Numericals.

Electrolytic polarization, Decomposition potential, over voltage, concentration polarization, Measurement of over voltage, influence of current density and temperature on over voltage, Ionic discharge as the slow process at cathodes. Tafel and proton transfer theory of hydrogen over voltage, Numericals.

**UNIT-I I: (15 Periods)**

**(A) MOLECULAR SPECTROSCOPY**

Molecular spectra, microwave spectroscopy (Rotational spectroscopy), selection rule for rotational spectra, frequency of rotational spectral lines, vibrational spectra of diatomic molecule, isotopic effect in molecular spectra, harmonic vibration, potential energy, force constant, amplitude of vibration, Anharmonic vibration, Morse potential energy. Numericals.

**(B) NUCLEAR CHEMISTRY**

Radiation detectors- Gas ionization detectors- principle, Ion chambers- proportional counter, G.M. Counter-scintillation detector- principle, features, Inorganic & organic scintillators, solid state detectors, Radiochemical principle and use of tracers- Reaction-Mechanism- (esterification, hydrolysis, oxidation of fumaric acid, Friedel-Craft reaction). Isotope dilution analysis. Neutron activation analysis.

**UNIT-III: SURFACE & COLLOID CHEMISTRY (15 Periods)**

Surface active agents, classification of Surface active agents, micellization, hydrophobic interaction, critical micellar concentration (CMC), factors affecting the CMC of surfactants, Krafft point and cloud point, counter ion binding to micelles, thermodynamics of micellization-mass action and phase separation model, solubilization, microemulsion, reverse micelles.

Gibbs adsorption isotherms and the determination of surface area/molecule, estimation of surface area of adsorbents (BET equation), surface films on liquids, electrical double layer, Zeta potential and its determination by electrophoresis, Effect of salt on zeta potential, DLVO theory of colloid stability, catalytic activity at surfaces.

**Reference Books:**

- 1) Physical Chemistry, P. W. Atkins, 6<sup>th</sup> Edition, ELBS.
- 2) Chemical Kinetics, K. J. Laidler, 3<sup>rd</sup> Edition, Harper and Row, 1987.
- 3) Micelles, Theoretical and Applied Aspects, V. Moroi, Plenum.
- 4) Introduction to Polymer Science, V. R. Gowarikar, N. V. Vishwanathan & J. Sridhar, Wiley Eastern.
- 5) Principles of Polymer Science P. Bahadur and N. V. Sastry, Narosa 2006,
- 6) Mathematics for Chemistry, Doggett and Sucliffe, Longman.
- 7) Mathematical preparation for Physical Chemistry , F. Daniels , McGraw Hill
- 8) Quantitative Analysis, 6<sup>th</sup> Ed., R. A. Day and A. L. Underwood, Prentice – Hall of India , 1993.
- 9) Experimental Physical Chemistry: A Laboratory Textbook, A.M. Halpernand J. Reeves Scott, Foresman And Co., 1988.
- 10) Basic Chemical Kinetics by G. L. Agrawal
- 11) Chemical Kinetics, Ira N. Levine, Prentice Hall.
- 12) Kinetics and Mechanism of Chemical Transformations, J. Rajaraman and J. Kuriacose, McMillan.
- 13) Thermodynamics of Chemist, Glasstone, Van Nostrand Co.
- 14) Thermodynamic Properties of Non-electrolyte Solutions by W.E. Acree, Academic Press, 1984.
- 15) An Introduction of Chemical Thermodynamics, R.P. Rastogi and R. R. Misra, Vikas Publishing House, New Delhi.
- 16) Essentials of Nuclear Chemistry by H. J. Arnikar (Wiley Eastern Ltd., 1981).
- 17) Textbook of Polymer Science by Billmeyer Wiley.
- 18) Quantum Chemistry including Spectroscopy by B. K. Sen.
- 19) A Textbook of Physical Chemistry, Vol. 4, K. L. Kapoor, McMillan, 1985.
- 20) Introduction to Molecular Spectroscopy, G. M. Barrow , McGraw – Hill.
- 21) Modern Spectroscopy, J. M. Hollas, John Wiley.
- 22) Basic Principles of Spectroscopy, R. Chang, McGraw-Hill.
- 23) Introduction to Polymer Chemistry by A.M. Lesk, Prentice – Hall Inc., 1982.
- 24) Micelles, Theoretical and Applied Aspects, V. Morol, Plenum.
- 25) Introduction to Colloid and Surface Chemistry by Shaw.
- 26) Physical Chemistry by Protuon and Marron.
- 27) Statistical Thermodynamics by Gupta M.C.
- 28) Modern Electrochemistry, Vol. 1 & 2, J.O.M. Bookris and A. K. N. Reddy.
- 29) Introduction to Electrochemistry by Glasstone.

