NORTH MAHARASHTRA UNIVERSITY, JALGAON

DEPARTMENT OF ORGANIC CHEMISTRY

SYLLABUS FOR

MASTER OF SCIENCE

In

ORGANIC CHEMISTRY

PART- I

(Semester I and II)

w. e. f. July 2010

NORTH MAHARASHTRA UNIVERSITY, JALGAON
DEPARTMENT OF ORGANIC CHEMISTRY

Syllabus for M.Sc. Part-I Organic Chemistry

(Semester - I & II)

(With Effect from July 2010)

Course Structure for First Year

The following will be the structure for revised syllabus from July 2010 for semester I and semester II

SEMESTER - I

Sub. Code: Title

CH-110: Physical Chemistry-I

CH-130: Inorganic Chemistry-I

CH-150: Organic Chemistry-I

CH-P-1: Physical Chemistry Practical-I (Annual)

CH-I-1: Inorganic Chemistry Practical-I (Annual)

SEMESTER - II

Sub. Code: Title

CH-210: Physical Chemistry-II

CH-230: Inorganic Chemistry-II

CH-250: Organic Chemistry-II

CH-290: Analytical Chemistry

CH-O-1: Organic Chemistry Practical-I (Annual)

Important Notes:

1. Each theory course prescribed for M. Sc. should be covered in 4 lectures, each of 60 minutes duration per week per course including lectures, tutorials, seminars etc. (Total 60 hrs / theory course)

2. Each practical course will require 6 hours of laboratory work per week and the course will be extended over two semesters and will be examined at the end of the year. (Total 180 hrs / practical course)

3. There should not be more than 10 students in a batch for M. Sc. Practical course.

4. For theory course the question paper should include at least 20 % weightage for problem solving. Problem solving would include numerical, short answer, long answer questions to test understanding of the subject

5. Of the 60 lectures in each course about 10 lectures will include tutorials, student seminars and class tests.

6. The marks for each paper are distributed as external examination 75 marks and internal examination 25 marks. For internal assessment of each theory course, 2 written tests will be taken in which best will be considered for internal marks.

7. Department of Organic Chemistry has implemented **CGPA system from July 2009**.

CH-110: Physical Chemistry-I

Time: 60 Clock hrs. **Max Marks: 75 (External) + 25 (Internal)**

1. Classical Thermodynamics:

Brief introduction to laws of thermodynamics, partial molar properties; partial molar free energy, chemical potential, partial molar volume, partial molar heat content and their significance, Gibbs-Duhem equation, Determination of partial molar volume by method of intercept, concept of fugacity, determination of fugacity, Non-ideal solutions, activity and activity coefficient, Debye-Huckel theory for activity coefficient of electrolytic solutions, Determination of activity and activity coefficient, ionic strength, Numericals.

(12 L)

2. Statistical Thermodynamics:

Partition function, Expression for translational, rotational, vibrational and electronic partition functions, numerical problems, relation between partition function and thermodynamic properties. (08 L)

3. Chemical Dynamics:

Collision theory, modified collision theory, weakness of the collision theory, theory of absolute reaction rates, equilibrium hypothesis, Derivation of the rate equation, statiscal mechanical derivation and thermodynamic formulation. Isotope effect on reaction rate. Primary salt effect, secondary salt effect.

Dynamics of uni-molecular reactions, Lindmann, Hinschelwood, KRR and slater's treatment for uni-molecular reactions. Kinetics of fast reactions, study of fast reactions by stopped flow method, relaxation method, flash photolysis and NMR method.

Reactions in solution: Reaction between ions, influence of solvent-double sphere model, single sphere model, influence of ionic strength, numericals.

(15 L)

4. Phase rule:

Recapitulation of phase rule and terms involved in it, Three component system: Representation of ternary systems. Partially miscible three liquid systems: a) system composed of three liquid components, one partially miscible pairs, two partially miscible, three partially miscible pairs, b) system composed of two solid and a liquid components – formation of eutecfic systems, crystallization of pure components only, formation of binary compounds, one double salt formation, formation of binary compounds hydrate

formation, formation of ternary compounds, formation of solid solutions, partially miscibility of phases.

(10 L)

5. Electrochemistry:

Anomaly of strong electrolytes, Debye-Huckel theory, on sager equation and its verification wien effect, Dhy-Hkenhagen effect, ion solvent, interactions. Thermodynamics of electrifield interface equation, Derivation of electrocapillary, lippmann equation. Structure of electrifield interfaces equation, Electrical double layer, Theories of structure of electrical double layer. Helmoholtz perrin. Gony-Chapman theory, sternis theory.

Polarography: Ilkovic equation and its derivation, concentration polarization, instrumentation, advantages of DME, half wave potential, Applications of polarography. Numericals.

(15 L)

CH-210: Physical Chemistry-II

Time: 60 Clock hrs. **Max Marks: 75 (External) + 25 (Internal)**

1. Quantum Chemistry: **(20 L)**

A. Introduction to Quantum Mechanics

Postulates of quantum mechanics and Schrodinger equation, discussion of Schrodinger equation to particle in a box (one dimensional and three dimensional box), the harmonic oscillator, the rigid rotator, the hydrogen atom, numerical.

B: Approximate methods

The variation theorem, linear variation principle, Perturbation theory (first order & non - degenerate), application of variation method and perturbation theory to Helium atom.

C: Angular Momentum

Angular momentum vector, angular momentum operators, ladder operators, Commutation rules, orbital & Spin angular momentum, Russell – Saunders Coupling Scheme, term symbols, numericals,

D: Molecular orbital theory

Huckel theory of Conjugated Systems, application to ethylene, butadiene, Cyclopropenyl radical and cyclobutadiene, numericals.

2. Spectroscopy: **(10 L)**

Regions of Spectrum, interaction of radiation with matter, selection rules, intensity of spectral lines, natural line width and natural line broadening.

A. Microwave Spectroscopy

Classification of molecules, rigid rotor model, intensities of Spectrum lines, effect of isotopic substitution, numericals.

B. Vibrational Spectroscopy

a) Intrared Spectrocopy

Review of linear harmonic oscillator, Vibrational energies of diatomic molecules, zero point energy, force constant & bond strengths.

b) Raman Spectroscopy

Classical & quantum theories of Raman effect, pure rotational, Vibrational & Vibrational-rotational Rama Spectra, mutual exclusion principle

3. Surface Chemistry: **(20 L)**

A. Adsorption

Surface tension, capillary action, pressure difference across curved surface (laplace equation), Gibb's adsorption isotherm, BET isotherm and derivation of BET equation, estimation of surface area, Catalytic activity at surfaces.

B. Micelles

Surface active agents, classification of surface active agents, micellisation, critical micellar, Concentration (CMC) factors affecting the CMC of surfactants, thermodynamics of micellisation – phase separation and mass action models.

C. Macromolecules

Polymers- Defination, types of polymers, Kinetics of polymerization, mechanism of polymerization, number and mass average molecular mass, molecular mass determination by osmometry, viscometry, light scattering methods.

4. Crystallography: **(10 L)**

Classification of Solids on the basis of shapes and bonding, crystal lattice and unit cell, laws of crystallography, symmetry elements, lattice planes and their designations, Principle of crystal structure, close packing of atoms, packing of equal sizied spheres in HCP, CCP, BCC structures. Packing in ionic solids, ionic radius, radius ratio rules, (3, 4, 6, 8 Coordinate structure). Octahedral and tetrahedral voids, isomorphism and polymorphism, Numericals.

References:

Ref 1: Physical Chemistry 8th edition, By P. Atkins, J d Paula, Oxford University Press

Ref 2: Principles of Physical Chemistry 41th millennium edition, By Sharma, Puri and Pathaniya.

Ref 3: Quantum Chemistry 4th Edition, By R. K. Prasad, New Age International.

Ref 4: Quantum Chemistry, By Ira N. Levine.

Ref 5: Introduction to Quantum Chemistry, By A. K. Chandra

Ref 6: Advanced Physical Chemistry, By Gurudeep-Raj.

Ref 7: Fundamentals of Molecular Spectroscopy, By C. N. Banwell.

Ref 8: Solid State Chemistry, By A. R. West.

Ref 9: Solid State Chemistry, By N. B. Hannary.

Ref 10: Introduction to Polymer Science, By V. R. Gowarikar.

CH-P-1: PHYSICAL CHEMISTRY PRACTICAL-I

Time: 06 hrs/week **Max Marks: 75 (External) + 25 (Internal)**

The Student should perform minimum of 18 experiments. It is expected to perform at least one experiment from each technique.

Conductometry:

1) Determination of degree of hydrolysis and hydrolysis constant of sodium acetate conductometrically.

2) To determine solubility of sparingly soluble salt at different temperatures conductometrically and determination of ΔG, ΔH and ΔS of the dissolution.

3) Determination of the concentration of sulphuric acid, acetic acid and copper sulphate by conductometric titration with sodium hydroxide.