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**PAPER-IV (INSTRUMENTAL & CHEMICAL ANALYSIS)**

**Max. Marks: 60 ( External – 42 + Internal – 18 )**

**Total Periods: 45**

**SEMESTER-I**

**UNIT-I: SPECTROSCOPY: UV-Vis and IR**

**(15 Periods)**

**UV-Visible Spectrophotometry:**

Review of different electronic transition, Woodward's rules for  $\alpha$ ,  $\beta$ -unsaturated ketones, Diene systems, Effect of solvent on absorption bands – Elementary idea of double beam automatic recording, Spectrophotometer.

**IR Spectrophotometry:**

Spectrophotometer – Components of IR spectrophotometer – Sample handling – Calibration of wavelength – Interpretation of IR spectra using correlation charts – Study of few representative spectra, n-hexane, 2-methyl pentane, n-hexyl amine, n-butyl methyl ether, butyramide, n-hexanol, n-butyl-acetate, acetophenone, ethyl benzoate, n-hexanoic acid, benzoic acid, phenol, Effect of H-bonding on absorption bands – Elementary idea about FT-IR spectrophotometer.

**UNIT-II: CHROMATOGRAPHY, TLC and GC**

**(15 Periods)**

**Thin-Layer Chromatography:** Selection of stationary and mobile phase – Detection techniques – Elementary idea of HPTLC.

**Gas Chromatography:** Selection of mobile phase – Selection of stationary phase in GLC and GSC – Detectors: FID (with modifications), TCD and ECD, Their comparison, Packed column, WCOT, SCOT (advantages and disadvantages) – Temperature programming – Derivatisation in GC – Quantitative Analysis.

**UNIT-III: CHEMICAL MATHEMATICS**

**(15 Periods)**

Errors in Chemical analysis, classification of errors, nature and origin of errors, Propagation of error, Accuracy and precision, Average deviation and standard deviation and its physical significance, Normal Distribution curve and its properties. Confidence limit and probability, Statistical treatment for error analysis, student 't' test, rejection criteria and Q test, method of least square.

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**PAPER-IV (RECENT TRENDS IN CHEMISTRY)**

**Max. Marks: 60 ( External – 42 + Internal – 18 )**

**Total Periods: 45**

**SEMESTER-II**

**UNIT-I: PHOTOCHEMISTRY**

**(15 Periods)**

Molecular orbital view of excitation, Qualitative description of Fluorescence and Phosphorescence. Excited states and modes of dissipation of energy. Energy transfer processes, quantum efficiency, Photosensitized reactions: Reactivity of electronically excited ketones. Representation of excited states of ketones, Photo reduction. Norrish Type I & II reactions. Reactions of cyclic ketones, Oxetane formation (Paterno-Buchi reaction), Photochemistry of Olefins: cis-trans isomerisations, Dimerisation reactions, Photochemistry of conjugated dienes.

**UNIT-I I: SUPRAMOLECULAR CHEMISTRY and NANOTECHNOLOGY (15 Periods)**

**Introduction to nanotechnology:** Terminology like soft (condensed) matter, complex fluids Nanoparticles: Synthesis (top down and bottom up approach), Block copolymer nanoaggregates as templates for nanoparticle fabrication, Characterization, properties and applications of nanoparticles.

**Introduction to Supramolecules:** Host guest chemistry involving crown ethers, cyclodextrins and calixarenes, molecular recognition.

**UNIT-III: GREEN CHEMISTRY**

**(15 Periods)**

**Introduction:** Twelve principles of Green chemistry, Atom economy and Waste minimization.

**Green solvents and their applications:** Ionic liquids, types, properties and applications, ILs as solvents, Supercritical fluids, Supercritical CO<sub>2</sub>, its properties and applications in dry cleaning and decaffeination of coffee.

**Microwave assisted synthesis:** Mechanism and advantages with some examples, Biobased materials: Basic idea on Biopesticides, Biodegradable polymers.

**Aqueous phase reaction:**

- |                              |                             |
|------------------------------|-----------------------------|
| 1. Baeyer-Villiger Oxidation | 2. Claisen-Schmidt Reaction |
| 3. Diels-Alder reaction      | 4. Knoevenagel Condensation |

**Green approach in the synthesis of:**

- |                |                        |             |                |
|----------------|------------------------|-------------|----------------|
| 1. Adipic acid | 2. Methyl methacrylate | 3. Catechol | 4. Paracetamol |
|----------------|------------------------|-------------|----------------|