4) To determine concentration of Fe^{+2} ions by titrating it with potassium dichromate solution conductometrically.

Potentiometry:

1) To determine the stability constant of a complex ion $[Ag(S_2O_3)]^{-3}$ potentiometrically.

2) To determine the amount of each halide in a mixture of halides containing a) KI and KBr/KCl or b) KI, KBr and KCl potentiometrically.

3) To determine standard free energy change ΔG^0 and equilibrium constant for the reaction $Cu + 2Ag^+ = Cu^{+2} + 2Ag$ potentiometrically.

4) To determine activity coefficient of an electrolyte by potentiometry

pH -metry:

1) Determination of Hammett constant of a given substituted benzoic acid by pH measurements.

2) To determine acidic and basic dissociation constants of an amino acid and hence the isoelectric point of the acid.

3) To determine pH values of various mixtures of sodium acetate and acetic acid in aqueous solutions and hence dissociation constant of the acid.

4) To determine the three dissociation constants of polybasic acid such as H_3PO_4 by pH measurements.

Colorimetry/ Spectrophotometry:

1) To determine pKa and Ka of given indicator by colorimetry/spectrophotometry

2) Determination of amount of Cu (II) and Fe (III) in a mixture by titrating it against standard EDTA solution spectrophotometrically.

3) To determine the empirical formula of Ferric salicylate complex by Job's method and verify by slope ratio method.

4) Simultaneous determination of $Cr_2O_7^{2-}$ and MnO_4^- ions or Co^{2+} and Ni^{2+} in the solution by spectrophotometry.

Flame photometry:

1) Estimation of Na, K in the given solution by flame photometry.

2) Estimation of Na, K in the given drinking water sample by flame photometry.

Turbidimetry:

1) To determine the molecular weight of a given polymer by turbidimetry.

Radioactivity:

1) To determine the maximum energy of beta particles and calculate the absorption coefficients and half thickness of Aluminium absorber for beta particles.

2)

Flame photometry:

1) Estimation of Na, K in the given solution by flame photometry.

2) Estimation of Na, K in the given drinking water sample by flame photometry.

Polarimetry:

1) To investigate the inversion of cane sugar in presence of HCl at room temperature.

2) Determine the percentage of two optically active substances (d-glucose and d-tartaric acid) in a mixture polarimetrically.

Chemical kinetics:

1) To determine the rate constant for depolymerization of diacetone alcohol catalyzed by sodium hydroxide using dilatometer.

2) To determine the rate constant for the hydrolysis of acetal catalyzed by an acid using dilatometer.

3) To determine the order of the reaction between potassium persulphate and potassium iodide by fractional change method.

4) To investigate the kinetics of iodination of acetone.

5) To determine energy of activation of the hydrolysis of methyl acetate in presence of hydrochloric acid (Calculations and graphs expected from excel programming).

Non instrumental:

1) Determine the transport number of H^+ and Cl^- ions by moving boundary method.

2) Freundlich and Langmuir adsorption isotherms for adsorption of acetic acid on activated charcoal.

3) Determination of partial molar volume of ethanol in dilute aqueous solutions.

References:

1) Findley's Practical physical Chemistry (9^{th} edition)
   Edited by B.P.Levitt (Longman group Ltd)
2) Systematic experimental Physical Chemistry (2nd edition)
   By S.W.Rajbhoj and Dr. T.K.Chondekar (Anjali Publication, Aurangabad)
3) Advanced Practical Physical Chemistry (19^{th} edition or latest edition)
   By J.B.Yadav (Goel Publishing House, Meerut).
4) Experimental physical Chemistry
   By V.D.Athawale P.Mathur (New age international Ltd, New Delhi)
5) Advanced Practicals in physical Chemistry (4^{th} revised edition 2008 or latest edition)
   By Dr.Pande, Dr.Mrs. Datar &, Dr.Mrs. Bhadane (Manali Publication, Pune)
6) University Practical Chemistry (2008 or latest edition)
   By P.C.Kamboj (Vishal Publishing Co. Jalandhar, Panjab)

CH-130: INORGANIC CHEMISTRY-I

Time: 60 Clock hrs. **Max Marks: 75 +25**

I Symmetry and group Theory in Chemistry : **[20hr]**

Introduction to symmetry operations, symmetry elements, point group, Schonflies symbol, determination of point group of H_2O, NH_3, CO_2, BF_3, C_2H_4, H_3BO_3, PCl_3, PCl_5, CO, HCl, Square planer & tetrahedral AB_4 type molecule,, cis & trans -AB_2C_2 type molecules, C_6H_6, o, m, & p substituted benzene molecule. Symmetry and stereoisomerisms, definition of group, properties of group , group multiplication table, matrix representation of symmetry elements. Reducible and irreducible representation, Character of representation, Character of matrix, Conjugate matrix, Properties of irreducible representations, Great orthogonality theorem (without proof) and it's importance, construction of character table of C_{2v} & C_{3v} point group. Mulliken symbolism rules for irreducible representations & numericals. Standard reduction formula direct product and uses, numericals.