**Reference Books:**

1. Fundamental of molecular spectroscopy, C. N. Banwell, Tata McGraw Hill Pub. Camp.
2. Spectrometric Identification of Organic Compounds (4<sup>th</sup> edition/5<sup>th</sup> edition), Silverstein,
3. Bassler & Morrill, John Wiley & Sons. Introduction to Molecular Spectroscopy, G. M. Barrow , McGraw – Hill.
4. Modern Spectroscopy, J.M.Hollas, John Wiley.
5. Basic Principles of Spectroscopy, R.Chang, McGraw-Hill.
6. Modern Methods of Chemical Analysis (2<sup>nd</sup> ed.), Pecsok, Shields, Cairns & McWilliam, John Wiley & Sons.
7. Instrumental Analysis by R. D. Braun, McGraw-Hill.
8. Mathematics for Chemistry, Doggett and Sucliffe, Longman.
9. Mathematical preparation for Physical Chemistry , F. Daniels , McGraw Hill.
10. Introduction to Instrumental Analysis by R. D. Brawn, McGraw-Hill Book.
11. Fundamentals of Analytical Chemistry: Skoog D. R. and West D. M. (Holt, Rinehart & Winston, New York).
12. Chemical Analysis in Industry (in Gujarati) by M. N. Desai.
13. Instrumental Methods of Analysis by G. W. Ewing.
14. Modern Method of Chemical Analysis by Pecsok, Shield, Cairns, McWilliam, John Wiley and Sons.
15. Quantitative Analysis, 6<sup>th</sup> Ed., R. A. Day and A. L. Underwood , Prentice – Hall of India, 1993.
16. Molecular Reactions and Photochemistry by Charles H. Depuy and Orville L. Chapman (Prentice Hall of India Pvt. Ltd., 1975).
17. Fundamentals of Photochemistry by K. K. Rohatgi-Mukherjee (Eastern Limited, New Delhi-110 002, 1978).
18. Organic Chemistry (3/e) by J. B. Hendrickson, Donald J. Crem and George S. Rammond (McGraw-Hill Book Co. & Kogekusha Co. Ltd., 1970).
19. Materials Science & Engineering: An Introduction by Jr. W. D. Callister, John Wiley & Sons: New York.
20. Green chemistry by V. K. Ahluwalia, Narosa Pub New Delhi
21. Green Chemistry, Theory and Practice, P. T. Anastas and John C. Warner, Oxford University Press, 2000, New York, USA.
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**VEER NARMAD SOUTH GUJARAT UNIVERSITY, SURAT.****M.Sc. Part-I , CHEMISTRY PRACTICAL SYLLABUS****Marks: 37 [External-26 + Internal-11]****SEMESTER -I****GROUP-A ( ORGANIC )**

Separation and identification of components in a mixture containing three components (Candidate will prepare two derivatives. Each student should carry out 8 separations)

Separation of organic compounds using paper chromatography technique.

**GROUP-B ( INORGANIC )**

Inorganic Qualitative Analysis (IQA).( One Rare Element )

Spot test detection of Rare Earth metal ion.

Inorganic Preparation.

**GROUP-C ( PHYSICAL )**

1. Determine the dissociation constant of a given monobasic acid pH-metrically.
2. Determine the amount of ferrous sulphate / ferrous ammonium sulphate in given flask potentiometrically using ceric salt solution.
3. Verification of Onsager's equation and determination of equivalent conductance at infinite dilution of strong electrolytes
4. Determine the CMC of a surfactant by conductivity measurements.
5. Calculate the molar absorptivity of each of the given two solutions (A) and (B) and also find out concentration of supplied unknown solution colorimetrically.
6. Investigation the reaction between  $K_2S_2O_8$  and KI at two different temperatures and calculate the energy of activation for the reaction.
7. To study the phase diagram of a three component system Water – acetic acid – chloroform.
8. Determination of CMC and area per molecule of a surfactant by surface tension measurement.

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**SEMESTER -II**

**GROUP – A ( ORGANIC )**

Preparation of the following organic compounds involving not more than two steps (*Minimum 5*):

- (i) Resacetophenone from resorcinol
- (ii) m-Nitroaniline from nitrobenzene
- (iii) p-Nitroaniline from acetanilide
- (iv) p-Bromoaniline from acetanilide
- (v) 3-Resorcyclic acid from resorcinol
- (vi) Benzimidazole from o-phenylene diamine
- (vii) Acid Orange-II from sulphanilic acid
- (viii) 4-Methyl 7-hydroxy coumarin from resorcinol

Organic Estimations ( ANY THREE )

- (i) To determine the amount of carboxylic acid and amide in mixture of carboxylic acid and amide.
- (ii) To determine the amount of ester and acid in a mixture of ester and acid.
- (iii) Determination of molecular weight by Rast's method
- (iv) Estimation of Formaldehyde
- (v) Amine by bromination

**GROUP – B ( INORGANIC )**

Inorganic Gravimetric Estimations.

Inorganic Volumetric Estimations.

**GROUP – C ( PHYSICAL )**

1. Determine the dissociation constant of a given dibasic acid pH-metrically.
2. Determine the velocity constant of the hydrolysis of ethyl acetate with sodium hydroxide at room temperature by conductance measurements.
3. Determine the solubility of silver chloride in water potentiometrically.
4. To determine the concentration of given components in a mixture colorimetrically.
5. Determine the equilibrium constant of the reaction  $I^- + I_2 = I_3^-$  by distribution method.
6. Investigation the reaction between  $H_2O_2$  and HI at two different temperatures and calculate the energy of activation for the reaction
7. Determine the formula of a complex between  $Cu_2^+$  and  $NH_3$  by distribution method.  
$$Cu^{2+} + nNH_3 = [Cu(NH_3)_n]^{2+}$$
8. Determine the molecular weight of a given polymer from viscosity measurement.