II. Reaction mechanism of transition metal complexes. : **[12 hr]**

Introduction, Acid hydrolysis, factors affecting the acid hydrolysis. Base hydrolysis, conjugate base mechanism, Anation reaction, reaction without metal ligand bond cleavage. **Trans effect:,** trans directing series, Polarization theories of trans effect, mechanism of substitution reaction in square planer complexes, application of trans effect in the synthesis of some square planer complexes with suitable examples. **Electron Transfer Reaction:** Introduction, mechanism of inner and outer sphere electron transfer reaction in octahedral complexes.

III. Application of Valence bond theory for structural identification of transition and non transition compounds: **[06 hr]**

i). Interhalogen compounds, ii).Nobel gas compounds, iii).First transition metal complexes, iv). Inorganic anions : PO_4^{---}, CO_3^{--}, SO_4^{--}, limitation of VBT,

IV). Crystal field theory: **[06 hr]**

Introduction, splitting of d- orbital in octahedral, tetrahedral, square planer and tetragonal complexes, factors affecting magnitude of Δ_o application of CFT, crystal field splitting energy and their uses. Paramagnetic , diamagnetic, ferromagnetic, antiferromagnetic compounds. Methods of measurement of magnetic moment, Magnetic properties of transition metal complexes, Designing of numericals on experimental magnetic moment and spin magnetic moment and their interpretations.

V). Application of molecular orbital theory: : **[06 hr]**

Construction of molecular orbital energy level diagram for Homonuclear & Hetronuclear diatomic molecules or ions (cation and anions), construction of molecular orbital energy level diagram of Tetrahedral and octahedral transition metal complexes with suitable examples.

VI).Chemistry of non transition elements: **[10 hr]**

Synthesis properties and structures of : Borazine, Silicates, Silicones. Phosphazenes,

Reference books:

1. Symmetry and Spectroscopy of Molecules, K. Veera Reddy.

2. Group Theory and symmetry in Chemistry, Gurdeep Raj.Ajay Bhagi and Vinod Jain.

3.Inorganic Chemistry, J.E.Huhey.

4.Mechanism of Inorganic Reaction. II Edn. Fred Basolo and R.G.Pearsons.

5.Selected Topic in Inorganic Chemistry, Wahid U. Malik, G.D. Tuli and R.D.Madan.

6.Advanced Inorganic Chemistry, F.A.Cotton and Wilkinson.

7.Advanced Inorganic Chemistry, Satyaprakash, G.D.Tuli, S.K.Basu and R.D.Madan.

8.Advanced Inorganic Chemistry, Volume I and II Gurdeep Raj.

9.Concise Inorganic Chemistry, J.D.Lee.

10.Chemical application of Group Theory, F.A.Cotton.

11.Element of Magnetochemistry - By A.Samal & R. L. Datta.

CH-230: INORGANIC CHEMISTRY-II

Time: 60 Clock hrs. **Max Marks: 75 +25**

I) Spectroscopic term symbols: **[10 hrs]**

Terms, inter-electronics repulsion, spin orbit coupling, ground terms, determination of terms symbol for d^1 to d^5 Configuration / complexes, application of Hund's rule, calculation of mcrostates for d , t_{2g}, e_g and $t_{2g}e_g$ orbital containing various electrons, Racah Parameter, numericals

II) Term Diagrams : **[10 hrs]**

Weak and stronger field approach, correlation diagram of d^1, d^2, d^8 and d^9 configuration in octahedral and tetrahedral environments, Non-crossing rule, selection rules for electronic transitions, Orgel diagram of d^1 to d^9 configuration in an octahedral and tetrahedral environments, Tanabe Sugano diagram for d^2 configuration of an octahedral environments.

III) Electronic Spectra of metal complex : [**10 hrs]**

Types of experimental recording of the spectra, Band intensities, intensity of d-d bands, intensity of change transfer bands, interpretation of electronic spectra of transition metal with suitable example. Konign's methods for calculation s of D_q, B and β parameters. and numericals,. Charge transfer spectra, Classification , mechanisms and interpretation of with suitable examples.

IV).Organotranstion metal complexes/ compounds [13]

Definitions, Classification of organotransition metal complexes, based on the number of coordinated carbon (Hapticity), number of electrons donated by ligands, and type of bonding. IUPAC nomenclature, applications of 16, 17, 18 electron rule, electron counting for common ligands, Oxidation state, coordination number and geometry of organo transition metal compounds.

i) Synthesis , chemical properties , structure and bonding of : η^2 - alkene, η^3 -allyl, η^4 - butadiene, η^4 -Cyclobutadiene, η^5 -Cyclopentadienyl η^6 Arene transition metal compounds (at least select first transition metal compounds) .

V). Catalytic processes involving organotransition metal compound: [12]

Catalysis, Catalyst, types of catalyst, properties of catalysts, catalytic steps**,** Hydrogenation of alkene using wilkinson's catalysts, hydrosilation reaction, hydroformulation of alkene (oxo process) using cobalt, Rhodium, Ruthenium complex catalysts. Ethylene dimerization using $RhCl_3$ catalyst, Ziegler Natta polymerizations. Fischer Tropsch process, water gas shift reaction. Monsanto process for acetic acid synthesis., Wacker process of oxidation of alkene.

Role of metal ions in biological process: [05]

Selective transport and storage of iron, (siderophores, iron transport proteins in higher organisms, release of iron transferring, ferritin, the cellular Fe store, electron transfer, (General considerations, electron transfer cyctochrome, FeS cluster , copper transfer centers).

References Books:

1. Inorganic electronic spectroscopy, - A.B.P. Lever.
2. Symmetry and Spectroscopy of Molecules - K. Veera Reddy.
3. Physical Chemistry through problem - Dogra and Dogra.
4.Inorganic Chemistry - Attkin and Shriver.
5.Concise Inorganic Chemistry - By J.D. Lee.
6.Element of Magnetochemistry - By A.Samal & R. L. Datta.
7..Introduction to Ligand Field - B. N. Figgis.
8. Organo metallic Chemistry, R. C. Mehrotra, & A. Singh

9. Principal and applications of organotransition metal Chemistry,
J. P. Collman, L. S. Hegedus, J. R. Norton and R. G. Finke,
10. Inorganic Chemistry , Attkin and Shriver

CH-I-1: Inorganic Chemistry Practical-I

Time: 06 hrs/week **Max Marks: 75 (External) + 25 (Internal)**

I. Preparation of coordination compound:

Preparation and IR, UV spectrum of (ligand & their complexes) and estimation of percentage of metal ion of the following metal complexes:

List of metal complexes to be prepared (any 06) (use mole reaction concept)

1. $Ti(C_9H_8NO)_2.2H_2O$ 2.$VO(acac)_2$ 3.Cis-$K[Cr(C_2O_4)_2(H_2O)_2]$
4. $[Mn(acac)_3]$ 5.$K_3[Fe(C_2O_4)_3]$ 6.$[Co(II)(Py)_2Cl_2]$
7. $[Co(III)(NH_3)_6]Cl_3$ 8.$[Co(III)(NO_2)(NH_3)_5]Cl_2$
9.Tris (thiourea) Copper(II) Sulphate
10. Bis (thiourea) Zinc (II) sulphate
11. $NH_4[(Cr(III)(C_2O_4)_3]$
12. [Ni(II) $(Salicyldoxime)_2$]
13. [Copper (II) $(Acetyl\ acetone)_2$]
14. Manganese (II) Phthalocyanine

II) A. Separation and estimation of metal ions from the following binary mixture solutions : (volumetric and gravimetric method)

Any[03]

1. Copper- Nickel 2. Copper- Iron 3. Nickel- Zinc
4. Iron- Magnesium 5. Copper- Barium
6. Iron –Aluminum

III) Semi micro Qualitative Inorganic analysis. (at least 04) mixture (including rear earth elements from following groups) (minimum 4 radicals should be mixed in the mixture) :

1. Identification of basic radicals from II group
2. Identification of basic radicals from IIIA group
3. Identification of basic radicals from IIIB group
4. Identification of basic radicals from IV group
4. Identification of basic radicals from V group

IV. Preparation of Inorganic Polymers [Any 01]

1. Preparation and spectral study of Diphenylsilanediole and dimethylchlorosilane

2. Preparation of phosponitryl chloride $(PNCl_2)_3$ and its derivatives.

V. Preparation of organometallic compounds using inert atmospheric technique [Any 01]

1. Preparation of Tetraphenyl lead, phenyl lithium, ferrocene and their applications.

VI. Preparation and characterization of following Nonmaterial using co-precipitation or Sol Gel method and their application (Any 02)

1. Titanium oxide
2. Nickel nano particles using hydrazine hydrate as a reducing agent :
3. Preparation of silver Nano particles.
4. Aluminium oxide.

VII). Determination of hardness of water. COD, BOD,

VIII). Analysis of Alloy i). Solder alloy, ii). Cupro-nickel alloy.

CH-150: Organic Chemistry - I

Max Marks: 75 (External) + 25 (Internal) **[60 L]**

1. IUPAC Nomenclature of Organic Compounds. [**04 L**]

2. Aromaticity: Huckel's rule and Concept of Aromaticity, Annulences and Heteroannulenes, Fullerenes (C60). [**04 L**]
   Ref. J. March pp 40-67.

3. Reactive intermediates: Formation and stability of Carbocations, Carbanions, Free Radicals, Carbenes, Nitrenes, and Arynes. [**04 L**]
   Ref. J. March pp 165-204.

4. Aliphatic Nucleophilic Substitution: Introduction, S_N^2 Mechanism and evidence, SN^1 reaction, Nucleophilic Substitution of allylic systems S_N^1 & S_N^2 reaction, Nucleophilic displacements at Allylic halides/tosylates, Nucleophilic Substitution at Benzylic position, Nucleophilic Substitution of Vinylic & Aryl halide, S_N^i Mechanism, Mixed S_N^1 & S_N^2 Reactions. Ambient Nucleophiles, Set Mechanism, Neighboring Group Participation reaction (NGP). [**10 L**]

5. Aliphatic Electrophilic Substitution: Introduction, Different mechanism for Aliphatic electrophilic substitution, Electrophilic Substitution accompanied by double bond shift, Aliphatic Electrophilic Substitution in relation to substrate structure, Leaving group & solvent polarity. [**04 L**]

6. Aromatic Electrophilic Substitution: Mechanism, The arenium mechanism, SE1 mechanism, Orientation & reactivity, The ortho-para ratio, Ipso attack, Orientation in benzene rings, with more than one substituent, Orientation in other rings.

   Nitration, Halogenation, Sulfonation, Diazonium coupling, F.C. alkylation, F.C acylation, Ipso substitution reaction, Other methods of aryl-carbon bond formation. [**08 L**]

7. Nucleophilic Aromatic Substitution: The Addition –elimination mechanism, elimination –addition mechanism-benzyne. The arylation mechanism-diazonium salts. [**04 L**]

8. **Elimination Reactions-Alkenes and Alkynes:** The Reaction Mechanism: E1, E2 & E1cB mechanism, their mechanistic variables, E1 Versus E2. Elimination versus Substitution: Basicity versus Nucleophilicity, Substrate Structure, Solvent, Temperature. Direction of Elimination: Formation of the More-Substituted Alkene, Formation of the Less-Substituted Alkene. Stereochemistry: Anti Elimination, Stereoelectronic, Syn Elimination. Formation of Alkenes: Dehydrohalogenation, Dehalogenation, Dehydration, The Hofmann Elimination, Pyrolytic Elimination, Catalytic Dehydrogenation. Formation of Alkynes. Other Double and Triple Bonds: Aldehydes and Ketones, Nitriles. Orientation of the Double bonds-Regiochemistry of the Elimination Reactions. [**10 L**]
   Ref. Pine pp 464-516 & P. S. Kalsi.

9. **Addition Reactions:** Electrophilic Additions to Unsaturated Carbon
   The Mechanism of Electrophilic Addition: The Ad_E2 mechanism, Structural Effects and Reactivity. Direction and Stereochemistry of addition: Markovnikov Orientation, Stereochemistry of Addition. Addition to Alkenes and Alkynes: Halogenation, Hydrohalogenation, Hydration, Hydroboration, Epoxidation-Hydroxylation, Carbene Addition, Hydrogenation, Ozonolysis, Addition of Alkenes and Alkynes, Alkenes and Alkynes as Petrochemical Raw Materials. Transition Metal Organometallics: Alkene-Transition Metal Organometallics, Homogeneous Catalysis, Industrial Application of Catalysis, Transition Metals in Biological Systems.
   Additions to Conjugated Compounds: Conjugated Dienes: The Mechanism of Electrophilic Conjugate Addition, Kinetic and Equilibrium Control. Double Bonds Conjugated with Carbonyl Groups: The Mechanism of Nucleophilic Conjugate Addition, Conjugate Additions in Synthesis.
   Ref. Pine pp 517-575. Pp 576-587.
   Addition Reactions of alkene, alkynes involving electrophile. Hydroboration/Oxidation of alkenes, stereochemical aspect. Hydrogenation of alkenes and alkynes, Birch reduction.
   Addition of Nucleophiles to C-C double bonds, Hydroxylation, epoxidation, carbene addition to alkenes, Nucleophilic addition to carbonyl, cyanide, oxygen or sulfur Nucleophiles. [**12 L**]

References:

1. Organic Chemistry by Stanley H. Pine.
2. Stereochemistry: Conformations and Mechanism by P. S. Kalsi.

3. Advance Organic Chemistry: Reactions, Mechanisms and Structure by Jerry March.
4. Organic Chemistry by Clayden, Greeves, Warren & Wothers.
5. Organic Chemistry by Morrison and Boyd.

CH-250: Organic Chemistry - II

[60 L]

1. Stereochemistry: Recognition of symmetry elements and chiral structures, R-S nomenclature, diastereo isomerism in acyclic and cyclic-systems, E-Z isomerism, conformational analysis of simple cyclic (Chair & Boat cyclohexanes and acyclic systems, Interconversion of Fischer, Newman & Sawharse Projections. [**08 L**]

2. Rearrangement of Reactions:
   Wagner-Meerwein, Pinacol, Wolff, Arndt-Eistert, Hofmann, Curtius, Schmidt, Lossen, Beckmann, Baeyer-Villiger, Favourskii, Benzilic acid, Steven, Wittig, Claisen, Sigmatropic Rearrangements. [**08 L**]

3. Selective Name Reactions: Aldol, Perkin, Stobbe, Dieckmann Condensation. Reimer-Tiemann, Reformatsky and Grignard reactions. Diels-Alder reaction, Robinson Annelation. Michael, Mannich, Stork-enamine, Sharpless Assymetric Epoxidation, Ene, Barton, Hofmann-Loffler Fretag, Shapiro reaction. Chichibabin Reaction. [**14 L**]

4. Reagents in Organic Synthesis:
Complex Metal hydrides, Gilman's reagent, Lithium dimethyl cuprate, LDA, DCC , 1,3-dithiane,Trimethylsilyl iodide, Tri-n-butyltinhydride, Woodward -Prevost hydroxylation, OsO_4,DDQ, SeO_2,PTC, Crown ethers & Merrifield resins, Peterson's synthesis, Wilkinson catalyst, Baker's yeast. [**12 L**]

5. Spectoscopy-
   Applications of U.V, IR, NMR Spectroscopy for structure elucidation of organic compounds.
   Introduction to Mass and CMR Spectroscopy. [**18 L**]

References:

1. Organic Chemistry by Stanley H. Pine.
2. Stereochemistry: Conformations and Mechanism by P. S. Kalsi.

3. Advance Organic Chemistry: Reactions, Mechanisms and Structure by Jerry March.
4. Organic Chemistry by Clayden, Greeves, Warren & Wothers.
5. Organic Chemistry by Morrison and Boyd.
6. Modern Methods of Organic Synthesis by W. Carruthers, Iain Coldham.
7. Spectroscopy of Organic compounds by P. S. Kalsi
8. Spectroscopic Identification of Organic compounds by R.M.Silverstein, G.C.Bassler and T. C. Morrill.
9. Stereochemistry of Carbon Compounds by E. L. Eliel.
10. Stereochemistry of Organic compounds. by D. Nasipuri.
11. Pavia spectroscopy of Organic compounds. – Pavia

CH-O-1: Organic Chemistry Practical-I

Time: 06 hrs/week **Max Marks: 75 (External) + 25 (Internal)**

1. Techniques: (At least One Practical of Each Technique)
   Crystallization, Fractional Crystallization, Sublimation, Distillation, Fractional Distillation , Steam Distillation, Vacuum Distillation, Column Chromatography, Thin Layer Chromatography (Purity would be checked by m. p. and mixed m. p.).

2. Preparation of Derivatives: (Each Derivative of two Compounds)
   Oxime, 2, 4-DNP, Acetyl, Benzoyl, Semicarbazone, Anilide, Amide, Aryloxyacetic acid.
3. Preparations: Single Stage (Any 15)
   i) Cyclohexanone to Adipic acid
   ii) Benzophenone to Benzhydral
   iii) Anthracene to Anthraquinone
   iv) Chlorobenzene to 2,4-Dinitrochlorobenzene
   v) 2,4-Dinitrochlorobenzene to 2,4-Dinitrophenol
   vi) Acetoacetic ester to 1-Phenyl-3-methyl-5 pyrazolone
   vii) Benzaldehyde to Cinnamic acid
   viii) 4-Chlorobenzaldehyde to 4-Chlorobenzoic acid + 4-Chlorobenzyl alcohol
   ix) Benzene to β-Benzoyl propionic acid
   x) Benzaldehyde to Dibenzylidene acetone
   xi) p-Aminobenzoic acid to p-Chlorobenzoic acid

xii) N,N-Dimethylaniline to 4-Formyl-N, N-dimethyl aniline

xiii) Benzophenone to Benzpinacol

xiv) p-Nitrotoluene to p-Nitrobenzoic acid

xv) Anisole to 2,4-Dinitroanisole

xvi) Phthalic anhydride to phthalimide

xvii) Phthalimide to Anthranilic acid

xviii) Acetanilide to p-Bromoacetanide

xix) p-Bromoacetanide to p-Bromoaniline

xx) m-Dinitrobenzene to m-Nitroaniline

4. Use of Computer - Chem Draw-Sketch, ISI – Draw: (Max. 30 Hours for each batch) Draw the structure of simple aliphatic, aromatic, heterocyclic organic compounds with substituents. Get the correct IUPAC name and predict the UV, IR and H^1-NMR signals.

5. Interpretation of UV and FT-IR spectrum of above synthesized compounds. (10 Compounds)

Pattern of Practical Examination

Q - 1. Techniques: Distillation or Column or TLC	25 marks
Q - 2. Preparation / Derivative	25 marks
Q - 3. Interpretation of spectrum or Use of Computer	10 marks
Q - 4. Journal	05 marks
Q - 5. Oral	10 marks

References:

Vogel's, Practical Organic chemistry.

CH-290: ANALYTICAL CHEMISTRY

Time: 60 Clock hrs. **Max Marks: 75 +25**

1. Data Analysis:

Accuracy, Precision, Types of errors, propogation of errors, least square analysis, average standard deviation.

Good Laboratory Practices: Quality Assurance, Importance of analysis, Quality system, Quality control.

2. Spectroscopy:

Theory, Instrumentation Applications of UV- Visible spectroscopy, IR spectroscopy NMR (^{1}H and ^{13}C) spectroscopy, Atomic (absorption- emission) spectroscopy, Raman spectroscopy.

3. Chromatographic Analysis:

Gas Chromatography theory and Instrumentation, Types of column, Switching techniques, Basic and specialized detectors, elemental detection.

High performance liquid chromatoqraphy, theory and instrumentation. Adsorption chromatoqraphy, liquid-liquid partion techniques, microbore and capillary chromatoqraphy, Applications of H.P.L.C.

4. Hyphenated Techniques:

Mass spectroscopy- Principle, Instrumentation. Ionization, methods - EL, CI, FAB, arc & spark photo ionization Thermal ionization, photoelectric ionization.

Coupled Techniques – GC-MS, HPLC-MS, GC-FTIR

5. Electroanalytical Techniques (In brief): Principle , Instrumentation and application of Voltametry, Cyclic Voltametry, Polarography, amphelotry DTA, TGA, DSC and on line analyser.

References:

1. Analytical chemistry, G.D. Christian, Wiley 6th Edn.

2. Fundamental of Analytical Chemistry, D. A. Skooq, D. M. West, F. J. Holler, S. R. Crouch, 8th Edn.

3. Instrumental methods of Analysis, H. H. Willard, L. L. Merritt, J. A. Dean, F. A. Settle. (CBS Publisher) 7th Edn.

4. Practical Aspects of Gas Chromatography / Mass spectroscopy, G.M. Message, John Wiley & Sons, New York (1984).
5. Instrumental Methods of Chemical Analysis, Gurudeep Chatwal, Sham Anand.
6. Organic Spectroscopy, P.S. Kalsi.
7. Spectroscopic Methods in Organic Chemistry, D. H. Williams and I. Fleming, McGraw Hill, 4th Ed (1989).
8. Application of Absorption Spectroscopy of Organic Compounds, J. R. Dyer, Prentice Hall.
9. Instrumental Methods of analysis, G. D. Brawn.
10. Analytical Chemistry, Kelmner.
11. Chemical Analysis, Farm cis, Roucssal and A mick Roucssal.
